DRAFT

Omnibus Essential Fish Habitat Amendment 2
Volume 3:
Spatial management alternatives
Environmental impacts of spatial management alternatives

Amendment 14 to the Northeast Multispecies FMP
Amendment 14 to the Atlantic Sea Scallop FMP
Amendment 4 to the Monkfish FMP
Amendment 3 to the Atlantic Herring FMP
Amendment 2 to the Red Crab FMP
Amendment 2 to the Skate FMP
Amendment 3 to the Atlantic Salmon FMP

Including a

Draft Environmental Impact Statement

Prepared by the
New England Fishery Management Council
In cooperation with the
National Marine Fisheries Service

Updated October 1, 2014

New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950
(978) 465-0492 tel.
(978) 465-3116 fax

National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930
(978) 281-9315 tel.
(978) 281-9135 fax

1 Contents: Volume 3

1.1 Table of contents

1 Contents: Volume 3 ... 2
1.1 Table of contents ... 2
1.2 Tables ... 9
1.3 Figures ... 20
1.4 Maps ... 25
2 Spatial management alternatives ... 35
2.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats ... 36
2.1.1 Eastern Gulf of Maine ... 46
2.1.1.1 Alternative 1 (No Action, no habitat management areas) ... 46
2.1.1.2 Alternative 2 (preferred) ... 46
2.1.1.3 Alternative 3 ... 48
2.1.2 Central Gulf of Maine ... 50
2.1.2.1 Alternative 1 (No Action) ... 51
2.1.2.2 Alternative 2 (No habitat management areas) ... 53
2.1.2.3 Alternative 3 ... 54
2.1.2.4 Alternative 4 (preferred) ... 56
2.1.3 Western Gulf of Maine ... 57
2.1.3.1 Alternative 1 (No Action, preferred) ... 59
2.1.3.2 Alternative 2 (No habitat management areas) ... 60
2.1.3.3 Alternative 3 ... 61
2.1.3.4 Alternative 4 ... 62
2.1.3.5 Alternative 5 ... 64
2.1.3.6 Alternative 6 ... 66
2.1.3.7 Alternative 7 (preferred) ... 68
2.1.3.8 Alternative 8 (preferred) ... 69
2.1.4 Georges Bank ... 71
2.1.4.1 Alternative 1 (No Action) ... 72
2.1.4.2 Alternative 2 (No habitat management areas) ... 74
2.1.4.3 Alternative 3 ... 75
2.1.4.4 Alternative 4 ... 76

2.1.4.5 Alternative 5 78
2.1.4.6 Alternative 6 80
2.1.4.7 Alternative 7 82
2.1.4.8 Alternative 8 84
2.1.5 Great South Channel and Southern New England 85
2.1.5.1 Alternative 1 (No Action) 86
2.1.5.2 Alternative 2 (No habitat management areas) 88
2.1.5.3 Alternative 3 89
2.1.5.4 Alternative 4 90
2.1.5.5 Alternative 5 92
2.1.5.6 Alternative 6 94
2.2 Alternative to improve groundfish spawning protection 96
2.2.1 Gulf of Maine 97
2.2.1.1 Alternative 1 (No Action, preferred) 97
2.2.1.2 Alternative 2 – Sector Rolling Closures, Whaleback, and Massachusetts Bay Spawning Protection Area 101
2.2.1.3 Alternative 3 – Massachusetts Bay Spawning Protection Area (preferred) 106
2.2.2 Georges Bank and Southern New England 108
2.2.2.1 Alternative 1 (No Action) 108
2.2.2.2 Alternative 2 – Seasonal Implementation of Closed Area I and Closed Area II 111
2.2.2.3 Alternative 3 – Seasonal implementation of Closed Area I North and Closed Area II 113
2.3 Alternatives to designate Dedicated Habitat Research Areas 117
2.3.1 Alternative 1 (No Action) – No DHRA designations 122
2.3.2 Alternative 2 – Eastern Maine Dedicated Habitat Research Area (preferred) 122
2.3.3 Alternative 3 – Stellwagen Dedicated Habitat Research Area (preferred) 124
2.3.3.1 Option A – Southern reference area 125
2.3.3.2 Option B – Northern reference area (preferred) 125
2.3.3.3 Option C – No reference area 125
2.3.4 Alternative 4 – Georges Bank Dedicated Habitat Research Area (preferred) 127
2.3.5 Alternative 5 – DHRA sunset provision (preferred) 129
2.4 Framework adjustments and monitoring 131
2.4.1 Alternative 1 (No action) – Current list of frameworkable measures and monitoring activities; ad-hoc initiation of framework adjustments 131

2.4.2 Alternative 2 – Planned, strategic framework adjustment and monitoring (preferred) ... 133

3 Considered and rejected spatial management options and alternatives ... 137

3.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats ... 137

3.2 Alternatives to improve groundfish spawning protection ... 142

3.3 Alternatives to designate Dedicated Habitat Research Areas ... 144

4 Environmental impacts of spatial management alternatives ... 146

4.1 Approach to analysis ... 146

4.1.1 Redistribution of fishing effort ... 149

4.1.2 Analysis of impacts on the physical and biological environment ... 155

4.1.2.1 Options 1 – Restrictions on mobile bottom-tending gears ... 155

4.1.2.2 Option 2 – Hydraulic clam dredge exemption ... 155

4.1.2.3 Options 3 and 4 – Ground cable modifications ... 156

4.1.2.4 EFH overlap analysis ... 160

4.1.2.5 Species diversity considerations ... 166

4.1.3 Analysis of impacts on the large-mesh groundfish resource ... 166

4.1.3.1 Juvenile groundfish habitat analyses ... 166

4.1.3.2 Groundfish spawning analyses ... 176

4.1.4 Analysis of impacts to human communities and the fishery ... 189

4.1.4.1 Economic analyses ... 189

4.1.4.2 Social impacts analyses ... 197

4.1.5 Terminology used to describe the relative impacts of the alternatives ... 204

4.2 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats ... 205

4.2.1 Physical and biological environment ... 206

4.2.1.1 Eastern Gulf of Maine ... 207

4.2.1.2 Central Gulf of Maine ... 216

4.2.1.3 Western Gulf of Maine ... 227

4.2.1.4 Georges Bank ... 245

4.2.1.5 Great South Channel/Southern New England ... 260

4.2.2 Large mesh groundfish stocks and their habitats ... 272

4.2.2.1 Gulf of Maine Preferred Alternatives ... 272

4.2.2.2 Gulf of Maine Alternative 1 (No Action, preferred in the western Gulf of Maine) ... 278

4.2.2.3 Eastern Gulf of Maine 283
4.2.2.4 Central Gulf of Maine 289
4.2.2.5 Western Gulf of Maine 293
4.2.2.6 Georges Bank/Southern New England Alternative 1 (No Action) 310
4.2.2.7 Georges Bank 316
4.2.2.8 Great South Channel/Southern New England 343
4.2.3 Human communities and the fishery 355
4.2.3.1 Eastern Gulf of Maine 355
4.2.3.2 Central Gulf of Maine 369
4.2.3.3 Western Gulf of Maine 385
4.2.3.4 Georges Bank 409
4.2.3.5 Great South Channel/Southern New England 440
4.2.4 Protected resources 477
4.2.4.1 Eastern Gulf of Maine 489
4.2.4.2 Central Gulf of Maine 491
4.2.4.3 Western Gulf of Maine 492
4.2.4.4 Georges Bank 495
4.2.4.5 Great South Channel/Southern New England 497
4.3 Alternative to improve groundfish spawning protection 499
4.3.1 Physical and biological environment 500
4.3.1.1 Gulf of Maine 500
4.3.1.2 Georges Bank and Southern New England 501
4.3.2 Large mesh groundfish stocks 503
4.3.2.1 Gulf of Maine 503
4.3.2.2 Georges Bank and Southern New England 514
4.3.3 Human communities and the fishery 526
4.3.3.1 Gulf of Maine 526
4.3.3.2 Georges Bank and Southern New England 537
4.3.4 Protected resources 543
4.3.4.1 Gulf of Maine 543
4.3.4.2 Georges Bank and Southern New England 544
4.4 Alternatives to designate Dedicated Habitat Research Areas 544
4.4.1 Physical and biological environment 545

4.4.1.1 Alternative 1 (No Action) 547
4.4.1.2 Alternative 2 (Preferred) 547
4.4.1.3 Alternatives 3A, 3B, and 3C (3B preferred) 549
4.4.1.4 Alternative 4 (Preferred) 552
4.4.1.5 Alternative 5 (Preferred) 552
4.4.2 Large mesh groundfish stocks 553
4.4.2.1 Alternative 1 (No Action) 553
4.4.2.2 Alternative 2 (Preferred) 556
4.4.2.3 Alternatives 3A, 3B, and 3C (3B preferred) 556
4.4.2.4 Alternative 4 (Preferred) 566
4.4.2.5 Alternative 5 (Preferred) 569
4.4.3 Human communities and the fishery 569
4.4.3.1 Alternative 1 (No action) 569
4.4.3.2 Alternative 2 (Preferred) 570
4.4.3.3 Alternatives 3A, 3B, and 3C (3B preferred) 570
4.4.3.4 Alternative 4 (Preferred) 581
4.4.3.5 Alternative 5 (Preferred) 582
4.4.4 Protected Resources 583
4.4.4.1 Alternative 1 (No Action) 583
4.4.4.2 Alternative 2 (Preferred) 583
4.4.4.3 Alternatives 3A, 3B, and 3C (3B preferred) 583
4.4.4.4 Alternative 4 (Preferred) 583
4.4.4.5 Alternative 5 (Preferred) 584
4.5 Framework adjustments and monitoring 584
4.5.1 Alternative 1 (No Action) 584
4.5.2 Alternative 2 – Planned, strategic framework adjustment and monitoring (Preferred) 585
4.6 Impacts of all spatial management alternatives on non-large mesh groundfish stocks and fisheries 586
4.6.1 Small mesh multispecies: silver and red hake 586
4.6.1.1 Biological impacts 586
4.6.1.2 Fishery impacts 593
4.6.2 Monkfish 601
4.6.2.1 Biological impacts 605

4.6.2.2 Fishery impacts 607
4.6.3 Skates 616
4.6.3.1 Biological impacts 616
4.6.3.2 Fishery impacts 626
4.6.4 Atlantic sea scallop 631
4.6.4.1 Biological impacts 631
4.6.4.2 Fishery impacts 639
4.6.4.3 Impacts of Dedicated Habitat Research Area alternatives 667
4.6.5 Atlantic herring 672
4.6.5.1 Biological impacts 672
4.6.5.2 Fishery impacts 673
4.6.6 Atlantic deep-sea red crab 676
4.6.6.1 Biological impacts 676
4.6.6.2 Fishery impacts 676
4.6.7 Atlantic salmon 676
4.6.7.1 Biological impacts 676
4.6.7.2 Fishery impacts 677
4.6.8 Atlantic surfclams and ocean quahogs 677
4.6.8.1 Biological impacts 677
4.6.8.2 Fishery impacts 680
4.6.9 Atlantic bluefish 691
4.6.9.1 Biological impacts 691
4.6.9.2 Fishery impacts 692
4.6.10 Atlantic mackerel, squids, and butterfish 694
4.6.10.1 Biological impacts 694
4.6.10.2 Fishery impacts 696
4.6.11 Spiny dogfish 699
4.6.11.1 Biological impacts 699
4.6.11.2 Fishery impacts 701
4.6.12 Summer flounder, scup, and black sea bass 704
4.6.12.1 Biological impacts 704
4.6.12.2 Fishery impacts 709
4.6.13 Golden tilefish 711

4.6.13.1 Biological impacts 711
4.6.13.2 Fishery impacts 712
4.6.14 Northern shrimp 712
4.6.14.1 Biological impacts 712
4.6.14.2 Fishery impacts 713
4.6.15 American lobster 715
4.6.15.1 Biological impacts 717
4.6.15.2 Fishery impacts 719
5 Index 722

1.2 Tables

Table 1 – Types of spatial management alternatives that effect fishing activities 36

Table 2 – Measures in existing groundfish closure areas 38

Table 3 – Summary of areas included in the various habitat management alternatives 40

Table 4 – VTR gear codes for mobile bottom-tending gears..... 42

Table 5 – VTR codes for "exempted gears", based on regulatory language at 50 CFR §648.2... 43

Table 6 – VTR gear codes that could be considered gears capable of catching groundfish. Gears are listed in order by NEGEAR code. This list represents all gears that are not identified as "exempted gears". 44

Table 7 – List VTR gear codes that combines mobile bottom-tending gears with gears capable of catching groundfish..... 45

Table 8 – Coordinates for habitat management areas in eastern Maine 46

Table 9 – Coordinates for habitat management areas in the central Gulf of Maine 51

Table 10 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Central GOM sub-region. 52

Table 11 – Coordinates for habitat management areas in the western Gulf of Maine..... 58

Table 12 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Western GOM sub-region. 59

Table 13 – Coordinates for habitat management areas on Georges Bank. MBTG indicates possible closure to mobile bottom-tending gears, with or without an exemption for hydraulic clam dredges. 71

Table 14 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Georges Bank sub-region. 73

Table 15 – Coordinates for habitat management areas in the Great South Channel and southern New England..... 86

Table 16 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Great South Channel/Southern New England sub-region..... 87

Table 17 – Current restrictions in the year round and seasonal closed areas in the Gulf of Maine 98

Table 18 – Coordinates for Gulf of Maine year round and seasonal closed areas..... 99

Table 19 – Coordinates for proposed Gulf of Maine groundfish spawning protection areas. The April, May, and June coordinates are identical to the existing coordinates to seasonal rolling closures that apply to sector-enrolled groundfish vessels. 103

Table 20 – Restrictions in the year round and seasonal closed areas on Georges Bank and in Southern New England 109

Table 21 - Latitude and longitude coordinates of areas included in the no action Georges Bank groundfish spawning alternative 110

Table 22 – Coordinates for the Closed Area I North spawning closure in Alternative 3. These are identical to the existing coordinates for the CAIN Habitat Closure Area. 114

Table 23 – Comparison between before-after control-impact and control-impact designs..... 121

Table 24 – Coordinates for Eastern Maine DHRA 123

Table 25 – Coordinates for Stellwagen DHRA and reference areas 126

Table 26 – Coordinates for Georges Bank DHRA 128

Table 27 – Spatial management-oriented measures that may be implemented via framework action, by fishery management plan. All citations are from 50 CFR Part 648. 133

Table 28 – Benthic vs. pelagic habitat use by species and lifestage 162

Table 29 – Essential habitat types used by each benthic species and lifestage 163

Table 30 – Classification of possible impacts on groundfish habitat and stocks..... 172

Table 31 – Estimation of gamma distribution cumulative distribution function, for distance between observed hauls and self-reported VTR fishing location 194

Table 32 – Impact definitions 205

Table 33 – EGOM: dominant substrate coverage within each management area. 207

Table 34 – EGOM: data support within each management area. 207

Table 35 – EGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear (83m). 208

Table 36 – Preferred alternative EFH designations within Eastern GOM HMAs..... 214

Table 37 – Average diversity indices within the eastern Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted. 216

Table 38 – CGOM: dominant substrate coverage within each management area 217

Table 39 – CGOM: data support within each management area. 217

Table 40 – CGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear. 218

Table 41 – Preferred alternative EFH designations within Central GOM No Action areas and HMAs..... 225

Table 42 – Average diversity indices within the central Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted. 227

Table 43 – WGOM: dominant substrate coverage within each management area. 228

Table 44 – WGOM: data support within each management area. 228

Table 45 – WGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop or clam dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear..... 229

Table 46 – Preferred alternative EFH designations within Western GOM No Action areas and HMAs..... 243

Table 47 – Average diversity indices within the western Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted. 245

Table 48 – GB: dominant substrate coverage within each management area. 246

Table 49 – GB: data support within each management area. 246

Table 50 – GB: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear. 247

Table 51 – Preferred alternative EFH designations within No Action areas on Georges Bank. 257

Table 52 – Preferred alternative EFH designations within Alternative 3-8 Georges Bank HMAs. Areas are arranged on the table so that overlapping/adjacent areas can be compared more easily. 258

Table 53 – Average diversity indices within the Georges Bank sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted. 260

Table 54 – GSC-SNE: Dominant substrate coverage within each management area. 261

Table 55 – GSC-SNE: Data support within each management area. 261

Table 56 – Minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area in the Great South Channel/Southern New England sub-region, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear. 262

Table 57 – Preferred alternative EFH designations within Great South Channel/Southern New England No Action areas and HMAs..... 270

Table 58 – Average diversity indices within the Great South Channel/Southern New England sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted. 272

Table 59 – Total unweighted and weighted hotspots in preferred alternative habitat management areas for the Gulf of Maine region..... 275

Table 60 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Gulf of Maine region. 280

Table 61 – Total unweighted and weighted hotspots in eastern Gulf of Maine habitat management area alternatives, compared to Alternative 1/No Action. 286

Table 62 – Total hotspots by species for eastern Gulf of Maine habitat management area alternatives, compared to Alternative 1/No Action. 286

Table 63 – Total unweighted and weighted hotspots in CGOM habitat management area alternatives compared to No Action. 292

Table 64 – Total hotspots by species for central Gulf of Maine habitat management area alternatives, compared to No Action. 292

Table 65 – Total unweighted and weighted hotspots in western Gulf of Maine habitat management area alternatives. 301

Table 66 – Total hotspots by species for Western Gulf of Maine habitat management area alternatives. 301

Table 67 – Total unweighted and weighted hotspots in habitat closures and year round groundfish closures in the Georges Bank and Southern New England region. 313

Table 68 – Total unweighted and weighted hotspots in GB habitat management area alternatives compared to No Action. 318

Table 69 – Total hotspots by species for GB habitat management area alternatives, compared to No Action. 318

Table 70 – Total unweighted and weighted hotspots in GSC habitat management area alternatives compared to No Action. 347

Table 71 – Total hotspots by species for Great South Channel/Southern New England habitat management area alternatives, compared to No Action. 347

Table 72 – Mobile bottom-tending gear revenues potentially impacted by the areas included in the Eastern Gulf of Maine Habitat Alternatives. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U= unknown vessel characteristics. 359

Table 73 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the areas included in the eastern Gulf of Maine alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns. 361

Table 74 – Party/charter recreational fishing revenue associated with the areas included in the eastern Gulf of Maine alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents to average number of anglers per year. All other statistics are estimates at the trip level. 361

Table 75 – Total number of vessels conducting mobile bottom-tending gear trips in 2012 in currently open portions of the eastern Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only. 362

Table 76 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the eastern Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only. 363

Table 77 – Mobile bottom-tending gear revenues potentially impacted by the areas included in the central Gulf of Maine Habitat Alternatives that are currently open to fishing. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. 374

Table 78 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the central Gulf of Maine Alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the yearly means, while the statistics are calculated at the individual level. Note that shrimp trawl effort is unreported due to privacy concerns. 375

Table 79 – Party/charter recreational fishing revenue associated with Platts Bank and Cashes Ledge. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. The Cashes Ledge area refers to both the current groundfish and habitat closures. 375

Table 80 – Current Cashes Ledge groundfish and habitat closures: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data. 376

Table 81 – Jeffreys Bank Habitat Closure Area: Average value per bottom trawl haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data. 377

Table 82 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the central Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only. 378

Table 83 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the central Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only. 378

Table 84 – Sum of 2012 party/charter recreational fishing revenue associated with the central Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only. 379

Table 85 – Mobile bottom-tending gear revenues potentially impacted by the areas included in western Gulf of Maine Habitat Alternatives 3, 4, and 5. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dashes indicate information dropped due to privacy concerns. 388

Table 86 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the western Gulf of Maine Alternatives 3, 4, and 5, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the yearly

means, while the other statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns..... 391

Table 87 – Party/charter recreational fishing revenue associated with the areas included in the western Gulf of Maine habitat alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. 392

Table 88 – Western Gulf of Maine [Groundfish] Closure Area: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data. 393

Table 89 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the western Gulf of Maine potentially impacted by the management alternatives. . 395

Table 90 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the western Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only. 396

Table 91 – Total number of vessels conducting party/charter recreational fishing trips in 2012. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only. 397

Table 92 – Sum of 2012 party/charter recreational fishing revenue associated with the western Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only. 398

Table 93 – Mobile bottom-tending gear in currently open portions of the areas included in the Georges Bank habitat alternatives. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics..... 417

Table 94 – Fishing effort (in hours fished), and individuals fishing in the areas included in the Georges Bank habitat alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level..... 421

Table 95 – Closed Area I: Average value per haul (calendar year 2007-2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data. 423

Table 96 – Closed Area II: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data..... 425

Table 97 – Recreational revenue estimated within a 10 nautical mile buffer of Closed Area I and Closed Area II, which are currently closed to recreational groundfishing. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate data censored due to privacy concerns. 426

Table 98 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Georges Bank alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only. 427

Table 99 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the Georges Bank Alternatives. Ports with less than 3 vessels each were included in the state totals only. * Changes in revenue for option 2 only listed for ports with 3 or more vessels affected by option 2 gear exemption..... 428

Table 100 – Sum of 2012 party/charter recreational fishing revenue associated with the Closed Area I buffer. Ports with less than 3 vessels each were included in the state totals only. 428

Table 101 – Nantucket Lightship: Average value per haul/set (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data..... 447

Table 102 – Mobile bottom-tending gear in currently open portions of the Great South Channel Alternative 3 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics..... 449

Table 103 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the areas included in the Great South Channel/Southern New England habitat alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Shrimp Trawl effort is not reported due to privacy concerns. 457

Table 104 – Party/charter recreational fishing revenue associated with the areas included in the Great South Channel/Southern New England habitat alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level. 459

Table 105 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Great South Channel/Southern New England Areas potentially impacted by the management alternatives..... 460

Table 106. Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the Great South Channel/Southern New England Alternatives. Ports with less than 3 vessels each were included in the state totals only. *Changes in revenue for option 2 only listed for ports with 3 or more vessels affected by option 2 gear exemption..... 463

Table 107 – Total number of vessels conducting recreational fishing trips in 2012. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only. ... 465

Table 108 – Sum of 2012 party/charter recreational fishing revenue associated with the Great South Channel/Southern New England Alternatives. Ports with less than 3 vessels each were included in the state totals only. 465

Table 109 – Gear Analysis for Entangled Large Whale Events (2006-2010) 480

Table 110 – Recent Harbor Porpoise Bycatch Estimates 481

Table 111 – Summary of unweighted and weighted large spawner hotspots by Gulf of Maine spawning protection alternative. Seasonal spawning = GOM cod spawning protection area. ... 505

Table 112 – Seasonal summary of unweighted and weighted large spawner hotspots for the No Action alternative. 514

Table 113 – Summary of unweighted and weighted large spawner hotspots during spring, comparing Georges Bank Alternatives 1/No Action, 2, and 3. 518

Table 114 – Revenue in currently open portions of the Massachusetts Bay Spawning Area (Alternatives 2 and 3) potentially impacted by the management options during November 1 - January 31. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics 530

Table 115 – Recreational fishing revenue associated with the GOM Spawning Alternative 2 areas in the relevant time frames being considered for closure. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. 531

Table 116 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting trips capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area. 532

Table 117 – Landing port and associated revenues for gear capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area. Ports with less than 3 vessels each were included in the state totals only.533

Table 118 – Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the GOM Spawning Alternative 2 in the relevant time frames being considered for closure. 533

Table 119 – Recreational revenue estimated within a 10 nautical mile buffer of areas within Georges Bank Spawning Alternative 2 currently closed to recreational groundfishing. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate data censored due to privacy concerns. 539

Table 120 – Total number of Massachusetts permits conducting recreational fishing trips within a 10 nautical mile buffer of Closed Area I (see previous table for revenue estimates). Other states and individual communities could not be identified due to privacy concerns. 540

Table 121 – Summary of substrate distribution, data quality, and total size of dedicated habitat research areas. Percentages indicate the coverage by area of substrate and data support values are listed in the text. 546

Table 122 – Average diversity indices by DHRA Alternative. 546

Table 123 – Total number of unweighted and weighted age 0/1 groundfish hotspots by season and DHRA alternative..... 554

Table 124 – Total number of age 0/1 groundfish hotspots by species and DHRA alternative... 555

Table 125 – Recreational fishing revenue currently associated with the Southern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate information censored due to privacy concerns. 575

Table 126 – Recreational fishing revenue currently associated with the Northern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level..... 580

Table 127 – Recreational fishing revenue currently associated with the entire Stellwagen DHRA. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level..... 581

Table 128 – Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the Northern and Southern Reference Areas..... 581

Table 129 – Sum of 2012 party/charter recreational fishing revenue associated with the Northern and Southern Reference Areas. Ports with less than 3 vessels each were included in the state totals only. 581

Table 130 – Estimated total discards of thorny skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document..... 619

Table 131 – Estimated total discards of smooth skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document..... 621

Table 132 – Estimated total discards of barndoor skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document. 623

Table 133 – Summary of the impacts of habitat management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. 623

Table 134 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted). 625

Table 135 – Summary of the impacts of research alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3..... 626

Table 136 – Summary of the impacts of habitat management alternatives on the skate fishery. No impacts are expected on rosette skate or clearnose skate. 628

Table 137 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted). 630

Table 138 – Summary of the impacts of research alternatives on the skate fishery. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3..... 631

Table 139 – Summary of NGOM scallop catch..... 640

Table 140 – Long-term and short-term yield potential from current EFH closed areas and several new areas under consideration. 645

Table 141 – Summary of 2015 results for several scenarios developed to capture the range of HMA alternatives under consideration in OA2 based on SAMS model outputs 653

Table 142 – Estimated landings (million lb)..... 658

Table 143 – Estimated landings net of No Action landings (million lb) 659

Table 144 - Estimated open area DAS per limited access vessel (not including effort in newly opened EFH areas – catch from those areas is not considered in these DAS estimates)..... 659

Table 145 – Preliminary projections for price (in 2013 inflation adjusted prices; average price in 2012=$9.77) 660

Table 146 – Preliminary revenue projections (in 2013 inflation adjusted values prices, undiscounted) 661

Table 147 – Cumulative present value of total scallop revenue (using 3% discount rate) 661

Table 148 – Present value of total scallop revenue net of no action revenue (using 3% discount rate) 661

Table 149 – Present value of total scallop revenue (using 7% discount rate) 662

Table 150 – Present value of total scallop revenue net of no action revenue (using 7% discount rate) 662

Table 151 – Average landings per unit of effort for all areas in pounds per day (meat weight) 663

Table 152 – Area Swept..... 663

Table 153 – Present value of producer surplus (using 3% discount rate)..... 664

Table 154 – Present value of producer surplus net of No Action values (using 3% discount rate) 664

Table 155 – Present value of producer surplus (using 7% discount rate)..... 665

Table 156 – Present value of producer surplus net of No Action values (using 7% discount rate) 665

Table 157 – Present value of total economic benefits (using 3% discount rate) 665

Table 158 – Present value of total economic benefits net of no action values (using 3% discount rate) 666

Table 159 – Present value of total economic benefits (using 7% discount rate) 666

Table 160 – Present value of total economic benefits net of no action values (using 7% discount rate) 666

Table 161 – Impacts of spatial management alternatives on the Atlantic herring resource 673

Table 162 – Impacts of spatial management alternatives on the Atlantic herring fishery..... 676

Table 163 – Current and future clam dredge effort in GSC/SNE and GB habitat areas 686

Table 164 – Commercial gear types associated with bluefish harvest by federally permitted vessels in 2011. 692

Table 165 – Mackerel landings (mt) in statistical areas with at least 1,000 mt of mackerel landed in at least one recent year. 696

Table 166 – Butterfish landings (mt) in statistical areas with substantial recent butterfish catch. 696

Table 167 – Longfin squid landings (mt) in statistical areas with at least 250 mt of longfin squid landed in at least one recent year. 697

Table 168 – Illex landings (mt)..... 697

Table 169 – Commercial gear types associated with spiny dogfish harvest for calendar years 2008-2011. Note that vessels with state issued permits only are not required to complete VTRs so total VTR landings are less than total dealer-reported landings. 701

Table 170 – Statistical areas that accounted for at least 5 percent of the summer flounder, scup, or black sea bass catch in 2012, NMFS VTR data. 710

Table 171 – Shrimp trawl revenue in the Large and Small Bigelow Bight areas, calendar years 2010-2012. All variables represent annual estimates derived from federal VTRs. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dashes indicate information dropped due to privacy concerns. Note that the small area is a subset of the large area. 714

1.3 Figures

Figure 1 - Flowchart - DHRA evaluation procedure. 130

Figure 2 - Linkages between VECs and impacts 149

Figure 3 – Length frequency of observed cod catches in the Gulf of Maine (Statistical Areas 511-515) by trawls (top) and gillnets (bottom) during 2010-2013. 154

Figure 4 – Schematic of trawl gear (top down view) showing the relative contribution of doors vs. ground cables vs. sweep to gear width/area swept. Not to scale. 157

Figure 5 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 spring surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean. 169

Figure 6 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 fall surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean. 170

Figure 7 – Illustration of potential impacts of habitat improvement on recruitment using actual spawning stock biomass and recruitment estimates for Gulf of Maine cod. Data are from NEFSC 2013; http://nefsc.noaa.gov/publications/crd/crd1311/..... 174

Figure 8 – Illustration of potential effects of increasing spawning success and its effect on recruitment produced by that increase. 180

Figure 9 – Cod length frequency in fishery catches (2009-present), all areas..... 182

Figure 10 – EGOM: distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. 209

Figure 11 – CGOM: Distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. The Ammen Rock, Platts Bank, and Fippennies Ledge areas are not shown because only a single grid overlaps them and therefore a density distribution cannot be generated. The Cashes Ledge Habitat Closure and Modified Cashes Ledge EFH area overlap the same set of SASI grid cells and therefore their vulnerability distributions overlap completely in the figure below. 219

Figure 12 – WGOM: distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. Alternatives 7a and 7b are not shown... 230

Figure 13 – Number of observed trips and hauls during 2008-2013 on vessels using shrimp trawls within the Inshore Roller Gear Restricted Area. Five percent of trips and nine percent of observed hauls used a roller size greater than 12 inches. 240

Figure 14 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, No Action areas (Alternative 1). A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.... 248

Figure 15 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, new or modified areas (Alternatives 3-8). A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.... 249

Figure 16 – GSC: Distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. 263

Figure 17 – Machias HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 476,109; 2008 - 2012 = $ 416,544; 2010 - 2012 = $ 439,210..... 355

Figure 18 – Large Eastern Maine HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,076,300; 2008 - 2012 =$ 2,059,535; 2010 - 2012 = $ 2,719,470 356

Figure 19 – Small Eastern Maine HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 612,696; 2008 - 2012 =$ 574,660; 2010 - 2012 = $ 661,771 357

Figure 20 – Toothaker Ridge HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 774,603; 2008 - 2012 = $ 825,982; 2010 - 2012 = $ 776,860..... 358

Figure 21 – Scallop fishing revenue within the vicinity of Platts Bank in 2013. Individuals are ranked from largest to smallest impact, in terms of revenue estimated to have been generated from Platts Bank, and are summarized in groups of five, to ensure confidentiality. A total of $42,373 is estimated to have been generated by scallop dredges in Platts Bank within the calendar year 2013. 370

Figure 22 – Average trip-level scallop fishing revenue within the vicinity of Platts Bank, by ranked permit group. Individuals are ranked from largest to smallest impact, in terms of revenue estimated to have been generated from Platts Bank, and are summarized in groups of five, to ensure confidentiality..... 371

Figure 23 – Jeffreys Bank HMA revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 490,005; 2008 - 2012 = $ 424,539; 2010 - 2012 = $ 212,244..... 372

Figure 24 – Platts Bank HMA revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 206,164; 2008 - 2012 = $ 185,991; 2010 - 2012 = $ 209,074..... 373

Figure 25 – Large Bigelow Bight HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy

concerns. Average annual total revenue: 2005-2012 = $ 6,507,068; 2008-2012 = $ 7,206,629; 2010-2012 = $ 7,860,367 386

Figure 26 – Small Bigelow Bight HMA commercial fishing revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005-2012 = $ 3,007,689; 2008-2012 = $ 3,117,597; 2010-2012 = $ 3,110,068 387

Figure 27 – Northern Edge HMA (Alternatives 3 and 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 852,785; 2008 - 2012 = $ 1,087,408; 2010 - 2012 = $ 1,454,659 410

Figure 28 –Georges Shoal Gear Modification Area (Alternative 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 3,448,932; 2008 - 2012 = $ 3,702,336; 2010 - 2012 = $ 5,053,355 411

Figure 29 – Northern Georges Gear Modification Area (Alternative 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 19,384,365; 2008 – 2012 = $ 21,334,179; 2010 – 2012 = $ 29,024,703 412

Figure 30 – Georges Shoal 1 MBTG closure HMA (Alternative 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that three gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 1,966,622; 2008 – 2012 = $ 2,106,342; 2010 – 2012 = $ 2,944,249 413

Figure 31 – EFH Expanded 1 HMA (Alternative 6A) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 5,821,773; 2008 – 2012 = $ 6,731,022; 2010 – 2012 = $ 7,803,157 414

Figure 32 – Georges Shoal 2 MBTG/EFH South MBTG (Alternative 7) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,617,306; 2008 – 2012 = $ 2,963,928; 2010 – 2012 = $ 3,698,026 415

Figure 33 – Northern Georges MBTG HMA (Alternative 8) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 19,464,700; 2008 – 2012 = $ 22,610,573; 2010 – 2012 = $ 26,819,277 416

Figure 34 – Great South Channel East HMA (Alt 3) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 22,732,371; 2008 – 2012 = $ 24,429,534; 2010 – 2012 = $ 36,185,396 441

Figure 35 – Cox Ledge HMA (Alts 3-6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 814,471; 2008 – 2012 = $ 895,190; 2010 – 2012 = $ 1,070,794 442

Figure 36 – Great South Channel HMA (Alt 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863 443

Figure 37 –Nantucket Shoals HMA (Alt 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863 444

Figure 38 –Nantucket Shoals West HMA (Alt 6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 7,585,618; 2008 – 2012 = $ 8,118,389; 2010 – 2012 = $ 11,383,584 445

Figure 39 – Great South Channel Gear Modification Area (Alt 6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 38,690,902; 2008 – 2012 = $ 43,448,967; 2010 – 2012 = $ 65,038,480 446

Figure 40 – Massachusetts Bay Groundfish Spawning Area revenue by gear, as a percentage of the total average revenue Nov. 1 – Jan 31 within each year range given. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 582,110; 2008 – 2012 = $ 680,528; 2010 – 2012 = $ 651,690 526

Figure 41 – Average recreational revenue generated within the Massachusetts Bay Spawning Area during Nov. 1 – Jan 31, delineated by whether or not groundfish were caught on a trip. . 527

Figure 42 – Recreational revenue estimated to have been generated by trips reported within the GOM Spawning Alternative 2 areas, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the areas. Note: Groups do not necessarily consist of the same individuals across years. 528

Figure 43 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the areas of GOM Spawning Alternative 2 during the relevant time periods. 529

Figure 44 – Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip occurred within a period that would provide access to these areas under Georges Bank Spawning Alternative 2..... 538

Figure 45 – Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip caught at least one groundfish. 539

Figure 46 – The total number of recreational trips (party and charter) reported within the southern reference area, grouped by whether at least one groundfish was caught on the trip. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012. 573

Figure 47 – Recreational revenue estimated to have been generated by trips reported within the southern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012... 574

Figure 48 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the southern reference area. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012. 575

Figure 49 – The total number of recreational trips (party and charter) reported within the northern reference area, grouped by whether at least one groundfish was caught on the trip.... 578

Figure 50 – Recreational revenue estimated to have been generated by trips reported within the northern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years 579

Figure 51 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the northern reference area 580

Figure 52 – Length frequency distribution of kept and discarded red hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls. 588

Figure 53 – Length frequency distribution of kept and discarded silver hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls. 589

Figure 54 – Monkfish landings (million lbs.) by the top five gears by region, 1994-2012 (continued on next page). Source: NMFS CFDBS data. Upper panel – GOM, SAs 464, 465, 511-515. Middle panel – GB, SAs 522, 525, 542, 543, 561, and 562. Lower panel – SNE, SAs 521, 526-541. 608

Figure 55 – Scallop shell height: meat weight anomaly for GB and MA (Hennen and Hart, 2012) 636

Figure 56 – Model generated estimate of meat weights for scallops larger than 125mm for Eastern and Western GB (based on scallops measured in CFF bycatch survey)..... 637

Figure 57 – Model generated estimates of meat weights for scallops larger than 125mm for Eastern (top) and Western GB (bottom) with potential seasonal closures included. Grey is spawning closure under consideration and yellow is in effect already for CAII to reduce yellowtail bycatch. 638

Figure 58 – Projected scallop landings (mt) for 2015-2027 for the five model runs..... 655

Figure 59 – Projected scallop biomass (mt) for 2015-2027 for the five model runs..... 655

Figure 60 – Projected area swept (nm^2) for 2015-2027 for the five model runs 657

Figure 61 – 2012 and 2013 VTR data for all scallop dredge vessels 671

1.4 Maps

Map 1 – Eastern Gulf of Maine Habitat Management Alternative 2 48
Map 2 – Eastern Gulf of Maine/Scotian Shelf Habitat Management Alternative 3 50
Map 3 – Central GOM Habitat Management Alternative 1 (No Action) 53
Map 4 – Central GOM Habitat Management Alternative 3 55
Map 5 – Central GOM Habitat Management Alternative 4 57
Map 6 – Western Gulf of Maine Habitat Management Alternative 1 (No Action). 60
Map 7 – Western Gulf of Maine Habitat Management Alternative 3. 62
Map 8 – Western Gulf of Maine Habitat Management Alternative 4. 64
Map 9 – Western Gulf of Maine Habitat Management Alternative 5. 66
Map 10 – Western Gulf of Maine Habitat Management Alternative 6. 67
Map 11 – Western Gulf of Maine Habitat Management Alternative 7. Existing area option (hatched) and alternate area option (shaded) roller gear areas that could be implemented as habitat management measures in combination with any of the other WGOM alternatives. 69
Map 12 – Western Gulf of Maine Alternative 1 with addition of exemption area for shrimp trawl gear (black outline) 70
Map 13 – Georges Bank Habitat Management Alternative 1 (No Action) 74
Map 14 – Georges Bank Habitat Management Alternative 3. 76
Map 15 – Georges Bank Habitat Management Alternative 4. The hatched Georges Shoal GMA is only being considered for ground cable modifications. 78
Map 16 – Georges Bank Habitat Management Alternative 5. 80
Map 17 – Georges Bank Habitat Management Alternatives 6a and 6b. 82
Map 18 – Georges Bank Habitat Management Alternative 7 83
Map 19 – Georges Bank Habitat Management Alternative 8 85
Map 20 – Great South Channel/SNE Habitat Management Alternative 1 (No Action). 88
Map 21 – Great South Channel/SNE Habitat Management Alternative 3. 90
Map 22 – Great South Channel/SNE Habitat Management Alternative 4. 92
Map 23 – Great South Channel/SNE Habitat Management Alternative 5. 94
Map 24 – Great South Channel/SNE Habitat Management Alternative 6. 96
Map 25 – Gulf of Maine Spawning Alternative 1 (No Action) 101
Map 26 – Gulf of Maine Spawning Alternative 2. 104
Map 27 – Gulf of Maine Spawning Alternative 3 107
Map 28 – Georges Bank Spawning Alternative 1 (No Action). 111

Map 29 – Georges Bank Spawning Alternative 2. Areas closed February 1-April 15 to vessels using gears capable of catching groundfish. 112

Map 30 – Georges Bank Spawning Alternative 3. Areas closed February 1-April 15 to vessels using gears capable of catching groundfish. 115

Map 31 – Eastern Maine Dedicated Habitat Research Area..... 124

Map 32 – Stellwagen Dedicated Habitat Research Area with two possible reference area options. 127

Map 33 – Georges Bank Dedicated Habitat Research Area 129

Map 34 – Considered and rejected adverse effects minimization habitat management areas 140

Map 35 - Considered and rejected juvenile groundfish habitat management areas 141

Map 36 – Areas of 100 km^2 blocks identified by the CATT as having concentrations of large mature groundfish to be considered as seasonal spawning closures..... 143

Map 37 – Current gillnet effort distribution (left, 2010-2013) compared to historic gillnet effort distribution (right, 1994-1998) before the Western Gulf of Maine closure. Lines represent the set and haul locations for fishing events observed at sea. 153

Map 38 – Distribution and overlap of WGOM Alternative 3, EGOM Alternative 3, and CGOM Alternative 4 with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, ME-NH, and IBS cod surveys. 171

Map 39 – Weighted spawner hotspot overlap with eastern Gulf of Maine habitat management areas by season. Grids are labeled by weighted value. 184

Map 40 – Weighted spawner hotspot overlap with central Gulf of Maine habitat management areas by season. Grids are labeled by weighted value. 185

Map 41 – Weighted spawner hotspot overlap with western Gulf of Maine habitat management areas by season. Grids are labeled by weighted value. 186

Map 42 – Weighted spawner hotspot overlap with Georges Bank habitat management areas by season. Grids are labeled by weighted value. 187

Map 43 – Weighted spawner hotspot overlap with Great South Channel/Southern New England habitat management areas by season. Grids are labeled by weighted value..... 188

Map 44 – EGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). 210

Map 45 – CGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). 220

Map 46 – WGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Alternatives 7a and 7b (roller gear restricted areas) are not shown on these figures. 231

Map 47 – Bigelow Bight substrate distribution comparison. Left panel – Maine Bottom Type data along coast (legend in upper left) overlaid on updated SASI grid with additional Jeffreys Ledge data (legend at right). Right panel – SASI grid on which vulnerability model runs are based. 232

Map 48 – Stellwagen substrate distribution comparison. Left panel – multibeam backscatter (mud, sand, and gravel) overlaid with boulder ridges and bedrock outcrops in red. Right panel – SASI grid on which vulnerability model runs are based. 233

Map 49 – Jeffreys Ledge substrate distribution comparison. Left panel – updated SASI grid. Data were collected using video and analyzed to match SASI methods. Right panel – SASI grid on which vulnerability model runs are based. 234

Map 50 – Observed trawl fishing effort by target species in the Western Gulf of Maine during 2008-2013 compared to SASI trawl vulnerability (darker grids represent higher substrate vulnerability) and substrate type. A red outlined area represents the proposed roller gear restriction in Alternative 7A, while the black outlined area is proposed in Alternative 7B. 239

Map 51 – Alternative 7A (hatched area) and Alternative 7B (shaded area) overlaid with substrate data. 241

Map 52 – GB: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). 250

Map 53 – GSC-SNE: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions. 264

Map 54 – Distribution of surfclams and ocean quahogs in clam dredge surveys since 2000 relative to the boundaries of existing and proposed habitat areas in the Great South Channel region. 265

Map 55 - Overlap of Preferred Alternative Habitat Management Areas in the Gulf of Maine region with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 276

Map 56 - Overlap of No Action habitat closures and year round groundfish closed areas in the Gulf of Maine region with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 281

Map 57 – Eastern Gulf of Maine Alternative 2 (red shading with red outline) and central Gulf of Maine Alternative 3 (black outline) overlap with spring (left), and fall (right) weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC and ME-NH survey data. 287

Map 58 – Eastern Gulf of Maine Alternative 3 (hatching with blue outline) and central Gulf of Maine Alternative 4 (dots with red outline) overlap with spring (left) and fall (right) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC, MADMF, ME-NH, and IBS survey data. There are no summer or winter weighted hotspots in this area. 288

Map 59 – WGOM Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 302

Map 60 – WGOM Alternatives 1, 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC, MADMF, ME-NH, and IBS survey data. 304

Map 61 – Location of observed hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared with outlined 100 km^2 blocks with the

30% of highest trawl vulnerability scores and substrate types in the Western Gulf of Maine sub-region. 306

Map 62 – Location of observes hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared spring (left) and fall (right) age 0/1 groundfish hotspots heavily weighted in favor of stocks that are at low biomass and/or associated with coarse and hard substrates..... 307

Map 63 – WGOM Alternatives 1, 7A and 7B overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data..... 308

Map 64 – Georges Bank Alternative 1 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC trawl and summer dredge survey data..... 314

Map 65 – Georges Bank Alternatives 1, 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC trawl and summer dredge survey data. Alternative 3 includes the Northern Edge only, while Alternative 4 includes both the Northern Edge and the Georges Shoal GMA. 319

Map 66 – Overlap of GB Alternatives 1, 3 and 4 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys..... 321

Map 67 – Overlap of GB Alternatives 1, 3 and 4 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys..... 322

Map 68 – Georges Bank Alternatives 1 and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data. 324

Map 69 – Georges Bank Alternatives 1 and 5 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys..... 326

Map 70 – Georges Bank Alternatives 1 and 5 overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys. 327

Map 71 – Georges Bank Alternatives 1, 6A and 6B overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data. 330

Map 72 – Georges Bank Alternatives 1, 6A, and 6B overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys..... 332

Map 73 – Georges Bank Alternatives 1, 6A, and 6B overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys..... 333

Map 74 – Georges Bank Alternatives 1, 7, and 8 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data. 337

Map 75 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys. 339

Map 76 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys. 340

Map 77 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 1982-1991 NMFS surveys. 341

Map 78 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 1972-1981 NMFS surveys. 342

Map 79 – GSC Alternatives 3, 4, and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 348

Map 80 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys..... 350

Map 81 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys. 351

Map 82 – GSC Alternatives 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. Alternative 5 includes only the Nantucket Shoals west area (shaded light green with a black border). Alternative 6 includes the Nantucket Shoals west area and a Great South Chanel Gear Modification Area (brown hatching surrounded by a brown border). 353

Map 83 – Observed turtle interactions by month in gillnet, bottom trawl, and scallop dredge gears, 1989-2012 483

Map 84 – Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours. 484

Map 85 – Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours. 485

Map 86 – Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours. 486

Map 87 – Marine Mammal Takes 2007-2010 487

Map 88 – Atlantic Large Whale Take Reduction Plan Management Areas, with existing year-round closed areas 488

Map 89 – Harbor Porpoise Take Reduction Plan Management Areas, with existing year-round closed areas 489

Map 90 – No Action rolling and year round closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the Western Gulf of Maine sub-region, using 2002-2012 spring NMFS, MADMF, ME-NH, and IBS cod survey data. 508

Map 91 – Alternative 2 spawning closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the WGOM sub-region, using 2002-2011 spring NMFS, MADMF, ME-NH, and IBS cod survey data. 509

Map 92 – Proportion of cod abundance by stage of maturation during NMFS and MADMF spring trawl surveys, 2002-2011..... 510

Map 93 – Distribution of large mature cod during NMFS winter trawl and IBS trawl surveys, 2002-2007. 511

Map 94 – Location of Massachusetts Bay Cod Spawning Protection Area (orange with black border) compared to the location of acoustic receivers used in 2013-2014 winter cod spawning research by MADMF and to the location of other existing spawning protection areas in the Western Gulf of Maine. The relative number and proportion of cod in 2002-2012 spring surveys by maturation are shown as pie charts at the location of the observation..... 513

Map 95 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1/No Action areas. 516

Map 96 – Distribution of weighted large spawner groundfish hotspots in summer, fall, and winter seasons compared to Alternative 1/No Action areas. 517

Map 97 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1 areas. Closures to gears capable of catching groundfish would occur from Feb 1 to Apr 15. 520

Map 98 – Distribution of cod (left) and haddock (right) by small and large mature fish size classes during spring and summer surveys of Georges Bank during 2002-2011. 521

Map 99 – Distribution of cod (top) and haddock (bottom) by maturity stage during 2002-2011 surveys. 522

Map 100 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 2 areas. Closures to gears capable of catching groundfish would occur from Feb 1 to Apr 15. 524

Map 101 – Sediments and bathymetry in the Eastern Maine DHRA (solid black outline). Dotted line indicates the state/Federal waters boundary at 3 nm and the coastline is depicted in solid black. Source: Barnhardt et al 1998 (sediment) and the Nature Conservancy's Northwest Atlantic Marine Ecoregional assessment (bathymetry). 549

Map 102 – DHRA Alternatives 3 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data (continued on next page). 559

Map 103 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data (continued on next page)..... 561

Map 104 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data..... 562

Map 105 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal cod weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 563

Map 106 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal haddock weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. 564

Map 107 – VTR-reported cod catch per angler for commercial party and charter boats in the proposed Stellwagen Bank Dedicated Habitat Research Area and Reference Areas, 2008-2012. Catches are color coded by month, Jan (dark green) to August (yellow) to December (red). Each point represents a reported trip. 565

Map 108 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS survey data. 567

Map 109 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS survey data. 568

Map 110 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 spring trawl surveys. 590

Map 111 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 summer shrimp trawl and scallop dredge surveys. 591

Map 112 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 fall trawl surveys. 592

Map 113 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 3 in WGOM, CGOM, EGOM, and GB sub-regions, and Alternatives 3-5 in the GSC sub-region. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color. 597

Map 114 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 4 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color. 598

Map 115 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 5 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color. 599

Map 116 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 6 in WGOM, GB, and GSC sub-regions, with EGOM Alternative 2 and CGOM Alternative 4. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color. 600

Map 117 – Location of the Cultivator Shoals Small-mesh Exemption Area (open to fishing during June 15-Oct 31; blue shading with brown border) compared to the placement of the Georges Shoal 2 MBTG (Alternative 7; black border) and Northern Georges MTBG (Alternative 8; grey shading with purple border) areas. Observed trawl locations are represented by black lines, while fishing locations on vessel trip reports are represented by dots color coded by the month of landing, both data sets from 2008-2012. 601

Map 118 – Monkfish management areas including the boundary between the Northern and Southern (Monkfish) Fishery Management Areas (separated by thick red line). 603

Map 119 – Distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish. No Action EFH Closures (blue outline) and year round Groundfish Closed Areas (tan background with green borders) are shown with Monkfish Fishery Exemption Areas. 604

Map 120 – 2002-2012 spring (orange circles) and fall (red circles) biomass distribution with habitat closures, year-round groundfish closures and monkfish exemption areas shown. Source: NMFS trawl survey data. 606

Map 121 – Relationship between proposed Habitat Management Areas and No Action areas in the GOM. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM (Groundfish) Closed Area, as well as Alternatives 2, 3, and 4 in the Central and Eastern GOM. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison. 610

Map 122 – Relationship between proposed Habitat Management Areas and No Action areas in the Western Gulf of Maine. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM Groundfish Closed Area. Proposed and HMAs in the Central GOM are also shown. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison. 611

Map 123 – Relationship between proposed Habitat Management Areas and No Action areas in Central and Eastern Gulf of Maine. Shown are proposed Habitat Management Areas associated with Alternatives 2, 3, and 4. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison. 612

Map 124 – Relationship between proposed Habitat Management Areas and No Action areas on Georges Bank. Shown are proposed HMAs associated with Alternatives 5 and 6.1. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to

be on a Multispecies DAS under certain regulatory constraints are also shown for comparison. 614

Map 125 – Relationship between proposed Habitat Management Areas and No Action areas on Georges Bank. Shown are proposed HMAs associated with Alternatives 7 (Georges Shoal 2 MBTG and EFH South MBTG; black border) and 8 (Northern Georges MBTG; grey shading and purple border). These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. 615

Map 126 – Relationship between proposed Habitat Management Areas and No Action areas in SNE. Shown are proposed HMAs associated with Alternatives 3, 4, and 6. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison. 616

Map 127 – Fixed kernel utilization distribution (UD) of positive thorny skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence. 618

Map 128 – Fixed kernel utilization distribution (UD) of positive smooth skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence. 620

Map 129 – Fixed kernel utilization distribution (UD) of positive barndoor skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence. 622

Map 130 – Gulf of Maine scallop fishing locations during 2012 and 2013 based on vessel trip reports, with potential habitat management area boundaries 641

Map 131 – NEFSC shellfish survey strata with EFH areas under consideration (Georges Bank) with scallop numbers from scallop dredge survey years 2002-2012. 643

Map 132 – NEFSC shellfish survey strata with EFH areas under consideration (GSC/SNE) with scallop numbers from all scallop dredge survey years (1966-2013) 644

Map 133 – Scallop (number/tow) from NEFSC scallop dredge surveys (all years) with EFH areas on the northern edge of Georges Bank. There is substantial long term yield potential west of the existing habitat closure (indicated by a red circle). This area would close under the new Northern Edge HMA (Alternative 3 or 4), the EFH Expanded 1 and 2 HMAs (Alternatives 6A/6B), or under the Northern Georges MBTG HMA (Alternative 8). 648

Map 134 – Total scallop biomass (2013 VIMS dredge survey data) relative to Alternative 1, 3/4, 6A, 6B, 7, and 8 Habitat Management Areas. 649

Map 135 – Typical SAMS model areas, with statistical areas and NEFSC shellfish stratum boundaries on Georges Bank 652

Map 136 – VTR effort CY2008-2012 for LA scallop fishery. VTR catch 600 pounds and less considered LAGC effort and trips above 600 pounds were considered LA effort. 669

Map 137 – VTR effort CY2008-2012 for LAGC scallop fishery. 670

Map 138 – Overlap between herring egg EFH (blue) with Habitat Management Areas (pinks/reds, labeled). Non-overlapping habitat areas are outlined in black..... 672

Map 139 – VTR locations (red circles) of small mesh bottom trawl trips where the main species was noted as 'herring', 2008-2012..... 674

Map 140 – Surfclam landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, by year (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Summary (NEFSC 2013)..... 681

Map 141 – Ocean quahog landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, and time period. TMSQ in light blue had reported landings, but from fewer than three vessels (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Update (Chute at al. 2013)..... 682

Map 142 – Distribution of the surfclam and ocean quahog resource during summer clam dredge surveys from 2002-2012, relative to PSP closures, the PSP exemption area, and No Action and new/modified habitat management areas in the Georges Bank sub-region. Locations where both species were caught may appear green due to the overlap of blue and yellow shading. 688

Map 143 – Distribution of the surfclam and ocean quahog resource during summer clam dredge surveys from 2002-2012, relative to PSP closures, the PSP exemption area, and No Action and new/modified habitat management areas in the Great South Channel/Southern New England sub-region. 689

Map 144 – Bluefish catch by NMFS Statistical Areas. Shading reflects the cumulative percentage of landings with red and orange being the primary areas where the commercial landings are taken. 693

Map 145 – 2010 spiny dogfish catch by statistical area. Shaded areas indicate where spiny dogfish harvest occurs. Red areas comprise 5% or more of harvest and green areas 1% to 5% of harvest. 702

Map 146 – Distribution of EFH for juvenile and adult summer flounder. 705

Map 147 – Distribution of EFH for juvenile and adult scup. 706

Map 148 – Distribution of EFH for juvenile and adult black sea bass. 707

Map 149 - Overlap between lobster and scallop distributions in all NEFSC surveys, 2002-2012. Scallop weight per tow (blue) is partially transparent to show lobster distribution underneath (red). The central part of Closed Area II (shaded) contains lobsters but few scallops. 721

2 Spatial management alternatives

Essential Fish Habitat and Habitat Area of Particular Concern designations are based on species-specific distributions and life-history information, and are used primarily for analytical approaches in impact analyses and agency consultations. This section of the amendment outlines alternatives that designate spatial management areas that contain habitats of importance to multiple species, are vulnerable to impacts from fishing, and within which fishing activities would be restricted for conservation purposes on the basis of gear type (Table 1). Three types of areas are proposed: (1) year-round habitat management areas – Section 2.1, (2) seasonal spawning protection areas – Section 2.2, and (3) dedicated habitat research areas – Section 2.3. There are spatial overlaps between the three sets of areas, and there are various fishing restrictions possible within each type of area, so the final distribution of fishing effort restrictions will depend on which areas and measures are selected in combination. The impacts of those restrictions are described in Section 4 below, as well as in the Cumulative Effects Analysis in Volume 4.

The amendment includes action alternatives/areas designed to address specific goals and objectives, and related no action spatial management alternatives, which consist of combinations of current areas and measures that currently fulfill similar purposes to their corresponding action alternatives. The intent of the action alternatives in each category is explicit – either year round protection of vulnerable habitats from fishing gear effects or seasonal protection of spawning fish. However, the original rationales behind the areas that constitute the no action alternatives are often not as explicitly defined. Furthermore, the existing management areas currently produce multiple benefits, which may not link directly to the original purpose of the designations. In contrast to some past spatial management efforts, the action alternatives are not designed to reduce fishing mortality per se, but to protect fish habitats, particularly for juvenile groundfish, to minimize fishing impacts on spawning, and to facilitate research focused on links between habitat characteristics and use by managed species.

Table 1 – Types of spatial management alternatives that effect fishing activities

Alternative type	Year round or seasonal	Which areas comprise the action alternatives?	Type of restrictions (generally)	Rationale
Habitat protection	Year round, long term	Modified versions of existing habitat management areas in groundfish and scallop FMPs, new areas based upon SASI and groundfish hotspot analyses.	Mobile bottom-tending gears – prohibit their use, or allow dredges and require gear modifications for trawls only. Option to exclude hydraulic clam dredges from the restriction if all mobile bottom-tending gears are prohibited. Some areas (Eastern Maine, Ammen Rock) consider broader restrictions.	Minimize adverse effects of fishing on highly structured seafloor habitats with long recovery times to protect the areas ability to shelter fish and fish prey. Some areas focus on encompassing habitats for juvenile large mesh multispecies in particular.
Spawning protection	Seasonal, long term	Existing rolling and year round closures, redesignated as spawning areas; new area in Massachusetts Bay	Closed to gears capable of catching groundfish, with exemptions as appropriate. Options to include recreational groundfishing in the restriction.	Avoid capture of fish during their spawning season, prevent disruption of spawning activity
Habitat research	Year round, triggered sunset provision	Subsets of existing habitat management areas, or new habitat management areas	At minimum, prohibit use of mobile bottom-tending gears. Stellwagen area maintains no-action restrictions and also includes a reference area that would further restrict recreational groundfish catch.	Create opportunity for research that investigates the relationship between habitat, fishing, and fish productivity

2.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats

The alternatives in this section were designed around two sets of goals and objectives. Some candidate habitat management areas were identified through the Habitat Plan Development Team and Habitat Committee, based on the results of the Swept Area Seabed Impact (SASI) analyses and related extra-SASI information including sources of substrate data not included in SASI and bathymetric data. **The primary goal addressed with these areas was to minimize the adverse effects of fishing on vulnerable seabed habitats, across all areas managed by the Council.** Additional areas were later identified by the Closed Area Technical Team and Groundfish Committee, based on an analysis of juvenile groundfish distributions, combined with information about the current status of various stocks and their affinities for vulnerable habitat types. **The**

primary goal addressed with these areas was to improve groundfish productivity, specifically by protecting habitats used by critical life stages (i.e. juveniles). The SASI approach is detailed in Appendix D, and the results are summarized in the habitat vulnerability section of Volume 1. The groundfish distribution analysis is detailed in Appendix E, and the results are summarized in the hotspot analysis portion of the affected environment section in Volume 1. These separate, but complementary, analyses were conducted because the Council added goals and objectives specific to groundfish protection later in the amendment's development. **Regardless of the origin of a particular area, the merged sets of areas in each alternative are intended, collectively, to comply with the requirement of the MSA to minimize the adverse effects of fishing on essential fish habitats:**

> *"Fishery Management Plans must describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat" (Magnuson-Stevens Fishery Conservation and Management Act, As Amended Through January 12, 2007)*

The Secretarial EFH guidelines (67 FR 2343, January 17, 2002) define an 'adverse effect' as any impact that reduces the quality and/or quantity of essential fish habitat, but only requires that actions be take to prevent, mitigate, or minimize adverse effects from fishing, if they are both 'more than minimal' and 'not temporary'. However, determinations about what exactly is meant by minimal and temporary, and about what management measures are practicable, are left to the Council's discretion.

All of the habitat management areas described in this section would be implemented on an indefinite, year-round basis, and the fishing restriction measures focus on minimizing impacts associated with mobile bottom-tending gears. The alternatives in this section are grouped sub-regionally. A sub-regional organization was used to facilitate discussion, analysis, and decision making. Each sub-region has a unique mix of habitat types, stocks, and fisheries. Grouping management areas into alternatives at a larger spatial scale (Gulf of Maine vs. Georges Bank/Southern New England, or the full jurisdiction of the New England Council) was thought to be less practical for discussing trade-offs and local considerations.

Alternative 1 for each sub-region (the No Action alternative) consists of mobile-bottom tending gear closures first identified via Northeast Multispecies Amendment 13 as well as the year-round groundfish closures, which were implemented at various times and for various purposes, but often restrict mobile bottom-tending gears and provide some of the same benefits in terms of minimizing adverse effects on EFH, at least within areas not currently fished.

Table 2 – Measures in existing groundfish closure areas

Area	Closed to	Exemptions
Cashes Ledge and Western Gulf of Maine Closure Areas	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Charter and party vessels with a letter of authorization; • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls; • Vessels participating in the mid-water trawl exempted fishery; • Vessels that are transiting, provided that gear is properly stowed
Nantucket Lightship Closure Area	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Classified as charter, party or recreational vessel, provided that: (A) LOA, (B) Fish species managed by the NEFMC or the MAFMC are not sold, (C) no gear other than rod and reel or handline gear on board, (D) vessel does not fish outside the Nantucket Lightship Closed Area during the period specified by the LOA • Fishing with or using dredge gear designed and used to take surfclams or ocean quahogs • Fishing for scallops within the Nantucket Lightship Access Area • Vessels that are transiting, provided that gear is properly stowed
Closed Area I	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Fishing in a Special Access Program • Fishing for scallops within the Closed Area I Access Area • Vessels that are transiting, provided that gear is properly stowed
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Fishing in a Special Access Program • Tuna purse seine gear outside of the portion of CA II known as the Habitat Area of Particular Concern • Fishing in the CA II Yellowtail Flounder/Haddock SAP or the Eastern U.S./Canada Haddock SAP Program • Transiting the area, provided the vessel's fishing gear is stowed and there is a compelling safety reason • The vessel has declared into the Eastern U.S./Canada Area and is transiting CA II • Fishing for scallops within the Closed Area II Access Area • Vessels that are transiting, provided that gear is properly stowed

Alternative 2 for each sub-region is a "no closure" alternative. This means no year-round habitat management areas; however, Alternative 2 does not preclude seasonal closures for spawning, or year-round management areas employed for other purposes (e.g. research). In the eastern Gulf of Maine sub-region, where there are no current closed areas, the No Action and no closure alternatives are the same and are combined for the purpose of analysis.

Alternatives 3-8 for each sub-region (2-3 for eastern Gulf of Maine) consist of combinations of new or modified habitat management areas. In some cases, different alternatives in a sub-region include smaller and larger versions of an area. These are named "Small XX HMA and "Large XX HMA" to distinguish between them; the associated maps clarify which area is included in a given alternative. The areas included in each alternative are summarized in Table 3.

With the exception of the Ammen Rock area (see below), management measures for each area can generally be selected from the following five options. Different measures could be selected in each area. Information about what constitutes a mobile bottom-tending gear, or a gear capable of catching groundfish, is discussed later in this introduction.

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.
- Option 5, complete restriction on gears capable of catching groundfish.

The Ammen Rock area is proposed as a closure to all fishing, with the exception of lobster trapping; this is the only habitat management area that would be managed in this way. Restrictions on lobster traps are not proposed in any of the habitat management, spawning management, or research areas because, in general, lobster pot gear is not expected to result in significant adverse effects on vulnerable habitat, similar to other fixed gears. In addition, lobster pots are not currently considered gear capable of catching groundfish. Further, the Council has very limited authority to regulate lobster pot fishing to those instances when the successful management of a Council resource requires it. In this case, because of the minimal impacts to highly vulnerable habitat from lobster pots and the small, if any, amount of regulated groundfish caught in lobster pots, restrictions on that gear is not necessary to successfully achieve the goals and objectives of this amendment.

In order to develop the juvenile groundfish-oriented HMAs, the Closed Area Technical Team reviewed the weighted juvenile groundfish hotspot grids by season. The weighted grids combine hotspots weighted by four factors: B_{msy}/B (stock vulnerability), whether or not the stock has known or possible sub-populations, whether the stock is more resident (as compared to more migratory), and affinity for complex substrates. Stocks that do not have a strong affinity for coarse substrates were zeroed out of the weighted grids, such that the locations of the juvenile groundfish-oriented HMAs were based on the distribution of the following stocks only: Georges

Bank cod, Gulf of Maine cod, Georges Bank haddock, Gulf of Maine haddock, pollock, Acadian redfish, Atlantic halibut, ocean pout, and Atlantic wolffish. The hotspot weighting procedure is described fully in Volume 1.

The first step in identifying candidate management areas was to find contiguous areas with numerous hotspots in each of the seasonal weighted hotspot data layers. The result was a set of rough management area boundaries for each season. The seasonal boundaries were then compared to identify areas important to juvenile groundfish across multiple seasons. The seasonal boundaries were also overlaid onthe habitat vulnerability layer from the SASI model. Both the weighted hotspot and SASI grids were generated at the same 100 km^2 resolution to facilitate comparison of the two datasets. The final candidate management areas were thus locations with a contiguous grouping of hotspots across one or more seasons, with relatively high vulnerability values. As a last step, the candidate management areas were limited to areas in Federal waters.

Table 3 – Summary of areas included in the various habitat management alternatives

Sub-region	Alternative	Areas included	Fishing restriction options
Eastern Gulf of Maine	1 (No Action, no closure)	None	n/a
	2	Large Eastern Maine HMA, Machias HMA	1-5
	3	Small Eastern Maine HMA, Machias HMA, Toothaker Ridge HMA	1-4
Central Gulf of Maine	1 (No Action)	Jeffreys Bank Habitat Closure Area, Cashes Ledge Habitat Closure Area, Cashes Ledge Closed Area	Current measures
	2 (no closure)	None	n/a
	3	Modified Jeffreys Bank HMA, Modified Cashes Ledge HMA, Ammen Rock HMA, Fippennies Ledge HMA, Platts Bank HMA	1-4, Ammen Rock closed to all fishing
	4	Modified Jeffreys Bank HMA, Modified Cashes Ledge HMA, Ammen Rock HMA	1-4, Ammen Rock closed to all fishing
Western Gulf of Maine	1 (No Action)	Western Gulf of Maine Habitat Closure Area, Western Gulf of Maine Closed Area	Current measures
	2 (no closure)	None	n/a
	3	Large Bigelow Bight HMA, Large Stellwagen HMA	1-4
	4	Large Bigelow Bight HMA, Small Stellwagen HMA, Jeffreys Ledge HMA	1-4
	5	Small Bigelow Bight HMA, Small Stellwagen HMA, Jeffreys Ledge HMA	1-4
	6	Large Stellwagen HMA	1-4
	7a	Inshore Roller Gear Restricted Area	Trawl roller gear limited to 12 inches diameter

Sub-region	Alternative	Areas included	Fishing restriction options
	7b	Alternate Roller Gear Restricted Area	Trawl roller gear limited to 12 inches diameter
	8	WGOM Shrimp Trawl Exemption Area	Shrimp trawls exempted from mobile bottom-tending gear closure
Georges Bank	1 (No Action)	CAI and CAII EFH, CAI and CAII GF	Current measures
	2 (no closure)	None	n/a
	3	Northern Edge HMA	1-4
	4	Northern Edge HMA and Georges Shoal Gear Modified Area	NE: 1-4, GS: 3-4
	5	Georges Shoal 1 MBTG HMA and Northern Georges Gear Modified Area	GS: 1-2, NG: 3-4
	6a	EFH Expanded 1 HMA	1-4
	6b	EFH Expanded 2 HMA	1-4
	7	Georges Shoal 2 MBTG HMA and EFH South MBTG HMA	1-2
	8	Northern Georges MBTG HMA	1-2
Great South Channel /Southern New England	1 (No Action)	Nantucket Lightship Habitat Closure Area, Nantucket Lightship Closed Area	Current measures
	2 (no closure)	None	n/a
	3	Great South Channel East HMA and Cox Ledge HMA	1-4
	4	Great South Channel HMA and Cox Ledge HMA	1-4
	5	Nantucket Shoals HMA and Cox Ledge HMA	1-4
	6	Nantucket Shoals West MBTG HMA, Great South Channel Gear Modified Area, Cox Ledge HMA	NSW: 1-2, GSC: 3-4, CL: 1-4

Management Option 1 would close an area to mobile bottom-tending gears, generally trawls and dredges. More specifically, using the list of gears available for VTR reporting purposes, mobile bottom-tending gears (MBTG) include the gears listed in Table 4. If Option 2 is selected, **hydraulic** clam dredges would be exempted from the mobile bottom tending gear restriction. Toothed clam dredges used along the Maine coast to target mahogany quahogs would still be restricted.

Table 4 – VTR gear codes for mobile bottom-tending gears

Gear type	GEARCODE	NEGEAR	NEGEAR2
Fish bottom otter trawl	OTF	50	5
Scallop bottom otter trawl	OTC	52	5
Twin bottom otter trawl	OTT	53	5
Ruhle trawl	OTR	54	5
Bottom pair trawl	PTB	56	5
Haddock separator trawl	OHS	57	5
Shrimp trawl	OTS	58	5
Other bottom otter trawl	OTO	59	5
Sea scallop dredge	DRS	132	13
Sea scallop dredge with chain mat	DSC	132	13
Danish seine	SED	160	16
Beam trawl	OTB	350	35
Scottish seine	SES	360	36
Other dredge	DRO	381	38
Mussel dredge	DRM	385	38
Urchin dredge	DRU	387	38
Ocean quahog/surfclam dredge	DRC	400	40

Eastern Gulf of Maine Alternative 2 proposes closure of the Large Eastern Maine and Machias areas to "gears capable of catching groundfish", i.e. management Option 5. As a starting point for developing such area-specific lists, gears capable of catching groundfish are defined as any gears that are not on the exempted gear list in the Fisheries of the Northeastern United States regulations at 50 CFR §648.2. These exempted gears are as follows:

> *"Exempted gear, with respect to the NE multispecies fishery, means gear that is deemed to be not capable of catching NE multispecies, and includes: Pelagic hook and line, pelagic longline, spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dipnets, stop nets, pound nets, pelagic gillnets, pots and traps, shrimp trawls (with a properly configured grate as defined under this part), and surfclam and ocean quahog dredges."*

However, this regulatory language is not precisely duplicated in the Vessel Trip Report gear codes which are relied upon in many of the analyses for this amendment, so the language was mapped to the gear codes in the VTR database (Table 5). In a small number of instances, it is not possible to identify whether a VTR gear code would correspond to one of the exempted gears. Specifically, the mixed gear (MIX), other gear (OTH), and other gill net (GNO) categories are not specific enough to identify as exempted gears, so these gear codes are not listed in the tables in this section. It is important to note the distinction between exempted fisheries and exempted gears. For example, small mesh exemption areas confer an exemption from Northeast multispecies mesh size restrictions, but small mesh bottom trawls are not an exempted gear. On the other hand, the herring fishery is prosecuted in year round closed areas as an exempted fishery.

Table 5 – VTR codes for "exempted gears", based on regulatory language at 50 CFR §648.2.

Gear name	GEARCODE	NEGEAR	NEGEAR2
Harpoon	HRP	30	3
Pelagic longline	LLP	40	4
Shrimp trawl	OTS	58	5
Trap	TRP	80	8
Small mesh drift gillnet	GNT	110	11
Large mesh drift gillnet	GND	115	11
Other pots	PTO	180	18
Mixed pots	PTX	180	18
Fish pot	PTF	181	18
Conch/whelk pot	PTW	183	18
Eel pot	PTE	186	18
Hagfish pot	PTH	186	18
Shrimp pot	PTS	190	19
Lobster pot	PTL	200	20
Stop seine	STS	240	24
Hand rake	RAK	250	25
Weir	WEI	260	26
Crab pot	PTC	300	30
Fyke net	FYK	320	32
Diving gear	DIV	330	33
Cast net	CST	340	34
Ocean quahog/surfclam dredge	DRC	400	40
Runaround gillnet	GNR	500	50

Gears that are not exempted (Table 6) are used as a starting point to define a list of gears capable of catching groundfish. It is important to categorize the VTR gear types as capable or not capable of catching groundfish in order to facilitate impacts analyses based on VTR data. For example, an evaluation of potentially displaced revenue requires the analyst to bin all VTR effort into gear capable of catching groundfish vs. gears not capable of catching groundfish. Also, listing out the exempted and restricted gears helps the Council and the public to see which gears would be affected by any particular alternative. Of course, the Council may choose to deviate from these lists when defining restrictions for a specific management area. For example, some sector vessels have requested the ability to use fish pots to target regulated multispecies. Although the regulatory language identifies all pots as exempted, this classification may not be appropriate for fish pots and the Council could choose to put this gear into the gear capable of catching groundfish category. Conversely, other gears that are not considered exempted may in practice catch very low numbers of groundfish, e.g. specialized dredges such as urchin dredges.

Table 6 – VTR gear codes that could be considered gears capable of catching groundfish. Gears are listed in order by NEGEAR code. This list represents all gears that are not identified as "exempted gears".

Gear name	GEARCODE	NEGEAR	NEGEAR2
Bottom longline	LLB	10	1
Hand line/rod & reel	HND	20	2
Fish bottom otter trawl	OTF	50	5
Scallop bottom otter trawl	OTC	52	5
Twin bottom otter trawl	OTT	53	5
Ruhle trawl	OTR	54	5
Bottom pair trawl	PTB	56	5
Haddock separator trawl	OHS	57	5
Other bottom otter trawl	OTO	59	5
Haul seine	SEH	70	7
Sink gillnet	GNS	100	10
Purse seine	PUR	120	12
Sea scallop dredge	DRS	132	13
Sea scallop dredge with chain mat	DSC	132	13
Danish seine	SED	160	16
Midwater pair trawl	PTM	170	17
Beam trawl	OTB	350	35
Scottish seine	SES	360	36
Midwater trawl	OTM	370	37
Other dredge	DRO	381	38
Mussel dredge	DRM	385	38
Urchin dredge	DRU	387	38

If an area is closed to both mobile bottom-tending gears and gear capable of catching groundfish, the gears listed in Table 7 would be prohibited. This list is the gear capable of catching groundfish list, with the addition of shrimp trawls and clam dredges.

Table 7 – List VTR gear codes that combines mobile bottom-tending gears with gears capable of catching groundfish

Gear type	GEARCODE	NEGEAR	NEGEAR2
Bottom longline	LLB	10	1
Hand line/rod & reel	HND	20	2
Fish bottom otter trawl	OTF	50	5
Scallop bottom otter trawl	OTC	52	5
Twin bottom otter trawl	OTT	53	5
Ruhle trawl	OTR	54	5
Bottom pair trawl	PTB	56	5
Haddock separator trawl	OHS	57	5
Shrimp trawl	OTS	58	5
Other bottom otter trawl	OTO	59	5
Haul seine	SEH	70	7
Sink gillnet	GNS	100	10
Purse seine	PUR	120	12
Sea scallop dredge	DRS	132	13
Sea scallop dredge with chain mat	DSC	132	13
Danish seine	SED	160	16
Midwater pair trawl	PTM	170	17
Beam trawl	OTB	350	35
Scottish seine	SES	360	36
Midwater trawl	OTM	370	37
Other dredge	DRO	381	38
Mussel dredge	DRM	385	38
Urchin dredge	DRU	387	38
Ocean quahog/surfclam dredge	DRC	400	40

2.1.1 Eastern Gulf of Maine

The habitat management alternatives for the eastern Gulf of Maine sub-region include various combinations of four areas: Toothaker Ridge, Small Eastern Maine, Large Eastern Maine, and Machias. **Alternative 2 with Options 1 and 5 is the preferred alternative.**

Table 8 – Coordinates for habitat management areas in eastern Maine

Toothaker Ridge HMA (Alt 3)			Small Eastern Maine HMA, * see note B (Alt 3)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
1	43° 40.0’	69° 15.4’	1	44° 02.5’	68° 06.1’
2	43° 40.0’	69° 07.9’	2	43° 51.0’	68° 33.9’
3	43° 45.4’	69° 07.9’	3*	43° 56.6’	68° 38.1’
4	43° 45.4’	69° 00.5’	4*	44° 07.6’	68° 10.6’
5	43° 40.0’	69° 00.5’			
6	43° 40.0’	68° 45.6’	Machias HMA, see note A (Alts 2 and 3)		
7	43° 34.6’	68° 45.6’	Point	N Latitude	W Longitude
8	43° 34.6’	68° 53.1’	1	44° 27.7’	-67° 08.9’
9	43° 29.2’	68° 53.1’	2	44° 28.0’	-67° 27.1’
10	43° 29.2’	69° 00.5’	3	44° 46.0’	-66° 54.8’
11	43° 29.2’	69° 07.9’			
12	43° 34.6’	69° 07.9’			
13	43° 34.6’	69° 15.3’			
Large Eastern Maine HMA, * see note B (Alt 2)			*A. Western boundary state waters; eastern boundary state waters/EEZ*		
Point	N Latitude	W Longitude	*B. Landward boundary at state waters. Only endpoints provided.*		
1	44° 07.1’	68° 00.2’			
2	43° 51.7’	68° 00.0’			
3	43° 42.2’	68° 33.1’			
4	43° 42.3’	-68° 46.0’			
5*	43° 49.0’	-68° 45.9’			
6*	43° 55.9’	-68° 41.0’			
7*	43° 56.8’	-68° 39.3’			
8*	44° 07.1’	-68° 10.8’			

2.1.1.1 *Alternative 1 (No Action, no habitat management areas)*

Because there are currently no year-round closed areas in this sub-region, the no action habitat management alternative in the eastern Gulf of Maine region does not include any habitat management areas. If the Council prefers a no-habitat-management-area strategy in this sub-region, the No Action alternative should be selected. If the Council prefers a strategy with habitat management areas in this sub-region, Alternative 2 or 3 should be selected.

2.1.1.2 *Alternative 2 (preferred)*

This alternative (Map 1) would designate two new habitat management areas, the Large Eastern Maine Habitat Management Area and the Machias Habitat Management Area, in all FMPs. Measures for both of these areas could include:

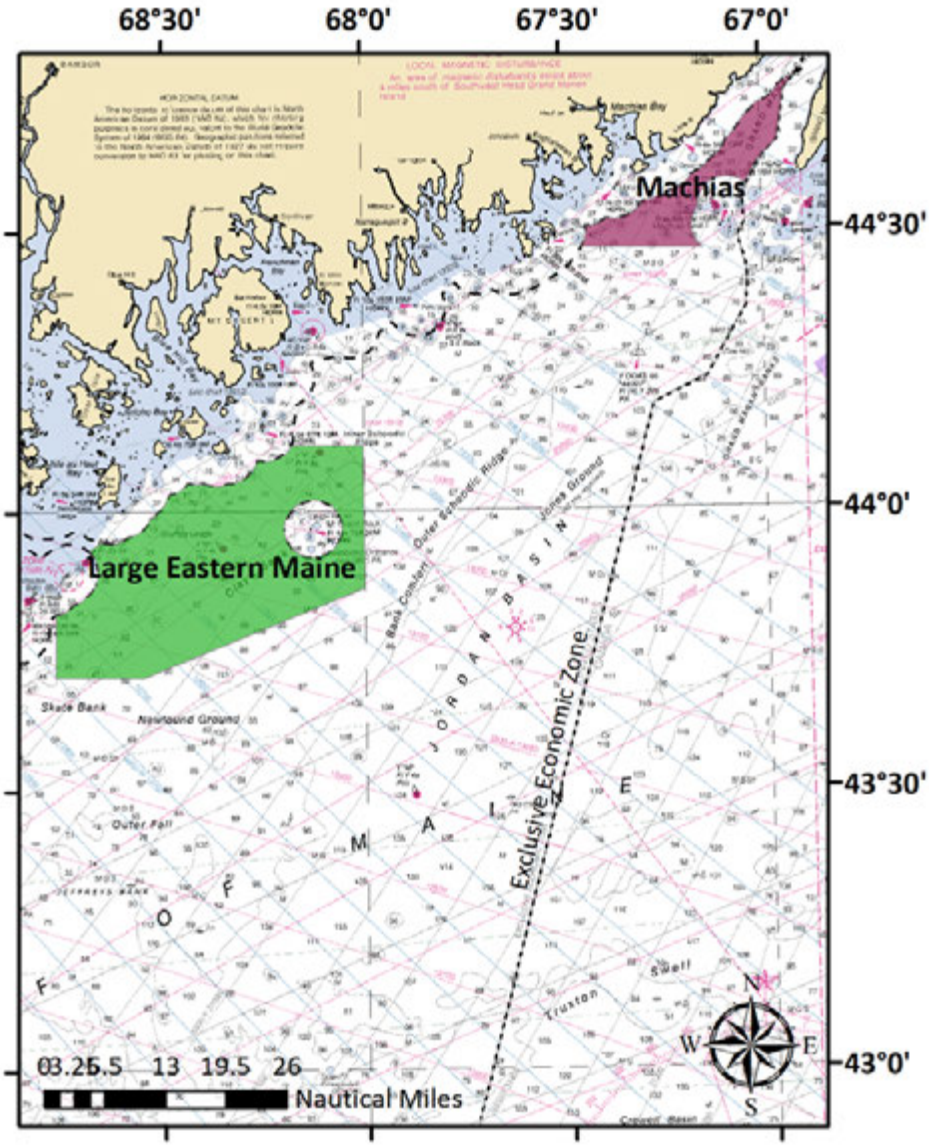
- Option 1, complete restrictions on use of mobile bottom-tending gears (per Table 4), or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.
- Option 5, complete restrictions on use of gears capable of catching groundfish (per Table 6).

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

The Council's preferred management approach is to apply Options 1 and 5 in both the Machias and Large Eastern Maine HMAs.

Rationale: The Eastern Maine area was designed to minimize the adverse effects of fishing on habitats used by juvenile groundfish, including redfish, alewife, silver hake, white hake, windowpane flounder, winter flounder, and witch flounder. The larger version of the Eastern Maine area included in this alternative includes additional juvenile hotspots compared to the smaller area identified in Alternative 3. Habitats in the Eastern Maine area are vulnerable to fishing impacts, as indicated by the SASI spatial analysis. The Machias area was developed to minimize the adverse effects of fishing on juvenile cod, haddock, and halibut habitats.

Map 1 – Eastern Gulf of Maine Habitat Management Alternative 2



2.1.1.3 ***Alternative 3***

This alternative (Map 2) designates three new habitat management areas, the Small Eastern Maine Habitat Management Area, the Machias Habitat Management Area, and the Toothaker Ridge Habitat Management Area. All three areas would be designated in all Council FMPs. Measures for all three of these areas could include:

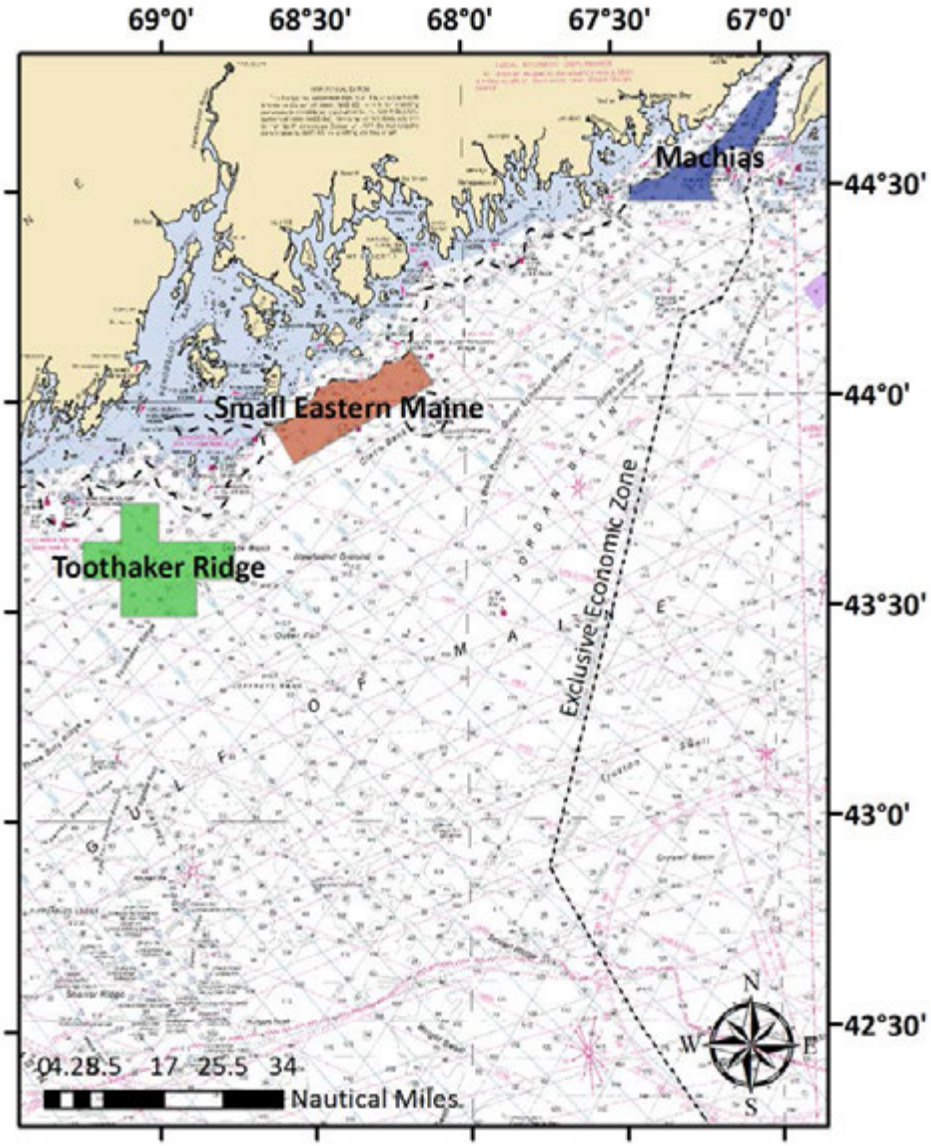
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The Toothaker Ridge area was developed specifically for juvenile groundfish habitat protection, and includes juvenile redfish and witch flounder habitat. The Small Eastern Maine area is expected to protect habitats of similar species as compared to the larger area (i.e. redfish, alewife, silver hake, white hake, windowpane flounder, winter flounder, and witch flounder), but with fewer impacts to industry, which is why the smaller area was combined with the nearby Toothaker Ridge area. The Machias area is the same as in Alternative 2; it was developed to minimize the adverse effects of fishing on juvenile cod, haddock, and halibut habitats.

Map 2 – Eastern Gulf of Maine/Scotian Shelf Habitat Management Alternative 3



2.1.2 Central Gulf of Maine

The habitat management alternatives for the central Gulf of Maine region include various combinations of eight areas: Jeffreys Bank (no action), Modified Jeffreys Bank, Cashes Ledge Habitat Closure Area (no action), Cashes Ledge Groundfish Closed Area (no action), Modified Cashes Ledge HMA, Ammen Rock HMA, Fippennies Ledge HMA, and Platts Bank HMA (which is comprised of two sub-areas that would be implemented together). **Alternative 4 Option 1 is the preferred alternative.**

Table 9 – Coordinates for habitat management areas in the central Gulf of Maine

Jeffreys Bank Habitat Closure Area (Alt 1)			Modified Jeffreys Bank EFH HMA (Alts 3 and 4)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
JB1	43° 40′	68° 50′	1	43° 31′	68° 37′
JB2	43° 40′	68° 40′	2	43° 20′	68° 37′
JB3	43° 20′	68° 40′	3	43° 20′	68° 55′
JB4	43° 20′	68° 50′	4	43° 31′	68° 55′
Cashes Ledge Habitat Closure Area (Alt 1)			Modified Cashes Ledge EFH HMA (Alts 3 and 4)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
CLH1	43° 01′	69° 03′	1	43° 01.0′	69° 00.0′
CLH2	43° 01′	68° 52′	2	43° 01.0′	68° 52.0′
CLH3	42° 45′	68° 52′	3	42° 45.0′	68° 52.0′
CLH4	42° 45′	69° 03′	4	42° 45.0′	69° 00.0′
Cashes Ledge Closure Area (Alt 1)					
Point	N Latitude	W Longitude			
CL1	43°07′	69°02′			
CL2	42°49.5′	68°46′			
CL3	42°46.5′	68°50.5′			
CL4	42°43.5′	68°58.5′			
CL5	42°42.5′	69°17.5′			
CL6	42°49.5′	69°26′			
Ammen Rock HMA (Alts 3 and 4)			Fippennies Ledge HMA (Alt 3)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
1	42° 55.5′	68° 57.0′	1	42° 50.0′	69° 17.0′
2	42° 52.5′	68° 55.0′	2	42° 44.0′	69° 14.0′
3	42° 52.5′	68° 57.0′	3	42° 44.0′	69° 18.0′
4	42° 55.5′	68° 59.0′	4	42° 50.0′	69° 21.0′
Platts Bank HMA 1 (Alt 3)			Platts Bank HMA 2 (Alt 3)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
1	43° 13.0′	69° 37.5′	1	43° 10.5′	69° 32.0′
2	43° 10.5′	69° 37.5′	2	43° 07.5′	69° 32.0′
3	43° 10.5′	69° 42.5′	3	43° 07.5′	69° 37.5′
4	43° 13.0′	69° 42.5′	4	43° 10.5′	69° 37.5′

2.1.2.1 ***Alternative 1 (No Action)***

The no action habitat management alternative in the central Gulf of Maine region includes the Jeffreys Bank and Cashes Ledge Habitat Closure Areas. These areas were initially implemented via Amendment 13 to the Northeast Multispecies FMP (2004) as areas closed to all mobile bottom-tending gears, regardless of the FMP or Council under which that effort was managed. The areas were subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. This alternative also includes the Cashes Ledge Closure Area, which was closed to groundfishing year-round by Secretarial action on May 1, 2002.

Current restrictions for the three areas are summarized below. Two types of mobile bottom-tending gears, shrimp trawls and surfclam/quahog dredges, are exempted from the Cashes Ledge Closure Area. However, these gears are very unlikely to ever fish in the groundfish closure due to the distribution of their target species, so effectively all three areas have functioned as mobile bottom-tending gear closures since designation (2002 and 2004 for the groundfish and habitat closure portions, respectively).

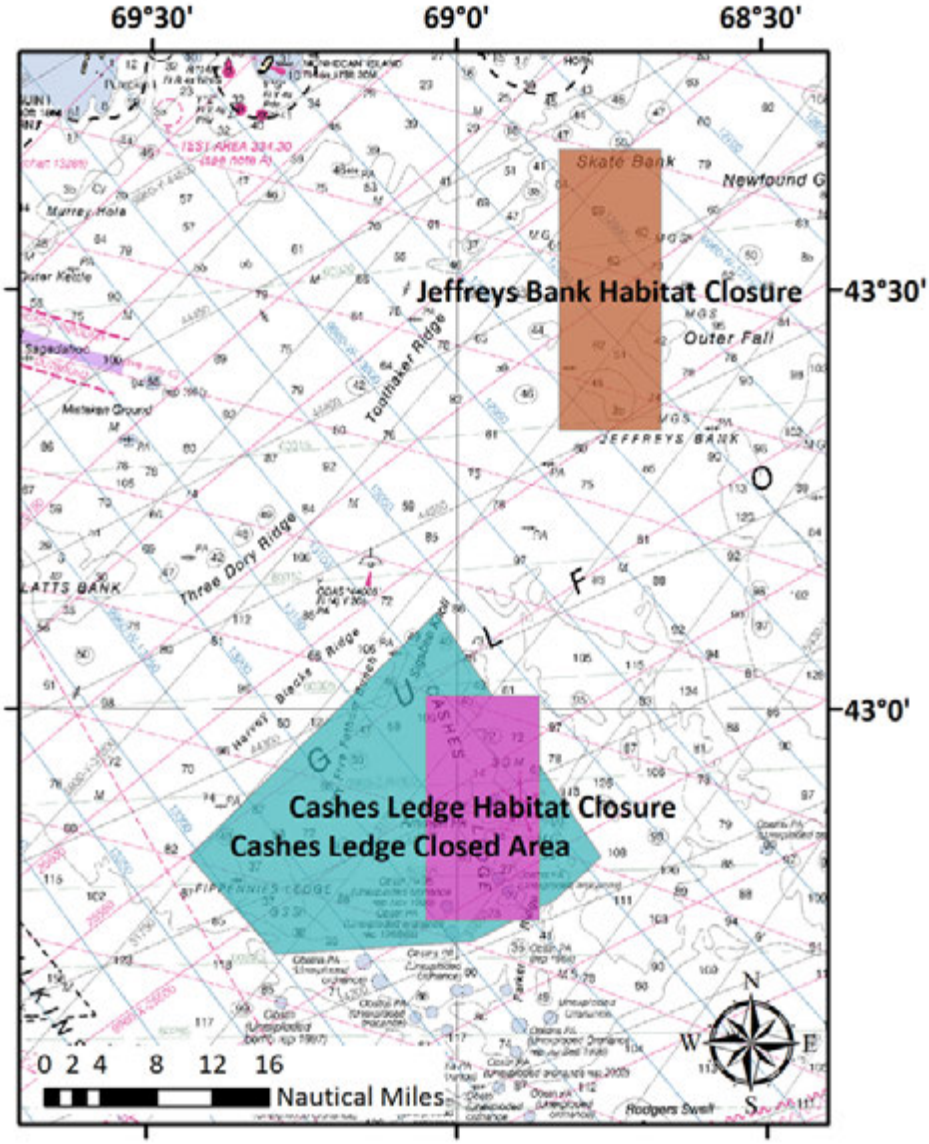
Table 10 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Central GOM sub-region.

Area name	Prohibitions	Exemptions
Cashes Ledge Habitat Closure Area, Jeffreys Bank Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	• Vessels that are transiting, provided that gear is properly stowed
Cashes Ledge Closure Area	Closed year round to all fishing vessels, except for:	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls[1] • Vessels participating in the mid-water trawl exempted fishery • Vessels that are transiting, provided that gear is properly stowed

Rationale: The habitat closure areas, and also the groundfish closure area, restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the central Gulf of Maine region.

[1] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the Western Gulf of Maine and the Cashes Ledge Closure Areas

Map 3 – Central GOM Habitat Management Alternative 1 (No Action)



2.1.2.2 *Alternative 2 (No habitat management areas)*

This alternative would remove the current Cashes Ledge and Jeffreys Bank Habitat Closure Areas and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom-tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.2.3 ***Alternative 3***

This alternative (Map 4) would modify the boundaries of the current Jeffreys Bank and Cashes Ledge Habitat Closure Areas, and designate three new habitat management areas: Ammen Rock, Fippennies Ledge, and Platts Bank (Platts Bank is comprised of two sub-areas). All five of these areas would be designated in all Council FMPs. The Ammen Rock area would be closed to all fishing gears and activities, except for lobster trapping. Measures for the other four areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all four areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The current Jeffreys Bank Habitat Closure Area encompasses both shallower hard-bottom habitats on the bank (southern portion) and deeper, muddy habitats (northern portion). The modification would change the boundaries to focus on just the southern portion, with an expansion of the area to the east and to the west to incorporate the portion of Jeffreys Bank shallower than approximately 100 m. This better focuses the area on more vulnerable habitat types in order to minimize the adverse effects of fishing on EFH.

Most of the hard-bottom, shallower habitats on Cashes Ledge are included in the modified, smaller area, including all features shallower than 100 meters. The Ammen Rock pinnacle, which is the shallowest part of Cashes Ledge, represents a particularly unique and vulnerable kelp forest habitat type that would benefit from enhanced levels of protection. Although for an equal amount of area swept fixed gears were estimated to have substantially reduced adverse effects in comparison to trawls and dredges, habitat impacts due to fixed gear use could be significant and long lasting (‘adverse’ effects requiring mitigation are both ‘more than minimal’ and ‘not temporary’) for some types of benthic features, including those found on Ammen Rock.

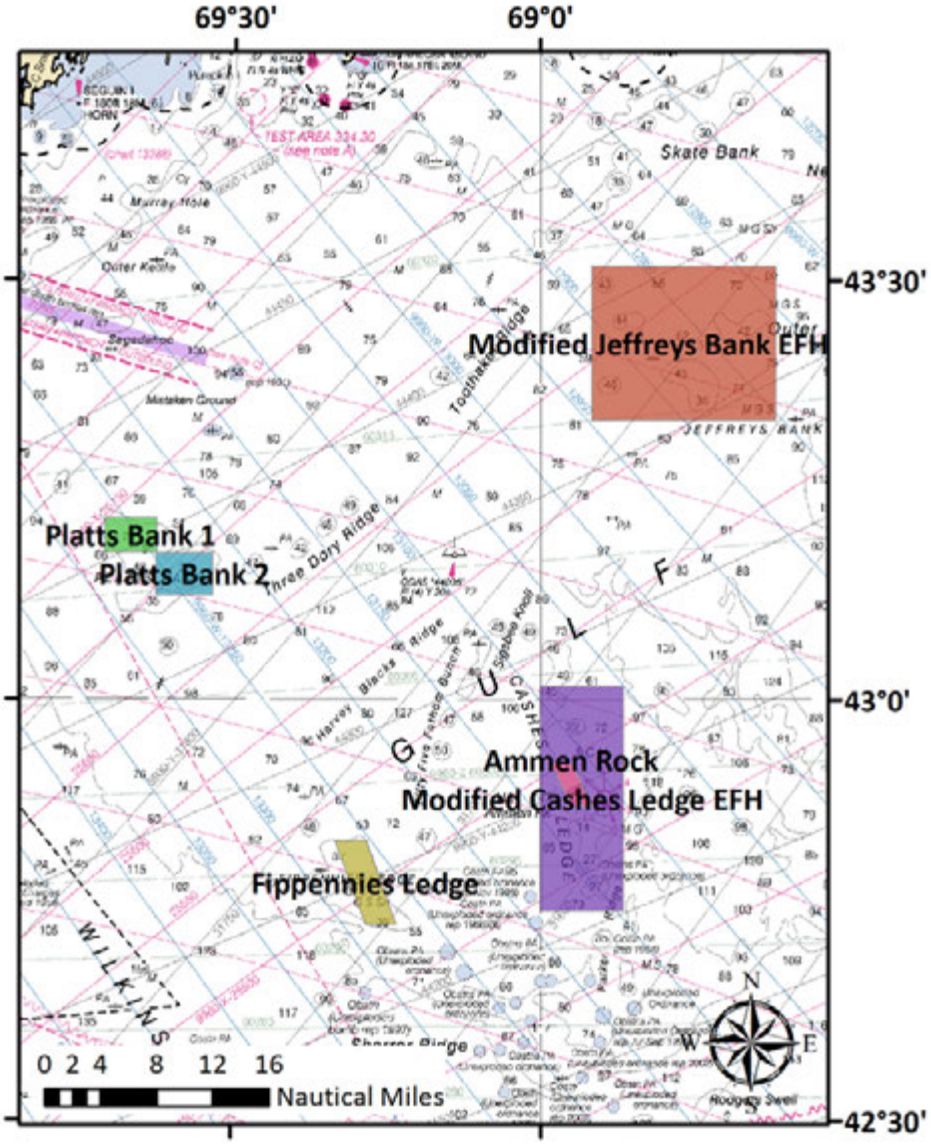
Fippennies Ledge and Platts Bank would be new habitat management areas, although Fippennies Ledge lies within the existing Cashes Ledge [Groundfish] Closure Area. Each of these areas is designed to focus on the core, shallow portions of the features. The design objective was to protect a representative array of substrate and habitat types while allowing fishing activity along the edges of the features.

None of these areas were identified through evaluation of juvenile groundfish distributions (i.e., the “hotspot analysis”), although the areas contain habitats for redfish on Platts Bank, haddock

on Fippennies Ledge, and redfish, plaice, haddock, and silver hake on Cashes Ledge. Designating these habitat management areas is expected to minimize fishing impacts on vulnerable habitats and improve groundfish productivity. Survey sampling on Cashes and Fippennies Ledges is extremely limited, so the analysis may not reflect the importance of these habitats to juvenile fish.

This alternative removes the Cashes Ledge Closure Area. Portions of the groundfish closure not overlapping with habitat area proposals generally contain mud habitat types, which are estimated to be less vulnerable to accumulating adverse effects.

Map 4 – Central GOM Habitat Management Alternative 3



2.1.2.4 ***Alternative 4 (preferred)***

This alternative (Map 5) would modify the boundaries of the current Jeffreys Bank and Cashes Ledge Habitat Closure Areas and designate a new habitat management area on Ammen Rock. All three of these areas would be designated in all Council FMPs. The Ammen Rock area would be closed to all fishing gears and activities except for lobster trapping. Measures for the modified areas could include:

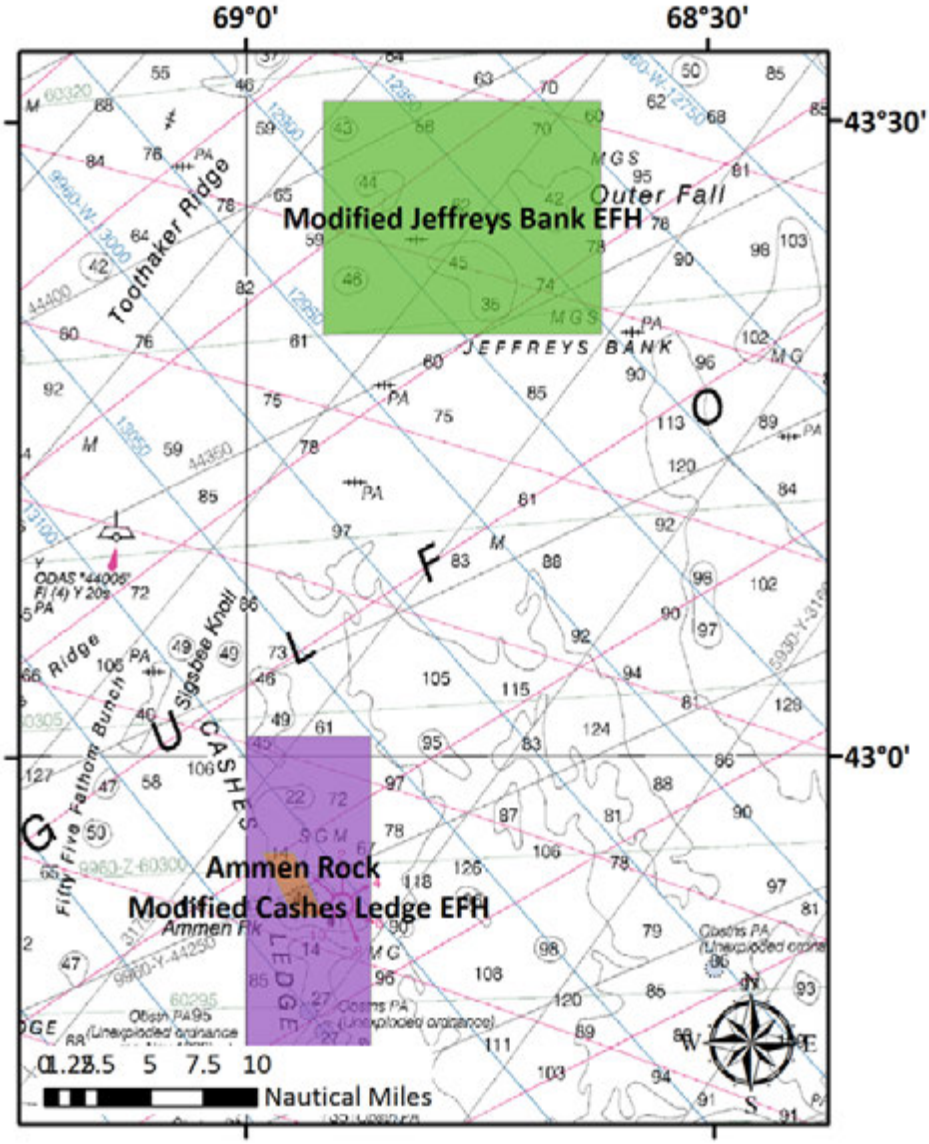
- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by Council.

The Council's preferred management approach is to apply Option 1 to the Jeffreys Bank and Cashes Ledge HMAs.

Rationale: This alternative includes a subset of the areas proposed via Alternative 3, and would not designate the Platts Bank and Fippennies Ledge Habitat Management Areas. This alternative would minimize adverse effects of fishing on EFH within some features in the central Gulf of Maine region, allowing fishing on other features including Platts Bank and Fippennies Ledge. This alternative removes the Cashes Ledge Closure Area, since many portions of that area not overlapping with habitat area proposals consist of mud habitat types estimated to be less vulnerable to accumulating adverse effects.

Map 5 – Central GOM Habitat Management Alternative 4



2.1.3 Western Gulf of Maine

The habitat management alternatives for the western Gulf of Maine region include various combinations of seven areas: Western Gulf of Maine Habitat Closure Area (no action), Western Gulf of Maine Groundfish Closed Area (no action), Jeffreys Ledge HMA, Small Stellwagen HMA, Large Stellwagen HMA, Small Bigelow Bight HMA, Large Bigelow Bight HMA, and WGOM Shrimp Trawl Exemption Area. **A combination of Alternatives 1, 7A, and 8 are the preferred alternatives.**

Table 11 – Coordinates for habitat management areas in the western Gulf of Maine

Western Gulf of Maine Habitat Closure Area (Alt 1)			Western Gulf of Maine Closure Area (Alt 1)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
WGM4	43° 15’	70° 15’	WGM1	42°15’	70°15’
WGM1	42° 15’	70° 15’	WGM2	42°15’	69°55’
WGM5	42° 15’	70° 00’	WGM3	43°15’	69°55’
WGM6	43° 15’	70° 15’	WGM4	43°15’	70°15’
Small Stellwagen HMA (Alt 4 and 5)			Small Bigelow Bight HMA (Alt 5)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
1	42° 38.0’	70° 07.0’	1*	43° 07.1’	70° 24.4’
2	42° 31.0’	70° 07.0’	2	42° 07.1’	70° 21.6’
3	42° 31.0’	70° 02.0’	3	42° 50.9’	70° 21.1’
4	42° 15.0’	70° 02.0’	4*	42° 50.6’	70° 44.6’
5	42° 15.0’	70° 15.0’	5*	42° 57.1’	70° 41.7’
6	42° 38.0’	70° 15.0’	6*	43° 03.4’	70° 35.9’
			7*	43° 07.6’	70° 32.7’
Jeffreys Ledge HMA (Alts 4 and 5)			Large Stellwagen HMA (Alts 3 and 6)		
Point	N Latitude	W Longitude	Point	N Latitude	W Longitude
1	43° 13.0’	70° 00.0’	1	42° 15.0’	70° 00.0’
2	42° 44.4’	70° 00.0’	2	42° 15.0’	70° 15.0’
3	42° 44.4’	70° 15.0’	3	42° 45.2’	70° 15.0’
4	42° 55.0’	70° 15.0’	4	42° 46.0’	70° 13.0’
5	42° 55.0’	70° 08.0’	5	42° 46.0’	70° 00.0’
6	43° 09.0’	70° 08.0’			
7	43° 09.0’	70° 05.0’			
8	43° 13.0’	70° 05.0’			
Large Bigelow Bight HMA (Alts 3 and 4)					
Point	N Latitude	W Longitude			
1*	43° 39.2’	69° 45.1’			
2	43° 29.1’	69° 45.0’			
3	43° 28.9’	70° 07.3’			
4	43° 18.1	70° 07.1’			
5	43° 18.0’	70° 14.4’			
6	43° 07.2’	70° 14.2’			
7	43° 07.1’	70° 21.6’			
8	42° 50.9’	70° 21.1’			
9*	42° 50.6’	70° 44.6’			
10*	42° 57.1’	70° 41.7’			
11*	43° 03.4’	70° 35.9’			
12*	43° 07.2’	70° 33.8’			
13*	43° 07.6’	70° 32.7’			
14*	43° 09.6’	70° 31.3’			
15*	43° 17.3’	70° 29.3’			

2.1.3.1 ***Alternative 1 (No Action, preferred)***

The no action habitat management alternative in the western Gulf of Maine region (Map 6) includes the Western Gulf of Maine Habitat Closure Area. This area was initially implemented via Amendment 13 to the Northeast Multispecies FMP as an area closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The area was subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. This alternative also includes the Western Gulf of Maine Closure Area, which was implemented as a year-round groundfish closure in 1998.

Current restrictions for the three areas are summarized below. As with the Cashes Ledge Closure Area, two types of mobile bottom-tending gears, shrimp trawls and surfclam/quahog dredges, are exempted from the Western Gulf of Maine [Groundfish] Closure Area. However, these gears are unlikely to fish in the eastern portion of the groundfish closure not overlapping the habitat closure due to the distribution of their target species, so effectively the entirety of the Western Gulf of Maine Closure Area has functioned as a mobile bottom-tending gear closure since designation in 1998.

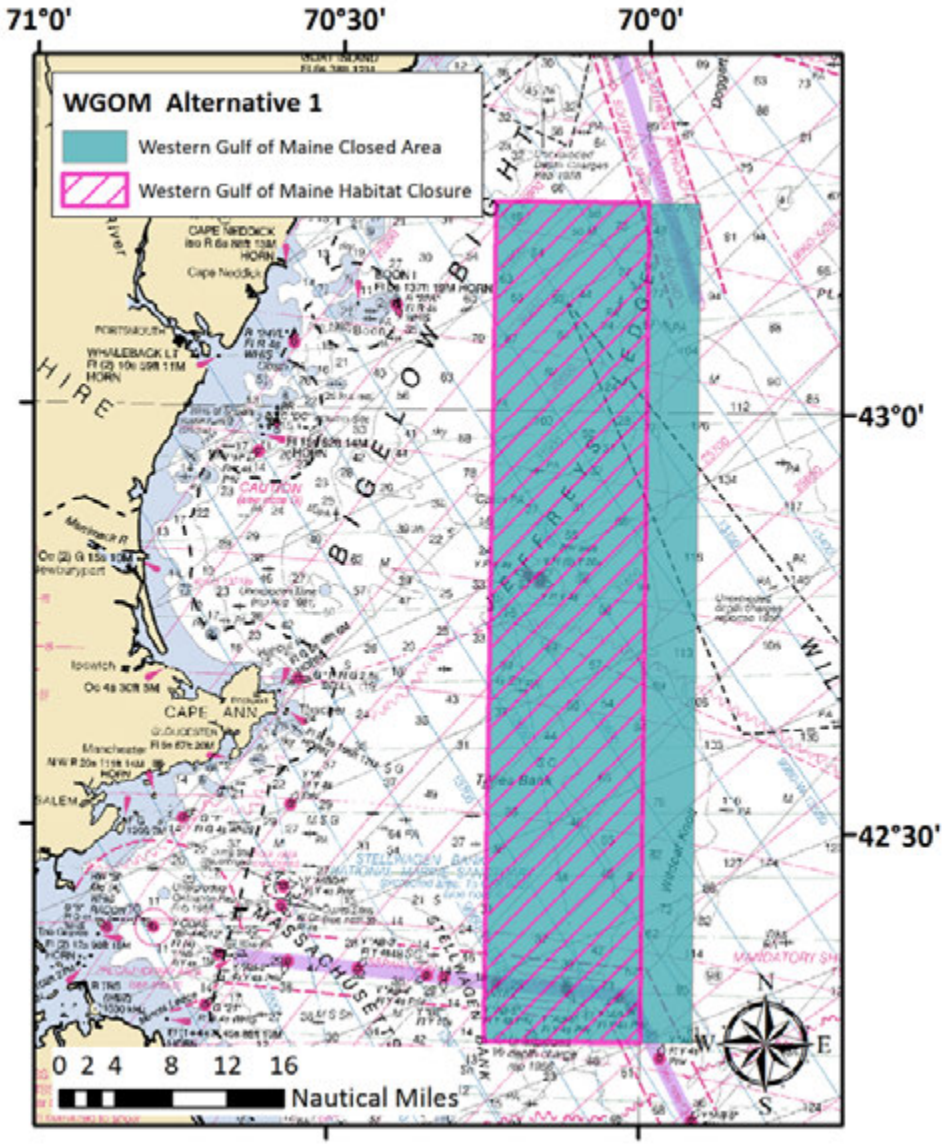
Table 12 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Western GOM sub-region.

Area name	Prohibitions	Exemptions
Western Gulf of Maine Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	• Vessels that are transiting, provided that gear is properly stowed
Western Gulf of Maine Closure Area	Closed year round to all fishing vessels, except for:	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls[2] • Vessels participating in the mid-water trawl exempted fishery • Vessels that are transiting, provided that gear is properly stowed

Rationale: The habitat and groundfish closures restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the western Gulf of Maine region.

[2] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the WGOM and CL groundfish closures

Map 6 – Western Gulf of Maine Habitat Management Alternative 1 (No Action).



2.1.3.2 *Alternative 2 (No habitat management areas)*

This alternative would remove the current Western Gulf of Maine Habitat Closure Area and Western Gulf of Maine Closure Area, and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.3.3 ***Alternative 3***

This alternative (Map 7) would modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Large Stellwagen Habitat Management Area, and designate the Large Bigelow Bight Habitat Management Area. Both of the areas would be designated in all Council FMPs. Measures for both of these areas could include:

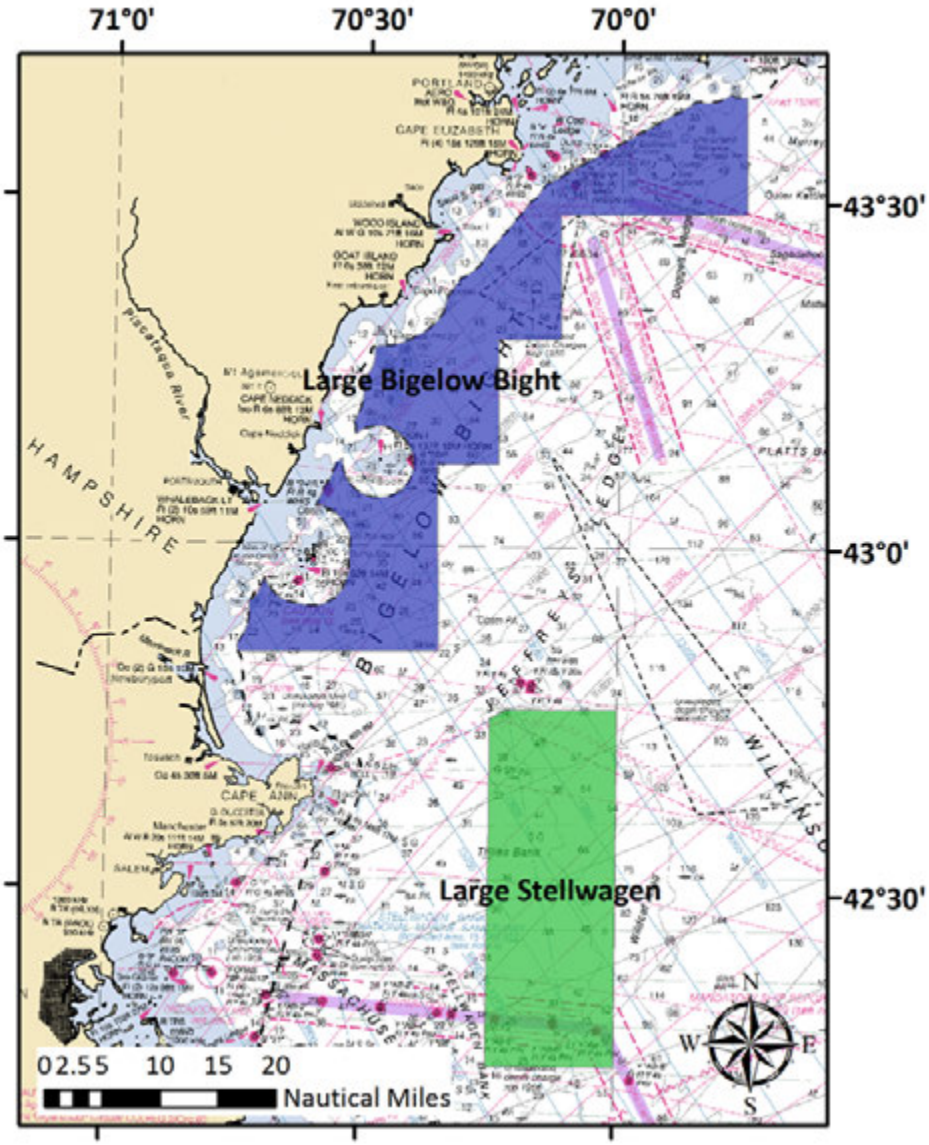
- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western Gulf of Maine region. The Stellwagen HMA was designed to encompass areas with high-intensity backscatter values from the multibeam survey, which represent coarse sand, gravelly sand, sandy gravel, gravel (including boulder ridges and piles of boulders), and bedrock outcrops (Valentine et al 2005a). Defining a habitat management area in this location and restricting the operation of mobile bottom-tending gears within it would be expected to reduce the accumulation of adverse effects in these particularly vulnerable habitats. The boulder ridges were identified using various types of information including topographic and backscatter data, terrain ruggedness index values, and thousands of video and photographic stations (Valentine et al 2005b). Some of the boulder ridges are quite large, with the largest tens of meters wide and hundreds of meters long, with a maximum height of 18 m (Valentine et al 2005b). The ridges are composed of cobbles and boulders interspersed with voids, and harbor an array of attached organisms as well as various fish species (Valentine et al 2005b, Auster and Lindholm 2005). The SASI vulnerability assessment indicates that cobble and boulder-dominated habitats and their associated geological and biological features have relatively high susceptibility to fishing gear impacts and relatively slow recovery.

The Large Bigelow Bight HMA was designed to protect habitats for juvenile redfish, alewife, plaice, cod, monkfish, haddock, pout, pollock, red hake, silver hake, white hake, winter flounder, witch flounder, and yellowtail flounder. This alternative includes the Large Stellwagen HMA only and not the Jeffreys Ledge HMA in order to balance the potential economic impacts associated with the larger version of the Bigelow Bight HMA.

Map 7 – Western Gulf of Maine Habitat Management Alternative 3.



2.1.3.4 ***Alternative 4***

This alternative (Map 8) would modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Large Bigelow Bight Habitat Management Area. The three areas would be designated in all Council FMPs. Measures for all three of these areas could include:

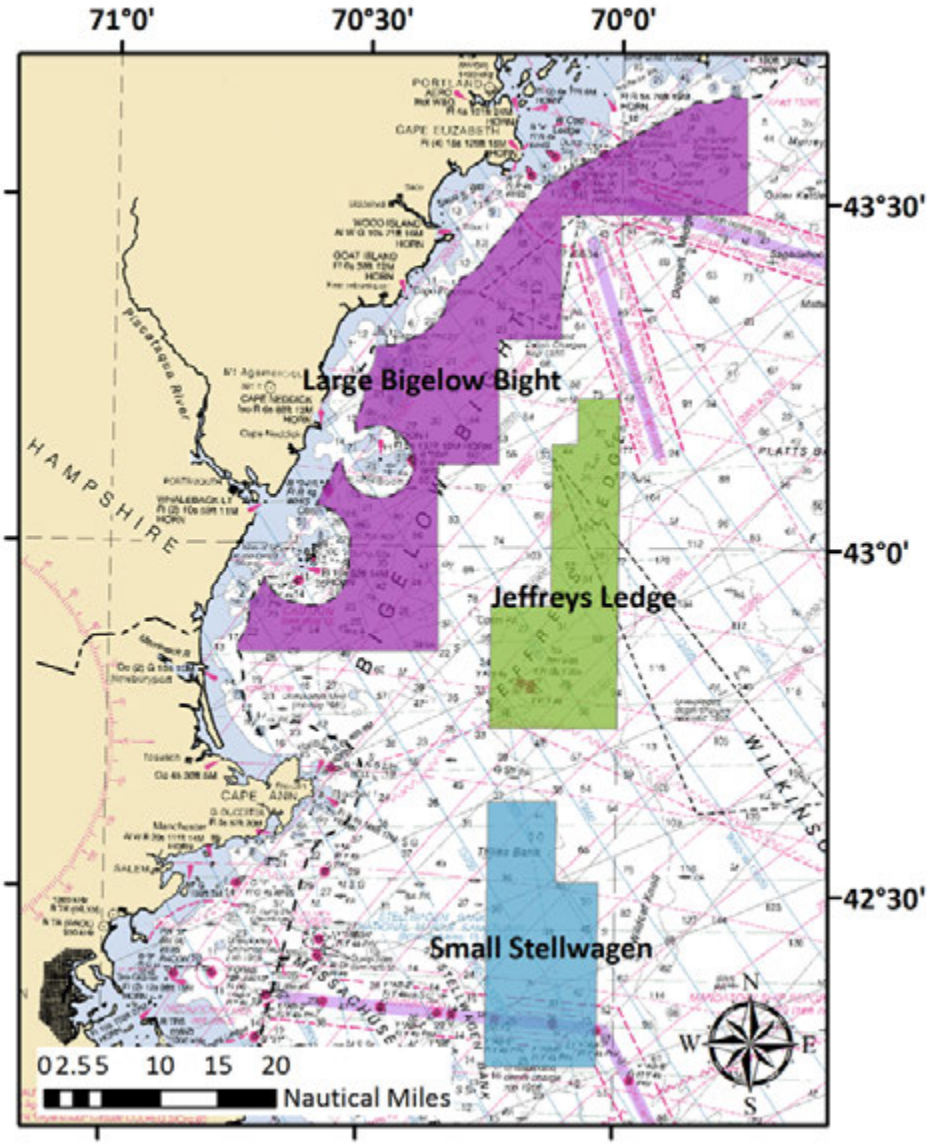
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western Gulf of Maine region. In this alternative, the eastern boundary of the Stellwagen area extends only to the edge of the multibeam sampling area discussed above, not to the current habitat closure boundary, because the existence of vulnerable habitat types is best documented in the areas sampled with multibeam. The northern part of the Western Gulf of Maine Habitat Closure Area was modified to remove the deeper, muddier habitats in the northwest corner to focus on protection of Jeffreys Ledge itself, which contains complex benthic habitats vulnerable to the impacts of fishing. The Bigelow Bight HMA is as described in Alternative 3.

Map 8 – Western Gulf of Maine Habitat Management Alternative 4.



2.1.3.5 ***Alternative 5***

Similar to Alternative 4, this alternative would also modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Small Bigelow Bight Habitat Management Area. All three areas would be designated in all Council FMPs. Measures for all three of these areas could include:

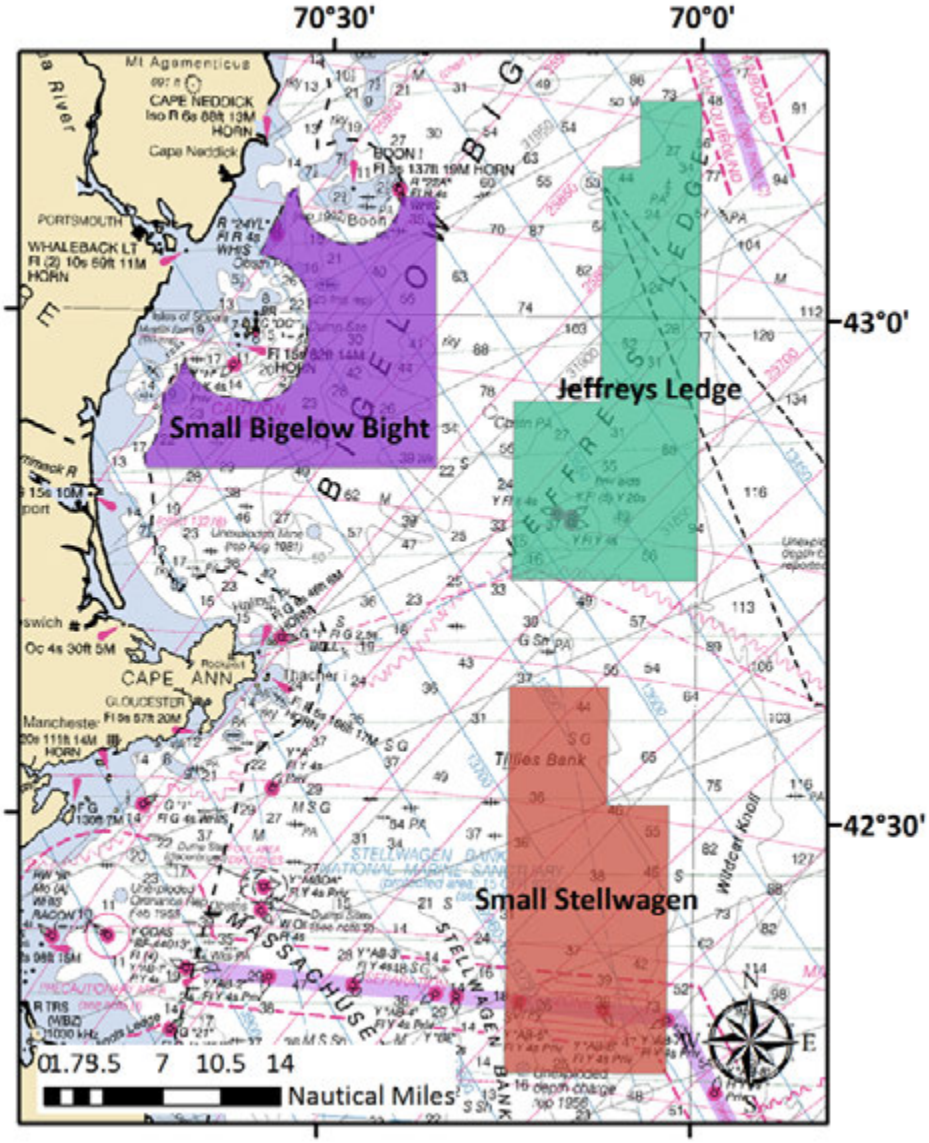
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western Gulf of Maine region. Due to concerns about potential economic impacts associated with the full version of the Bigelow Bight HMA, an alternative, smaller area was developed.

Map 9 – Western Gulf of Maine Habitat Management Alternative 5.



2.1.3.6 ***Alternative 6***

This alternative (Map 10) would modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Large Stellwagen Habitat Management Area. This area would be implemented in all Council FMPs. Measures for this area could include:

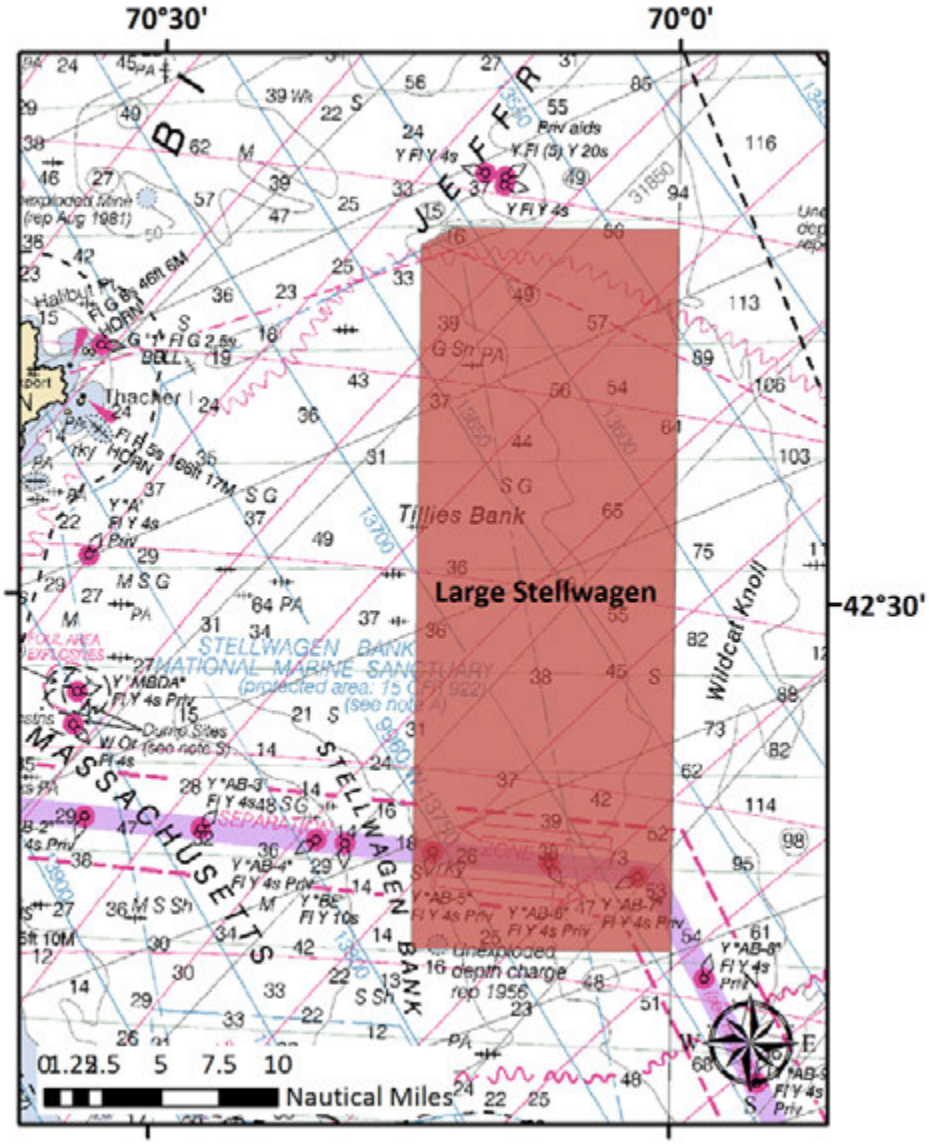
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or

- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: This alternative is a subset of the areas proposed in Alternative 3 and was proposed due to concerns about economic impacts associated with Alternatives 3, 4, and 5. This alternative would minimize adverse effects to EFH within some parts of the western Gulf of Maine region, but allow fishing in the inshore Bigelow Bight areas and on Jeffreys Ledge.

Map 10 – Western Gulf of Maine Habitat Management Alternative 6.



2.1.3.7 ***Alternative 7 (preferred)***

Alternative 7 would implement roller gear size restrictions as a habitat management measure in the western Gulf of Maine. This alternative can be implemented in addition to any of the other six alternatives.

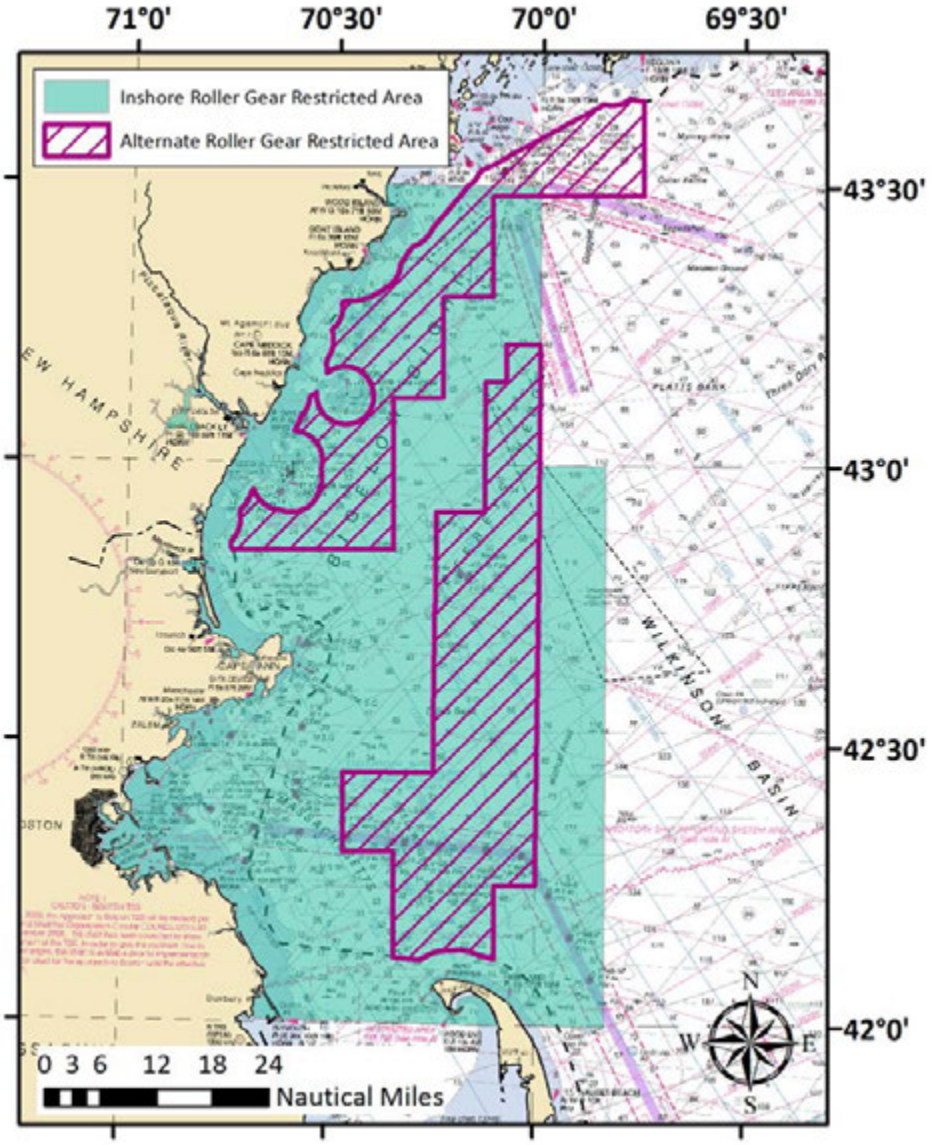
Option A would define the current Inshore Roller Gear Restricted Area, which limits trawl roller gear to a maximum diameter of 12 inches, as a habitat management measure. **This is the Council's preferred option.**

Option B would apply this same restriction to a different set of areas representing the maximum extent of all habitat management areas proposed at the June 2013 Habitat/Groundfish Committee meeting. Both sets of areas are depicted on Map 11.

Because the focus here is on minimizing the adverse effects of fishing on seabed habitats, the roller gear size limit would apply to all bottom trawl gears, even though the current Inshore Roller Gear Restricted Area regulations are limited to vessels fishing on a Northeast Multispecies Day-at-Sea or sector trip. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council under the Northeast Multispecies FMP.

Rationale: When it was implemented via Framework Adjustment 27 to the Northeast Multispecies FMP, the Council discussed the inshore roller gear restriction as limiting trawl activity over complex habitat types, although the measure was primarily discussed as a mechanism for reducing mortality on Gulf of Maine cod. Option 1 would designate this restriction as an adverse effects minimization measure. Option 2 would implement the roller gear restriction as a habitat management measure within all the various western Gulf of Maine areas identified for adverse effects minimization or juvenile groundfish habitat protection.

Map 11 – Western Gulf of Maine Habitat Management Alternative 7. Existing area option (hatched) and alternate area option (shaded) roller gear areas that could be implemented as habitat management measures in combination with any of the other WGOM alternatives.

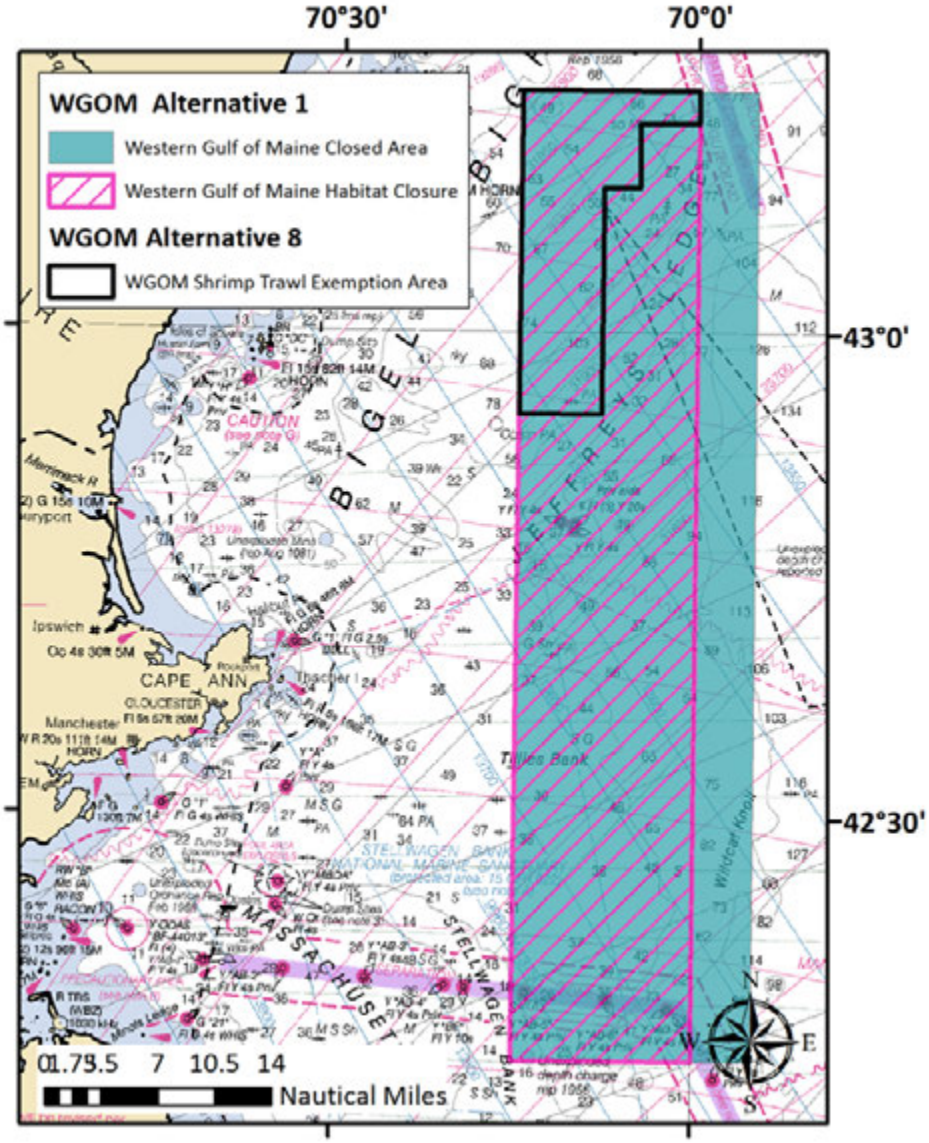


2.1.3.8 ***Alternative 8 (preferred)***

This alternative would exempt shrimp trawling from the northwestern portion of the existing Western Gulf of Maine Habitat Closure Area. The boundaries of the exemption area are derived from the Jeffreys Ledge HMA, which is shown in Alternatives 4 and 5. This alternative only makes sense as an add-on to Alternative 1/No Action, since Alternatives 2-6 would remove the exemption area from management for habitat purposes. It is listed as a separate alternative because this measure represents a change from No Action management. The shrimp trawl exemption area (black outline) is shown in combination with the No Action areas on the map below.

Rationale: Mud habitats are considered less vulnerable to fishing impact as compared to cobble- and boulder-dominated areas, and the exemption area is off of Jeffreys Ledge in a deeper, muddier, basin. If the existing Western Gulf of Maine Habitat Closure Area remains in place, this alternative would allow shrimp trawls to prosecute their fishery in these less vulnerable seabed types. Realized adverse effects from the shrimp fishery would likely be minimal as the fishery is seasonal and effort would only occur this far offshore in years when the season runs long, because the shrimp are inshore of this exemption area earlier in the winter when the season opens. In recent shrimp seasons, fishing effort has not overlapped this area.

Map 12 – Western Gulf of Maine Alternative 1 with addition of exemption area for shrimp trawl gear (black outline)



2.1.4 Georges Bank

The habitat management alternatives for the Georges Bank region include various combinations of ten areas: Closed Area II Habitat Closure Area (no action), Closed Area I N Habitat Closure Area (no action), Closed Area I S Habitat Closure Area (no action), Northern Edge HMA, Closed Area II Groundfish Closed Area (no action), Closed Area I Groundfish Closed Area (no action), Georges Shoal MBTG HMA, Small Georges Shoal Gear Modification Area, Large Georges Shoal Gear Modification Area, Closed Area II EFH South HMA, Georges Shoal 2 HMA, and Northern Georges Bank HMA. **No preferred alternative was identified for this sub-region.**

Table 13 – Coordinates for habitat management areas on Georges Bank. MBTG indicates possible closure to mobile bottom-tending gears, with or without an exemption for hydraulic clam dredges.

Closed Area II Habitat Closure Area (Alt 1)			Closed Area I Habitat Closure Area North (Alt 1)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
CIIH1	67° 20’	42° 10’	CI1	69° 23’	41° 30’
CIIH2	67° 09.3’	42° 10’	CI4	68° 30’	41° 30’
CIIH3	67° 0.5’	42° 00’	CIH1	68° 30’	41° 26’
CIIH4	67° 10’	42° 00’	CIH2	69° 01’	41° 04’
CIIH5	67°10’	41° 50’	Point	W Longitude	N Latitude
CIIH6	67° 20’	41° 50’			
Closed Area I Habitat Closure Area South (Alt 1)			Closed Area I (Groundfish Closure Area, Alt 1)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
CIH3	68° 53’	40° 55’	CI1	69˚ 23'	41˚ 30'
CIH4	68° 30’	40° 58’	CI2	68˚ 45'	40˚ 45'
CI3	68° 30’	40° 45’	CI3	68˚ 30'	40˚ 45'
CI2	68° 45’	40° 45’	CI4	68˚ 30'	41˚ 30'
Closed Area II (Groundfish Closure Area, Alt 1)					
Point	W Longitude	N Latitude			
CII1	67˚ 20'	41˚ 00'			
CII2	66˚ 35.8' (1)	41˚ 00'			
G5	66˚ 24.8' (1)	41˚ 18.6'			
CII3	67˚ 20'	42˚ 22'			
(1) US – Canada maritime boundary					
Northern Edge HMA (Alts 3 and 4)			Georges Shoal Gear Modification Area (Alt 4)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1	67° 11.4’	42° 12.3’	1	67° 20.0’	42° 40.0’
2	67° 00.5’	42° 00.0’	2	67° 56.0’	41° 40.0’
3	67° 16.8’	42° 00.0’	3	67° 56.0’	41° 56.0’
4	67° 25.8’	42° 09.6’	4	67° 39.7’	41° 56.0’
5	67° 20.0’	42° 11.3’			
6	67° 15.2’	42° 12.2’			
Northern Georges Gear Modification Area (Alt 5)			Georges Shoal 1 MBTG HMA (Alt 5)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1	66° 34.9’	41° 30.1’	1	67° 20.0’	41° 30.0’
2	68° 10.0’	41° 30.0’	2	67° 56.0’	41° 30.0’
3	68° 09.9’	41° 55.1’	3	67° 56.0’	41° 40.0’

4	67° 09.7′	42° 10.3′	4	67° 20.0′	42° 40.0′
EFH Expanded 1 (Alt 6A)			EFH Expanded 2 (Alt 6B)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1 (CIIH2)	67° 09.3′	42° 10′	1	67° 22′ 16″	42° 10′
2 (CIIH3)	67° 0.5′	42° 00′	2	67°10′	41° 56′ 1″
3 (CIIH4)	67° 10′	42° 00′	3 (CIIH5)	67°10′	41° 50′
4 (CIIH5)	67°10′	41° 50′	4	67°30′	41° 50′
5	67°30′	41° 50′	5	67°30′	42° 10′
6	67°30′	42° 10′			
EFH South HMA (Alt 7)			Georges Shoal 2 MBTG HMA (Alt 7)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1	67° 07′	41° 57′	1	67° 46′	41° 46′
2	67° 02′	41° 50′	2	67° 40′	41° 39′
3 (CIIH6)	67° 20′	41° 50′	3	67° 40′	41° 30′
4	67° 20′	41° 57′	4	68° 10′	41° 30′
			5	68° 10′	41° 41′
Northern Georges Bank MBTG HMA (Alt 8)					
Point	W Longitude	N Latitude			
1	67° 17′ 29′′	42° 19′ 13′′			
2	67° 57′ 21′′	41° 56′ 14′′			
3	68° 02′ 42′′	41° 24′ 00′′			
4	68° 02′ 42′′	41° 57′ 54′′			

2.1.4.1 ***Alternative 1 (No Action)***

The no action habitat management alternative in the Georges Bank region (Map 13) includes the Closed Area I and Closed Area II Habitat Closure Areas. These areas were initially implemented via Amendment 13 to the Northeast Multispecies FMP as areas closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The same areas were subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. Note that between the implementation of Scallop Amendment 10 in 2004 and Amendment 15, a slightly different set of scallop habitat closures was in effect. Also note that the Closed Area II Habitat Closure Area is also designated as a Habitat Area of Particular Concern, a designation which carries no restrictions on fishing. This designation was made in 1999 with the first Omnibus EFH Amendment and is a preferred alternative in this action (see Volume 2). Alternative 1 also includes Closed Area I and Closed Area II, which were implemented as year round groundfish closures in their present configuration in 1994, although a variety of fishing exemptions have been allowed in portions of these areas over time.

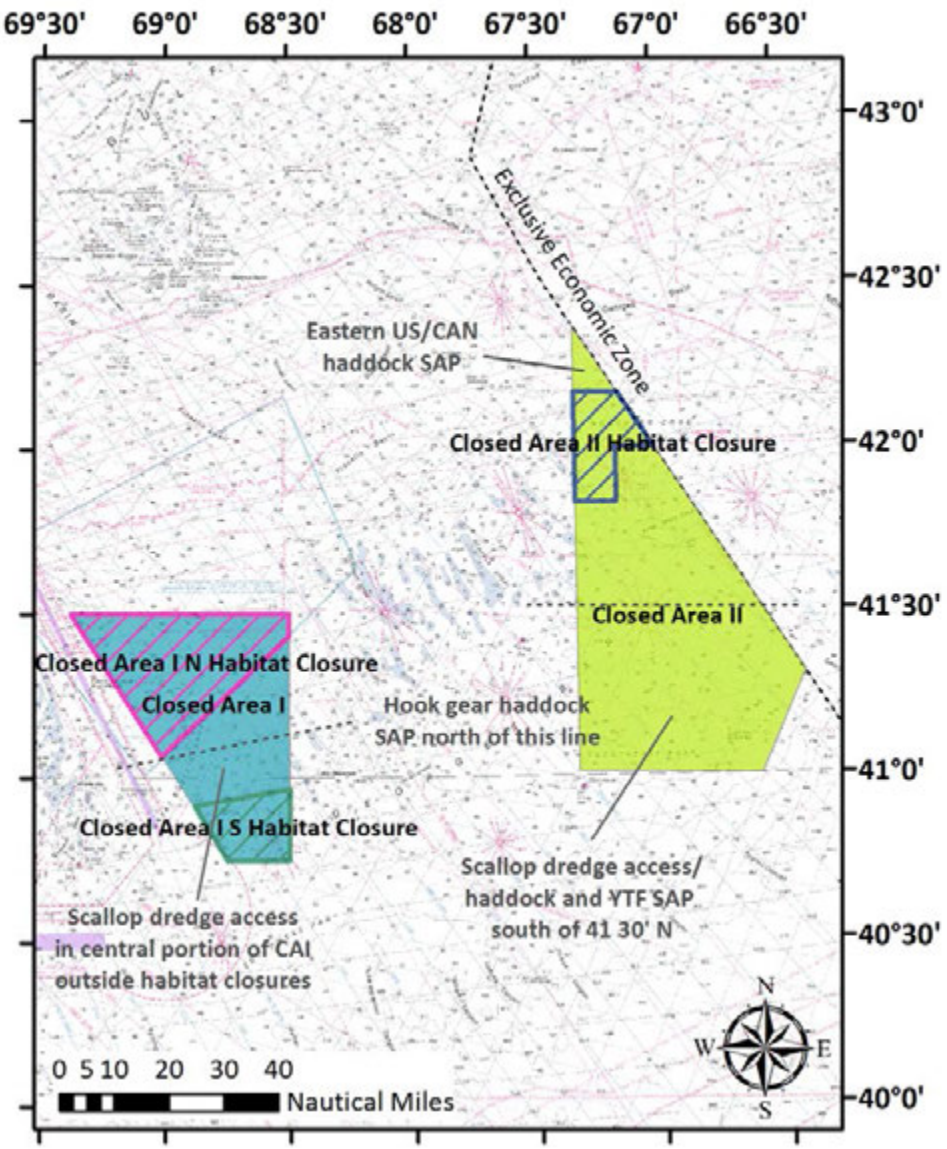
Current restrictions for the three areas are summarized below. The various exemptions mean that mobile bottom-tending gears have been used throughout many of the non-habitat closure portions of these areas, including the central portion of Closed Area I, and the northern and southern portions of Closed Area II.

Table 14 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Georges Bank sub-region.

Area name	Prohibitions	Exemptions
Closed Area I and Closed Area II Habitat Closure Areas	Closed year round to all vessels using mobile bottom-tending gears	• Vessels that are transiting, provided that gear is properly stowed
Closed Area I	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Fishing in a Special Access Program • Fishing for scallops within the Closed Area I Access Area • Vessels that are transiting, provided that gear is properly stowed
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Fishing in a Special Access Program • Tuna purse seine gear outside of the portion of CA II known as the Habitat Area of Particular Concern • Fishing in the CA II Yellowtail Flounder/Haddock SAP or the Eastern U.S./Canada Haddock SAP Program • Transiting the area, provided the vessel's fishing gear is stowed and there is a compelling safety reason • The vessel has declared into the Eastern U.S./Canada Area and is transiting CA II • Fishing for scallops within the Closed Area II Access Area • Vessels that are transiting, provided that gear is properly stowed

Rationale: The habitat closure areas, and also the groundfish closure areas, restrict various types of fishing, including fishing with mobile gears, which reduces the adverse effects of EFH on the seabed in the Georges Bank region. Note that some types of mobile gears are currently exempted from some portions of the groundfish closures.

Map 13 – Georges Bank Habitat Management Alternative 1 (No Action)



2.1.4.2 *Alternative 2 (No habitat management areas)*

This alternative would remove the current Closed Area I and Closed Area II habitat closure areas and would not designate any additional habitat management areas in the region. This alternative would not affect the HAPC designation.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.4.3 ***Alternative 3***

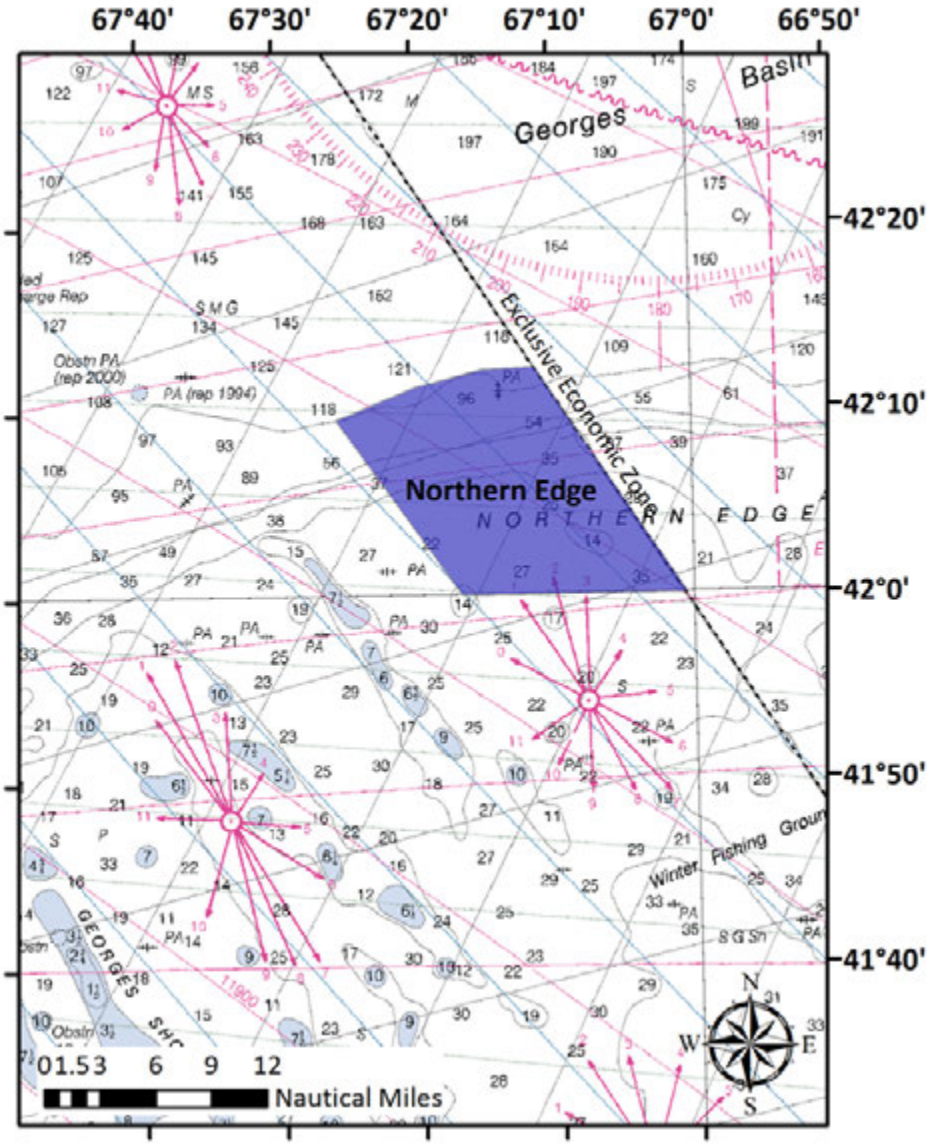
This alternative (Map 14) would remove the current Closed Area I Habitat Closure Area and would modify the Closed Area II Habitat Closure Area to create the Northern Edge Habitat Management Area, and implement it in all Council FMPs. Measures for the Northern Edge HMA could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The Northern Edge HMA encompasses cobble habitats with associated epifauna that are vulnerable to the adverse effects of fishing, so designation of this area as a mobile bottom-tending gear closure would minimize the adverse effects of fishing on EFH. The area and adjacent areas were identified in the Swept Area Seabed Impact analysis. The northern, deeper part of the area contains juvenile haddock and cod habitats, although high cod catches per tow in the area are more historic than recent. Thus, protection would be expected to increase productivity of these stocks. The proposed area is smaller than the current habitat closure area and shifted to the north, so it could provide increased fishery access for the scallop fishery, if Closed Area II is converted to a seasonal spawning area only (see Section 2.2.2) and/or if a scallop access area is created.

Map 14 – Georges Bank Habitat Management Alternative 3.



2.1.4.4 ***Alternative 4***

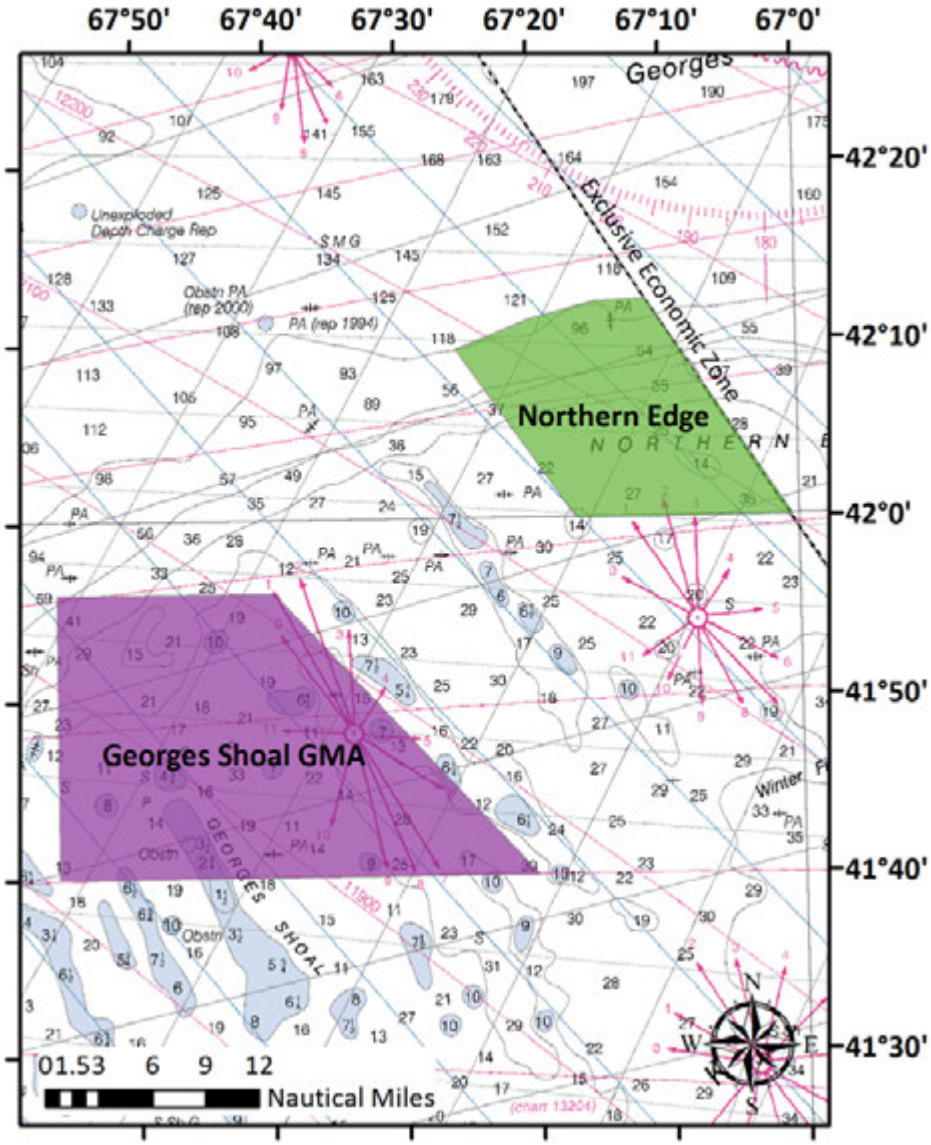
This alternative (Map 15) would remove the current Closed Area I Habitat Closure Area and would modify the Closed Area II Habitat Closure Area to create the Northern Edge Habitat Management Area, and implement it in all Council FMPs. In addition, this alternative would establish the Georges Shoal Gear Modification Area (GMA), which would mandate either the no ground cable or the raised ground cable trawl gear restrictions (Options 3 and 4, above). The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council. Measures for the Northern Edge HMA could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>

- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

Rationale: The Northern Edge HMA is discussed above. The Georges Shoal GMA could provide additional habitat benefits via reduced area swept by requiring modified ground cables, although the size of this benefit would depend on tradeoffs between decreased catch rates and increased fishing time when using the modified gear.

Map 15 – Georges Bank Habitat Management Alternative 4. The hatched Georges Shoal GMA is only being considered for ground cable modifications.



2.1.4.5 ***Alternative 5***

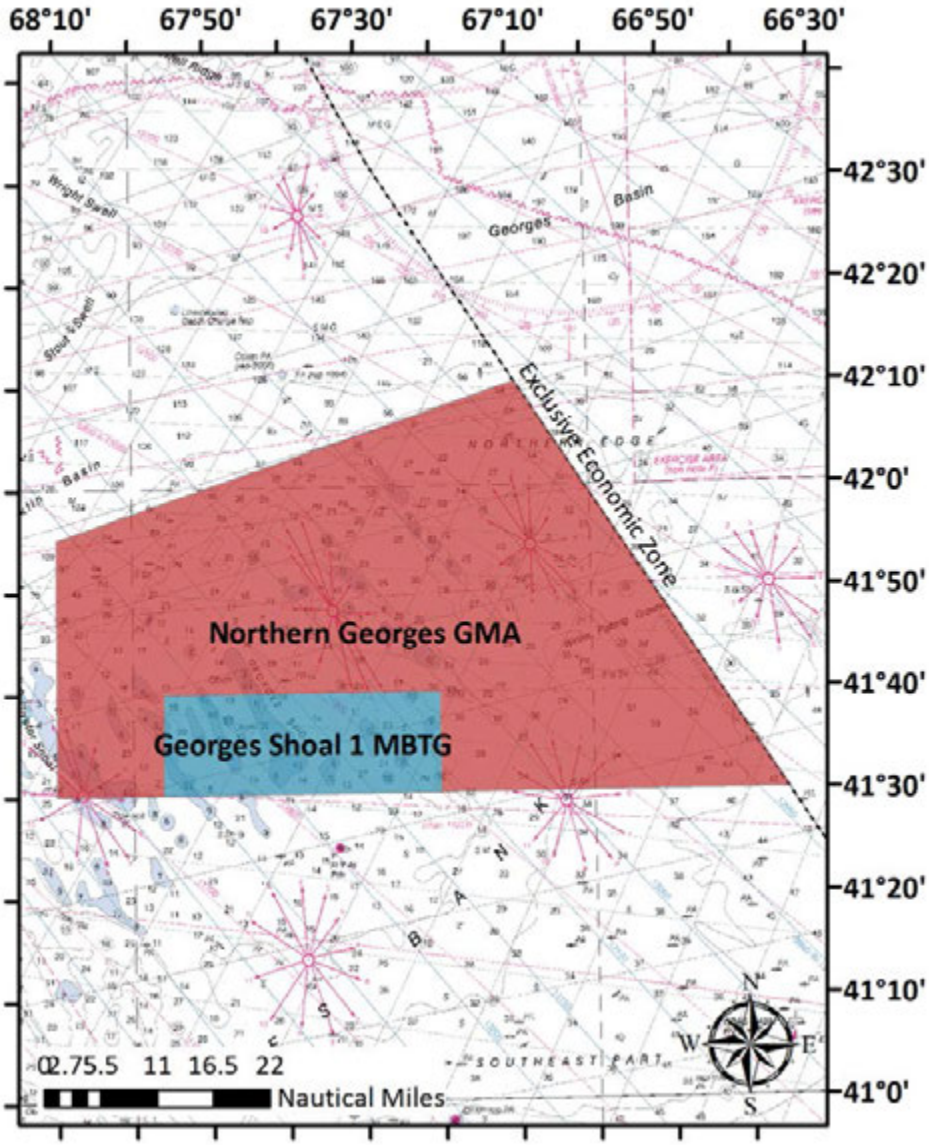
This alternative (Map 16) would remove the current Closed Area I and Closed Area II Habitat Closure Areas from the multispecies and sea scallop regulations. This alternative would establish the Georges Shoal 1 mobile-bottom tending gear HMA, and close it to mobile bottom-tending gears, with (Option 2) or without (Option 1) an exemption for hydraulic clam dredges. In addition, this alternative would establish the Northern Georges Gear Modification Area (GMA), which would mandate either the no ground cable or the raised ground cable trawl gear restrictions:

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: This alternative does not create a smaller habitat area on the northern edge, and therefore would provide the greatest flexibility in terms of access to the northern edge scallop resource, aside from Alternative 2. The larger Northern Georges GMA could provide habitat benefits via reduced area swept by requiring modified ground cables, but as above, this size of this benefit would depend on tradeoffs between decreased catch rates and increased fishing time when using the modified gear.

Map 16 – Georges Bank Habitat Management Alternative 5.



2.1.4.6 ***Alternative 6***

This alternative (Map 14) would remove the current Closed Area I Habitat Closure Areas and create a new habitat management area based on the Closed Area II Habitat Closure Area, and implement it in all Council FMPs. There are two boundary options described below (6A and 6B). Measures for this area could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

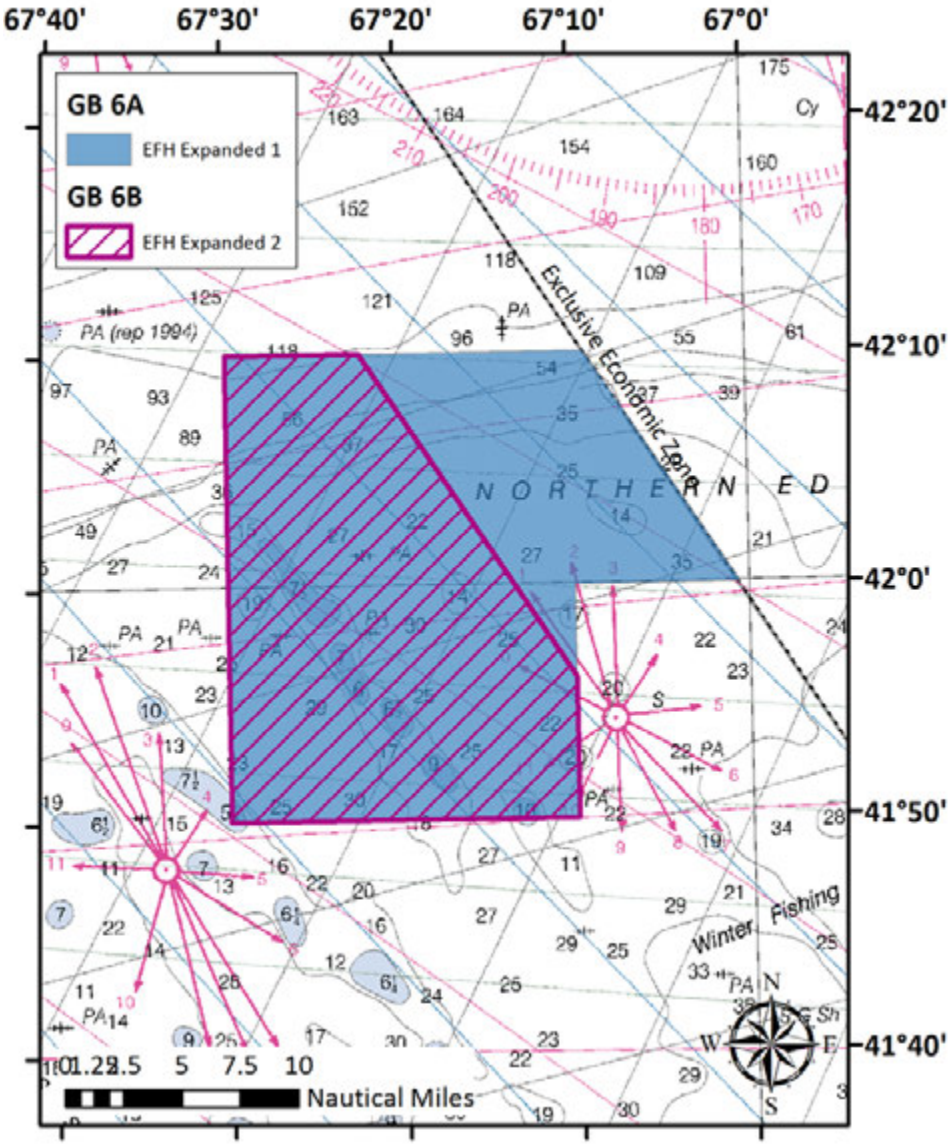
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Alternative 6A would designate an area that includes the existing CAII habitat closure extended west to 67° 30' W longitude as a habitat management area. The area is called "EFH Expanded 1".

Alternative 6B overlaps A in the west, but there would be an 8 nm open area buffer along the EEZ. This area is called "EFH Expanded 2".

Map 17 – Georges Bank Habitat Management Alternatives 6a and 6b.



2.1.4.7 *Alternative 7*

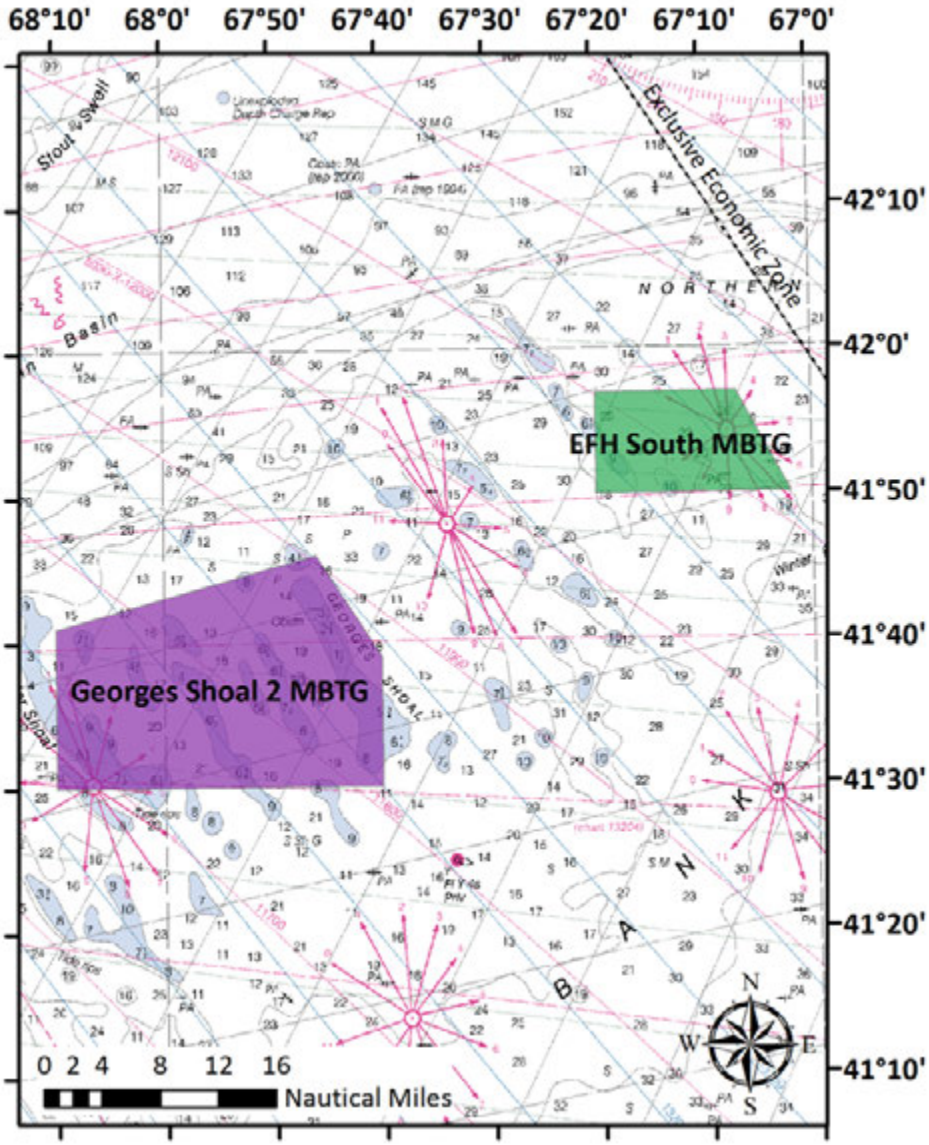
This alternative (Map 18) would remove the current Closed Area I Habitat Closure Areas and would modify the Closed Area II Habitat Closure Area to create the CAII EFH South Habitat Management Area, and implement it in all Council FMPs. This alternative would also implement the Georges Shoal 2 Habitat Management Area. Measures the areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges.

The same restrictions need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: This alternative encompasses vulnerable habitat areas identified by the Swept Area Seabed Impact analysis while allowing access to groundfish and scallops on the northern portion of Georges Bank.

Map 18 – Georges Bank Habitat Management Alternative 7



2.1.4.8 ***Alternative 8***

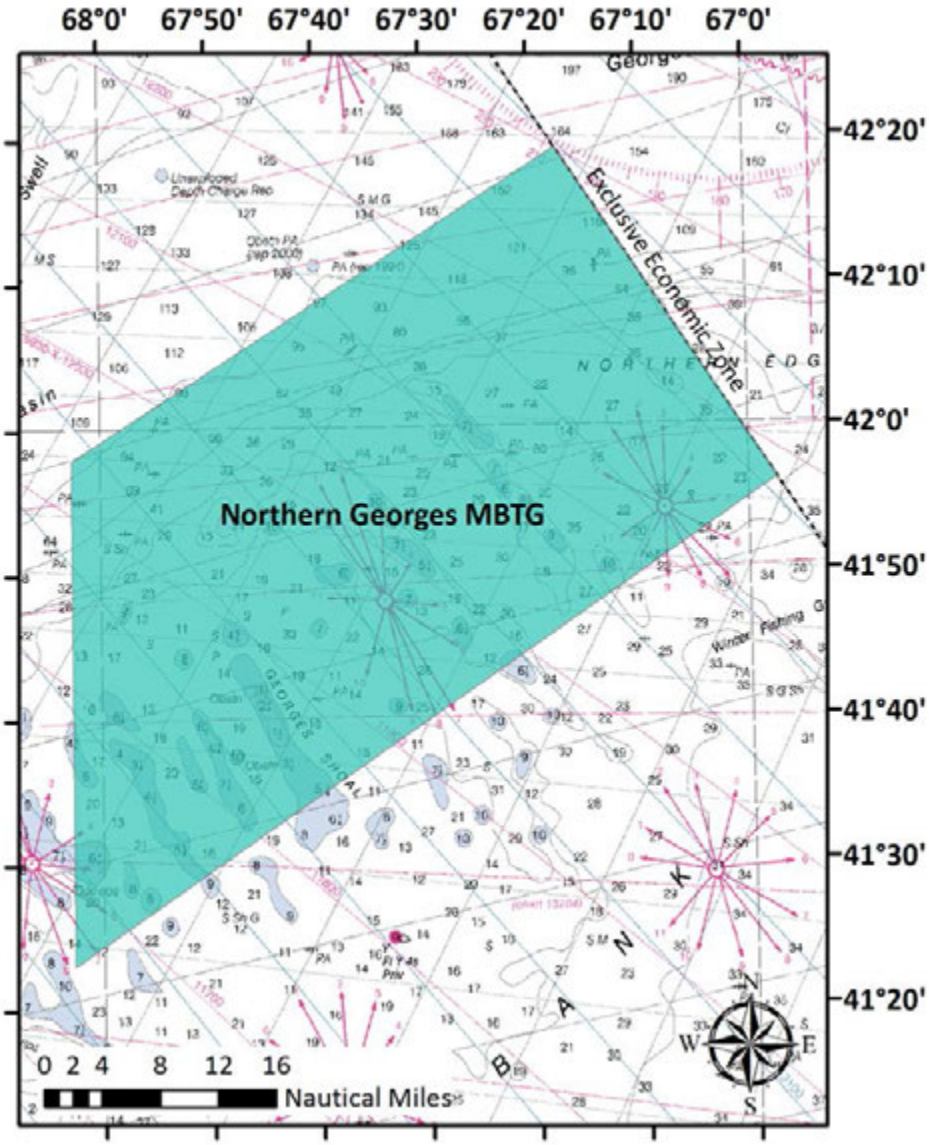
This alternative (Map 18) would replace the current habitat closures on Georges Bank with the Northern Georges Bank HMA, and implement it in all Council FMPs. Measures the area could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: This area encompasses most of the vulnerable seabed habitats in the Georges Bank sub-region as identified by the Swept Area Seabed Impact analysis. It also encompasses a small number of juvenile groundfish hotspots as well as juvenile cod and haddock of various size classes, although not at hotspot levels of abundance.

Map 19 – Georges Bank Habitat Management Alternative 8



2.1.5 Great South Channel and Southern New England

The habitat management alternatives for the Great South Channel and Southern New England region include various combinations of seven areas: Nantucket Lightship Habitat Closure Area (no action), Great South Channel HMA, Great South Channel East HMA, Nantucket Shoals HMA, Great South Channel Gear Modification Area, Nantucket Shoals West MBTG HMA, and the Cox Ledge HMA (which is comprised of two sub-areas that would be implemented together). **No preferred alternative was identified for this sub-region.**

Table 15 – Coordinates for habitat management areas in the Great South Channel and southern New England

Nantucket Lightship Habitat Closure Area (Alt 1)			Nantucket Lightship Closed Area (Alt 1)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
NLH1	70° 00’	41° 10’	G10	69°00’	40°50’
NLH2	69° 50’	41° 10’	CN1	69°00’	40°20’
NLH3	69° 30’	40° 50’	CN2	70°20’	40°20’
NLH4	69° 30’	40° 20’	CN3	70°20’	40°50’
NLH5	70° 00’	40° 20’			
Great South Channel HMA (Alt 4)			Great South Channel East HMA (Alt 3)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1	69° 31.0’	41° 30.3’	1	69° 49.5’	41° 44.9’
2	69° 18.5’	41° 0.00’	2	69° 31.0’	41° 30.3’
3	69° 18.5’	40° 51.7’	3	69° 25.2’	41° 30.0’
4	69° 48.9’	40° 51.6’	4	69° 12.9’	40° 58.0’
5	69° 49.3’	41° 30.2’	5	69° 18.5’	40° 58.0’
			6	69° 18.5’	40° 51.7’
			7	69° 48.9’	40° 51.6’
Nantucket Shoals HMA (Alt 5)					
Point	W Longitude	N Latitude			
1	69° 30.0’	41° 30.2’			
2	69° 30.0’	40° 51.5’			
3	69° 53.5’	40° 51.5’			
4	69° 53.5’	41° 30.2’			
Nantucket Shoals West MBTG HMA (Alt 6)			Great South Channel Gear Modified Area (Alt 6)		
Point	W Longitude	N Latitude	Point	W Longitude	N Latitude
1	70° 00.0’	40° 50.0’	1	69° 23.0’	41° 30.0’
2*	69° 60.0’	41° 11.4’	2	69° 00.0’	41° 02.9’
3*	69° 60.0’	41° 25.7’	3	69° 00.0’	40° 50.0’
4*	69° 60.0’	41° 29.3’	4	69° 30.0’	40° 50.0’
5*	69° 60.0’	41° 29.5’	5	69° 30.0’	41° 30.0’
6*	69° 57.5’	41° 30.2’			
7	69° 30.0’	41° 30.0’			
8	69° 30.0’	40° 50.0’			
**State waters boundary*					
Cox Ledge HMA 1 (Alts 3-6)			Cox Ledge HMA 2 (Alts 3-6)		
Point	W Longitude	N Latitude	Point	Longitude	Latitude
1	71° 03.0’	41° 05.0’	1	70° 55.0’	41° 12.0’
2	71° 03.0’	41° 00.0’	2	70° 55.0’	41° 07.5’
3	71° 14.0’	41° 00.0’	3	71° 01.0’	40° 07.5’
4	71° 14.0’	41° 05.0’	4	71° 01.0’	41° 12.0’

2.1.5.1 ***Alternative 1 (No Action)***

The no action habitat management alternative in the Great South Channel/southern New England region includes the Nantucket Lightship Habitat Closure Area (Map 20). This area was initially implemented via Amendment 13 to the Northeast Multispecies FMP as an area closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The

same area was subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. Note that between the implementation of Scallop Amendment 10 in 2004 and Amendment 15, a slightly different set of scallop EFH closures was in effect. This alternative also includes the Nantucket Lightship Closed Area, which was implemented year round in its current configuration in 1994 for groundfish management purposes.

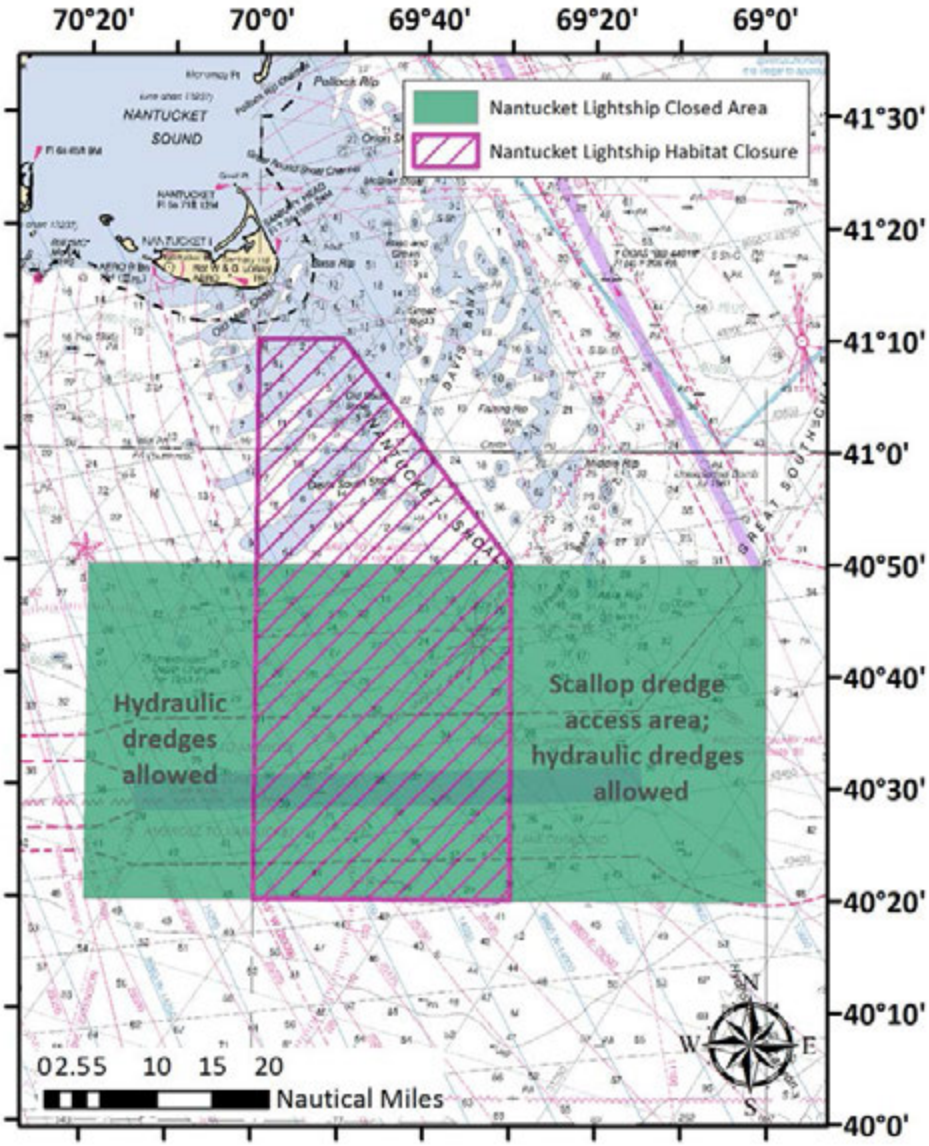
Current restrictions for both areas are summarized below. Some parts of the Nantucket Lightship [Groundfish] Closed Area have been fished by mobile bottom-tending gears. Specifically, east of the habitat closure is a scallop dredge access area, and hydraulic clam dredges are exempt from the groundfish area, so that gear may be used west and east of the habitat closure.

Table 16 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Great South Channel/Southern New England sub-region.

Area name	Prohibitions	Exemptions
Nantucket Lightship Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	• Vessels that are transiting, provided that gear is properly stowed
Nantucket Lightship Closure Area	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Classified as charter, party or recreational vessel, provided that: (A) LOA, (B) Fish species managed by the NEFMC or the MAFMC are not sold, (C) no gear other than rod and reel or handline gear on board, (D) vessel does not fish outside the Nantucket Lightship Closed Area during the period specified by the LOA • Fishing with or using dredge gear designed and used to take surfclams or ocean quahogs • Fishing for scallops within the Nantucket Lightship Access Area • Vessels that are transiting, provided that gear is properly stowed

Rationale: Both areas restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the Great South Channel/southern New England region. Note that some types of mobile gears are currently exempted from the groundfish closed area.

Map 20 – Great South Channel/SNE Habitat Management Alternative 1 (No Action).



2.1.5.2 *Alternative 2 (No habitat management areas)*

This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Closed Area, and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.5.3 ***Alternative 3***

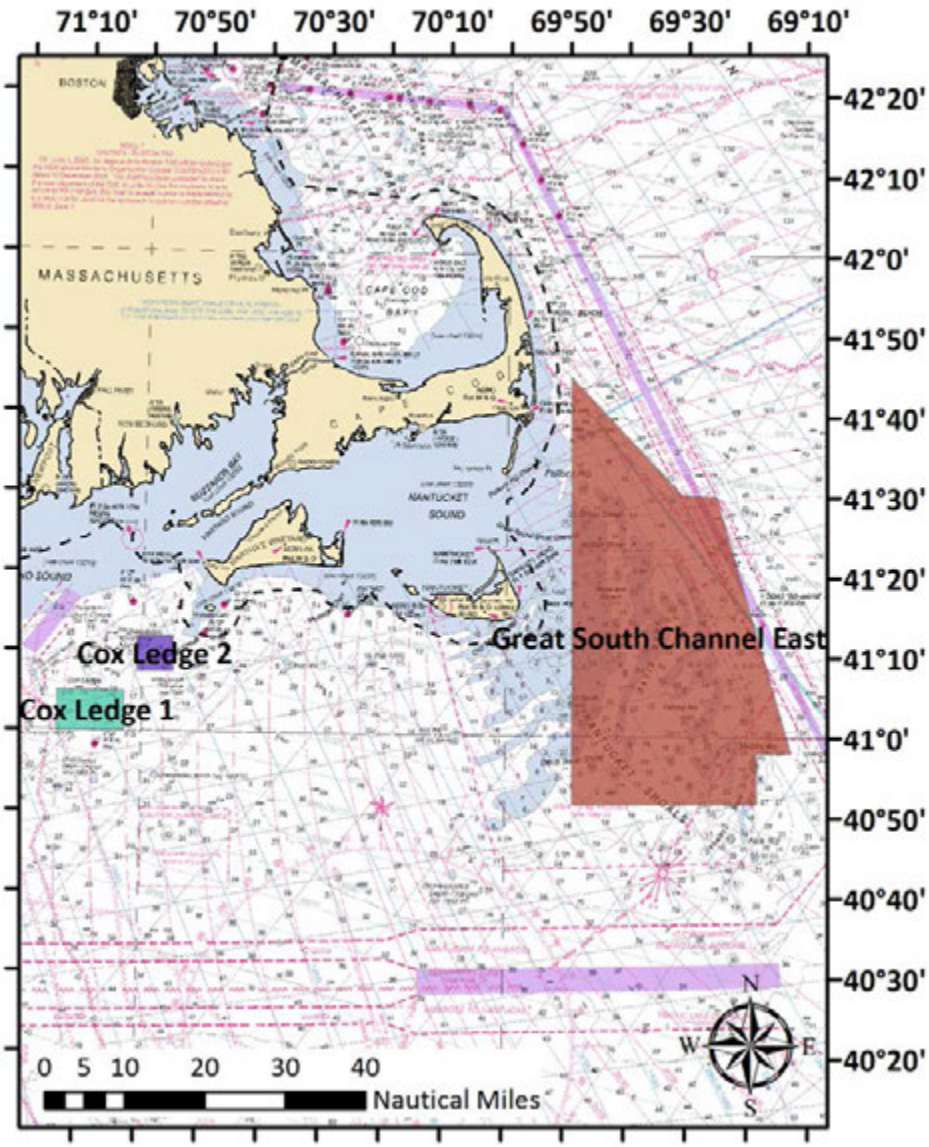
This alternative (Map 21) would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Closed Area, and would designate a new habitat management area further north and east in the Great South Channel, i.e. the Great South Channel East HMA. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Great South Channel East and Cox Ledge areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Great South Channel East HMA better encompasses cobble- and boulder-dominated habitat types compared to the existing habitat closure area. This version of the area in particular, which extends the furthest to the east of the any of the HMAs proposed for this region, would provide the best protection for juvenile cod. The Cox Ledge areas also include vulnerable seabed habitat types in locations previously not managed for adverse effects minimization.

Map 21 – Great South Channel/SNE Habitat Management Alternative 3.



2.1.5.4 ***Alternative 4***

This alternative (Map 22) would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Closed Area and would designate a new habitat management area further north and east in the Great South Channel. The Great South Channel HMA is a subset of the area proposed via Alternative 3. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Great South Channel and Cox Ledge areas could include:

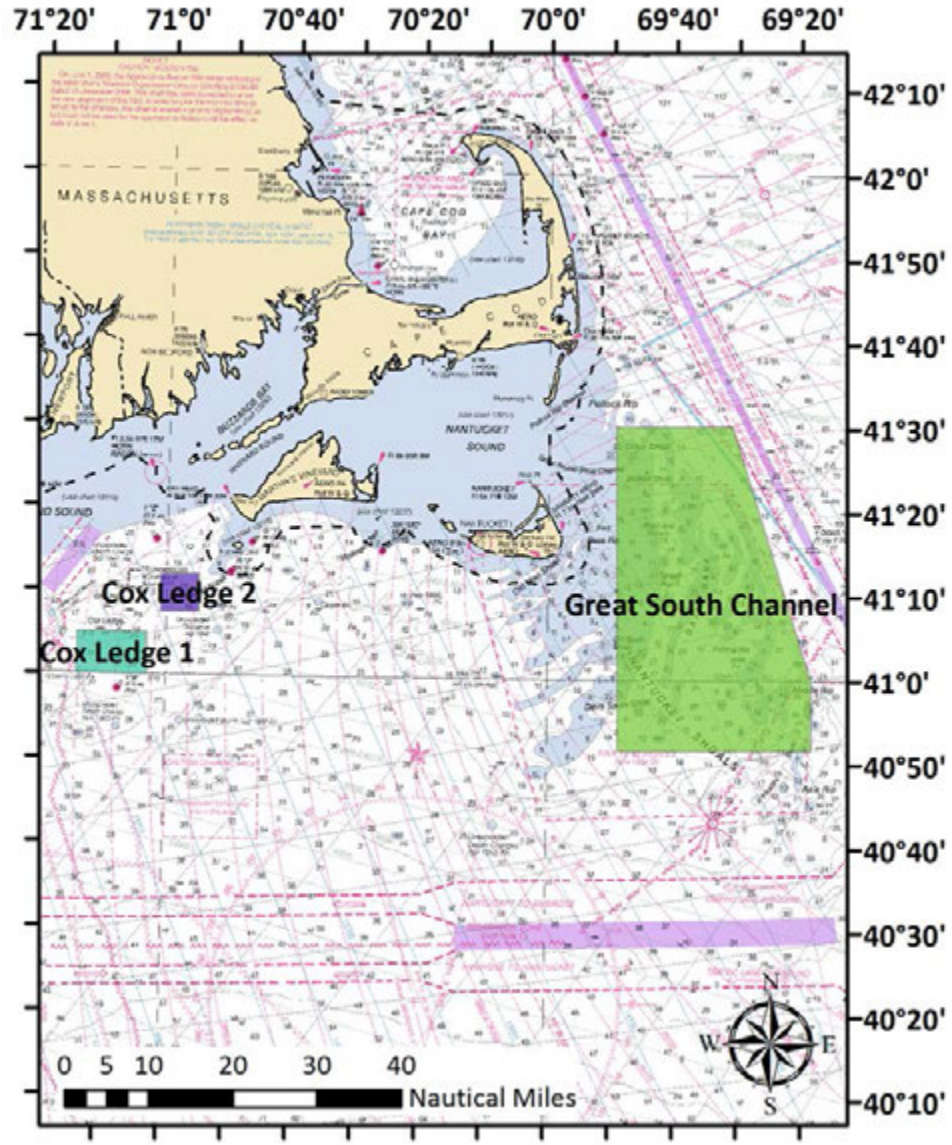
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Great South Channel HMA better encompasses cobble- and boulder-dominated habitat types compared to the existing habitat closure area. This version of the area does not include the northern and eastern portions of the area proposed via Alternative 3, and thus mitigates some concerns raised about fishery access. However, there is much less overlap with juvenile cod. The Cox Ledge areas include vulnerable seabed habitat types.

Map 22 – Great South Channel/SNE Habitat Management Alternative 4.



2.1.5.5 ***Alternative 5***

This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Closed Area and would designate a new habitat management area further north on Nantucket Shoals as shown in (Map 23). This Nantucket Shoals HMA overlaps with the areas proposed via Alternatives 3 and 4, but is generally further to the west. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Nantucket Shoals and Cox Ledge areas could include:

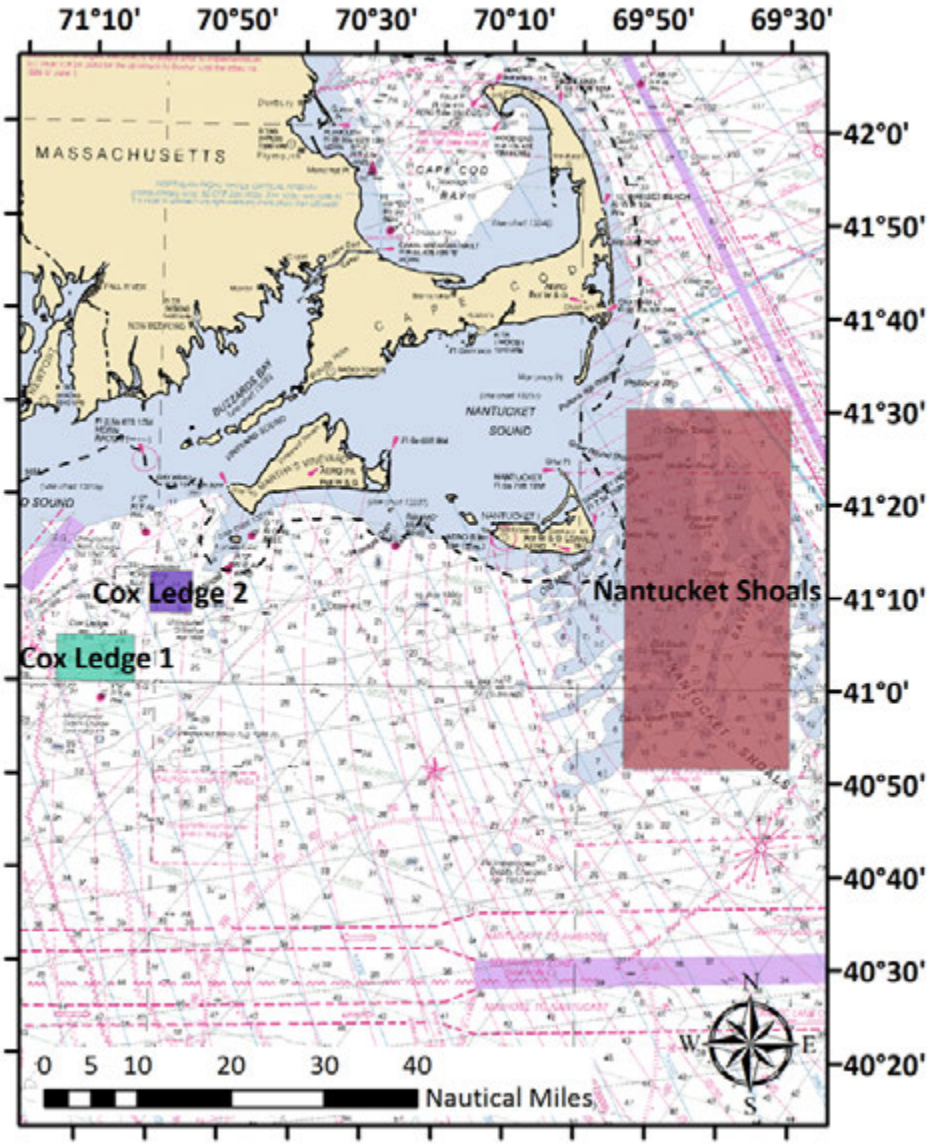
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Nantucket Shoals area better encompasses cobble- and boulder-dominated habitat types compared to the existing Nantucket Lightship habitat closure area, although the western and southern parts are generally sand dominated. This version of the area mitigates some concerns raised about fishery access, even as compared to the Great South Channel HMA in Alternative 4. The Cox Ledge areas include vulnerable seabed habitat types.

Map 23 – Great South Channel/SNE Habitat Management Alternative 5.



2.1.5.6 ***Alternative 6***

This alternative (Map 24) would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Closed Area and would designate a new habitat management area further north on Nantucket Shoals, the Nantucket Shoals West MBTG HMA, which is similar to the area proposed via Alternative 5. This area would be a mobile bottom-tending gear closure, with or without an exemption for hydraulic dredge gears (i.e., management option 1 or 2). An additional area further east in the Great South Channel would be designated as a gear modification area, with a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms, <u>or</u> a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. An

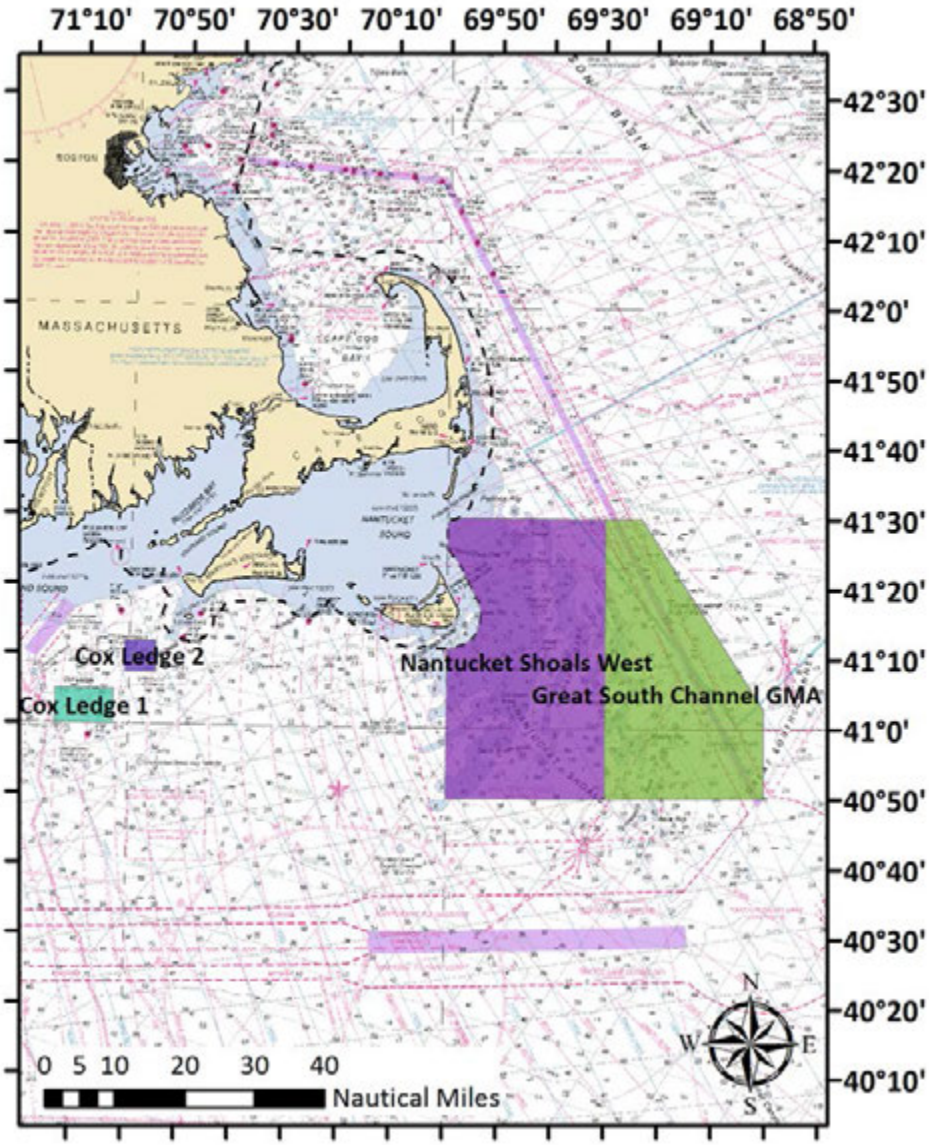
additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Cox Ledge areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with 20 centimeter diameter elevating disks spaced at 5 fathoms, with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by the Council.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The western area proposed in this alternative is very similar to the Nantucket Shoals area described in Alternative 5, but extends further west to state waters and slightly further south. It is only being considered as a closure to mobile bottom-tending gears. Most of these additional areas are likely sand dominated, although they are not especially well sampled from a habitat type or fish distribution standpoint. The eastern area, which includes deeper waters and complex cobble and boulder habitats, would be designated as a gear modification area. As with the Georges Shoal Gear Modification Areas, this area could provide additional habitat benefits via reduced area swept by requiring modified ground cables, although this would depend on tradeoffs between decreased catch rates and increased fishing time. The distribution of juvenile cod in the region overlaps mainly with the eastern gear modification area. The Cox Ledge areas include vulnerable seabed habitat types.

Map 24 – Great South Channel/SNE Habitat Management Alternative 6.



2.2 Alternative to improve groundfish spawning protection

This section describes alternatives designed to meet the following objectives:

- Improved groundfish spawning protection; including protection of localized spawning contingents or sub-populations of stocks
- Improved access to both the use and non-use benefits arising from closed area management across gear types, fisheries, and groups.

These objectives reflect the Council's intent to shift the focus of groundfish area management designations based on mortality reduction to those based on protection of specific attributes that contribute to stock productivity, such as spawning. Similarly, the habitat management spatial

alternatives focus in part on protection of habitats that contain concentrations of juvenile groundfish, in order to improve stock productivity. **All of the spawning protection areas described in this section would be defined on a seasonal basis, and the measures focus on limiting the use of gears that are capable of catching groundfish within these areas during the closed seasons, with possible exemptions for recreational groundfish fishing or other fisheries.** The no action areas are part of the Northeast Multispecies FMP, and any new areas or adjustments to the prohibited gear types or closed seasons in existing areas would also be changed in the Northeast Multispecies FMP and its corresponding regulations. Adjustment of these measures would be accomplished via an amendment or framework adjustment (as appropriate) to that FMP.

Concurrent with this action, the Council may consider additional spawning closures in Framework Adjustment 53 to the Northeast Multispecies FMP.

2.2.1 Gulf of Maine

Alternatives 1 and 3 are the preferred spawning alternatives for the Gulf of Maine.

2.2.1.1 *Alternative 1 (No Action, preferred)*

Alternative 1/No Action would retain (1) the Western Gulf of Maine Closure Area and the Cashes Ledge Closure Area, (2) the Gulf of Maine Rolling Closures Areas that apply to sector and common pool vessels, and (3) the Gulf of Maine Cod Spawning Protection Area, commonly referred to as the 'Whaleback' area (Map 25). Measures for the areas are listed in Table 17, and the coordinates for these areas are listed in Table 18.

Rationale: In addition to the original intended effects related to fishing mortality reduction, these year round and seasonal closures have incidental effects that provide protection for spawning groundfish. The Western Gulf of Maine area was intended to provide incidental protection to spawning cod and haddock in the Gulf of Maine. The Cashes Ledge year round groundfish closed area was intended to provide protection to spawning and resident cod. The Gulf of Maine Cod Spawning Protection Area was designed specifically to protect spring cod spawning activity.

Table 17 – Current restrictions in the year round and seasonal closed areas in the Gulf of Maine

Area name	Prohibitions	Exemptions
Western Gulf of Maine and Cashes Ledge Closure Areas	Closed year round to all fishing vessels, except for:	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls[3] • Vessels participating in the mid-water trawl exempted fishery • Vessels that are transiting, provided that gear is properly stowed
Rolling Closure Areas I-V (Thirty minute blocks included, C=common pool, S=sector)	Closed to all fishing vessels during the following months: • I – March (121-123 C) • II – April (121-133 C; 124, 125, 132, 133 S) • III – May (124-140 C; 132, 133, 138-140 S) • IV – June (132, 133, 139-147, 152 C; 139, 140, 145-147, 152 S) • V – October/November (124, 125 C)	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls • Vessels participating in the mid-water trawl exempted fishery • Vessels fishing under a scallop DAS or in a scallop dredge exemption area • Vessels participating in the raised footrope trawl exempted whiting fishery • Sector vessels can fish in areas I and V, and also in the offshore portions of areas II, III, and IV. • Vessels that are transiting, provided that gear is properly stowed
GOM Cod Spawning Protection Area	From April 1 through June 30 of each year, no fishing vessel or person on a fishing vessel may enter, fish in, or be in the area, and no fishing gear capable of catching NE multispecies may be used on, or be on board a vessel in the area.	• Vessels that have not been issued a NE multispecies permit and that are fishing exclusively in state waters • Vessels that are fishing with or using exempted gears • Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species (i.e. vessels targeting tuna) • Vessels that are transiting

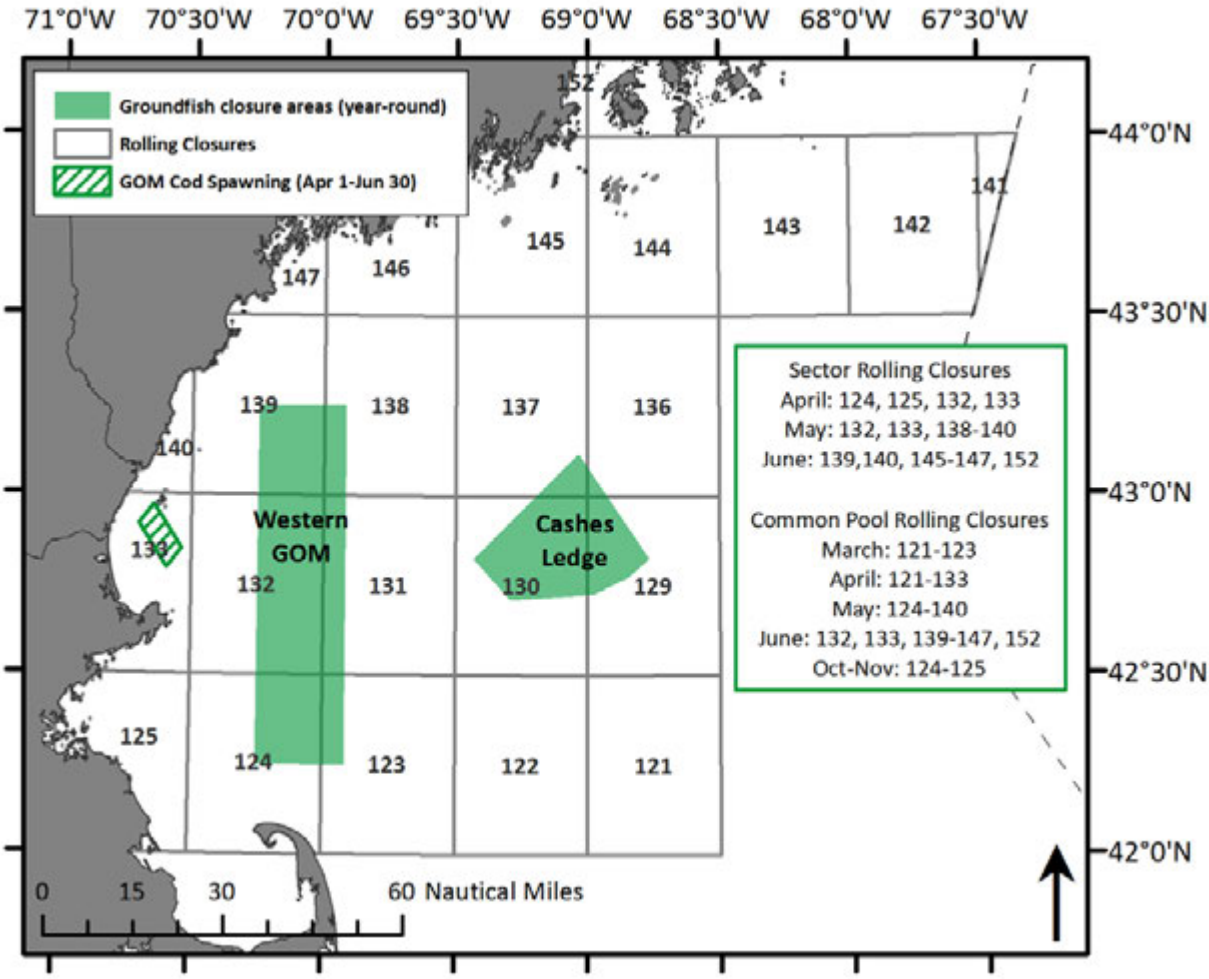
[3] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the WGOM and CL groundfish closures

Table 18 – Coordinates for Gulf of Maine year round and seasonal closed areas

Area	Point	Latitude	Longitude
Western Gulf of Maine Closure Area	WGM1	42°15′	70°15′
	WGM2	42°15′	69°55′
	WGM3	43°15′	69°55′
	WGM4	43°15′	70°15′
Cashes Ledge Closure Area	CL1	43°07′	69°02′
	CL2	42°49.5′	68°46′
	CL3	42°46.5′	68°50.5′
	CL4	42°43.5′	68°58.5′
	CL5	42°42.5′	69°17.5′
	CL6	42°49.5′	69°26′
[Common Pool] Rolling closure Area I – March	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM5	42°00′	68°30′
	GM6	42°30′	68°30′
	GM23	42°30′	70°00′
[Common Pool] Rolling closure Area II - April	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM5	42°00′	68°30′
	GM13	43°00′	68°30′
	GM10	43°00′	New Hampshire shoreline
Sector Rolling Closure Area II – April	GM1	42°00′	MA shoreline
	GM2	42°00′	Cape Cod, MA shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod, MA shoreline on the Atlantic Ocean
	SGM1	42°00′	70°00′
	SGM2	43°00′	70°00′
	SGM3	43°00′	New Hampshire shoreline
[Common Pool] Rolling Closure Area III - May	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM4	42°00′	70°00′
	GM23	42°30′	70°00′
	GM6	42°30′	68°30′
	GM14	43°30′	68°30′
	GM18	43°30′	Maine shoreline
Sector Rolling Closure Area III - May	SGM4	42°30′	Massachusetts shoreline
	SGM5	42°30′	70°00′
	SGM6	43°00′	70°00′
	SGM7	43°00′	69°30′
	SGM8	43°30′	69°30′
	GM18	43°30′	Maine shoreline
[Common Pool] Rolling closure Area IV – June	GM9	42°30′	Massachusetts shoreline
	GM23	42°30′	70°00′
	GM17	43°30′	70°00′
	GM19	43°30′	67°32′ or U.S.-Canada maritime boundary
	GM20	44°00′	67°21′ or U.S.-Canada maritime boundary
	GM21	44°00′	69°00′
	GM22	Maine shoreline	69°00′
Sector Rolling Closure	SGM9	43°00′	New Hampshire shoreline

Area IV - June	SGM6	43°00′	70°00′
	SGM10	43°30′	70°00′
	SGM11	43°30′	69°00′
	GM22	Maine shoreline	69°00′
[Common Pool] Rolling closure area V – October and November	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM4	42°00′	70°00′
	GM8	42°30′	70°00′
	GM9	42°30′	Massachusetts shoreline
GOM Cod Spawning Protection Area (April, May, and June)	CSPA1	42°50.95′	70°32.22′
	CSPA2	42°47.65′	70°35.64′
	CSPA3	42°54.91′	70°41.88′
	CSPA4	42°58.27′	70°38.64′
	CSPA1	42°50.95′	70°32.22′

Map 25 – Gulf of Maine Spawning Alternative 1 (No Action)



2.2.1.2 *Alternative 2 – Sector Rolling Closures, Whaleback, and Massachusetts Bay Spawning Protection Area*

This alternative (Map 26) would maintain the existing rolling closures that currently apply to sector enrolled vessels during April, May, and June for groundfish spawning protection purposes. These closed areas would apply from April to June to all vessels capable of catching groundfish, whether the vessel is in the common pool or enrolled in a sector, with possible exemptions as identified in the options below.

This alternative would also designate the Massachusetts Bay Cod Spawning Protection Area. This area is a subset of the existing October-November common pool rolling closure area, and would be closed from November 1 through January 31 with the same restrictions as the GOM Cod Spawning Protection (Whaleback) Area.

Under this alternative, the March-June common pool rolling closures would be eliminated. The Western Gulf of Maine and the Cashes Ledge Closure Areas would also be eliminated unless

maintained for habitat protection purposes. The Gulf of Maine Cod Spawning Protection (Whaleback) Area would be maintained as is. Overlapping habitat management areas for the Gulf of Maine region are proposed in sections 2.1.1, 2.1.2 and 2.1.3.

Two options are proposed; Option A would restrict various gears that catch groundfish, but exempt recreational groundfish fishing from the April, May, and June closures, and Option B would restrict various gears that catch groundfish including recreational gears.

This alternative would not preempt or change any overlapping state closures in Massachusetts, New Hampshire, or Maine state waters.

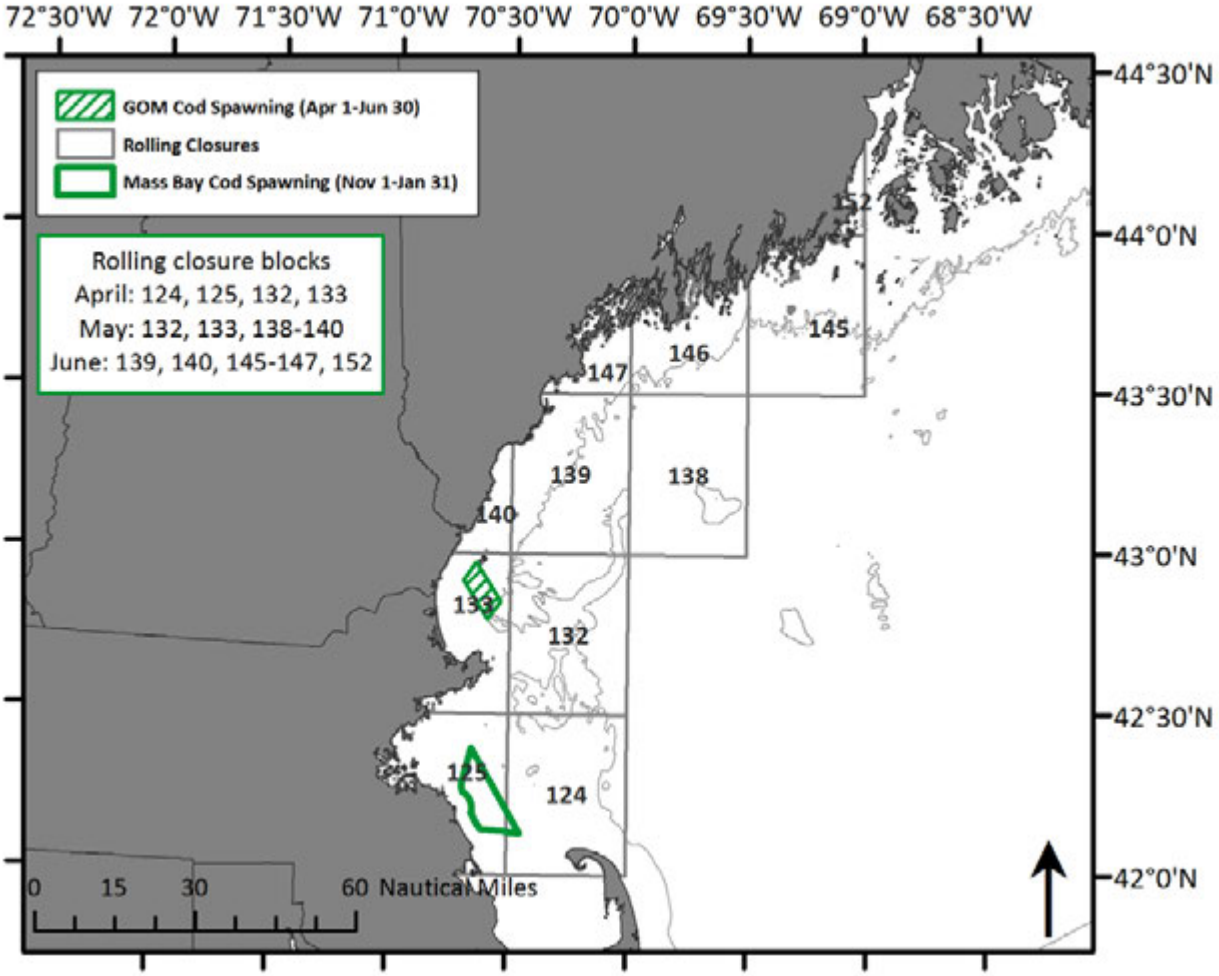
Rationale: New science and published research show a large degree of overlap between the sector rolling closures and groundfish spawning, particularly for cod and haddock. The Council had anticipated developing more precise spawning closure areas based on these data and analyses, but rejected novel area closure boundaries in favor of using a modification of the existing system of areas to meet spawning objectives in the Gulf of Maine. The rolling closures largely overlap identified concentrations of large groundfish and are appear to be sufficiently broad to capture variability in the timing and geographical range of annual spawning activity. The Massachusetts Bay Cod Spawning Protection Area would protect known aggregations of winter spawning cod, in order to improve productivity of the Gulf of Maine cod stock.

Table 19 – Coordinates for proposed Gulf of Maine groundfish spawning protection areas. The April, May, and June coordinates are identical to the existing coordinates to seasonal rolling closures that apply to sector-enrolled groundfish vessels.

Area	Point	Latitude	Longitude
April (Thirty minute squares 124, 125, 132, 133)	GM1	42°00′	MA shoreline
	GM2	42°00′	Cape Cod, MA shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod, MA shoreline on the Atlantic Ocean
	SGM1	42°00′	70°00′
	SGM2	43°00′	70°00′
	SGM3	43°00′	New Hampshire shoreline
May (Thirty minute squares 132, 133, 138-140)	SGM4	42°30′	Massachusetts shoreline
	SGM5	42°30′	70°00′
	SGM6	43°00′	70°00′
	SGM7	43°00′	69°30′
	SGM8	43°30′	69°30′
	GM18	43°30′	Maine shoreline
June (Thirty minute squares 139, 140, 145-147, 152)	SGM9	43°00′	New Hampshire shoreline
	SGM6	43°00′	70°00′
	SGM10	43°30′	70°00′
	SGM11	43°30′	69°00′
	GM22	Maine shoreline	69°00′
GOM Cod Spawning Protection Area (April 1-June 30)	CSPA1	42°50.95′	70°32.22′
	CSPA2	42°47.65′	70°35.64′
	CSPA3	42°54.91′	70°41.88′
	CSPA4	42°58.27′	70°38.64′
	CSPA1	42°50.95′	70°32.22′
Massachusetts Bay (November 1-January 31) (1)	1	42° 23.6′	70° 39.2′
	2	42° 07.7′	70° 26.8′

(1) Western boundary at Massachusetts state waters

Map 26 – Gulf of Maine Spawning Alternative 2.



2.2.1.2.1 Option A: Commercial gear restrictions

The April, May, and June rolling closure areas identified in this alternative (Map 26) would be sequentially closed for one-month periods to all fishing vessels, with the following exemptions, which are the exemptions currently in effect:

- Vessels that do not have a Federal Northeast multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Vessels participating in the mid-water trawl exempted fishery
- Sea scallop dredge gear when under a scallop day-at-sea
- Vessels lawfully in a scallop dredge exemption area
- Vessels participating in the Raised Footrope Trawl Exempted Whiting Fishery
- Vessels that are transiting

- Charter and party vessels[4]
- Recreational vessels

The Massachusetts Bay Spawning Protection Area and the Gulf of Maine Cod Spawning Protection Area (Whaleback) would be closed seasonally to all fishing vessels with the following exemptions (these are the exemptions currently associated with the Gulf of Maine Cod Spawning Protection Area):

- Vessels that do not have a Federal Northeast multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species or ocean pout
- Vessels that are transiting

Rationale: Specific concentrations of spawning cod have been identified in Massachusetts Bay and Gulf of Maine Cod Spawning Protection Areas, and spawning activities in these areas would be disrupted if they are open to recreational groundfishing. While other portions of the rolling closures encompass groundfish spawning activity, specific areas have not yet been identified and it is not clear that recreational fishing would disturb more widely distributed spawning activity. Therefore, recreational groundfishing would be allowed in the larger April, May, and June closures.

2.2.1.2.2 Option B: Commercial and recreational gear restrictions

The April, May, and June rolling closure areas identified in this alternative would be sequentially closed for one-month periods to all fishing vessels, with the following exemptions, which are the exemptions currently in effect except that recreational vessels would not be exempted:

- Vessels that do not have a Federal Northeast multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Vessels participating in the mid-water trawl exempted fishery
- Sea scallop dredge gear when under a scallop day-at-sea
- Vessels lawfully in a scallop dredge exemption area
- Vessels participating in the Raised Footrope Trawl Exempted Whiting Fishery
- Vessels that are transiting

[4] Currently, charter and party vessels may fish in the rolling closures provided they have a Letter of Authorization from the Regional Administrator to enter or fish in these areas (additional requirements also apply).

The Massachusetts Bay Spawning Protection Area and the Gulf of Maine Cod Spawning Protection Area (Whaleback) would be closed seasonally to all fishing vessels with the following exemptions (these are the exemptions currently associated with the Gulf of Maine Cod Spawning Protection Area):

- Vessels that do not have a Federal Northeast multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species or ocean pout
- Vessels that are transiting

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce.

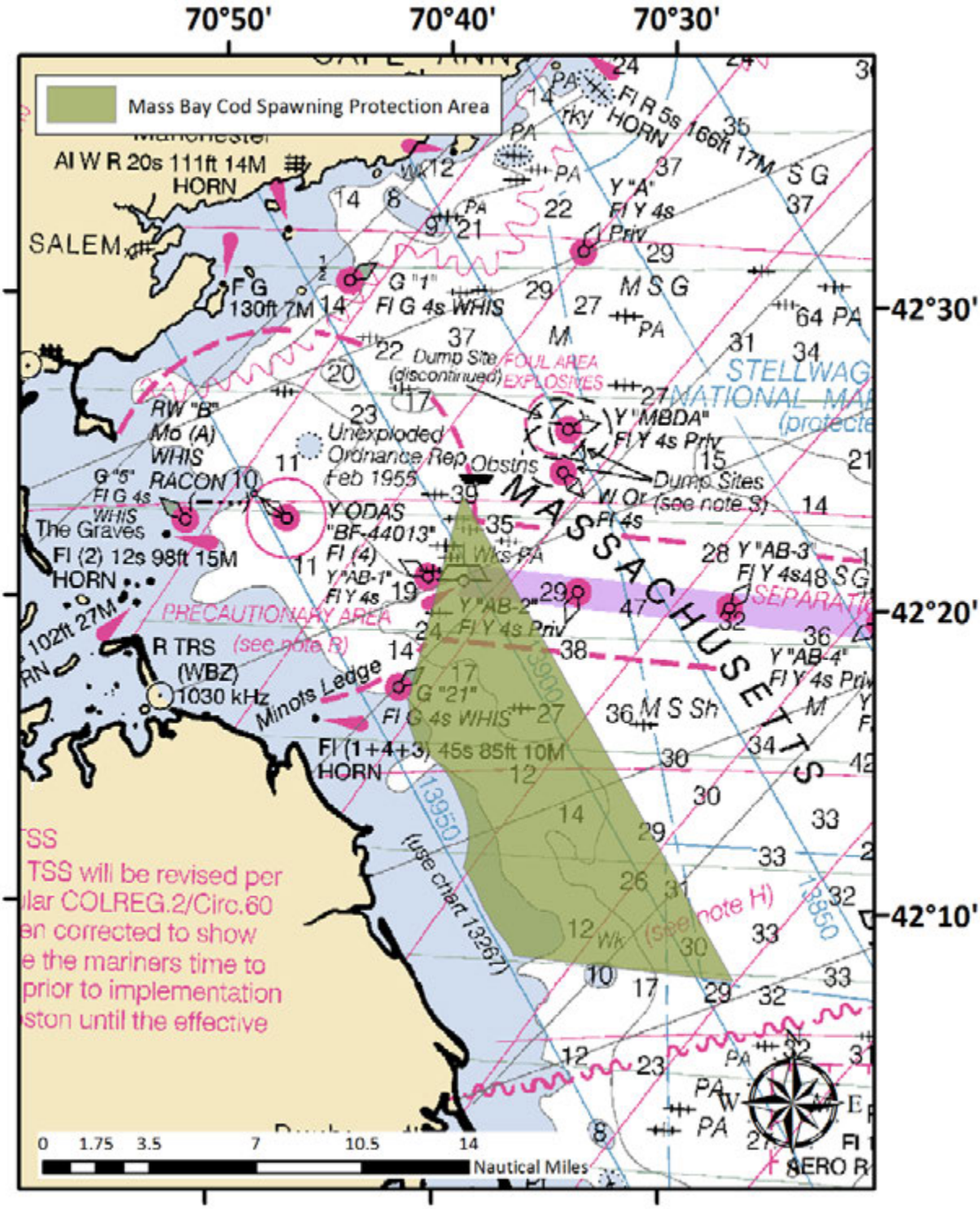
2.2.1.3 ***Alternative 3 – Massachusetts Bay Spawning Protection Area (preferred)***

This alternative would designate the Massachusetts Bay Spawning Protection Area as described under Alternative 2A/2B (see lower right panel in Map 26). The Council's intent was that this designation could be combined with Alternative 1/No Action. The area would be closed to all fishing vessels from November 1 to January 31 with the following exemptions (these are the exemptions currently associated with the Gulf of Maine Cod Spawning Protection Area):

- Vessels that do not have a Federal Northeast multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species or ocean pout
- Vessels that are transiting

Rationale: This area is being studied by the Massachusetts Division of Marine Fisheries and their research partners for the presence and duration of cod spawning behavior. It has been identified by fishermen as a unique site that often supports winter cod spawning and is consistent with industry-based survey catches and survey catch hotspot analysis of large spawning groundfish, particularly cod.

Map 27 – Gulf of Maine Spawning Alternative 3



2.2.2 Georges Bank and Southern New England

Alternative 2B is the preferred spawning alternative for Georges Bank and Southern New England.

2.2.2.1 *Alternative 1 (No Action)*

No Action would retain the existing year round closed areas on Georges Bank and in southern New England, specifically Closed Area I, Closed Area II, the Nantucket Lightship Closed Area, and the Georges Bank Seasonal Closure Area (Map 28). Measures for these areas are summarized in Table 20 and coordinates for these areas are shown in Table 21.

Rationale: In addition to their original intended effects related to fishing mortality reduction, these year round and seasonal closures have incidental effects that provide protection for spawning groundfish. Closed Area I and Closed Area II, in particular, were originally designed to protect cod and haddock spawning activity.

Table 20 – Restrictions in the year round and seasonal closed areas on Georges Bank and in Southern New England

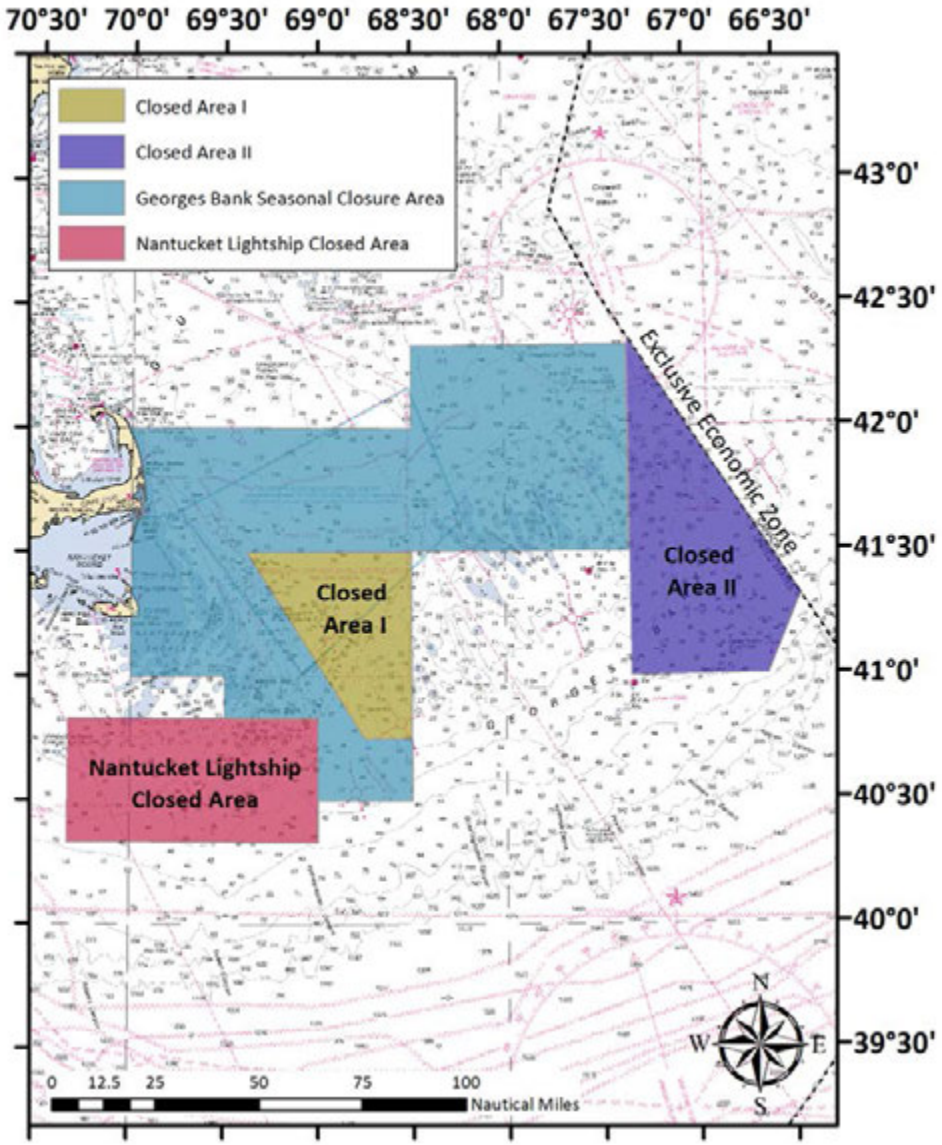
Area name	Prohibitions	Exemptions
Nantucket Lightship Closed Area	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Classified as charter, party or recreational vessel, provided that: (A) LOA, (B) Fish species managed by the NEFMC or the MAFMC are not sold, (C) no gear other than rod and reel or handline gear on board, (D) vessel does not fish outside the Nantucket Lightship Closed Area during the period specified by the LOA • Fishing with or using dredge gear designed and used to take surfclams or ocean quahogs • Fishing for scallops within the Nantucket Lightship Access Area • Vessels that are transiting, provided that gear is properly stowed
Closed Area I	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Fishing in a Special Access Program • Fishing for scallops within the Closed Area I Access Area • Vessels that are transiting, provided that gear is properly stowed
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Fishing in a Special Access Program • Tuna purse seine gear outside of the portion of CA II known as the Habitat Area of Particular Concern • Fishing in the CA II Yellowtail Flounder/Haddock SAP or the Eastern U.S./Canada Haddock SAP Program • Transiting the area, provided the vessel's fishing gear is stowed and there is a compelling safety reason • The vessel has declared into the Eastern U.S./Canada Area and is transiting CA II • Fishing for scallops within the Closed Area II Access Area • Vessels that are transiting, provided that gear is properly stowed
Georges Bank Seasonal Closure Area	From May 1-May 31, no fishing vessel or person on a fishing vessel may enter, fish, or be in the area, except for:	• Exempted gears - spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets pound nets, pots and traps, purse seines, midwater trawls, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, shrimp trawls • Charter/party or recreational vessels; • Fishing with dredge gear under a scallop DAS, and provided that the vessel complies with the NE multispecies possession restrictions for scallop vessels, or when lawfully fishing in the Scallop Dredge Fishery Exemption Areas • Fishing in the CA I Hook Gear Haddock Access Area • Fishing under the restrictions and conditions of an approved sector

Area name	Prohibitions	Exemptions
		operations plan • Fishing under the provisions of a Northeast multispecies Handgear A or B permit • Vessels that are transiting, provided that gear is properly stowed

Table 21 - Latitude and longitude coordinates of areas included in the no action Georges Bank groundfish spawning alternative

Closed Area I (year-round)			Closed Area II (year-round)		
Point	N. Lat.	W. Long.	Point	N. Lat.	W. Long.
CI1	41˚ 30'	69˚ 23'	CII1	41˚ 00'	67˚ 20'
CI2	40˚ 45'	68˚ 45'	CII2	41˚ 00'	66˚ 35.8' (1)
CI3	40˚ 45'	68˚ 30'	G5	41˚ 18.6'	66˚ 24.8' (1)
CI4	41˚ 30'	68˚ 30'	CII3	42˚ 22'	67˚ 20'
Nantucket Lightship Closed Area - Year round			Georges Bank Seasonal Closure - May 1 – May 31		
Point	N. lat.	W. long.	Point	N. Lat.	W. Long.
G10	40°50′	69°00′	1	42˚ 00'	(2)
CN1	40°20′	69°00′	2	42˚ 00'	68˚ 30'
CN2	40°20′	70°20′	3	42˚ 20'	68˚ 30'
CN3	40°50′	70°20′	4	42˚ 20'	67˚ 20'
(1) US – Canada maritime boundary *(2) Northward to its intersection with the shoreline of Massachusetts*			5	41˚ 30'	67˚ 20'
			6	41˚ 30'	69˚ 23'
			7	40˚ 45'	68˚ 45'
			8	40˚ 45'	68˚ 30'
			9	40˚ 30'	68˚ 30'
			10	40˚ 30'	69˚ 00'
			11	40˚ 50'	69˚ 00'
			12	40˚ 50'	69˚ 30'
			13	41˚ 00'	69˚ 30'
			14	41˚ 00'	70˚ 00'
			15	(2)	70˚ 00'

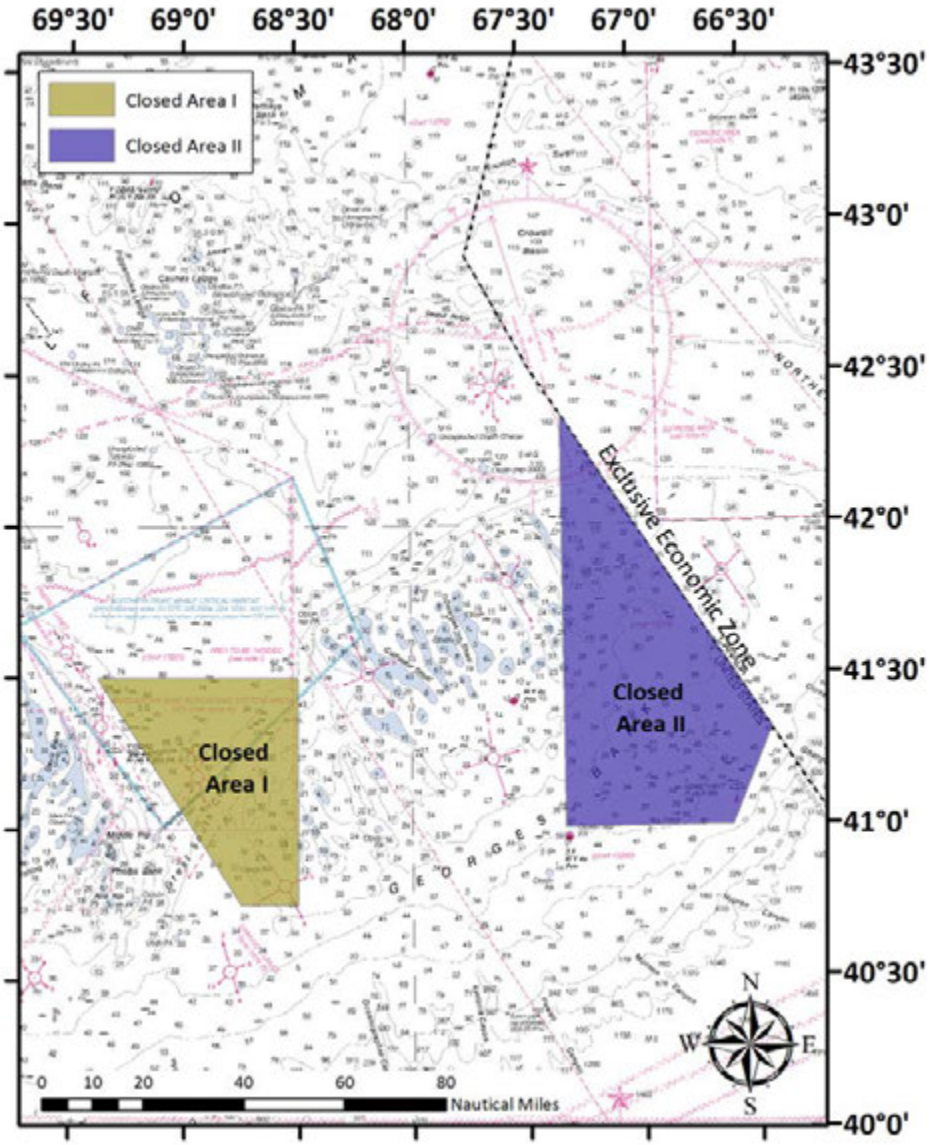
Map 28 – Georges Bank Spawning Alternative 1 (No Action).



2.2.2.2 *Alternative 2 – Seasonal Implementation of Closed Area I and Closed Area II*

This alternative (Map 29) would retain as spawning closures Closed Area I and Closed Area II during the months of February, March, and the first half of April. The Nantucket Lightship Closed Area and the Georges Bank Seasonal Closure Area would be eliminated. The options consider closures to just commercial gears (Option A) or commercial and recreational gears (Option B). Coordinates for Closed Areas I and II are given above.

Map 29 – Georges Bank Spawning Alternative 2. Areas closed February 1-April 15 to vessels using gears capable of catching groundfish.



2.2.2.2.1 Option A: Commercial gear restrictions

Closed Areas I and II would be closed February 1-April 15 to all fishing vessels with the following exemptions:

- Vessels fishing with spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, or single pelagic gillnets
- Vessels participating in the mid-water trawl exempted fishery
- Charter and party vessels
- Recreational vessels

- Vessels that are transiting

Rationale: This alternative would exempt charter, party, and recreational vessels. Although cod spawn in these areas, specific locations have not yet been identified and it is not clear that recreational fishing would disturb more widely distributed spawning activity. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity.

2.2.2.2.2 Option B: Commercial and recreational gear restrictions (preferred)

Closed Areas I and II would be closed February 1-April 15 to all fishing vessels with the following exemptions:

- Vessels fishing with spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, or single pelagic gillnets
- Vessels participating in the mid-water trawl exempted fishery
- Vessels that are transiting

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity.

2.2.2.2.3 Option C: Exempt sea scallop dredges from gear restrictions

Option C would exempt scallop dredge vessels from the February 1 to April 15 spawning closures in Closed Areas I and II. Option C could be selected independently of whether the spawning closure allows recreational fishing (Option A) or does not allow recreational fishing (Option B). If Option C is not chosen, then trailing framework adjustments in the Scallop FMP would exclude scallop fishing during the proposed spawning closure, otherwise scallop fishing could occur at any time of year in Closed Area I and II, subject to restrictions imposed by the Scallop FMP.

Rationale: Scallop dredge vessels do not target groundfish and are limited by sub-Annual Catch Limits for certain stocks. Scallop access area measures currently do not allow scallop fishing in the southern half of Closed Area II during August 15 to November 15, when bycatch rates of yellowtail flounder are high relative to scallop yield. Cod and haddock spawning occur in spring (February to April) and yellowtail flounder spawning takes place in June to August, however.

2.2.2.3 ***Alternative 3 – Seasonal implementation of Closed Area I North and Closed Area II***

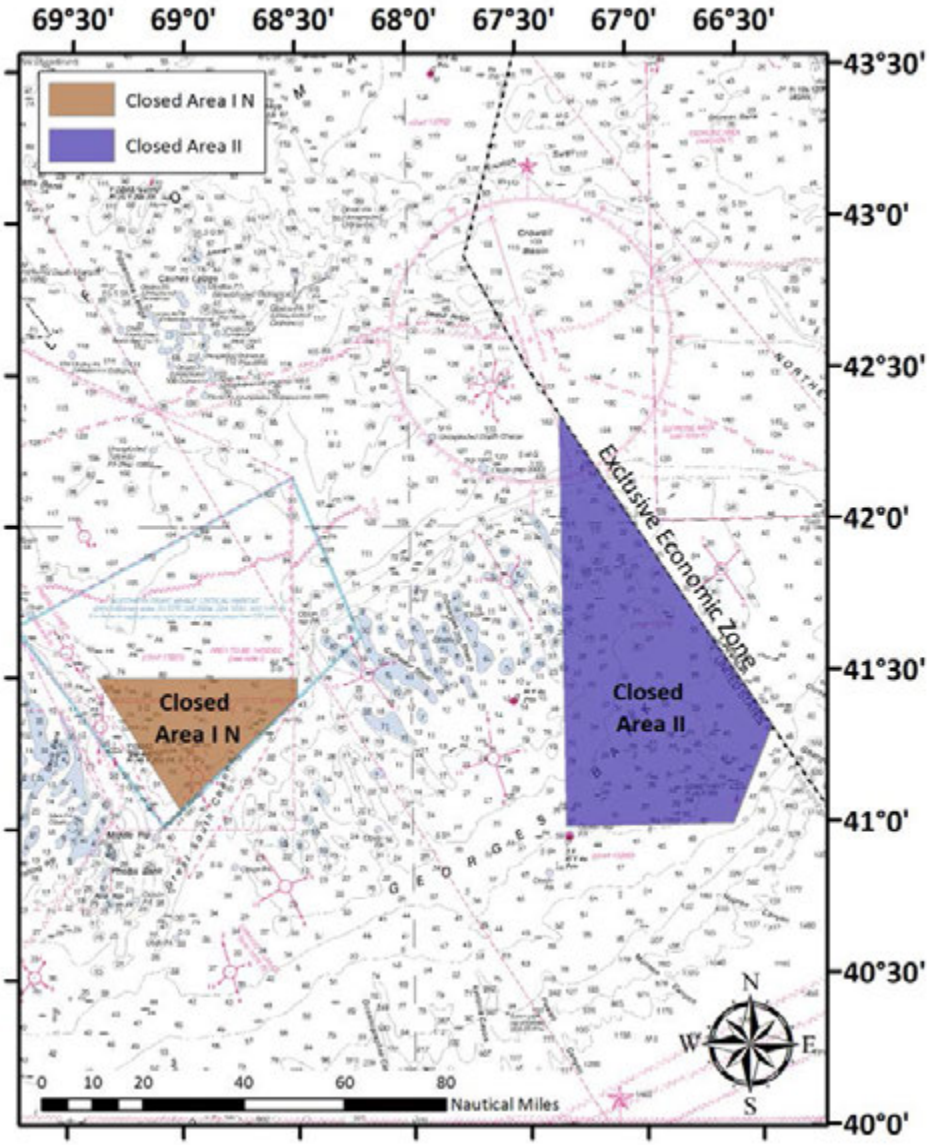
This alternative (Map 30) would retain as spawning closures the northern part of Closed Area I and Closed Area II during the months of February, March, and the first half of April. The

Nantucket Lightship Closed Area and the Georges Bank Seasonal Closure Area would be eliminated. The options consider closures to just commercial gears (Option A) or commercial and recreational gears (Option B). The coordinates for the northern part of Closed Area I are provided below.

Table 22 – Coordinates for the Closed Area I North spawning closure in Alternative 3. These are identical to the existing coordinates for the CAIN Habitat Closure Area.

Closed Area I		
Point	W. Long.	N. Lat.
1	69˚ 23'	41˚ 30'
2	68˚ 30'	41˚ 30'
3	69˚ 30'	41˚ 26'
4	69˚ 01'	41˚ 04'
5	69˚ 23'	41˚ 30'

Map 30 – Georges Bank Spawning Alternative 3. Areas closed February 1-April 15 to vessels using gears capable of catching groundfish.



2.2.2.3.1 Option A: Commercial gear restrictions

The northern part of Closed Area I and all of Closed Area II would be closed February 1-April 15 to all fishing vessels with the following exemptions:

- Vessels fishing with spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, or single pelagic gillnets
- Vessels participating in the mid-water trawl exempted fishery
- Charter and party vessels
- Recreational vessels

- Vessels that are transiting

Rationale: This alternative would exempt charter, party, and recreational vessels. Although cod spawn in these areas, specific locations have not yet been identified and it is not clear that recreational fishing would disturb more widely distributed spawning activity. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. The northern portion of Closed Area I was identified by the Council as an area that might contain the majority of Closed Area I spawning activity.

2.2.2.3.2 Option B: Commercial and recreational gear restrictions

The northern part of Closed Area I and all of Closed Area II would be closed February 1-April 15 to all fishing vessels with the following exemptions:

- Vessels that are transiting
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, or single pelagic gillnets)
- Vessels participating in the mid-water trawl exempted fishery

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. The northern portion of Closed Area I was identified by the Council as an area that might contain the majority of Closed Area I spawning activity.

2.2.2.3.3 Option C: Exempt sea scallop dredges from gear restrictions

Option C would exempt scallop dredge vessels from the February 1 to April 15 spawning closures in Closed Areas I and II. Option C could be selected independently of whether the spawning closure allows recreational fishing (Option A) or does not allow recreational fishing (Option B). If Option C is not chosen, then trailing framework adjustments in the Scallop FMP would exclude scallop fishing during the proposed spawning closure, otherwise scallop fishing could occur at any time of year in Closed Area I and II, subject to restrictions imposed by the Scallop FMP.

Rationale: Scallop dredge vessels do not target groundfish and are limited by sub-Annual Catch Limits for certain stocks. Scallop access area measures currently do not allow scallop fishing in the southern half of Closed Area II during August 15 to November 15, when bycatch rates of yellowtail flounder are high relative to scallop yield. Cod and haddock spawning occur in spring (February to April) and yellowtail flounder spawning takes place in June to August, however.

2.3 Alternatives to designate Dedicated Habitat Research Areas

The Council has identified Dedicated Habitat Research Area Alternatives 2, 3B, 4, and 5 as preferred.

One goal of this amendment is to minimize the adverse effects of fishing on essential fish habitat to the extent practicable. In order to better inform managers about trade-offs associated with minimization of adverse effects, the Habitat PDT developed the Swept Area Seabed Impact (SASI) approach, including a spatial model combining habitat maps, habitat vulnerability estimates, and fishing effort data. This approach was intended to aid in identifying areas throughout the region that are most vulnerable to each type of commercial fishing gear. While a clear step beyond previous efforts, the model rests on a set of general assumptions that are not necessarily equally applicable in all habitats and in all sub-regions. There is a need to test these assumptions and to improve the utility of the model with empirical studies from across the region. Further, there is a critical need to improve our understanding of the linkages between habitat and the productivity of managed species (and their prey) in order to better target management and conservation actions.

One approach to address information needs is to designate Dedicated Habitat Research Areas (DHRAs) in concert with Habitat Management Areas. These DHRAs would be the focus of research activities to provide information to managers, improve understanding of the ecological effects of fishing across a range of habitats, and ultimately improve model forecasts and inform future habitat management. An important aspect about DHRAs is that they would allow coordinated research and build upon past studies and baselines. The current ad hoc nature of fish habitat and gear effects research has minimized potential synergies and potentially reduced the amount of information of use to managers.

There are five management alternatives in this section. Under DHRA Alternative 1 (No Action), no DHRAs would be designated. If one or more of the action alternatives in this section (Alternatives 2, 3, and 4) are selected, the Council would designate up to three separate DHRAs in Gulf of Maine and Georges Bank locations. Any combination of these alternatives could be selected. In all cases, the DHRAs overlap with other management areas that currently exist or are proposed in this amendment. All of the dedicated habitat research areas described in this section would be defined on a year-round basis. Alternative 5, if selected, would implement a sunset provision for all of the designated DHRAs. The measures for each DHRA restrict certain types of fishing to create appropriate reference conditions in the research area, in order to facilitate scientific study.

The structure of the alternatives in this document implies that DHRA designations would be considered as separate but overlapping management area designations, potentially with different restrictions on fishing activity than the habitat and/or spawning areas that they overlap with.

Research agenda for designated DHRAs

The Council identified a set of priority research questions that the DHRAs should address. Identifying the questions is a critical first step in designing research areas in appropriate habitats

with a statistically valid range of treatments. The questions are based on four broad focus areas: gear impacts, habitat recovery, natural disturbance, and productivity.

- **Impacts:** These questions address the differential susceptibility and recovery of habitats by gear type, and gear contact with the seabed.
- **Recovery:** These questions focus on recovery models, patch size effects, and effort-response issues.
- **Natural disturbance**: These questions address the difference between natural and fishing disturbance.
- **Productivity:** These questions address productivity by habitat type.

Gear impacts

How do different types of bottom tending fishing gear (e.g., trawl nets, dredges, hook and line, traps, gillnets, longlines) affect the susceptibility and recovery of physical and biological characteristics of seabed habitat, and how do these impacts collectively influence key elements of habitat including spatial complexity, functional groups, community state, and recovery rates and dynamics?

In order to study the impact of different fishing gears and variable intensities of fishing on biological and geologic characteristics of habitat, it is necessary to design management experiments. The potential redesign of the existing closures in the region provides an ideal opportunity to examine this question because the existing habitat closures most likely approach habitat undisturbed by fishing impacts in the region. Thus, allowing prescriptive fishing efforts inside a portion of these closures and comparing effects to undisturbed control areas will provide insight into how each gear type impacts the susceptibility and recovery of habitat features.

These questions aim in part to address some key assumptions in the SASI model and outstanding questions about habitat impacts:

- How accurate are the susceptibility and recovery scores for biological and geological components derived in the SASI model?
- How accurate are the assumptions in SASI model about the cumulative impacts of each gear type (e.g. multiple passes)?
- Has SASI correctly identified the most vulnerable habitats?
- Are the differences in magnitude of impact among gear types correct?
- Have we significantly over- or under-estimated the impacts of particular gear types?

Are our estimates of gear contact with the bottom accurate? Can we develop trawl gear that minimizes contact on the bottom, thereby reducing the potential for gear impacts?

SASI 'rewards' fishing gear types that have less contact with the seabed by assigning a lower contact index value to those gear types. This results in lower area swept estimates that enter the model in each time step and thus lower estimates of adverse effects that result from that type of fishing. For example, imagine two vessels fishing with the same size trawl and doors but one fishes with a raised footrope sweep and the other fishes with a rockhopper sweep. While the contact of the doors and ground cables are assumed to be similar for both types of gear, seabed contact of the sweep was assumed to be much lower for the raised footrope gear. Thus, if the vessels fish for the same amount of time/distance in the same area, the adverse effects associated with the raised footrope are estimated to be less by the model.

Clearly, this example is an oversimplification, and different types of fish occur on different habitats with varying vulnerability to fishing gear. However, if contact indices can be better specified, SASI provides a way to estimate the magnitude reduction in adverse effects to EFH that would be associated with substitution of reduced impact gears for those gears currently in use. Further research in this subject area could also improve estimates of fixed gear seabed contact, which are presently highly uncertain.

Evaluating gear contact with the seabed and developing lower impact gears will require gear technology scientists to work with fishermen.

Habitat Recovery

What recovery models (e.g., successional vs. multiple-stable states) are operant in the region and how resilient are seafloor habitats to disturbance? In other words, how do seafloor habitats recover, and are there thresholds after which habitats have achieved an alternate state and are no longer capable of recovering to their previous undisturbed condition?

This critical question addresses our underlying assumptions about fishing effects. We often assume that seafloor communities recover in a successional manner; i.e., if we stop the impacts, the habitat recovers to a previously unimpacted state. Although we know this happens in some areas, there are research results that suggest that other community models are at play in other areas. In terms of measuring 'success' of management measures intended to promote habitat recovery, it is important to be able to distinguish between habitats that have experienced some recovery but require more time to achieve full recovery, vs. habitats that have experienced some recovery, but look different ecologically than they did prior to disturbance. Habitats that have recovered to a different state than they were in originally may nonetheless provide similar functional value for managed and ecosystem component species.

Do "small" fishing-caused disturbances surrounded by unimpacted habitat recover more quickly and exhibit greater resilience in contrast to "large" fishing-caused disturbances embedded with small unimpacted patches?

In other words, how does the size of a habitat management area vs. the intensity of fishing influence habitat recovery and resilience?[5] Answers to this question relate directly to understanding how management strategies focused on maximizing CPUE relate to habitat impacts.

When a particular area is fished for the first time vs. subsequent efforts, are these impacts equal per unit effort? Or, is the first pass over an area much more detrimental? Conversely, is there a tipping point beyond which the habitat is no longer capable of recovering?

Answers to this question can help define management strategies for the region. If first pass impacts are most critical in some habitat types, there is a stronger argument for setting areas aside entirely in order to protect habitats from damage. If long-term, cumulative effects are the bigger issue, than the management strategy might be different, and be aimed at controlling but not eliminating fishing in vulnerable habitats. This question will require setting up research areas in the closures and controlling the level of fishing allowed in each to examine the impacts of the first versus subsequent units of effort on the susceptibility and recovery of key habitat components.

Natural Disturbance

In the absence of fishing, what are the dynamics of natural disturbance (e.g., major storm events) on seafloor habitat (especially biological components) across five major grain size classes (mud, sand, coarse sand-granule, pebble-cobble, boulder) and across oceanographic regimes? In areas where natural disturbance is high, are signals of the impacts of fishing masked?

We need to know what seafloor habitat and communities look like in the absence of fishing impacts in order to evaluate the role of natural disturbance combined with fishing effects.

Productivity

How does the productivity of managed species (and prey species) vary across habitat types nested within the range of oceanographic and regional settings? And how does this productivity change when habitats are impacted by fishing gear? Do durable mobile bottom tending gear closures increase fish production? Why are highly productive areas so productive?

This is probably the most important habitat-related question from a fisheries management standpoint. This question extends beyond the current modeling capacity of SASI, but addresses a key limitation of SASI, specifically that addresses impacts to habitat in a generic way without and assuming that one area is more important than another from a productivity standpoint. Integrating SASI-derived habitat vulnerability with a better understanding of which habitats influence the productivity of managed species will greatly enhance management efforts. Without

[5] See Auster and Langton 1999 for a discussion of this issue.

this integrated effort, management actions based solely on reducing impacts may actually focus efforts on habitats that are more vulnerable but less important as EFH.

A gradient of impacts to particular habitat types, focused in impact treatment areas, allows assessment of variation in the role of habitat in population responses. In other words, comparisons of fished to unfished areas will reveal how fished species respond to changes in biological and geological components of habitat. Addressing these questions requires comparisons of closed areas that are opened vs. closed areas that remain closed.

Design and implementation elements common to all DHRAs

Dedicated Habitat Research Areas would be a new type of management area designation for the Council, so there are a number of design and implementation elements to think through.

Area design and fishing impact treatments

While a before-after control-impact design was recommended as the ideal, the three DHRAs proposed in this amendment would be control-impact designs. These two approaches are contrasted in Table 23.

Table 23 – Comparison between before-after control-impact and control-impact designs

A before-after control-impact design could produce results that:	**A control-impact design will:**
• Will separate the effects of fishing from environmental variability and species interactions. • Address effects of timing (season) and size (spatial footprint) of impacts. • Address the potential for multiple states of recovery • Identify the effects of particular types of gear and levels of effort on habitats in multiple states of recovery. • Determine how fish production is affected by seafloor habitats in multiple states and different trajectories of recovery.	• Limit all comparisons of recovery to the single state existing within the current closed areas • Address effects of timing (season) and size (spatial footprint) of impacts • Identify the effects of particular types of gear and levels of effort • Determine how fish production is affected by seafloor habitats • The control-impact approach would fail to take advantage of a unique opportunity to advance our knowledge of the potential benefits of closed areas (recovery dynamics, gear specific impacts and relationships to fish productivity).

Another consideration related to DHRA design is how fishing impacts treatments will be implemented. Three approaches were discussed during development of the amendment:

1. General closure of research areas with all impact treatments as research fishing,
2. General closure of research areas with impacts coming from some kind of limited access fishery in specified fishing treatment areas, or
3. Open fishery access specified fishing treatment areas.

All three DHRAs in this amendment follow the first approach. Specifically, fishing effort would be contracted or arranged specifically by project scientists to occur in particular areas using specific gears. This decision means that the Council would not need to specify treatment areas within a particular DHRA at the time of DHRA designation, but rather, that the location of study sites and treatments would be determined by researchers using the DHRA. This approach also helps to ensure that fishing effort occurs in the locations desired and at the magnitude desired. There would be lower administrative costs at the front end because specification of levels of fishing activity is left to the researchers. However, this requires researchers to invest the greatest amount of resources in designing the fishing impact.

One potential cost of a research fishing approach is that it might be hard to generate effort that is of sufficient magnitude to replicate a commercial fishery impacts. There might be gaps in impacts if funding is limited, which could be an issue in long-term impacts studies. Also, researchers would need to figure out how to fund the activities and, working through the Regional Office's exempted fishing program, whether the fish could be landed and if so they would need to come out of the fishery's overall allocation, or if vessels would need to agree to use DAS or quota to cover the trips.

It will be important for the Council to understand how the DHRAs are being used. Coordination and oversight will probably need to happen at the Council level on an ongoing basis, perhaps through the Council's Research Steering Committee or the Habitat Committee and Plan Development Team. The Greater Atlantic Regional Fisheries Office will also be involved with coordination and oversight to determine where research treatment sites are located and to assure there are no conflicts that would bias results. Researchers may need to obtain letters of acknowledgement, exempted fishing permits, and/or letters of authorization (under the Marine Mammal Protection Act) before conducting research in a DHRA. Researchers should coordinate with the Regional Office prior to conducting research.

2.3.1 Alternative 1 (No Action) – No DHRA designations

Currently there are no DHRAs designated in the region. Under No Action, this would continue and DHRAs would not be designated as part of this amendment.

2.3.2 Alternative 2 – Eastern Maine Dedicated Habitat Research Area (preferred)

This alternative would designate a Dedicated Habitat Research Area in the eastern Gulf of Maine as shown in Map 31. Measures for this area would be closure to all mobile bottom-tending gear on a year round basis. If the DHRA overlaps with a habitat management area with less restrictive measures (i.e., either the Large or Small Eastern Maine HMA), the DHRA measures would take precedence.

Rationale: The purpose of this alternative is to establish a management regime in the eastern Gulf of Maine region that will facilitate the study of:

- fishing gear impacts on benthic habitats,
- habitat recovery,

- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources.

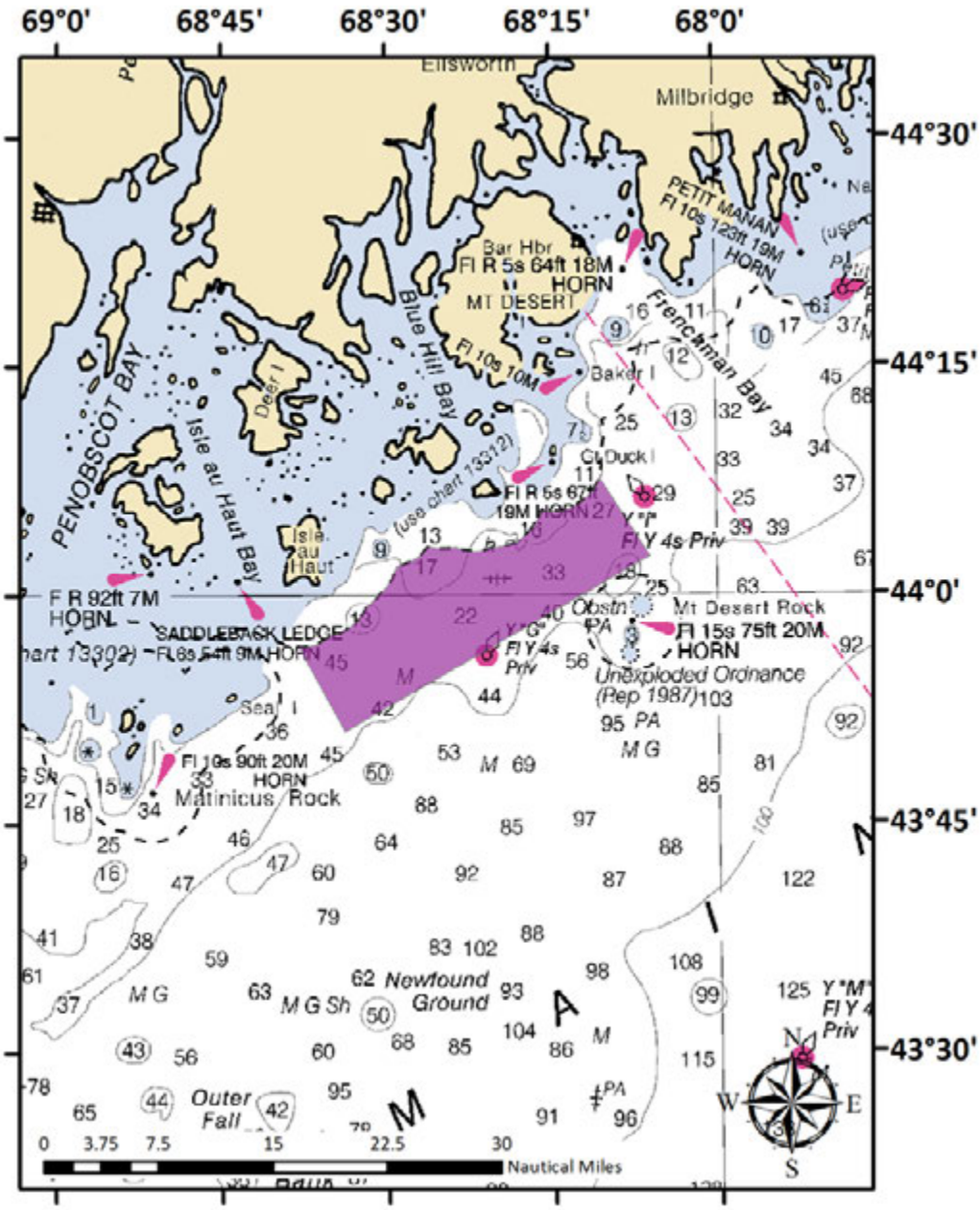
Designation of the DHRA should help to focus research efforts on this location, and facilitate the permitting process for those projects. Relative to present conditions, where groundfish resources are relatively depleted, this region previously supported additional groundfish resources and groundfish fisheries. Dam removal inshore of this area may lead to recovery of prey resources and improved production of managed species via an increase in feeding opportunities. Routine sampling of fishery and prey species in this area could help to identify these ecological linkages.

Table 24 – Coordinates for Eastern Maine DHRA

Eastern Maine DHRA (Same as Small Eastern Maine HMA)		
Point	N Latitude	W Longitude
1	44° 02.5’	68° 06.1’
2	43° 51.0’	68° 33.9’
3*	43° 56.6’	68° 38.1’
4*	44° 07.6’	68° 10.6’

A. Western boundary state waters; eastern boundary state waters/EEZ
B. Landward boundary at state waters. Only endpoints provided.

Map 31 – Eastern Maine Dedicated Habitat Research Area



2.3.3 Alternative 3 – Stellwagen Dedicated Habitat Research Area (preferred)

This alternative would designate a Dedicated Habitat Research Area in the western Gulf of Maine as shown in Map 32. Measures for the entire area would be closure to mobile bottom-tending gear, sink gillnet gear, and demersal longline gear on a year round basis (not including mobile bottom tending gear deployed by scientific research vessels conducting scientific research, outside of the authority of the Magnuson-Stevens Act). Mid-water and pelagic gears would be permitted throughout. This alternative includes an optional reference area that would additionally be closed to recreational and party/charter groundfish fishing if selected. If the

DHRA overlaps with a habitat management area with less restrictive measures, the DHRA measures would take precedence.

This DHRA would represent a control-impact style design as it lies completely within the existing Western Gulf of Maine habitat closed area. The specific boundaries identified for the area were recommended by an independent ad-hoc working group of fishermen and scientists that are involved with both Stellwagen Bank National Marine Sanctuary and the Council's Habitat Omnibus process, although the boundaries and fishing restrictions would be adopted as a Council management alternative under the Magnuson Stevens Act.

Rationale: The purpose of this alternative is to establish a management regime in the western Gulf of Maine region that will facilitate the study of:

- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources.

Designation of the DHRA should help to focus research efforts on this location, and facilitate the permitting process. The DHRA area contains a wide array of habitat types and species, and there are numerous baseline studies of the area that could be built upon in the future. Stellwagen Bank in general is a highly productive area, and a better understanding as to why this is could improve fisheries management in the Western Gulf of Maine.

The purpose of the reference area is to create a site where removals of groundfish are limited, in order to be able to study how the ecology of the reference area may change under such conditions. The two reference area options sub-divide an area of relatively high recreational fishing effort. Siting the reference area in a location with relatively large amounts of recreational fishing will best ensure a contrast in before vs. after conditions. If there are significant ecosystem effects of limiting groundfish removals from the major sources, they will be more likely to be detected with a substantial before/after contrast.

2.3.3.1 *Option A – Southern reference area*

Option A includes the southern reference area.

2.3.3.2 *Option B – Northern reference area (preferred)*

Option B includes the northern reference area.

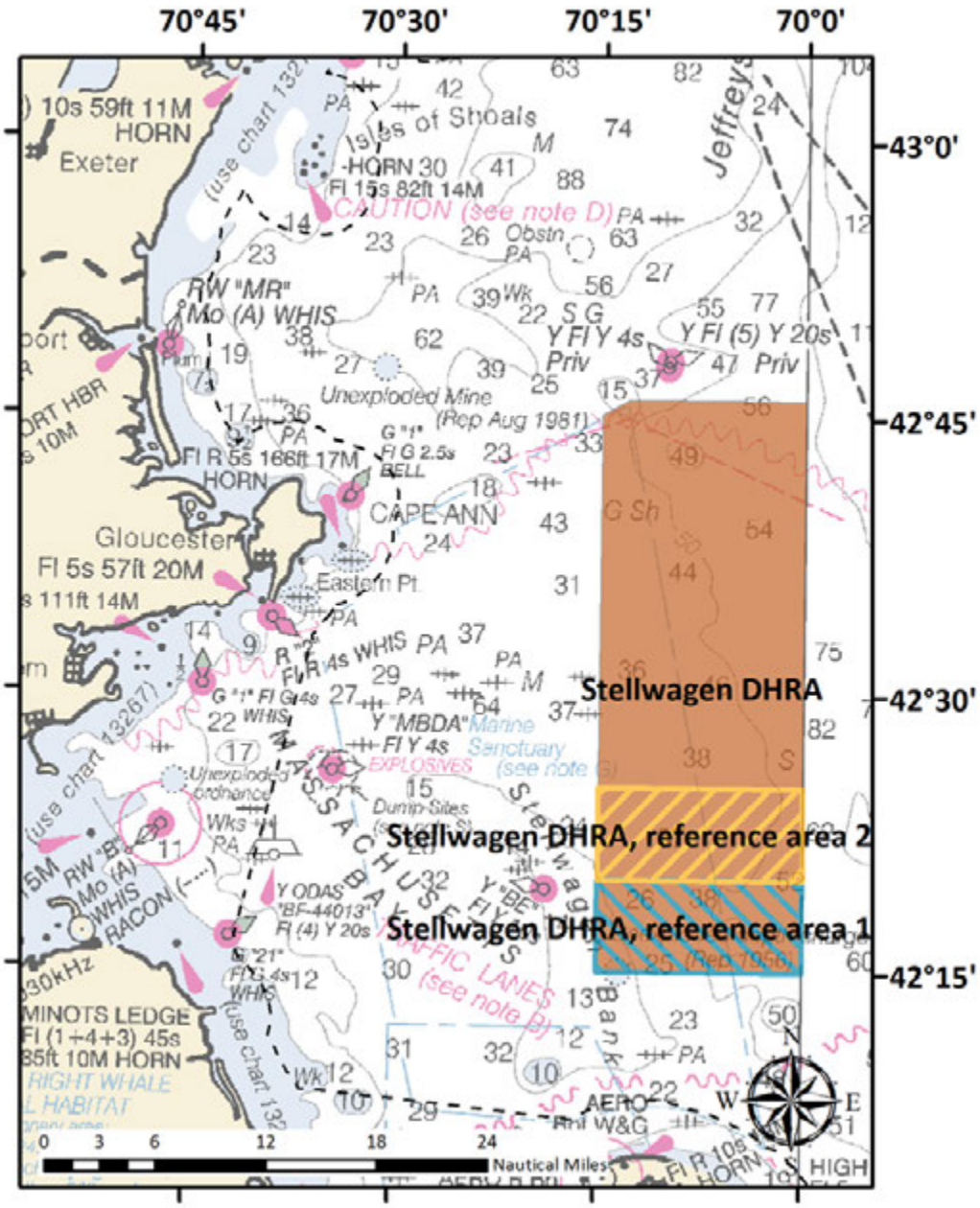
2.3.3.3 *Option C – No reference area*

Option C would designate the DHRA without the reference area.

Table 25 – Coordinates for Stellwagen DHRA and reference areas

Stellwagen DHRA (Same as Large Stellwagen HMA)		
Point	N Latitude	W Longitude
1	42° 15.0’	70° 00.0’
2	42° 15.0’	70° 15.0’
3	42° 45.2’	70° 15.0’
4	42° 46.0’	70° 13.0’
5	42° 46.0’	70° 00.0’
Southern reference area (A)		
1	42° 20’	70° 00’
2	42° 15’	70° 00’
3	42° 15’	70° 15’
4	42° 20’	70° 15’
Northern reference area (B)		
1	42° 25’	70° 00’
2	42° 20’	70° 00’
3	42° 20’	70° 15’
4	42° 25’	70° 15’

Map 32 – Stellwagen Dedicated Habitat Research Area with two possible reference area options.



2.3.4 Alternative 4 – Georges Bank Dedicated Habitat Research Area (preferred)

This alternative would designate a Dedicated Habitat Research Area on Georges Bank as shown in Map 33. Measures for this area would be closure to all mobile bottom-tending gear on a year round basis (not including mobile bottom tending gear deployed by scientific research vessels conducting scientific research, outside of the authority of the Magnuson-Stevens Act. If the DHRA overlaps with a habitat management area with less restrictive measures, the DHRA measures would take precedence.

Rationale: The purpose of this alternative is to establish a management regime in the Georges Bank region that will facilitate the study of:

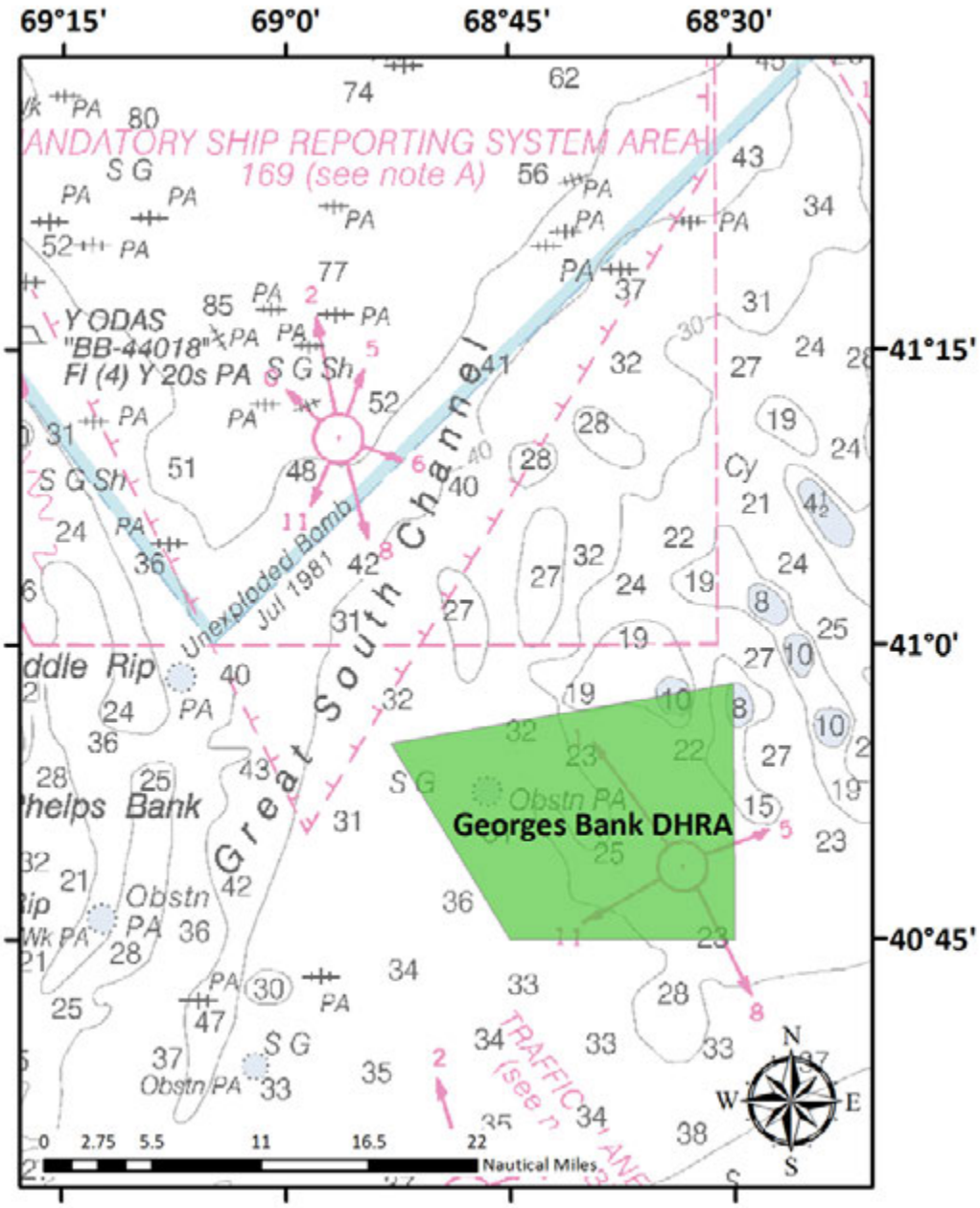
- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources, especially the relationships between scallop distribution, abundance, growth, and seabed type.

Designation of the DHRA should help to focus research efforts on this location, and facilitate the permitting process.

Table 26 – Coordinates for Georges Bank DHRA

Georges Bank DHRA (Same as Closed Area I South EFH Closure Area)		
Point	N Latitude	W Longitude
CIH3	40° 55’	68° 53’
CIH4	40° 58’	68° 30’
CI3	40° 45’	68° 30’
CI2	40° 45’	68° 45’

Map 33 – Georges Bank Dedicated Habitat Research Area



2.3.5 Alternative 5 – DHRA sunset provision (preferred)

This alternative would create a sunset provision for DHRAs that would allow administrative removal without further Council action three years after implementation, if no research that is designed to evaluate habitat effects of fishing had been initiated (see introduction to section 2.3 for a list of possible research topics). This alternative would apply to all DHRAs designated via this action. Removal would be accomplished by NMFS via rulemaking or some kind of notice, and would be coordinated by the Greater Atlantic Regional Fisheries Office. The following criteria must be met in order for the DHRA to continue after the three-year review:

- ***Documentation of active and ongoing research in the DHRA area, in the form of data records, cruise reports or inventory of samples with analytical objectives focused on DHRA topics outlined in the introduction to section 2.3.***
- ***Documentation of pending or approved proposals or funding requests (including ship time requests) with objectives focused on DHRA topics.***

These criteria would be evaluated using the following approach:

Figure 1 - Flowchart - DHRA evaluation procedure.

1. Is there active research being conducted in the DHRA?

   Yes--> see #2. No --> see #3.

2. Is it anticipated that it will continue beyond this fishing year? *This assumes that NOAA will publish a notice and the change of status would be effective at the start of the next fishing year. This may require a verbal commitment on the part of researchers, rather than letters of support/funding from the funding agency, as agencies are sometime reluctant to make commitments for the next year until their own funding allocations are more certain.*

   Yes --> DHRA remains classified as such. No --> See #3.

3. Is there potential research currently in the permitting process at GARFO or other entities, e.g. Stellwagen Bank National Marine Sanctuary? *Note that many types of research can be conducted without a permit or letter of acknowledgment.*

   Yes --> See #6. No --> see #4.

4. Is there potential research currently in the funding process? *Note that in some cases, outside funding may not be required, as the project could be part of an organization's routine operations. Ship time allocation requests could also be used as a marker.*

   Yes --> See #5. No --> see #7.

5. Is there a high likelihood that the project will be funded? *This assessment will be very subjective and is probably not a good indicator, unless for some reason it appears that funding is very unlikely or very likely.*

   Yes --> See #6. No --> see #8.

6. Are the fishing restrictions associated with the DRHA designation an explicit part of the design of the project?

Yes --> DHRA remains classified as such. No --> see #8.

7. Is there potential research [at some other critical stage in the idea-->funding process]? I.e., is there a coherent research plan or proposal in the pre-submission process? This plan should be responding to a current research funding process or planning process such as ship time allocations, and it should have an actionable timeline.

   Yes-->See #5. No--> See #8.

8. DHRA classification is removed.

Rationale: This alternative responds to Council and stakeholder concerns that DHRAs might be designated but remain unused, thereby causing economic hardship to the fishing industry without improving habitat science. This scenario is possible because although the Council has the ability to designate DHRAs and enact fishing restrictions within them, as well as the ability to set research priorities, it does not directly conduct or fund research activities. The intent is that the three year review would evaluate whether appropriate research activities were either ongoing or imminent. Allowing for research activities to be in the planning stage but not yet on the water at the three year mark acknowledges the fact that proposal development, submission, review, and allocation of funds can be a lengthy process.

2.4 Framework adjustments and monitoring

The Council has identified Alternative 2 as preferred.

2.4.1 Alternative 1 (No action) – Current list of frameworkable measures and monitoring activities; ad-hoc initiation of framework adjustments

There is extensive language in the fishery management plans developed by the Council, and in their implementing regulations, related to framework adjustments and measures that can be implemented or changed via framework adjustment. Generally speaking, the framework-related regulations document procedures for analyzing and implementing annual/biennial/triennial fishery specifications, but other measures are specifically identified in the regulations as candidates for implementation via framework (Table 27). Specifically, the existing regulations allow the Council to initiate a framework adjustment to modify, add, or eliminate various management measures used to regulate the groundfish fishery, including area closures and gear restrictions.

The decision to initiate an area-management-oriented framework adjustment or amendment is currently made on an ad-hoc basis, responding to specific issues, and there is no schedule for evaluating or updating spatial management measures.

Currently, Council-specified research priorities related to spatial management are embedded within plan-by-plan research priority documents, which are updated periodically by Plan Development Teams, Oversight Committees, Advisory Panels, and the Scientific and Statistical

Committee. Existing data collection from areas closed to fishing includes regular resource surveys by government vessels, ad hoc tagging programs and other research, and observed fishing trips surrounding closed areas.

Under Alternative 1/No Action, there would be no changes made to the lists of frameworkable items in the Council's FMPs, or to the procedures for reviewing the effectiveness of spatial management measures. No additional recommendations would be made regarding research priorities specifically intended to improve the development and evaluation of spatial management measures.

Rationale: The Council can use the existing framework adjustment procedures to respond to new fish habitat science or changing circumstances. According to current policies, a Council decision to initiate a framework adjustment would be weighed against other management priorities. Existing survey and fishery data collection programs provide some information that can be used to monitor the performance of area-based management, although currently conducted research is highly unlikely to sufficiently monitor smaller proposed closed areas. More targeted scientific research may or may not be conducted, depending on scientific interest and available funding.

Table 27 – Spatial management-oriented measures that may be implemented via framework action, by fishery management plan. All citations are from 50 CFR Part 648.

Fishery Management Plan and CFR section	Frameworkable measures (only the subset of measures relevant to measures discussed in OA2 are included in this table)
Northeast multispecies (§648.90)	As part of biennial review, the groundfish PDT may include **any of the management measures in the FMP**, including but not limited to: **gear restrictions**, **closed areas**, recreational fishing measures, **describing and identifying EFH, fishing gear management measures to protect EFH, and designating HAPCs within EFH**. In addition, the following conditions and measures may be adjusted through future framework adjustments: **gear requirements to reduce impacts of the fishery on EFH**.
Atlantic sea scallop (§648.55)	The Council's recommendations on adjustments or additions to management measures must include measures to prevent overfishing of the available biomass of scallops and ensure that OY is achieved on a continuing basis, and must come from one of the following categories: modifications to the opening dates of closed areas, size and configuration of rotational management areas, controlled access seasons to minimize bycatch and maximize yield, limits on number of area closures, area specific gear limits and specifications, **adjusting EFH closed area management boundaries or other associated measures**, and **any other management measures currently included in the FMP**.
Atlantic herring (§648.206)	Measures that may be changed or implemented through framework action include: gear restrictions or requirements, **measures to describe and identify EFH, fishing gear management measures to protect EFH, and designation of HAPCs within EFH**, and **any other measure currently included in the FMP**.
Skate complex (§648.321)	Measures that may be changed or implemented through framework action, provided that any corresponding management adjustments can also be implemented through a framework adjustment, include **description and identification of EFH, description and identification of HAPCs, measures to protect EFH**.
Monkfish (§648.96) and deep-sea red crab (§648.261)	No measures in framework regulations specifically related to OA2 issues.

2.4.2 Alternative 2 – Planned, strategic framework adjustment and monitoring (preferred)

This alternative would do three things:

- Specify additional spatial management measures as frameworkable in various Council FMPs,
- Develop a regular, strategic process to review the effectiveness of spatial management measures, and
- Define a series of research priorities related to the review and development of spatial management measures.

First, this alternative would add the following items to the list of frameworkable measures in all Council FMPs:

- Designation or removal of habitat management areas, and
- Changes to fishing restrictions within habitat management areas.

Second, a strategic process would be established that will routinely evaluate the boundaries, scope, characteristics, and timing of habitat and spawning protection areas. The foundation of this process would be a technical review that evaluates the performance of habitat and spawning protection areas. This review will be completed at **10 year intervals** following implementation of area management measures proposed by this amendment. The review and associated written report will be prepared using relevant available science and data to show whether or not the areas are meeting the objectives and advise the Council whether changes are warranted. Development of this technical review and report may be aided through:

- Review of new research and data (Council's Research Steering Committee),
- Independent evaluation (e.g. Gulf of Maine Research Institute, University of Massachusetts School for Marine Science and Technology),
- A workshop convened by the Council,
- Consultation with Council technical teams, and/or
- Peer review by the Council's Scientific and Statistical Committee or the Center for Independent Experts.

This review should consider but is not limited to the following questions:

Habitat protection

- Is juvenile abundance increasing in habitat management areas, compared with adjacent open fishing areas?
- Is overall stock-wide recruitment increasing due to better survival of juvenile fish in closed areas?
- Is growth of juveniles faster inside the closed areas than elsewhere?
- Are biotic factors (stomach contents, size at age, prey abundance) of juvenile fish different inside closed areas than elsewhere?
- Are there stronger associations with habitat types in closed areas than elsewhere?
- Is natural mortality for juvenile fish different inside closed areas than elsewhere?
- How long do juvenile fish remain in closed fishing areas?
- Does performance relative to the metrics listed above vary with closed area size?

Spawning protection

- How well does the timing of spawning coincide with the spawning closures?
- Does fishing actually disrupt spawning activity (apart from the effect of removing spawners)?
- Have the closed areas actually improved stock-wide recruitment?
- What is the variability of spawning activity (location and timing) over time? Are spawning closures as configured able to protect spawning activity, given this variability?
- Have new sub-populations of spawners been identified that require specific protection?

Based on this review, the Council may choose to initiate a framework adjustment to change spatial management measures.

Third, building on what the Council learned during the review of the performance of existing closed areas and the development of new EFH management in this amendment, the Council would identify and periodically revise research priorities to improve habitat and spawning area monitoring. New types of data to enable a satisfactory review of area management performance include:

- Spawning condition and other life history characteristics (stomach content, size at age, robustness)
- Juvenile fish condition, distribution, and movement
- Changes in prey availability
- Habitat quality (type, structure, cover, and size) associated with high abundance of juvenile fish
- Observation of fish spawning behavior within closed and open fishing areas
- Movement and migration
    - Telemetry tagging
    - Acoustic tagging
- Before-After-Control-Impact comparison of changes in fish biomass and characteristics before and after a closure inside a closed area and in surrounding fished areas
- More intensive egg and larval surveys at various times throughout the year
- Oceanographic information that affects egg and larval dispersion

Many of these data are critical to answering the questions posed above. One concern is that lethal sampling could undermine population improvements in very small management areas. Funding sources could be developed or promoted by a future management action that include, but are not limited to:

- Research set-asides from annual groundfish ACLs and/or extra landings allocations while conducting fishery impact research in habitat or spawning management areas
- Sector set-asides to fund research that collects information that sectors would use to justify closed or restricted area exemptions
- Experimental fisheries
- Cooperative research
- Enhancement of observer coverage in specific areas (e.g. modify Standardized Bycatch Reporting Methodology sampling allocations)
- More intensive survey sampling in and around closed or gear restricted areas.

Rationale: Management areas and measures may require reconsideration for a variety of reasons. Some habitat and groundfish area restrictions may not produce the results that had been expected, or may require modification to achieve the intended results. Or, habitat and spawning areas may have achieved the intended results, and the area-based fishing restrictions are no longer needed. Alternatively, areas that have achieved the intended results may be deemed as vital and possibly expanded upon. In other cases, new management areas may be warranted.

A regular review process would ensure that reevaluation of spatial management performance and effects on groundfish productivity would be conducted in a holistic rather than piecemeal fashion. Regulators, researchers, and fishermen would be on notice that a regular review is planned and that relevant information may be submitted to the Council in a timely manner for review. It also establishes the expectation that habitat and groundfish spawning management via area-based fishery restriction will be periodically reviewed so that the restricted areas that are selected are those areas that provide the greatest potential for protecting essential fish habitat and helping stocks rebuild.

The proposed review process is not intended to replace the authority for the Council to initiate an ad hoc review of a specific management issue at any time, or to respond to relevant new science that becomes available. It is also not intended as a substitute for the sunset evaluation process that would apply to Dedicated Habitat Research Areas (see Section 2.3.5) which is intended to promote habitat research in unfished areas for a period not less than three years.

Current sources of data will likely not be sufficient to monitor the proposed closed areas due to their small sizes. Identification of monitoring and research needs specific to spatial management issues would promote and enhance collection of data and scientific analyses that would inform future decisions. New data would address scientific and information gaps that were encountered during the development of Framework Adjustment 48 to the Northeast Multispecies FMP, when the Council reviewed the performance of existing year round groundfish closed areas, and during the development of this amendment.

The ten year review is suggested because enough time needs to pass to gather sufficient data and information to analyze the effects of area closures and expect statistically significant changes in fish populations. Recent research has suggested that a minimum of three generation times are needed to see population changes due to closed areas (Moffitt et al. 2013), which would be more than 15 years for Atlantic cod. Many types of data used to evaluate of the effectiveness of current closed areas will not be usable for future reviews after implementation of this action due to the relatively small sizes of the proposed closed areas and spatial pattern of current sampling. The current closed area evaluation is heavily based on the NEFSC bottom trawl surveys, which are effective at detecting total population trends, but are unlikely to have sufficient samples at appropriate time scales in the proposed closed areas due to the current stratification and random sampling design of the survey. Thus most questions are likely to not be answerable unless dedicated research is funded and implemented in a timely manner. It is highly unadvisable to open habitat or spawning areas within a few years based on partial data or insufficient sampling. If additional research is conducted with sufficient sampling, some metrics could be evaluated in a shorter time frame, but population level changes will take at least three generation times or more to be detectable for any given species of interest. Caution in including lethal sampling into additional research and monitoring would need to be taken since this sampling itself could impact the effectiveness of the area closures especially in the smaller proposed regions. Visual census approaches (i.e., camera sled, ROV) are applicable for this type of monitoring and there is a rich literature on sampling design and analytical approaches.

3 Considered and rejected spatial management options and alternatives

This section discusses alternatives developed by the technical teams and Committees that were not formally included by the Council for analysis in the amendment.

3.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats

The Habitat Committee, and later in the process, the jointly convened Habitat and Groundfish Committees, considered a large range of area management options to minimize the adverse effects of fishing on EFH and protect juvenile groundfish habitats before arriving at the set of areas analyzed in this document, as described in Section 2. This section briefly describes the areas considered but ultimately rejected. Map 34 depicts the areas developed mainly within the Habitat PDT and Committee process as adverse effects minimization areas. Map 35 depicts the areas developed by the CATT as juvenile groundfish habitat protection areas.

Eastern/Central Gulf of Maine

Habitat areas on offshore banks and ledges in the Gulf of Maine (Cashes, Fippennies, Platts, Jeffreys Bank, Jeffreys Ledge) were identified based on the presence of complex seabed habitats, but boundaries were generally defined using the 100 m contour. This was done because the entirety of the features was not mapped with a sampling device capable of detecting cobble and boulder substrates, so 100 meters and shallower was used a proxy for areas expected to contain more complex and vulnerable seabed habitat types. The Committee requested that the Fippennies Ledge and Platts Bank areas be made smaller to allow for fishing opportunities other than on the most complex habitat areas on the tops of the features.

Based on the juvenile groundfish hotspot analysis, the CATT initially identified a somewhat different set of 100 km^2 grids in the Eastern Maine region, specifically additional areas further east. As development of this area continued, the Committees focused on the eastern parts of the area that had been identified in the SASI LISA analysis and discussed as a dedicated habitat research area.

Western Gulf of Maine

In February 2012, the PDT developed a range of proposals covering complex habitat areas in the western Gulf of Maine. Four options were presented from which the Committee selected the smaller of the two Stellwagen areas. The original options (SWGOM 2-4) included an extension off the northwestern corner to include Tillies Bank, and an eastern extension to cover Wildcat Knoll. The PDT also identified Gloucester Bank and New Scantum off Jeffreys Ledge. Earlier, in August 2011, the PDT recommended extending the Jeffreys Ledge area to the southwest to cover the part of the ledge feature outside of the existing Western Gulf of Maine closure. In general, the Committee preferred to work with refinements to areas already managed, as opposed to additional areas.

The CATT developed a number of proposals in the western Gulf of Maine as many juvenile groundfish hotspots occurred in this sub-region. The original version of the Bigelow Bight area was more extensive than what is currently included in Alternatives 3-5 for this region, and including some areas in state waters and some additional 100 km^2 grids. The Habitat and Groundfish Committees were extremely concerned about the potential economic impacts associated with designation of this area as an HMA, and they rejected it at their May 2013 meeting. The CATT and PDT refined this area for a subsequent joint Habitat and Groundfish Committee meeting, and the updated versions (larger and smaller) were forwarded to the Council after further review. Two areas in Massachusetts Bay and Cape Cod Bay were also developed by the CATT, and rejected by the joint Habitat and Groundfish Committees due to concerns about economic impacts. A subset of the grids in the Massachusetts Bay area were presented to the Habitat and Groundfish Committees as an extension of the larger of the two Stellwagen areas, but it was not approved for Council consideration. In addition, the committees rejected a large area in the inshore Gulf of Maine, which extended to either 90 meters depth or 15 nm offshore, whichever was less. There were concerns about economic impacts of such an area, and also the Committees determined not to recommend year round habitat management area designations in state waters as a general rule.

Georges Bank

In August 2011 the PDT recommended as an alternative a subset of the existing CAII habitat closure (referred to at the time as the Northern Edge area), but the Committee chose not to move forward with analysis of the option. West of the existing closure, a range of proposals were developed to encompass the various shoals, including Georges Shoal. Part of the Georges Shoal East area was included in a new version of the Northern Edge area, which was approved for analysis as part of Alternatives 3 and 4. Given the development of the new area, Georges Shoal East was no longer necessary. A larger version of the Northern Edge area encompassing more Georges Shoal East area and the existing habitat closure in CAII was rejected by the Committee. Similarly, the Committee recommended an area further to the wet as a gear modification area in May 2013. This area, referred to in Alternative 4 as the Georges Shoal GMA, replaced the Georges Shoal West and Georges Shoal Large Areas.

The CATT developed an area on the northern edge, in deeper water along the edge of the bank. This area was identified on the basis of juvenile haddock. The area was combined with the new version of the Northern Edge area, which was approved for analysis as part of Alternatives 3 and 4. The CATT also developed the Southeast Parts HMA based on the distribution of juvenile haddock hotspots. The joint Habitat and Groundfish Committees rejected this area due to concerns over economic impacts, and based on a discussion of the lower habitat vulnerability (dynamic, sandy habitat) of the area such that there is less of a need to minimize fishing impacts on that type of habitat.

Concerned about the practicability of Georges Bank Habitat Management Alternatives 3 and 4, both NMFS GARFO and Council staff (at the Committee's request) developed additional alternatives for the northern edge region that were provided to the joint Habitat/Groundfish Committee (GARFO area) and the Council (GARFO and staff areas). Both areas removed the southern portion of the Northern Edge area in Georges Bank Habitat Alternatives 3 and 4, and

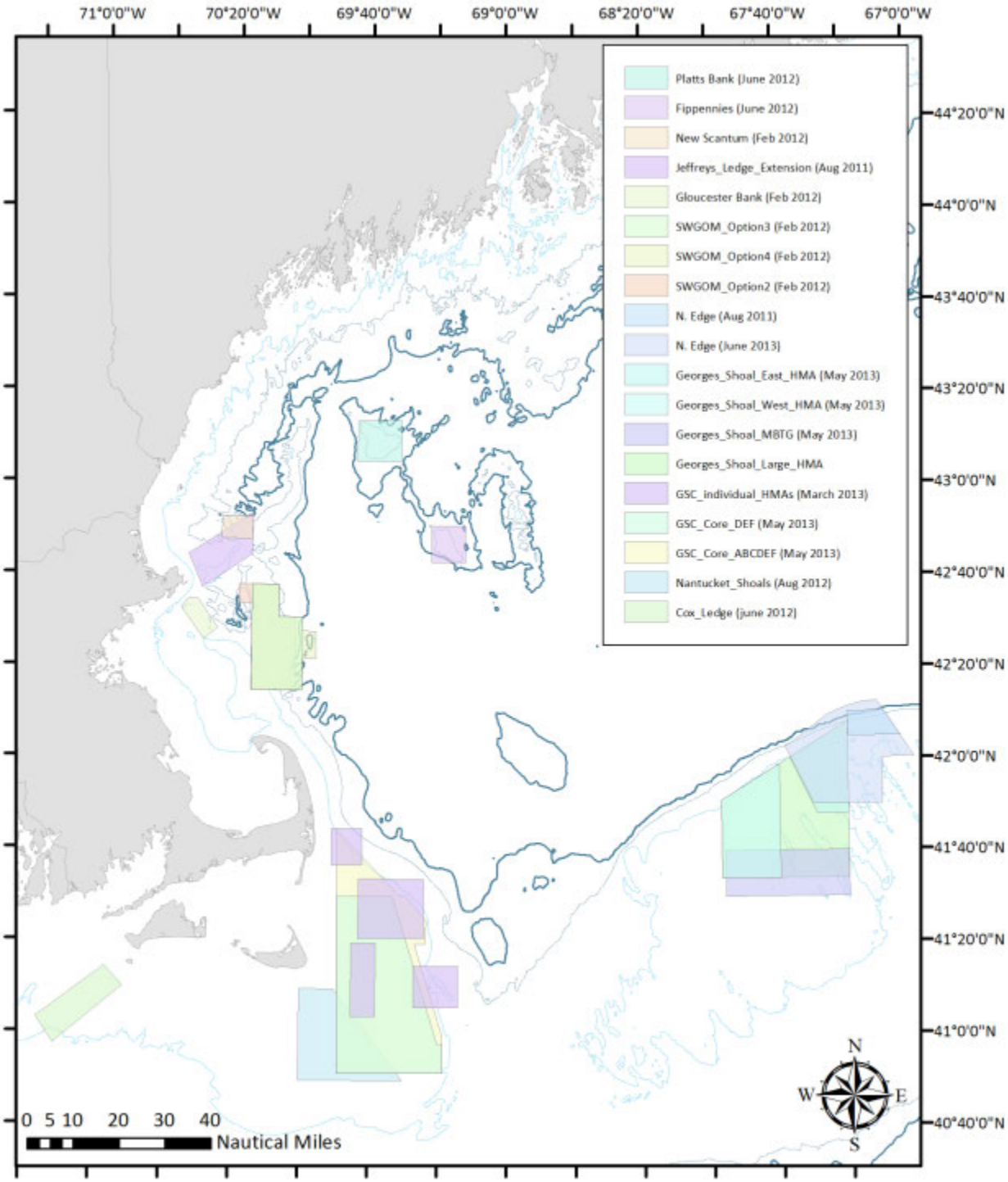
were intended to minimize the adverse effects of fishing on EFH in the Georges Bank region while allowing access to fishery resources, including dense concentrations of scallops that are currently within the Closed Area II Habitat Closure Area.

Great South Channel and Southern New England

In the Great South Channel, the PDT originally identified four discrete habitat management areas corresponding with concentrations of cobble habitat. A larger area combining all four boxes was also suggested, but it was probably too extensive in size to be practicable, and the Habitat Committee did not give it much consideration. Later in the process, the Committee requested development of a single area that provided similar protection for cobble and boulder habitats. A number of variations were recommended in March 2013. Two of those approved by the Committee for further analysis (GSC core + ABCDEF and GSC core + DEF) were later rejected and substantially similar areas were included in the range of alternatives approved for analysis by the Council in June 2013 (see Great South Channel Alternatives 3 and 4).

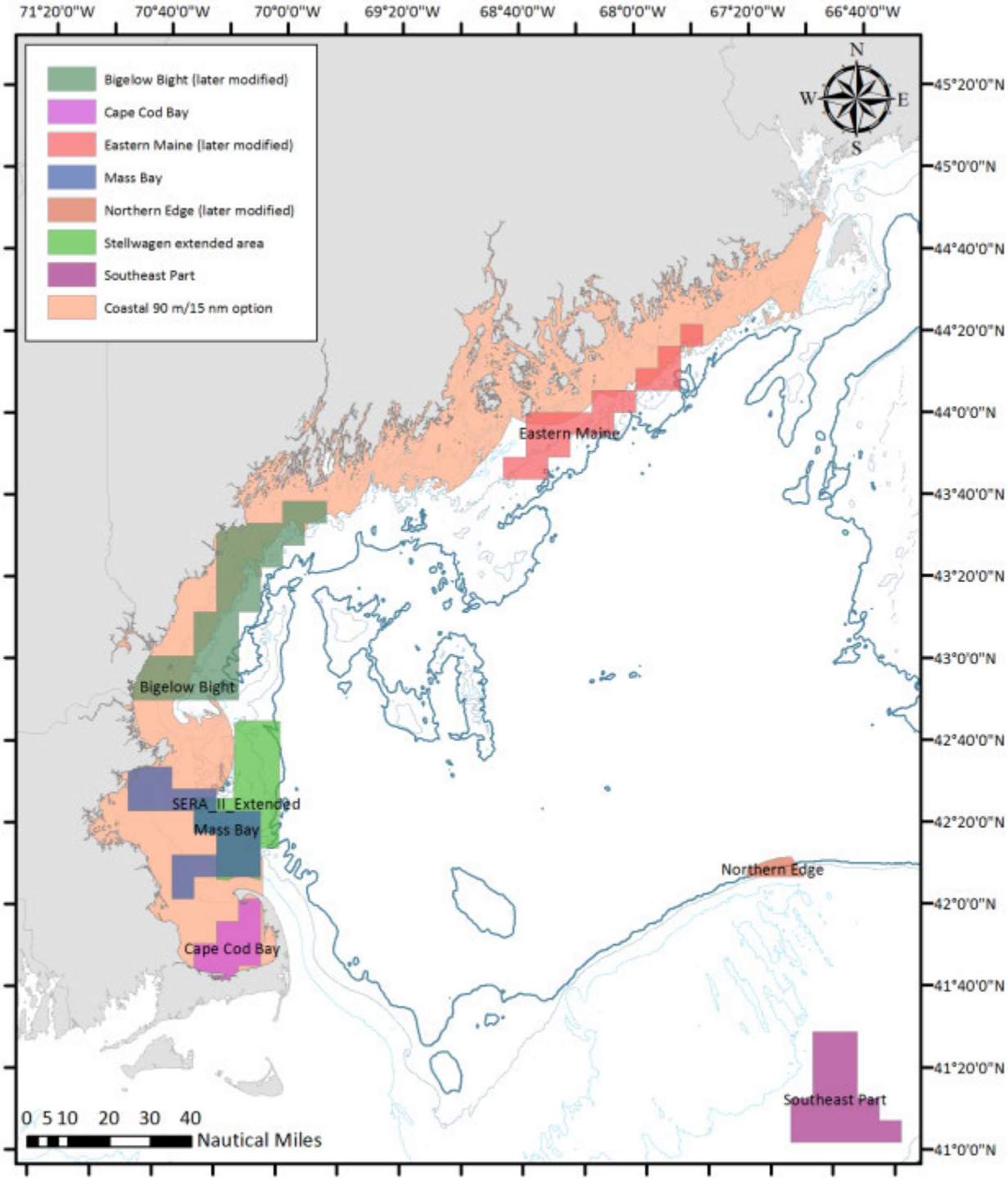
In a similar fashion to the revisions of the original Fippennies and Platts areas, the original Cox Ledge area was reduced in size to focus on areas with documented cobble habitat and to allow mobile bottom tending gear fishing along the edges with less vulnerable habitats.

Map 34 – Considered and rejected adverse effects minimization habitat management areas



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

Map 35 - Considered and rejected juvenile groundfish habitat management areas



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

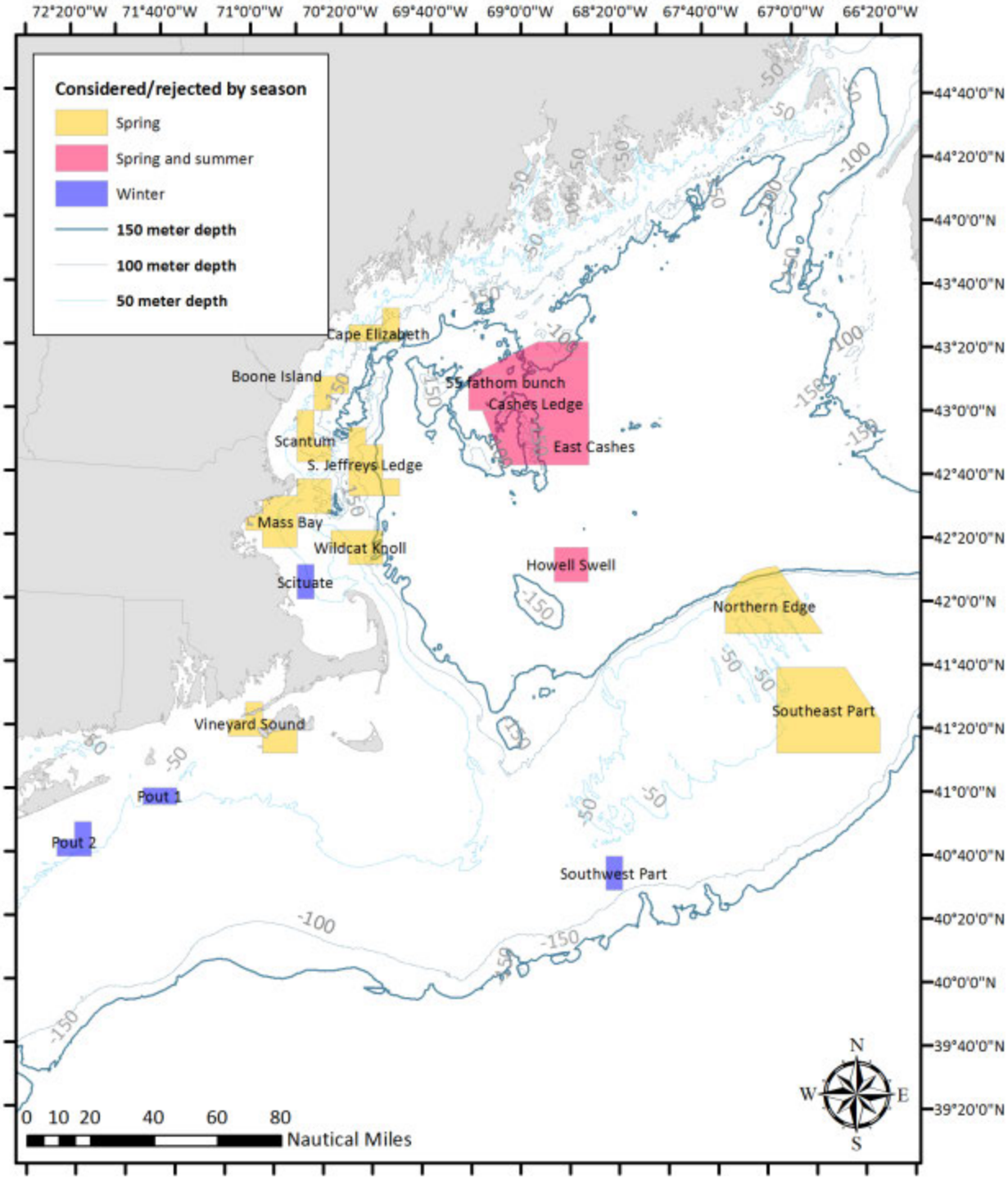
3.2 Alternatives to improve groundfish spawning protection

During the development of alternatives for this amendment, the Council's Closed Area Technical Team (CATT) reviewed relevant literature and conducted several types of analysis (see Appendix 6) to identify concentrations of large mature groundfish. It also examined the consistency of these areas with maturity condition of regulated groundfish caught on seasonal surveys. Using this information, the CATT proposed consideration of several areas in the Gulf of Maine and on Georges Bank for closure during seasons when groundfish were known to spawn (Map 36). The information was integrated over all regulated groundfish species based on several relevant factors, heavily weighted toward those species that were at low abundance, overfished, and therefore deemed to be vulnerable to reductions in productivity through fishing on spawning fish.

Many areas were rejected by the Council due to practicality concerns and belief that the areas identified by concentrations (or hotspots) of large mature fish in the survey data were not representative of spawning locations. The Council intends to collect and examine more information about spawning timing and locations to develop new spawning protection areas in a future Northeast Multispecies FMP management action.

The Georges Bank Seasonal (May) Closure Area was removed from the action spawning alternative in September 2013 at the recommendation of the Habitat and Groundfish Committees.

Map 36 – Areas of 100 km^2 blocks identified by the CATT as having concentrations of large mature groundfish to be considered as seasonal spawning closures.



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

3.3 Alternatives to designate Dedicated Habitat Research Areas

The Habitat PDT originally discussed Dedicated Habitat Research areas, or DHRAs, as a system of areas, with multiple designations per region. This would have allowed for comparison of research results among areas, to confirm ecological patterns and allow for stronger inferences to be made and applied to other similar habitats. However, the Habitat Committee felt that a much smaller number of areas should be designated. One of their objectives was to base DHRA designations on habitat management area boundaries, so some areas were not forwarded on to them for that reason.

The PDT identified the following areas as potential DHRAs, but did not develop them in detail or recommend them to the Committee for the reasons noted:

- Fippennies Ledge and Platts Bank – both are relatively small in size. This meant that the treatment areas associated with fishing impact research would likely include much of the HMA, which runs counter to the objective of minimizing adverse effects within the HMA boundaries.
- Wilkinson and Jordan Basins – there is no nexus to current or proposed management areas, with the exception of small coral zones under development in Jordan Basin as part of the deep-sea coral amendment.
- The southeast parts of Georges Bank – this area has been fished since 1999 by scallop dredge vessels as part of a rotational access program.
- The northern part of the Nantucket Lightship habitat closure – at the time, it appeared unlikely to continue as a habitat management area.
- Georges Bank canyons – not appropriate to some of the objectives, such as fishing impact studies, or comparisons of high vs. low energy habitats
- Fingers area (Southern New England) - no nexus to proposed or current management areas.
- Cox Ledge – not recommended because the proposed HMAs on Cox Ledge and 19 Fathom Bank are approximately 27 mi^2 and 55 mi^2, so the treatments areas associated with fishing impact studies would likely impact much of the HMA. In addition, Cox Ledge and 19 Fathom Bank are currently open to all types of fishing, so there is not the possibility for a currently closed and reopened to fishing disturbance treatment, or a closed-closed reference area.
- The New York Bight – there is no nexus to current or proposed NEFMC habitat management areas. Also, at their June 2012 meeting, the NEFMC Habitat Committee discussed forwarding any recommendations about Southern New England/Mid-Atlantic areas that are within the MAFMC region to the MAFMC for their consideration.

These areas were forwarded to the Committee by the PDT but were rejected at the Habitat Committee level:

- Jeffreys Bank
- Cashes Ledge – relatively further offshore, less practical
- Jeffreys Ledge
- Great South Channel

- Northern Edge – relatively further offshore, less practical. Concern about fishery impacts.

As noted above, the Committee felt that a smaller set of areas was more appropriate, so they focused their recommendations on the three areas with industry support.

4 Environmental impacts of spatial management alternatives

4.1 Approach to analysis

This section describes the impacts of the spatial management alternatives (sections 2.1, 2.2, 2.3, and 2.4) on the valued ecosystem components (VECs) identified and described in the affected environment section of the EIS (Volume 1) and summarized below:

- Physical and biological environment, with a focus on seabed habitats in particular
- Managed species – this includes all species managed by the New England Fishery Management Council as well as species managed by other authorities that occur in the New England Region where changes to spatial management measures are under consideration
- Human communities and the fishery – this includes fisheries targeting the above managed species, and the communities associated with those fisheries
- Protected resources – this includes large and small cetaceans, pinnipeds, sea turtles, Atlantic sturgeon, and Atlantic salmon that occur in the New England Region where changes to spatial management measures are under consideration

Some candidate habitat management areas were identified through the Habitat Plan Development Team and Habitat Committee, based on the results of the Swept Area Seabed Impact analyses[6] and related extra-SASI information including sources of substrate data not included in SASI and bathymetric data. The primary goal addressed with these areas was to minimize the adverse effects of fishing on vulnerable seabed habitats, across all areas managed by the Council. Additional areas were later identified by the Closed Area Technical Team and Groundfish Committee, based on an analysis of juvenile groundfish distributions[7], combined with information about the current status of various stocks and their affinities for vulnerable habitat types. The primary goal addressed with these areas was to improve groundfish productivity, specifically by protecting habitats used by critical life stages (i.e. juveniles).

In order to develop the juvenile groundfish-oriented HMAs, the Closed Area Technical Team reviewed the weighted juvenile groundfish hotspot grids by season. The weighted grids combine hotspots weighted by four factors: B_{msy}/B (stock vulnerability), whether or not the stock has known or possible sub-populations, whether the stock is more resident (as compared to more migratory), and affinity for complex substrates. Stocks that do not have a strong affinity for coarse substrates were zeroed out of the weighted grids, such that the locations of the juvenile groundfish-oriented HMAs were based on the distribution of the following stocks only: Georges Bank cod, Gulf of Maine cod, Georges Bank haddock, Gulf of Maine haddock, pollock, Acadian redfish, Atlantic halibut, ocean pout, and Atlantic wolffish. The hotspot weighting procedure is described fully in Volume 1.

[6] See the habitat vulnerability section of this volume as well as Appendix D for details.
[7] See the groundfish hotspot analysis section of this volume as well as Appendix E for details.

The first step in identifying candidate management areas was to find continguous areas with numerous hotspots in each of the seasonal weighted hotspot data layers. The result was a set of rough management area boundaries for each season. The seasonal boundaries were then compared to identify areas important to juvenile groundfish across multiple seasons. The seasonal boundaries were also overlaid onthe habitat vulnerability layer from the SASI model. Both the weighted hotspot and SASI grids were generated at the same 100 km^2 resolution to facilitate comparison of the two datasets. The final candidate management areas were thus locations with a continguous grouping of hotspots across one or more seasons, with relatively high vulnerability values. As a last step, the candidate management areas were limited to areas in Federal waters.

The analyses are presented by type of management alternative (habitat, spawning, research, framework/monitoring) and then by valued ecosystem component (i.e. physical and biological environment, managed species, human communities and the fishery, protected resources). Within this outline, the discussion is organized by region to correspond with the structure of section 2. Large-mesh groundfish are the focus of the managed species analyses in sections 4.2.2, 4.3.2, and 4.4.2. Section 4.6 addresses impacts specific to other managed resources and also provides a focused discussion of impacts to their associated fisheries, although the human and community impacts described in sections 4.2.3, 4.3.3, and 4.4.3 cover all impacted gear types and fisheries, not just the fishery for large-mesh groundfish.

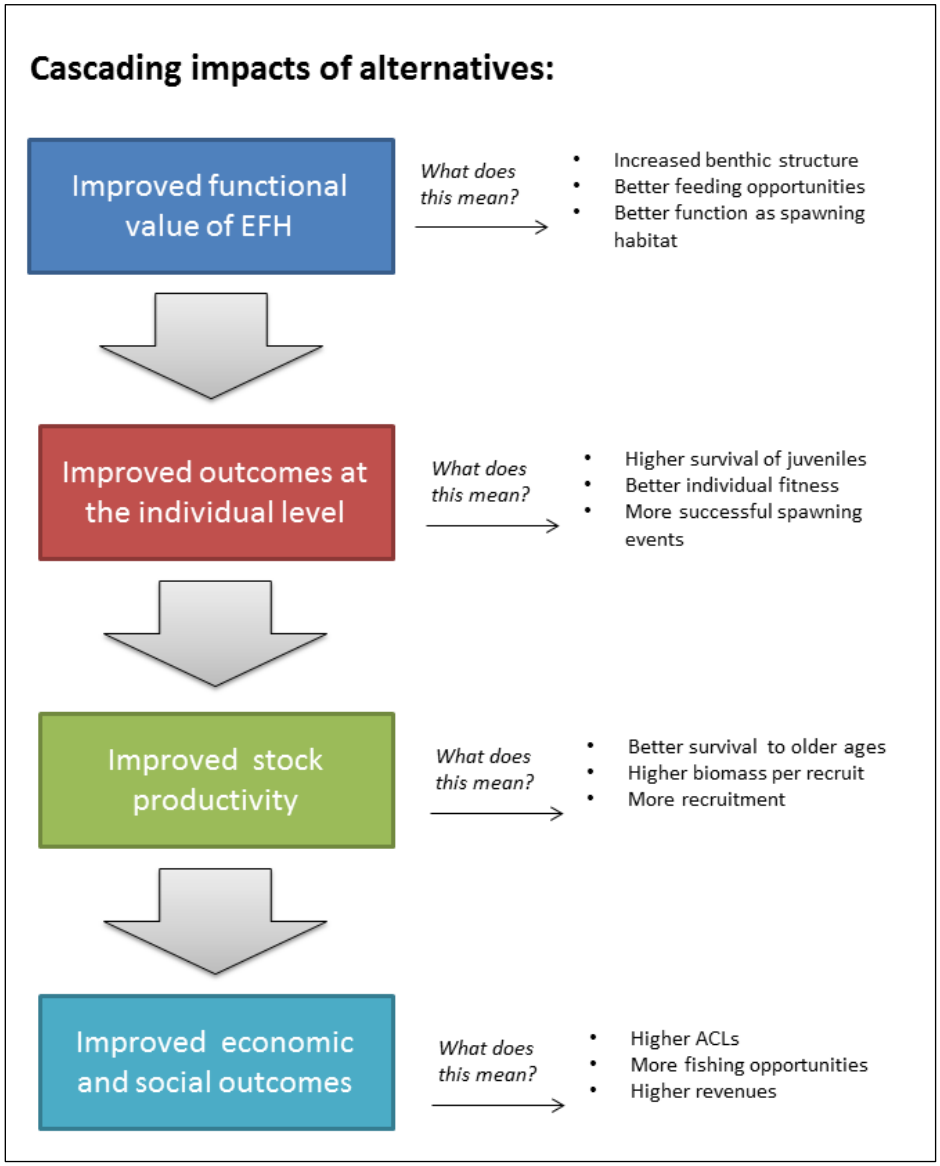
While the analytical approach and assumptions vary according to alternative type and VEC, there are some general issues and assumptions common to all alternative type/VEC combinations. The overall approach for the impacts analysis is to identify the attributes of the various areas that make up each alternative, and then use these attributes, or metrics, to evaluate the impacts of each alternative on the valued ecosystem component in question. Within the sub-region (habitat alternatives) or region (spawning alternatives), impacts are compared between each alternative and the no action alternative, and between action alternatives. Metrics include seabed habitat type and vulnerability, fish abundance and hotspots, revenue by gear type, spatial overlap with protected species management areas, etc. In some cases, the analyses describe these metrics at the alternative level, and in other cases, the analyses describe these metrics at the area level. To be clear, most of the alternatives consist of combinations of individual management areas.

One overarching issue that complicates development of the impacts analyses is that the purposes for the action alternatives do not always map directly to the original rationale for the areas and measures that make up the no action alternatives. In particular, the year-round groundfish closed areas (Closed Areas I and II, Nantucket Lightship Closed Area, Western Gulf of Maine and Cashes Ledge Closure Areas) are included in the no action habitat management alternatives and the no action spawning alternatives, but they were primarily designated to meet mortality reduction objectives, which is not an objective of this amendment. Thus, the analyses will address how the action alternative areas and measures meet the purpose and need of this amendment relative to how well the no action areas and measures meet the purpose and need of this amendment. This is different that an evaluation of how well the no action areas perform relative to their original intended purpose.

Another overarching issue is that it is difficult to specify with any certainty how fishing effort will shift in response to alternative spatial management scenarios. However, the impacts of any alternative are directly related to the displacement of fishing effort that results from any particular management area or combination of areas. The analyses in this section will attempt to evaluate how fishing effort may shift under the various alternatives, and assess the costs and benefits of such shifts. These potential changes in fishing effort are challenging to evaluate for several reasons. First, some of the areas into which effort could shift as a result of the alternatives in this amendment have been closed for many years to certain types of fishing, in some cases for since 1994. Since fisheries characteristics and stock biomass have changed so much since these closures went into effect, data describing previous effort distributions in these areas may be of little use to predict future effort distributions. Effort distribution data available have changed since 1994 as well; vessel trip reports (VTR), at-sea observer data, and vessel monitoring system (VMS) data were first collected in 1993, 1996, and 2000, respectively, so historical spatial distributions are often lacking and may not be representative of the fishery under current circumstances. Nonetheless, these older data provide some insight into how fishing effort may change as existing closed areas become available to fishing and new areas close to fishing using mobile bottom-tending gear. For example, VTR and observer data clearly show an abundance of gillnet effort on Jeffreys Ledge prior to the implementation of the Western Gulf of Maine Closure Area in 1998. In other cases, the current distributions of a stock may provide better insight to potential shifts in fishing effort, which is the approach taken with the sea scallop-related analyses, among others.

The impacts of the habitat management alternatives in particular on the various VECs are closely linked, and are expected to accrue over various timescales. These management alternatives were developed with the amendment's goals and objectives in mind. These include minimizing the adverse effects of fishing on EFH, and improving productivity of groundfish resources, among others (see Volume 1). Minimizing the adverse effects of fishing on EFH is important because it is a requirement of the Magnuson-Stevens Act, but the reason for doing so is that improving the functional value of a fish's habitat should improve survival and fitness. This should improve the stock overall, which should improve economic and social outcomes (Figure 2Figure 1).

Figure 2 - Linkages between VECs and impacts



4.1.1 Redistribution of fishing effort

As noted above, regional effort redistribution is expected to influence the magnitude and direction of impacts of the alternatives described in this section. Although the total catches are limited via Annual Catch Limits, the spatial distribution of fishing effort is important. A few general assumptions are made in the analyses relative to how fishing effort will be redistributed, depending on the management option selected.

If habitat management option 1 is selected, all mobile bottom-tending gear use would be displaced from the area. For some of the areas, this would represent a continuation of measures already in place, but for other areas, these gears would be newly excluded. Mobile bottom-tending gears would include bottom otter trawls used to target groundfish, scallops, and shrimp,

including small mesh trawls. Mid-water trawls would not be excluded. Mobile bottom-tending gear also includes all scallop dredges, regardless of size/width, and all clam dredges, both hydraulic and dry dredges. It is expected that displaced fishing effort will be redistributed surrounding the new habitat management area. If they re-open to fishing as a result of this action, some of this fishing effort would likely be redeployed into the existing groundfish closed areas (such as the eastern sliver of the Western Gulf of Maine Closure Area, Closed Area I, Closed Area II, and the Nantucket Lightship Closure Area,). Some of this effort may have already been redeployed by sector vessels under Framework 48 regulations.

With this redistribution of effort, the catch composition will change, making it easier to catch some species and harder to catch others. In the groundfish fishery, where most vessels fish in sectors, the species-specific limits allocated to that sector may be easier or more difficult to achieve if fishermen are forced to shift their fishing location as the result of a new closure. To the extent that fishing effort will be lower in areas with higher amounts of juvenile fish, fishing mortality associated with an ACL level may marginally decline. Alternatively, if fishing effort increases where there is a greater amount of sub-legal fish that are retained by the trawls, fishing mortality associated with an ACL could marginally increase. Other changes in the non-groundfish bycatch in the groundfish fishery may also occur, depending on limits in other fisheries and the overlap in species' distributions with reconfigured open fishing areas.

In areas that are closed to fishing with trawls, but remain open to fishing with gillnets and longlines, fishermen may increase the use of non-mobile gears to target groundfish. This change in gear use is more likely occur in inshore, shallower areas, like the Western Gulf of Maine Area. Gillnets are less frequently used around the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II, so significant effort shifts towards gillnets are much less likely in these areas, if one of the action alternatives is approved and they reopen.

While economic and other incentives to fish with gillnets may have changed since 1998 and may be different under sector management since 2010, one of the biggest changes during this time was the prohibition on using gillnets in the Western Gulf of Maine Closed Area. All habitat management alternatives except No Action propose to re-open the Western Gulf of Maine Closure Area to fishing with non-mobile gears. At present, most of the observed gillnet sets targeting groundfish and monkfish are located between the southern part of the Western Gulf of Maine and Massachusetts Bay, and other areas on southern Jeffreys Ledge, just inshore of the Western Gulf of Maine Area (Map 37, left), but gillnet fishing effort distribution has not always looked as it does now. Before 1998, there was considerable observed fishing effort with gillnets in what later became the Western Gulf of Maine Closure Area and the Western Gulf of Maine Habitat Closure Area (Map 37, right).

Because total catch is limited by ACLs for Council-managed species[8], the magnitude of catch is not expected to change significantly, but catch composition may. In terms of groundfish, gillnets

[8] Exceptions: Offshore hake, which is included in the southern silver hake catch limits, does not have an annual catch limit. The seven skate species managed under the Northeast Skate Complex have a single annual catch limit for the complex as a whole. For the Mid-Atlantic Council-managed species, the two squid species are exempt from

usually select larger fish like cod than trawls do, so groundfish fishing mortality (number of fish) could decline if a greater fraction of the ACLs by weight are caught with gillnets (Figure 3 shows the size distribution by gear for trawls and gillnets observed in the Gulf of Maine). If this occurs, in the longer term, assessments would re-estimate size selectivity and ACLs would be adjusted accordingly. Also over the longer term, better selectivity could increase yield-per-recruit and total yield from the fishery for stocks that have better size selectivity using gillnets. Increased gillnet use may increase gear conflicts with recreational fishing, interactions with marine mammals and other protected species, like sturgeon, and incidental catch of non-groundfish species.

Changes in patterns of fixed gear use are not limited to the reopening of existing groundfish closed areas. Some of the alternatives in this amendment would close or limit the use of mobile bottom-tending gears in new areas. Those areas that are closer inshore could attract new or additional gillnet fishing by groundfish vessels, particularly the Large and Small Bigelow Bight Areas and Platts Bank. Although less frequent since 2010, previously there were substantial amounts gillnetting in the Scantum Basin off New Hampshire and around Platts Bank (Map 37, right). While gillnet fishing in these areas is currently allowed, the presence of trawl fishing in these areas could be limiting the amount of fishing with fixed gears. In a habitat management area that is closed to mobile fishing gears, fishing with fixed gears could increase since the potential for gear loss would be reduced and gillnet catch rates could increase.

Another possibility is that vessels could switch to using fixed gears to catch the same species. However, this is likely very expensive, and might require acquisition of a new fishing vessel, so these types of gear switches are viewed as unlikely. Further, it is not really possible to harvest some species (e.g. scallops, clams) with fixed gears.

If option 2 is selected, fishing with hydraulic clam dredges would be permitted, but other types of mobile bottom-tending gear would be prohibited, including dry clam dredges. The assumption is made that fishing effort by any bottom-tending trawls or non-hydraulic dredges would be displaced from any areas currently fished by these gears. See section 4.1.2.2 for a discussion of the general habitat impacts associated with this option.

If option 3 or 4 is selected, a few different outcomes are possible. One possibility is that trawl vessel operators would choose fish in an area using the modified gear type if the trawl gear restriction is enacted, with similar numbers and distributions of trips and tows as in previous years, subject of course to changing catch limits and other restrictions. Another possibility is that vessel operators will fish less in the area after the gear modification is required, because the modified gear requirements compromise operations in some way (e.g., efficiency is reduced). Another possibility is that trawl operators will outfit themselves with the modified ground cables and use them in all areas they fish, to avoid the need to switch back and forth, such that the impacts of the modified gears would extend to other areas of the region.

---

the annual catch limit requirement because of their life history characteristics, as provided for in the National Standard 1 guidelines.

It is very difficult to assess which outcome is most likely, and an individual operator's choice may depend on the characteristics of their vessel, as well as the amount of fishing they normally do within any areas currently open to them. Also, note that Maine and Massachusetts shrimp trawl vessels are likely already compliant with options 3 and 4 based on current regulations:

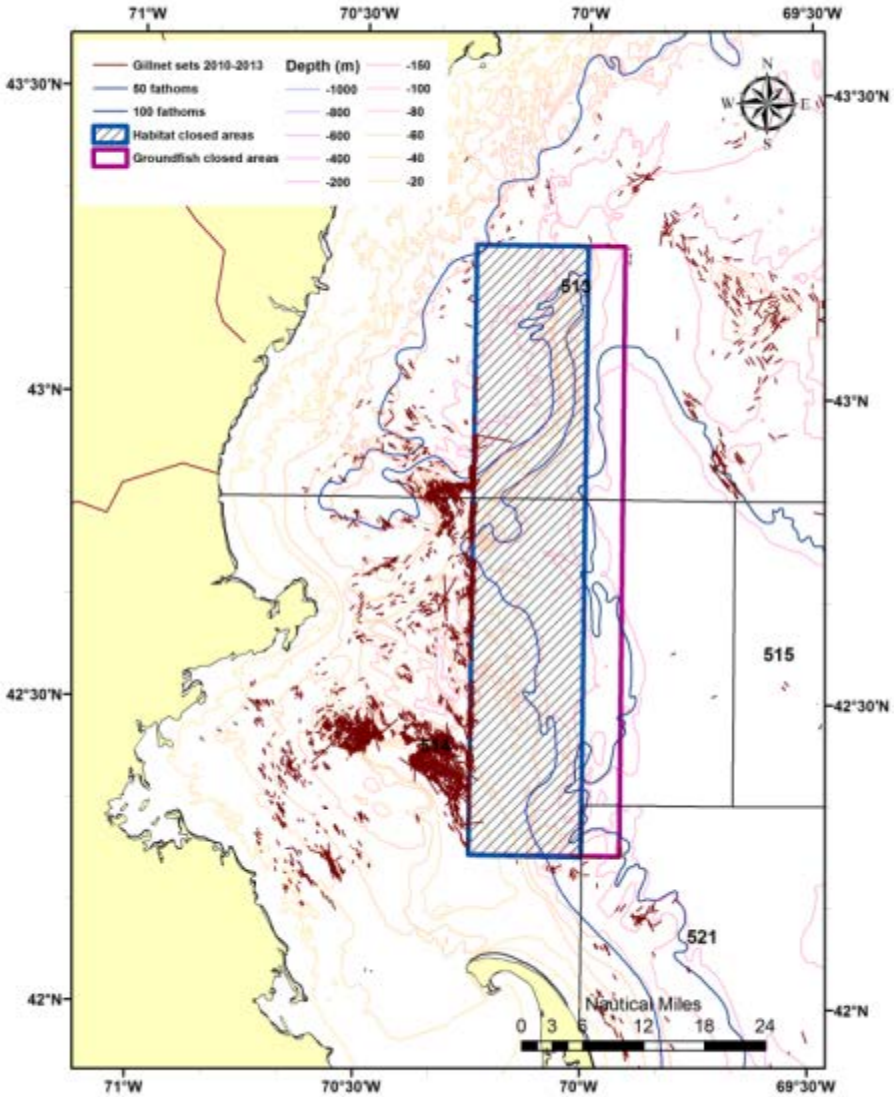
- Maine – The maximum length of the bottom legs of the bridle of any shrimp trawl net shall not exceed 15 fathoms of uncovered bare wire.
- Massachusetts – It is unlawful for any vessel to fish for shrimp with a net having: (A) more than 90 feet between the trawl doors and trawl wings, including the ground cables, bridles, and legs. (B) bottom legs of other than bare or uncovered wire or chain.

Each sub-region also includes a no habitat management area alternative (generally Alternative 2, except in the Eastern Gulf of Maine, where it is the no action alternative). This would mean that mobile bottom-tending gears would not be restricted on the basis of benthic habitat conservation in that sub-region, although they might be restricted as part of a spawning management area restriction, seasonally or year-round, depending on the spawning alternative selected. Even without habitat management areas, some locations may be only lightly fished by mobile bottom-tending gears because they are difficult to fish with these gears.

However, it is difficult to know to what extent complex seabed habitats are self-protecting because they are not fishable. This is true of areas that are currently open to mobile bottom tending gear where benthic habitat types are patchy, but the resolution of habitat characterization data and/or fishing effort data are fairly coarse, and it is especially true of areas currently closed to mobile bottom tending gear where there is no data on patterns of fishing in relation to habitat type. The assumption under this no-closure alternative is that mobile bottom tending gear vessels would fish within a sub-region in a way that balances available fishing quota for species found in the area, operating costs, and responds to market factors including prices.

Beyond the distribution of mobile bottom tending gear effort, another consideration for options 2, 3, and 4 that allow some types of mobile bottom-tending gear use is that the use of these gears may influence the distribution of commercial fixed gear effort, or recreational fishing effort. Patterns of effort by fixed vs. mobile gear type are likely to vary in an open area or area where some mobile bottom tending gear can be used vs. within an area where mobile bottom tending gear are completely prohibited, but fixed gears and/or recreational fishing are allowed. Specifically, fixed commercial and recreational gear use could increase in areas where mobile bottom-tending gear use is prohibited (option 1), or limited to hydraulic dredges only (option 2).

Map 37 – Current gillnet effort distribution (left, 2010-2013) compared to historic gillnet effort distribution (right, 1994-1998) before the Western Gulf of Maine closure. Lines represent the set and haul locations for fishing events observed at sea.



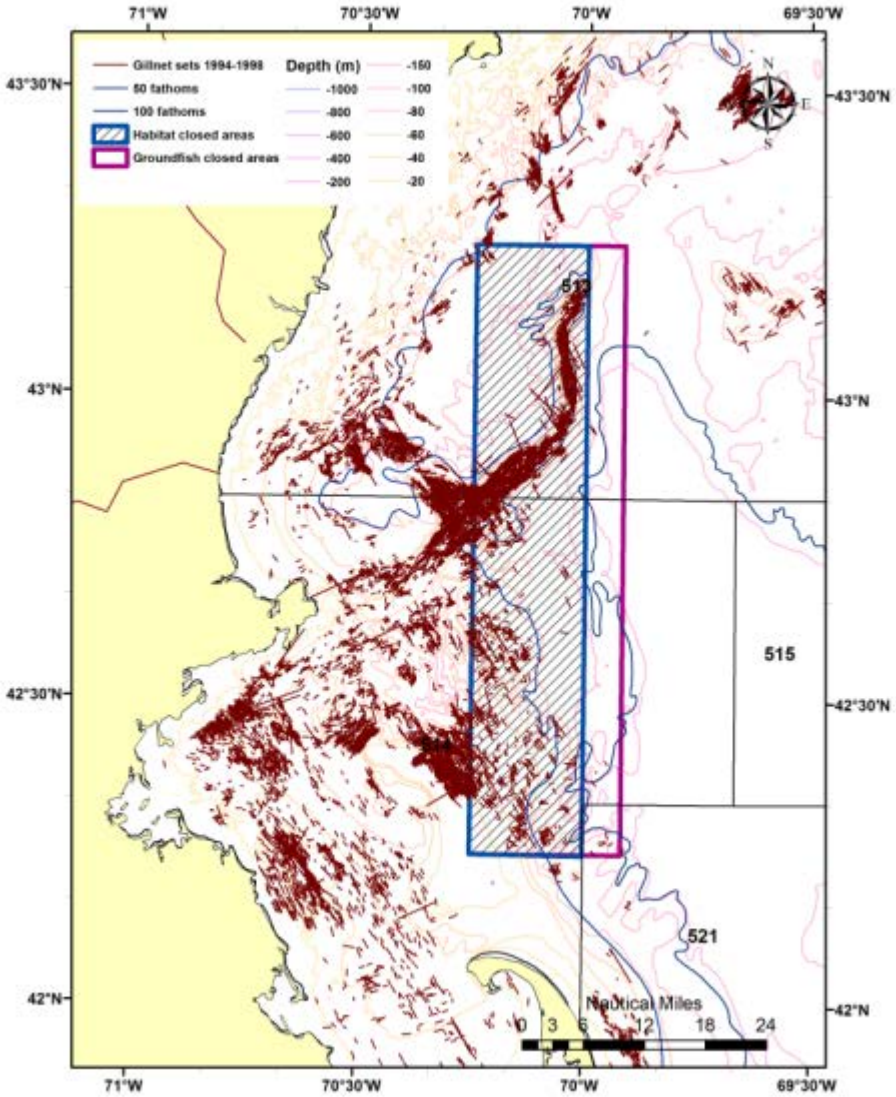
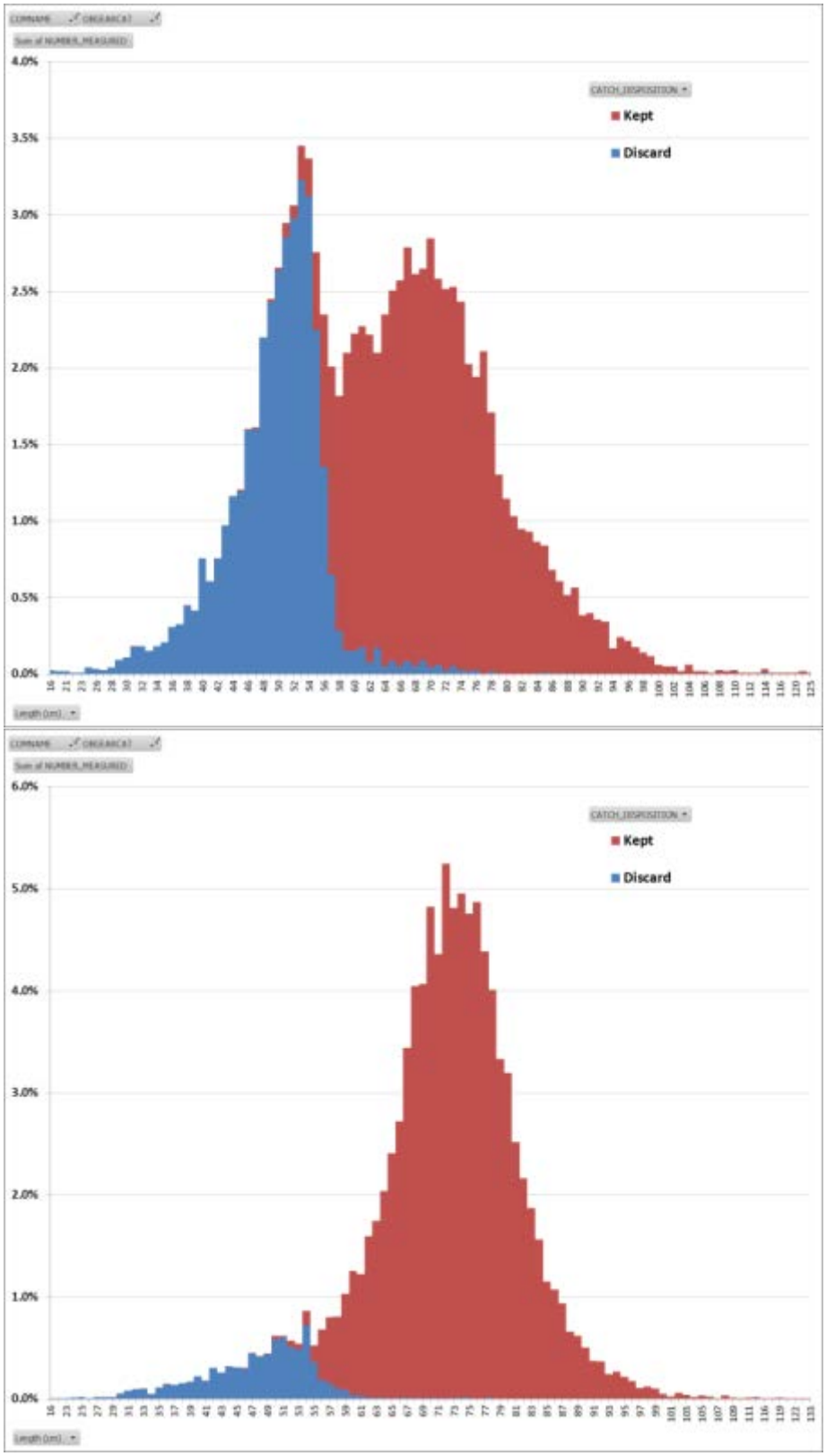


Figure 3 – Length frequency of observed cod catches in the Gulf of Maine (Statistical Areas 511-515) by trawls (top) and gillnets (bottom) during 2010-2013.



4.1.2 Analysis of impacts on the physical and biological environment

The Swept Area Seabed Impact (SASI) approach is the primary framework used to evaluate the impacts of the various habitat management alternatives on the physical and biological environment. This introductory section explains how the SASI results are used to understand the impacts of the various habitat management alternatives proposed in this amendment. Additional background on habitat vulnerability is provided in the Affected Environment section of this EIS (Volume 1) and in Appendix D.

- The vulnerability assessment and literature review concluded that cobble-boulder dominated seafloors are most vulnerable to the adverse effects associated with fishing due to the occurrence of biota that is susceptible to injury and in particular has long recovery times.
- A major premise of the SASI approach is that the overall magnitude of the adverse effects of fishing on habitat is related to the total amount of contact between fishing gear and the seabed. Thus, if fishing can be done in such a way as to minimize seabed contact, it will help to reduce the magnitude of adverse effects.
- The SASI analysis concluded that: (1) Mobile bottom-tending gears have a greater per unit area impact than fixed bottom-tending gears, and (2) they have a greater overall magnitude of impacts, since individual mobile gear fishing events contact more of the seabed than individual fixed gear fishing events and there is more overall fishing effort by mobile gears than fixed gears. Due to the much greater magnitude of mobile vs. fixed bottom-tending gear impacts, eliminating mobile bottom-tending gear use in an area should reduce the adverse effects of fishing on seabed habitats significantly within that area.

4.1.2.1 *Options 1 – Restrictions on mobile bottom-tending gears*

Within habitat management areas, complete closure to all mobile bottom-tending gears (**Option 1**) is one type of measure that can be used to achieve adverse effects minimization objectives. In terms of protecting vulnerable seabed habitats from the adverse effects of fishing, the greatest local reduction in adverse effects to the seabed will be achieved if all mobile bottom-tending fishing is prohibited from the area. This is the measure employed in all of the existing habitat closure areas (JB, CL, WGOM, CAII, CAI, NLCA).

4.1.2.2 *Option 2 – Hydraulic clam dredge exemption*

Similarly, **Option 2** would enact a complete closure to all mobile bottom-tending gears, but allow an exemption for hydraulic clam dredges. The rationale for this exemption is that hydraulic dredges can only be used in sands and fine gravels, which are less vulnerable to the adverse effects of fishing as compared to cobble- and boulder-dominated habitats as long as they are located in high energy environments subject to physical disturbance from bottom currents and storm wave action. In places like the shallower portions of Georges Bank and Nantucket Shoals, cobble- and boulder-dominated habitats are patchily distributed amongst sand- and granule-pebble-dominated areas (according to the SASI habitat map and other substrate maps). The assumption is that hydraulic clam dredges, if exempt from habitat management area restrictions, would be operating in the sand and fine gravel patches intermixed between areas dominated by cobble and boulder and, therefore, have a minimal adverse impact on benthic habitats in areas

where they can safely be used and where surfclams are more abundant[9]. While it might be possible to define the boundaries of habitat management areas so that they cover cobble-boulder areas and avoid sand and granule-pebble areas, this is somewhat difficult to achieve in practice due to the patchiness of the substrate distribution. Thus, a compromise is to allow gears that can only fish in the sand- and granule-pebble-dominated parts of the habitat management area to continue to operate there. While hydraulic clam dredges are exempted from some of the year-round groundfish closure areas based on the rationale that they have limited bycatch of groundfish, they are not exempted from any of the current habitat closure areas.

In addition to the fact that they cannot be used on certain habitat types, the per-trip area swept for hydraulic clam dredges is relatively low as compared to the per trip area swept for scallop dredges and otter trawls. Figures in the affected environment section provide a comparison across all ten gears evaluated in SASI. Hydraulic clam dredge area swept per trip values range from 0.07 km^2 to 0.20 km^2 from 2000-2009. Over that same time period, generic otter trawl values range between 5.64 km2 and 8.98 km^2 per trip, while limited access scallop dredge values range from 2.01 km^2 to 5.85 km^2 per trip. These lower per trip values contribute to lower overall area swept by hydraulic dredges relative to other mobile bottom-tending gears. Annual totals for hydraulic dredges between 2000-2010 ranged from 371 km^2 to 860 km^2, while totals for generic otter trawls and limited access scallop dredges ranged from 125,694-297,954 km^2 and 19,523-26,525 km^2, respectively, over that same period. Annual values are provided in the affected environment section for all gears.

Despite lower aggregate impacts from hydraulic dredges, over sand- and granule-pebble-dominated seabed types, the <u>per unit area</u> impact of hydraulic clam dredges is high relative to scallop dredges and otter trawls, and hydraulic dredge impacts were estimated to be greater in low energy areas than in high energy areas, due to longer estimated recovery times for geological and biological features in low energy environments. Thus, the seabed impacts associated with a hydraulic dredge exemption would be higher in low energy HMAs as compared to high energy HMAs, given similar levels of fishing effort. This does not account for the relative distribution of clams and clam fishing effort between high and low energy areas; both the clams and clam fishing effort tend to be concentrated in high energy areas where recovery would be somewhat more rapid. In some areas, a hydraulic clam dredge exemption would make no difference in terms of habitat impacts because there are few clams and no clam fishing effort.

4.1.2.3 ***Options 3 and 4 – Ground cable modifications***

Options 3 and 4 would allow mobile bottom-tending gear use, but restrict ground cable configuration and length (**Option 3**) or prohibit ground cable use (**Option 4**). Ground cables are defined as wire ropes extending along the seabed between the trawl doors and the bridles or net; they serve to herd fish and increase the area of seabed fished (swept) by the trawl. Ground cable diameter can be increased be passing the wires through rubber disks (cookies) or rollers; this modification is designed to assist passage of the ground cables over the seabed. Ground cables

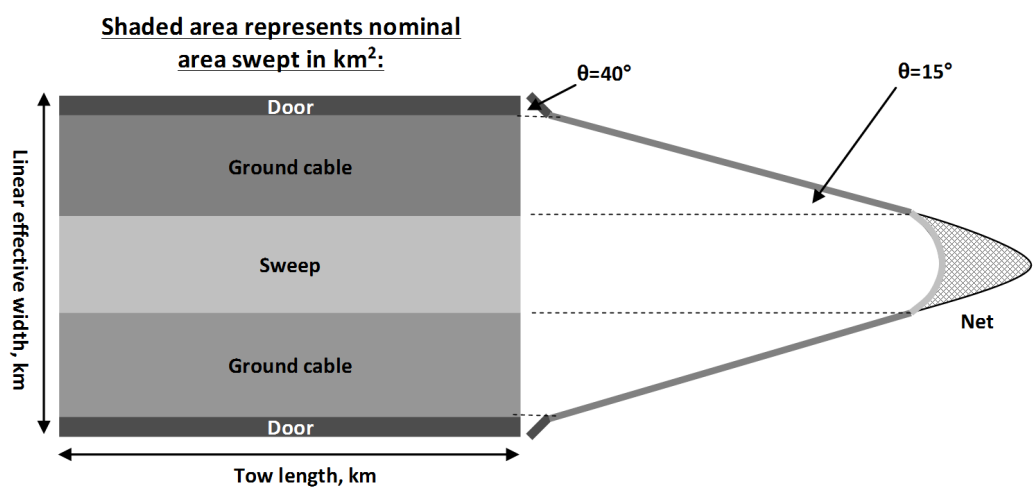
[9] Ocean quahogs, which are also harvested with hydraulic clam dredges, are found in deeper water and in a wider variety of bottom types than Atlantic surfclams. They are harvested in eastern Maine with "dry" dredges (toothed non-hydraulic dredges) that would not be exempt from option 2 regulations.

are typically constructed from twisted steel wire rope, often with small diameter rubber disks (cookies) compressed together along the entire cable length. There are some reports that a few fishermen use chain as an alternative to wire rope. Cable diameter ranges from $^{9}/_{16}$ inch to ¾ inch, with 1¾ to 3 inch diameter cookies (2 inch to 2 $^{3}/_{8}$ inch cookies are most commonly used).

Ground cable length varies between boats and typically is 30-80 ftm (55-146 m) although some larger boats may use up to 120 ftm (219 m). Generally, longer lengths are used on smooth seabeds, when the risk of hooking up on obstacles is small, and/or when targeting flatfish. Inshore boats (which also tend to be smaller) tend to use shorter ground cables (30–50 ftm, 55-91 m) so they can maneuver the trawl gear around rocky outcrops and other obstructions that can catch or damage the gear. Some fishermen do not vary ground cable length much under different circumstances as changes in cable length may affect the herding angle of the cables and catch rates. Others have been known to add or remove substantial lengths to their ground cables; however, it is not known if this is a regular or infrequent activity, nor is it known under which circumstances fishermen make such a change.

In comparison with the sweep and the doors, ground cables are the longest element of bottom trawl gear and thus they contribute the greatest proportion of area swept for a given fishing event (The figure below shows the relative contribution of each gear element to the effective width of the gear). Thus, shortening their length and/or reducing their contact with the seabed provides a mechanism to reduce gear width, assuming that the total length of the tow does not change.

Figure 4 – Schematic of trawl gear (top down view) showing the relative contribution of doors vs. ground cables vs. sweep to gear width/area swept. Not to scale.



Given some straightforward assumptions about angle of attack, and holding all else constant, it is possible to estimate the reductions in linear effective gear width that could result from shortened cable lengths. In addition, gear contact with the seabed may be reduced if ground cables are raised above the seabed with elevating disks. This also provides a mechanism to reduce area swept. However, in order to understand if there is a **net benefit** for use of these types of gear modifications to minimize total area swept, other information is needed:

What is the cable length/configuration/catchability trade-off for target species?

- If catchability is reduced with shortened cables, how does tow length/duration increase to compensate to achieve the same total catch? Would gear modifications lead to a net increase in area swept, and thus EFH adverse effects, within restricted areas because modified ground cables catch fewer fish?
- How does this relationship vary by species?
- What other changes might be made to the way the gear is rigged or fished to allow fishermen to compensate for reduced ground cable lengths?

What will the distribution of effort look like after the ground cable restrictions are implemented?

- Will reduced catchability cause vessels to fish elsewhere, thereby minimizing adverse effects within the area?
- Can target species within the ground cable area be captured using other gear types instead of trawls, e.g. gillnets or longlines?
- Is the target species readily available in other locations?

What is the effect of area size on the enforceability of ground cable length limit measures?

Does the ground cable length cap represent a significant reduction?

- 45 fathom limit is close to the current maximum size (generally there are no regulatory limits on ground cable length, although shrimp trawls are an exception to this)
- No ground cables represents a much greater % reduction
- These changes may be easier to make on some vessels as compared to others.

In terms of enforceability, there may be lessons in the way that the multispecies exemption areas are regulated. For example, exemption areas that allow the use of small mesh, have strict stowage requirements for small mesh nets when transiting other areas, and some of the areas require vessels to carry letters of authorization. There are also strict possession and landings limits for non-target species.

Past changes to fishing gears have been authorized following extensive field trials of the new gear type to determine how target and non-target species catches are affected. There is one good example of ground cable changes made in the North Pacific where habitat protection was one of the primary management objectives. Scientists and fishermen in the Bering Sea have examined the habitat and bycatch related benefits and costs to industry of ground cable changes (Rose et al. 2009, Rose et al. 2010). The wire ground cables (called sweeps in the North Pacific literature) were raised off the seabed by adding cookies of various sizes at various spacing intervals. They examined changes in the catch of target and incidental species and found that seafloor contact could be reduced with relatively low associated losses in catch. As of 2011, Bering Sea flatfish trawlers must use the reduced contact gear.

While there are some lessons that can be taken from the Bering Sea work, there are limits in terms of applying this work to our situation in the Northeast. Specifically, the Bering Sea flatfish trawl fishery operates primarily on mud and sand substrates, and prior to the new regulations, most vessels used cables made of coated wire. Here, the habitat management areas include a mix

of sand, granule-pebble, cobble, and boulder-dominated areas, and cable construction appears to be about 50/50 bare wire vs. cookies, according to the observer data examined for Georges Shoal and the Great South Channel. Chains, rollers, and rockhoppers are also reported as ground cable materials.

Also, it is not clear whether widely spaced elevating disks would allow the gear to pass over the types of geological and biological structures found in the proposed habitat management areas. The Bering Sea study (Rose et al 2009) found that the sweeps with disks only contacted the seabed at the disk positions, whereas the bare wire sweeps raised sediments clouds along their length, but they note that the structure-forming seafloor organisms of the eastern Bering Sea are generally 'small and flexible' and that elevating the cables by a few centimeters would not prevent contact with larger organisms. Similar experiments in the Northeast would be required to provide the knowledge necessary to fully gauge the net effect of gear modifications on EFH.

Two pilot studies have been conducted in the Northeast region and the results of one of the studies were provided to the PDT. A 6-day, May 2013 paired vessel study in Ipswich Bay compared standard ground cables with ground cables of the same length that used the elevating disks, as proposed by Option 3. Five one-hour tows were made each day, and the modified ground cables were moved from vessel to vessel on a daily basis. Six species were caught in sufficient numbers to statistically analyze differences in catch rates between the two nets. Three species, witch flounder, American plaice, and yellowtail flounder, were caught at significantly lower rates with the modified (disk elevated) ground cables. Three other species, silver hake, winter skate, and winter flounder, showed no significant difference in catchability between the two nets. Total catch was significantly higher with the standard net. Given the observed catch rates, the preliminary study report estimated that total fishing time would need to be about 18% higher to maintain the same catch with the modified ground cables as compared to the standard cables. While it appears that the modified cables raise the gear off the seabed somewhat, it is not clear that this reduction in contact would compensate for the necessary increase in tow length. It is important to note that this study should be regarded as a pilot project, and the results should not be extrapolated overmuch to other areas, vessel sizes, habitat types, or species. It is also important to note that the results of this study have not been reviewed by the Council's Research Steering Committee or peer-reviewed by an independent group.

In summary, the size and direction of changes in adverse effect estimates as a result of ground cable adjustments could be calculated using applications of the SASI model, but only if effort distribution is well understood and changes in area swept can be estimated pre- and post- gear modification. <u>Because the effect of ground cable modifications on species catchability, and therefore on area swept, is not well understood, it is very difficult to say with any certainty that there would be a net habitat benefit of requiring ground cables with elevating disks in habitat management areas.</u> However, the pilot study does indicate that the modified ground cables can at least be used by regional fishing vessels, and the 45 fathom length limit per side is not expected to be particularly constraining, given that many vessels already use shorter cables. Overall, Option 3 will have negative impacts on seabed habitats as compared to Options 1 and 2. However, the magnitude of the difference in impacts is uncertain.

The impacts of the option to eliminate ground cables entirely (Option 4) may be somewhat different. Comments made during informational interviews indicated that this requirement would be less constraining for smaller vessels than larger ones, because smaller vessels already use relatively short cables. Shrimp vessels in particular already appear to comply with this restriction, based on their gear requirements. It is possible that under a no-ground cable requirement, some effort would simply be displaced into other areas. Overall, it is not possible to determine the effect of a no ground cable measure on catchability, and therefore on overall swept area and adverse effects. Option 4 will have negative impacts on seabed habitats as compared to Options 1 and 2, but it is not possible to quantify the magnitude of the difference between the options.

4.1.2.4 ***EFH overlap analysis***

One way to evaluate the potential benefits of each habitat management alternative is to consider the extent to which its component Habitat Management Areas encompass the distributions of various Council-managed species. The preferred alternative EFH designations reflect the distribution of essential habitats occupied by a particular species and lifestage, and can be used to indicate which areas and management alternatives are most likely to provide the most habitat protection for the greatest number of species and life stages, especially those that occupy habitats that are more vulnerable to fishing impacts. EFH designations (detailed in Volume 2) include both a map representation (spatial coverage) and qualitative text description of preferred habitat attributes.

The egg and larval EFH map representations follow a few general approaches (see Appendix A). Some are egg and larval data binned by ten minute square, some are egg and larval data plus relative abundance trawl survey data from another lifestage (typically juveniles), and some use trawl survey data from another lifestage only. The egg and larval only maps have fairly patchy coverage, and while the focus of the habitat management areas is seabed conservation, the lifestages shown in these maps are pelagic. These pelagic lifestages are not summarized in the tables for reasons discussed below. The maps that use a proxy lifestage or a proxy lifestage plus egg and larval data are one step removed from the distribution of the lifestage in question. In these cases, the overlap between the egg and larval EFH designations and the management areas may be a less useful metric than overlaps between the juvenile and adult designations and the management areas.

Most of the juvenile and adult EFH map representations were developed by conditioning relative abundance survey data binned into ten minute squares by preferred depth and temperature ranges. Although two different catch rate thresholds were used to make the maps (see Appendix A), and survey catchability varies by species, it is reasonable to compare the degree of overlap across species and lifestages when assessing the benefits of different areas and alternatives. There are some cases where data from more than one lifestage were combined to develop a single juvenile/adult designation, so these will be a less reliable predictor of the lifestage for which data were deemed insufficient to develop a map representation on their own.

Some of the juvenile and adult designations do not follow this method (again, see details in Appendix A) and cannot really be compared to designations that do use the abundance/habitat considerations approach. EFH for some species (e.g. wolffish and scallops) was based on very

broadly defined geographic range information so spatial overlap with the proposed mgmt. area/alternatives is less meaningful. Atlantic wolffish EFH includes all waters north of 41° N in the Gulf of Maine and on Georges Bank, as limited by the habitat types outlined in the text description. Sea scallop EFH uses a species range (100% presence in all surveys) approach in the map representation.

Some Council-managed species have no designated EFH within the No Action and proposed habitat management areas, so they are not shown in the tables described below. The details of the No Action and alternative designations for these can be found in Volume 2. The map coverages for offshore hake and deep-sea red crab, which occur off the continental shelf on the slope, are too deep overlap the various habitat management areas. Rosette and clearnose skate occur south of the proposed management areas. Atlantic salmon EFH is designated in specific rivers and associated coastal waters to a distance of 3 nm, and therefore has no overlap with any habitat management areas, which are in federal waters only. However, the oceanic extent of the designation abuts some of the HMAs in the eastern and western Gulf of Maine sub-regions.

The habitat management measures focus on mobile bottom-tending gear restrictions, so this analysis is restricted to species and lifestages that are benthic versus pelagic (Table 28). Benthic lifestages that are in close association with the seabed are most likely to benefit from measures that protect seabed habitats. In general, egg and larval lifestages are typically pelagic, and juvenile and adult lifestages are benthic, but there are a few species with benthic eggs and larvae. For species where more than one lifestage is combined into a single designation (e.g. Atlantic halibut), if any of the lifestages are benthic, the designation was included in the analysis.

Table 28 – Benthic vs. pelagic habitat use by species and lifestage

Benthic eggs:	**Benthic larvae:**	**Benthic juveniles:**	**Benthic adults:**
Atlantic salmon, Atlantic wolffish, ocean pout, red crab (attached to adults), sea scallop, winter flounder, Atlantic herring. EFH is not designated for skate eggs, but skate egg cases are benthic.	Atlantic salmon, Atlantic wolffish, sea scallop after settlement (spat)	Acadian redfish, American plaice, Atlantic cod, Atlantic halibut, Atlantic salmon, Atlantic wolffish, barndoor skate, clearnose skate, monkfish, haddock, little skate, ocean pout, offshore hake, pollock, red crab, red hake, rosette skate, sea scallop, silver hake, smooth skate, thorny skate, white hake after settlement, windowpane flounder, winter flounder, winter skate, witch flounder, yellowtail flounder	Acadian redfish, American plaice, Atlantic cod, Atlantic halibut, spawning Atlantic herring, spawning Atlantic salmon, Atlantic wolffish, barndoor skate, clearnose skate, monkfish, haddock, little skate, ocean pout, offshore hake, pollock, red crab, red hake, rosette skate, sea scallop, silver hake, smooth skate, thorny skate, white hake, windowpane flounder, winter flounder, winter skate, witch flounder, yellowtail flounder
Pelagic/surface eggs: American plaice, Atlantic cod, Atlantic halibut, monkfish, haddock, offshore hake, pollock, red hake, silver hake, white hake, windowpane flounder, witch flounder, yellowtail flounder	**Pelagic/surface larvae:** Acadian redfish, American plaice, Atlantic cod, Atlantic halibut, Atlantic herring, Atlantic wolffish, monkfish, haddock, offshore hake, pollock, red crab, red hake, sea scallop prior to settlement, silver hake, white hake, windowpane flounder, winter flounder, witch flounder, yellowtail flounder	**Pelagic juveniles:** Atlantic herring, white hake prior to settlement	**Pelagic adults:** Atlantic herring, Atlantic salmon

Some habitat types, including cobble and boulder-dominated seabed types, particularly in low-energy regions, are more vulnerable to fishing impacts than others (see Volume 1, Section 4.1.2, Seabed vulnerability). The habitat management areas are generally designed to encompass these habitat types (see discussion in previous sections of this volume), so species associated with more vulnerable marine and estuarine habitat types (see bold type in Table 29) are expected to derive greater benefits from the habitat management alternatives proposed in this amendment. Juvenile fishes may benefit especially from the benefits these types of habitat provide in terms of shelter.

Table 29 – Essential habitat types used by each benthic species and lifestage

Species	Life Stage	Substrate Features of EFH
Acadiian redfish	**Juveniles**	**Complex rocky reef substrates with associated structure-forming epifauna (e.g., sponges, corals), and soft sediments with cerianthid anemones; occupy adjacent gravel habitats when local abundance on reefs is high**
	Adults	**Finer grained bottom sediments and variable deposits of gravel, silts, clays, and boulders; do not occupy boulder reef habitats.**
American plaice	Juveniles and adults	Soft bottom substrates (mud and sand), but also found on gravel and sandy substrates bordering bedrock
Atlantic cod	**YOY juveniles**	**Inshore, prefer gravel and cobble habitats and eelgrass beds after settlement, but also utilize adjacent un-vegetated sandy habitats for feeding; also settle on sand and gravel on Georges Bank (see haddock).**
	Older Juveniles	**Structurally-complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna**
	Adults	**Structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae**
Atlantic halibut	**Juveniles and adults**	**Sand, gravel, or clay substrates**
Atlantic herring	**Eggs**	**Deposited on the bottom in beds, stick to coarse sand, pebbles, cobbles, and boulders and/or on macroalgae**
Atlantic sea scallops	**Spat**	**Pelagic larvae settle on any hard surface, including shells, pebbles, and gravel; they also attach to macroalgae and other benthic organisms such as hydroids, but do not survive on shifting sand.**
	Juveniles	**When very small, attach to shells, gravel, and small rocks (pebble, cobble), preferring gravel; older juveniles not attached, occupy same habitats as adults.**
	Adults	**Often aggregate in beds on sand and gravel substrates**
Atlantic wolffish	**Eggs**	**Wolffish egg masses are hidden under rocks and boulders in nests**
	Juveniles	No strong substrate preferences
	Adults	**Spawn in rocky habitats; occupy a wider variety of sand and gravel substrates once they leave spawning habitats, but are not caught over muddy bottom**
Barndoor skate	**Juveniles and adults**	**Mud, sand, and gravel substrates**
Clearnose skate	Juveniles and adults	Primarily mud and sand, but also on gravelly and rocky bottom.
Deep-sea red crab	Juveniles and adults	Unconsolidated and consolidated silt-clay sediments
Haddock	**YOY juveniles**	**Settle on sand and gravel on Georges Bank, but are found predominantly on gravel pavement areas within a few months after settlement, then disperse over a greater variety of substrate types**
	Juveniles	**Hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel**

	Adults	**Hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel substrates**
Little skate	**Juveniles and adults**	**Sand and gravel, also found on mud**
Monkfish	**Juveniles**	**A variety of habitats, including hard sand, pebbles, gravel, broken shells, and soft mud, seek shelter among rocks with attached algae, feed along edges of rock ledges and boulder fields**
	Adults	**Hard sand, pebbles, gravel, broken shells, and soft mud; seem to prefer soft sediments over sand and gravel, and, like juveniles, utilize the edges of rocky areas for feeding.**
Ocean pout	**Eggs**	**Rocky habitats, eggs are laid in gelatinous masses, generally in sheltered nests, holes, or rocky crevices**
	Juveniles	**Wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel.**
	Adults	**Mud and sand, particularly in association with structure forming habitat types; i.e. shells, gravel, or bouders; congregate in rocky areas prior to spawning and frequently occupy nesting holes under rocks or in crevices**
Pollock	**Juveniles**	**Rocky bottom habitats with attached macroalgae (rockweed and kelp); YOY also use eelgrass. Older juveniles occupy same habitats as adults**
	Adults	**Tops and edges of offshore banks and shoals (e.g., Cashes Ledge) with mixed rocky substrates, often with attached macro algae.**
Red hake	YOY juveniles	Settle in depressions on the seabed
	Older juveniles	Bottom habitats providing shelter, including biogenic depressions in mud, eelgrass, macroalgae, shells, live bivalves, anemone and polychaete tubes, and artificial reefs
	Adults	Shell beds, soft sediments (mud and sand), and artificial reefs
Rosette skate	Juveniles and adults	Mud and sand substrates
Silver hake	YOY juveniles	Settle on muddy sand substrates, find refuge in amphipod tube mats
	Juveniles	Found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions in the Mid-Atlantic
	Adults	In bottom depressions or in association with sand waves and shell fragments; also in mud habitats bordering deep boulder reefs, and on boulder surfaces in the Gulf of Maine.
Smooth skate	**Juveniles and adults**	**Soft mud in deeper areas, but also on sand, broken shells, gravel, and pebbles on offshore banks in the Gulf of Maine.**
Thorny skate	**Juveniles and adults**	**Sand and gravel, also found on mud**
White hake	Juveniles	Fine-grained, sandy substrates in eelgrass, macroalgae, and un-vegetated habitats
	Adults	Fine-grained, muddy substrates and in mixed soft and rocky habitats
Windowpane flounder	Juveniles and adults	Mud and sand substrates

Winter flounder	**Eggs**	**Eggs are adhesive and deposited in clusters on mud, sand, muddy sand, gravel, and submerged aquatic vegetation, especially in areas with reduced bottom current where they are not buried by suspended sediment settling to the bottom; south of Cape Cod, sand seems to be the most common substrate.**
	YOY juveniles	**Inshore, tend to settle to the bottom on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks and disperse into coarser-grained substrates as they get older.**
	Juveniles	**Variety of bottom types, such as mud, sand, rocky substrates with attached macro algae, tidal wetlands, and eelgrass**
	Adults	**Muddy and sandy substrates, and on hard bottom on offshore banks; for spawning, also see eggs.**
Winter skate	**Juveniles and adults**	**Sand and gravel, also found on mud**
Witch flounder	Juveniles and adults	Mud and muddy sand substrates
Yellowtail flounder	Juveniles	Sand and muddy sand
	Adults	Sand, shell hash, muddy sand, and sand with gravel

The tables in each sub-regional habitat impacts section identify various levels of spatial overlap between the map representations for each species and lifestage and the corresponding habitat management area boundaries. Overlaps were assessed visually using Geographic Information System software and are coded as follows. The numeric scores were used to generate a comparison metric across areas. 'High' and 'full' were given the same numeric score because the differences between these two categories were typically minor, and in many cases the difference between high and full resulted from small areas eliminated from the map based on a depth contour-based clipping of the spatial coverage.

Overlap	Score	Definition
None	0	No spatial overlap
Slight	1	Overlap of less than 25% of the HMA
Moderate	2	Overlap of greater than 25% but less than 75% of the HMA
High	3	Overlap of greater than 75% of the HMA
Full	3	The entire HMA is mapped as EFH

Given the wide variety of species managed and the various locations, depths, and habitat types encompassed by the management areas, each is unique in terms of its EFH overlap. While the tables are arranged by management area, they identify the management alternative or alternatives associated with each, and the discussions accompanying the tables provide some comparison across alternatives.

At the bottom of each table, some summary statistics are provided. First, the numeric scores were added across all designations listed in the table to provide a metric representing both the number of designations represented and the degree of overlap for those designations. This "total score" metric ranges from a low value of 39 to a high value of 107, with a mean of 72.7. Next, a

"species count" metric is provided, which indicates the number of species that have at least one benthic lifestage designated in the HMA. Twenty three species total are included on the tables, since those stocks with no overlap with any HMAs are not shown (this is discussed further below). Some areas have all 23 species represented, while other areas are as low as only 11 species represented. The mean value is 19.0 species. Finally, a "designation count" metric is also included, which indicates the number of individual designations overlapping the area, out of the 43 benthic species/lifestage combinations included in the tables. The range of values was a high of all 43 designations represented, with a low of 19 designations represented. The mean value was 32.9 designations. As the tables indicate, some designations cover 2, 3, or all 4 lifestages.

Metric	Minimum value	Maximum value	Mean value
Total score	39	107	72.7
Count of species	11	23	19.0
Count of designations	19	43	32.9

Note that this analysis complements but is different from the groundfish hotspot analysis presented in the affected environment section of this amendment (Volume 1) and in the managed species impacts analysis in this volume for a few reasons:

- The EFH designations include all species managed by the Council, not just groundfish.
- The EFH designations include egg and larval distributions where available, whereas the hotspot analyses do not evaluate these lifestages. Only some eggs and larvae are benthic, however, as noted above.
- The EFH designations are typically based on a long time series of data (up to 37 years) whereas the hotspot analysis was conducted using ten years of recent data.
- The EFH designations classify all fish caught in the various trawl surveys as either juveniles or adults, while the hotspot analysis focuses on young (age-0 and age-1) juveniles and the largest adults (top 20% of biomass), leaving out animals of intermediate size.
- The EFH designations are generally broader, covering much of the distribution of the species/lifestage, as compared to the hotspot analysis, which focuses on the highest catch areas only.

4.1.2.5 *Species diversity considerations*

Species diversity indices described in the Affected Environment section were summarized by alternative to determine which areas are most diverse with respect to groundfish, regulated species and all species. All other factors being equal, the alternative with the highest overall diversity may provide positive benefits to the most species.

4.1.3 Analysis of impacts on the large-mesh groundfish resource

4.1.3.1 *Juvenile groundfish habitat analyses*

Two specific objectives of this amendment that are intended to enhance groundfish fishery productivity (a goal of the amendment) are to: (1)improve protection of critical groundfish habitats, and (2) improve refuge for critical life history stages. To accomplish these objectives,

habitat management measures in this amendment focus on habitats used by age 0/1 groundfish that are most vulnerable to the adverse effects of fishing.

Following standard practices for conducting a GIS hotspot analysis, trawl and dredge survey data from 2002-2012 were used to identify concentrations juvenile groundfish. Methods, assumptions, and parameter choices are given in Volume 1 and Appendix E of this document. Several choices were intentionally made that weighed the results in favor of critical life stages of groundfish species most associated with bottom habitat. These factors included affinity for hard substrates, degree of residency, evidence of formation of sub-populations, and stock status (expressed as the ratio of biomass at maximum sustainable yield (B_{msy}) to current biomass). Groundfish stocks that are associated with mud or sand substrates, stocks that are migratory, stocks that are not known to form distinct sub-populations, and stocks that are near or above B_{msy} were downweighted relative to other stocks. Overall, the analysis was restricted to fish estimated to be age 0 (i.e. spawned in the year observed by the survey) or up to age 1. The Council's Closed Area Technical Team recognized that the smaller fish were more likely to be associated with and dependent on habitat structure for survival and growth. While many species do not mature until a larger size, the older juvenile groundfish, in many cases, are thought to assume different diets and survival strategies that are often less associated with structured bottom habitat.

After the analysis identified hotspots for age 0/1 groundfish, the hotspots were weighted as noted above and binned into 10 km^2 grids, compatible with other information including estimates of vulnerability of bottom substrates to fishing. Contiguous areas of grids that had high weighted hotspot scores were further evaluated as potential candidates for groundfish habitat management areas. <u>The number of weighted hotspots and the species composition of the total number of hotspots in various Habitat Management Areas were used to evaluate the relative positive or negative impacts that the proposed alternatives would have on the groundfish resources. Proposed habitat management alternatives with a greater amount of weighted hotspots of age 0/1 groundfish were considered to have more favorable characteristics such that restrictions on fishing would have a more positive impact on groundfish habitat and groundfish stocks.</u>

However, absence of juvenile groundfish hotspots in proposed habitat management areas does not necessarily mean that closure of the area to all or certain types of mobile bottom-tending gear would have a negative impact on juvenile groundfish. Impacts on the groundfish resource would depend on where and how much fishing effort was shifted to other areas. If effort shifts to another area with groundfish, and substantial age 0/1 juvenile groundfish habitat is present in the areas that absorbed the effort shift, such shifts could constitute a negative impact on age 0/1 juvenile groundfish habitat. However, if effort shifts into areas with little age 0/1 juvenile groundfish habitat, then impacts might be neutral. The same logic can be applied to spawner hotspots and shifts in fishing effort; if effort shifts from areas and seasons with few large groundfish to areas and seasons with substantial biomass of large groundfish, this could constitute a negative impact. However, if effort shifts to other areas with relatively fewer large groundfish, impacts on spawning might be neutral. Further, the absence of hotspots does not necessarily indicate an absence of juvenile or spawning groundfish; this could be due to a lack of survey tows in the area and season, or indicative of somewhat lower biomass that did not reach hotspot levels of abundance.

Juvenile groundfish rely on both highly vulnerable habitat types and lower vulnerability habitat types. Not all high vulnerability habitats may be as directly important for all groundfish species due to less than optimal conditions, such as temperature, prey availability, and predator abundance. Conversely, habitats that are less vulnerable to the impacts of fishing may be very important to certain groundfish species. Habitat conservation measures intended to reduce impacts on habitats used by juvenile groundfish should focus on the spatial intersection of vulnerable habitat types and groundfish stocks, particularly those species known to rely on complex structured habitats that provide shelter from predators and a source of food. Using the SASI and hotspot analysis criteria in combination, the greatest positive impacts for critical life stages of groundfish will be realized by protecting habitats that are both highly vulnerable to fishing and that encompass high weighted hotspot values. The approach used to develop habitat management areas to benefit juvenile large-mesh groundfish is outlined briefly in the introduction to section 2.1.

4.1.3.1.1 Distribution of young juveniles (age 0/1)

When evaluating the impacts of the habitat management alternatives on groundfish, it is important to consider the size and age of fish targeted for conservation. Size ranges included in the hotspot analysis were selected to encompass juveniles in their first and second year of lige (ages 0 and 1), and management areas that are based around the results of the hotspot analyses, therefore, are designed to protect the habitats used by these smaller juveniles. Most often, these size fish (which varies by stock) are smaller than both the juvenile fish category in the EFH designations (see Volume 2) and also smaller than the size of sub-legal fish caught by commercial and recreational fishing vessels. These young fish were identified as most reliant on structured bottom habitat for survival and growth. Older, sub-legal, juvenile fish may not derive as much benefit from a habitat management area closure or gear restriction because they are generally less associated with the bottom, are better swimmers and are more capable of escaping predators, and more likely to consume a greater variety of prey organisms, including other fish.

In the case of cod in the western Gulf of Maine, the age 0/1 fish tend to be more associated with inshore (and generally) shallower areas, particularly in the spring (Map 38). Specifically, there is a notable difference in distribution of age 0/1 cod (<= 25 cm in spring and <= 35 cm in fall) compared to older, but still sub-legal cod <= 55 cm[10]. The age 0/1 cod are distributed more inshore and the older juveniles appear to be more abundant further offshore during both the spring and fall surveys (Map 38). This does not mean that cod older than age 1 are not inshore; however, there are relatively fewer in number. This also does not mean that there are not age 0/1 cod further offshore; however, they are fewer in number than older, sub-legal fish.

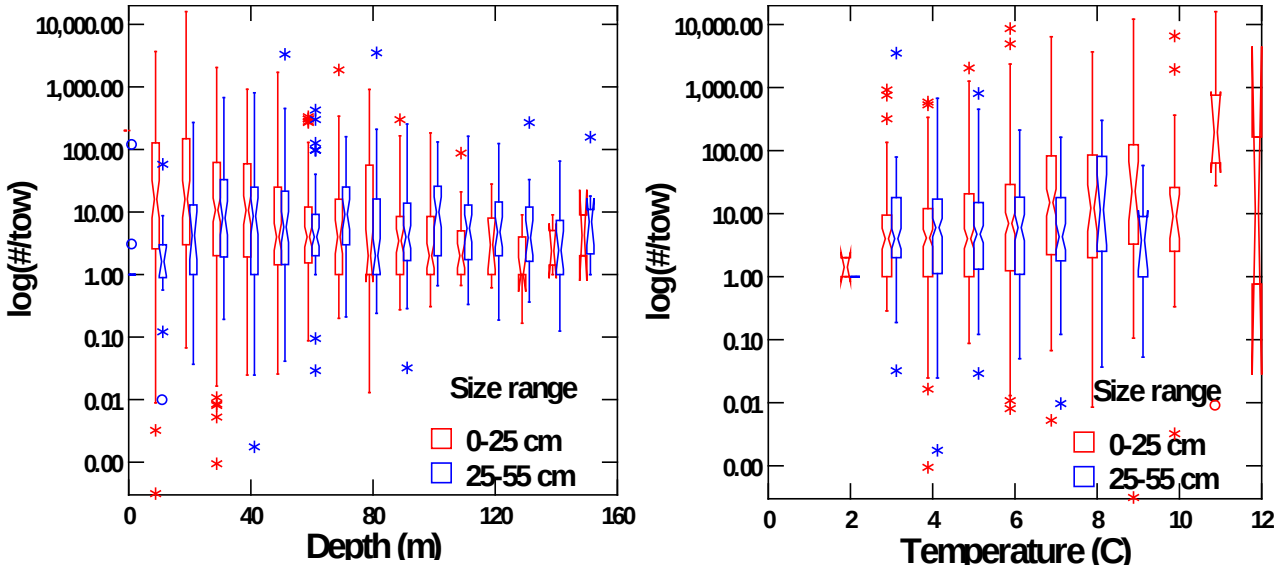
This inshore/offshore difference in distribution is not entirely due to depth or temperature (i.e. generally warmer inshore during the summer and falland colder during the winter and spring). There are significant differences in the distribution of younger versus older juveniles by depth,

[10] The legal minimum size cod for commercial vessels was 22 inches (55.9 cm) from August 1, 2002 [Interim Action; 67 FR 50292] to August 29, 2013 [Framework Adjustment 48; 78 FR 53363]. Other minimum sizes as large as 24 inches applied to recreational fishing vessels.

but they are more subtle than it might appear in Map 38. In the spring (Figure 5), abundance of age 0/1 cod appears to be significantly greater than abundance of older, sub-legal cod at depths up to 20 m. The opposite appears to be true at depths greater than 90 m, where the abundance of older sub-legal cod is greater than that of age 0/1 cod. Abundance of 0-25 (age 0/1) and 25-55 (older juveniles) cm cod are not significantly different at 20-90 m, depths often found in the offshore portions of the western Gulf of Maine (Map 38). In the spring (Figure 5), there appear to be significantly more 0-25 cm cod only at 7ºC, but not at any other temperature[11]. At temperatures above 9ºC, only sub-legal cod smaller than 25 cm were caught. In the fall (Figure 6), the relative abundance for these two size categories does not appear to be significantly different, except for depth less than 20 m, where there were very few older sub-legal cod in the survey catches. In the fall, there appear to be significantly more 35-55 cm sub-legal cod when the bottom temperature was 6ºC and more 0-35 cm cod when the bottom temperature was above 11ºC.

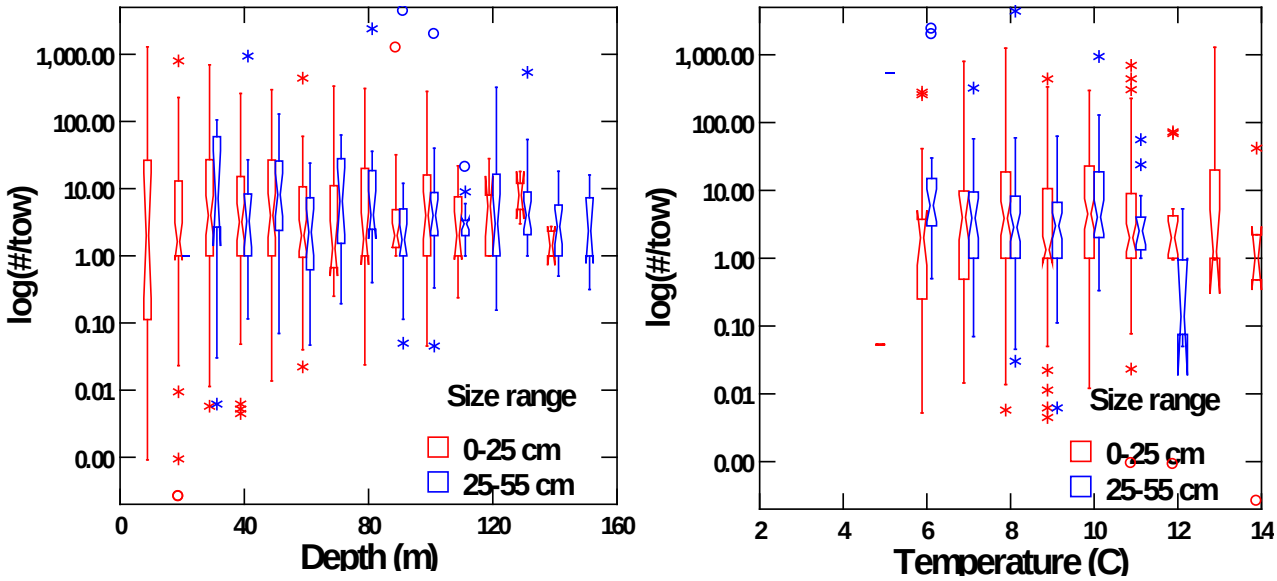
Offshore habitat management areas, such as the Western Gulf of Maine Habitat Closure Area, the Jeffreys Ledge Habitat Management Area, or the Stellwagen Habitat Management Areas (large and small) may benefit older, sub-legal cod, but they may also condense effort inshore where the smaller, younger cod are most abundant. <u>If mobile bottom-tending gear use reduces habitat quality inshore, this could reduce survival and growth of the youngest cod, which are believed to be more dependent on bottom habitat quality, and thus recruitment to the stock.</u>

Figure 5 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 spring surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean.



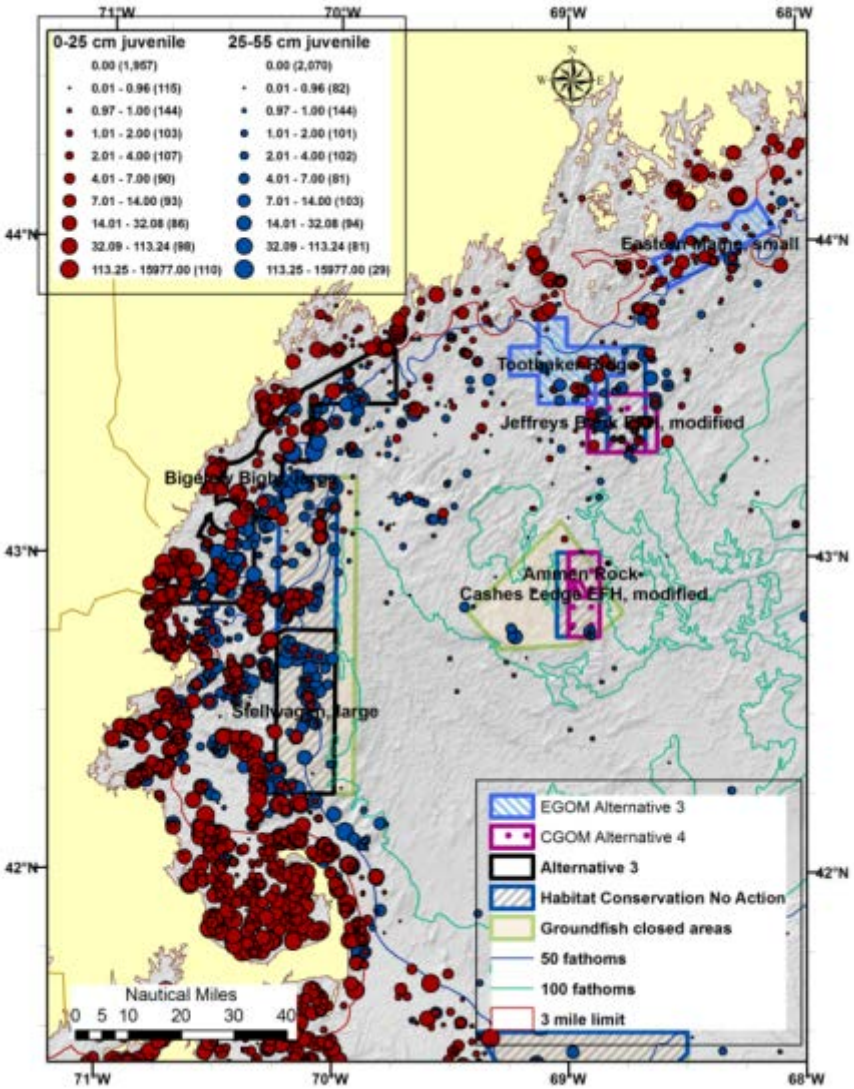
[11] These results should be interpreted with caution, however, due to influences of larger year classes during years when temperature was abnormally high or low.

Figure 6 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 fall surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean.

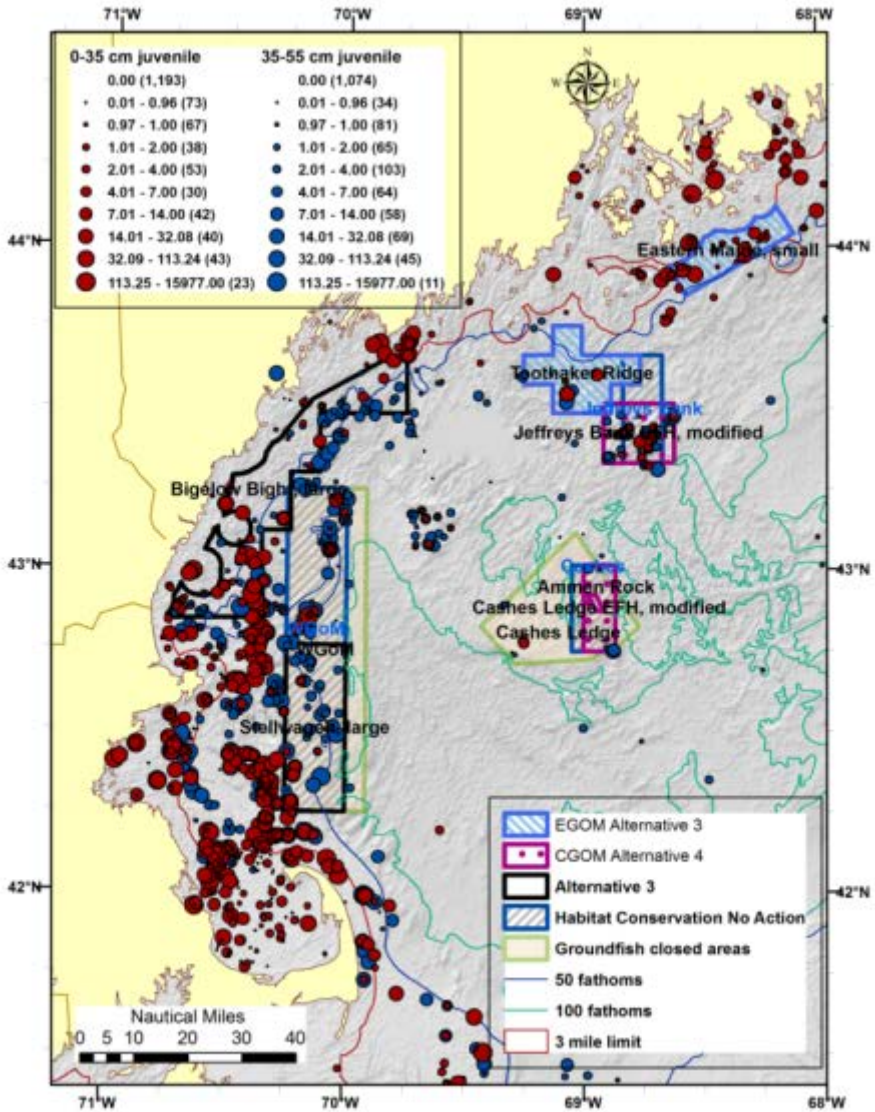


Map 38 – Distribution and overlap of WGOM Alternative 3, EGOM Alternative 3, and CGOM Alternative 4 with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, ME-NH, and IBS cod surveys.

Spring and summer



Fall and winter



4.1.3.1.2 Local, regional, and stock level effects

Local, regional, and stock-level habitat impacts are evaluated (Table 30). These local and sub-regional effects could change the quality of habitat with which age 0/1 groundfish stocks are associated. The positive impacts of habitat management alternatives are expected to be evident at the stock level, enhancing productivity and improving sustainable yield. The alternative-by-alternative analyses (sections 4.2.2) focus most closely on characterization of local habitat impacts and on relevant stock-level groundfish impacts.

Table 30 – Classification of possible impacts on groundfish habitat and stocks.

Classification of effects	Local impacts on groundfish habitat in the proposed habitat management areas, without considering the effects of potential effort displacement	Regional impacts on groundfish habitat in the Gulf of Maine or Georges Bank/Southern New England region, considering the effects of effort displacement and intensified fishing in adjacent areas	Stock-level effects: Impacts on groundfish population and productivity
Positive or beneficial	Quality and quantity of groundfish habitat is expected to improve.	Quality and quantity of groundfish habitat is expected to improve.	Habitat changes are expected to increase stock productivity.
Uncertain	It is unclear how the quality or quantity of groundfish habitat will change.	It is unclear how the quality or quantity of groundfish habitat will change.	It is unclear how habitat change will affect stock productivity
Neutral	Groundfish habitat quality or quantity is not expected to improve or worsen.	Groundfish habitat quality or quantity is not expected to improve or worsen.	Expected effect is not positive or negative
Negative or detrimental	Groundfish habitat quality or quantity is expected to worsen.	Groundfish habitat quality or quantity is expected to worsen.	Habitat changes are expected to decrease stock productivity.

On a local level, a reduction in adverse gear effects within a habitat management area would promote habitat recovery in previously fished areas, or continue habitat recovery in currently unfished or closed areas. The greatest benefits are expected to accrue to species that are known to associate with coarse substrates at very young ages. Negative or detrimental local groundfish habitat impacts are not expected to result from the habitat management alternatives, except in existing year-round groundfish and habitat closures that are currently off-limits to mobile bottom-tending gear fishing and could re-open to fishing with these gear types.

On a regional level, the direction and magnitude of the impacts relates to the effects of the alternatives on habitats inside the proposed habitat management areas as well impacts on neighboring habitats. The impacts to neighboring habitats relate to the potential for fishing effort to shift into adjacent areas or for fishermen to begin using other gears to target groundfish and

other species. It is very difficult to evaluate regional impacts without considering the total suite of potential alternatives in the Gulf of Maine or Georges Bank/Southern New England region. Alternatives that close some areas but leave neighboring areas with vulnerable habitat open to fishing might actually be detrimental to regional habitat quality, depending on the relative size and importance of habitats open to fishing vs. areas where fishing is restricted.

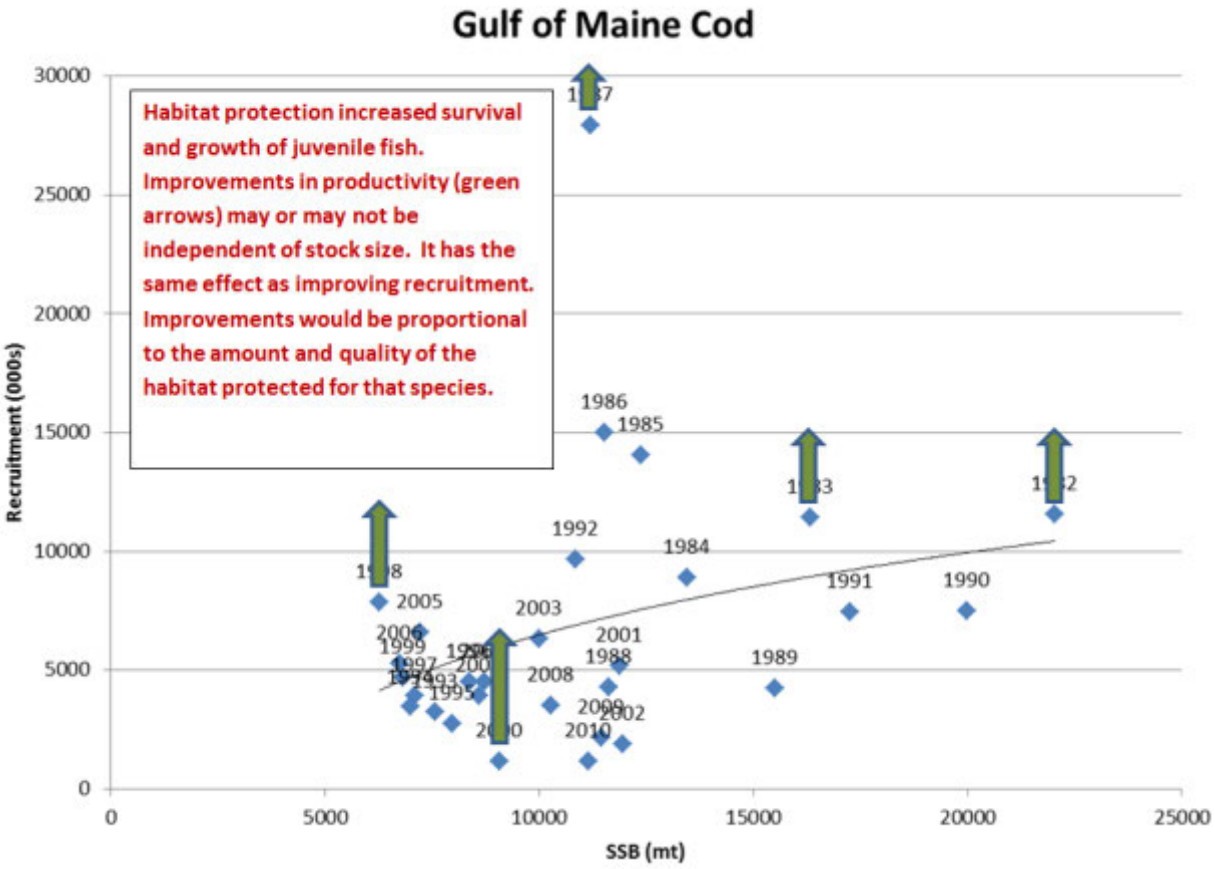
At a stock level, there are many ways to improve the productivity of a stock and increase sustainable yield, including improving survival and growth of young fish, through improved habitat quality, increasing the population of primary prey species, reducing population levels of predators, and reducing fishing mortality from discards. The discussion of impacts in this section focuses on the first of these effects, operating at a population level. When a particular alternative is expected to have a positive or beneficial effect for groundfish, the statement is made with respect to species with age 0/1 fish that are associated with coarse substrates and associated epifauna that are vulnerable to the effects of fishing with mobile bottom-tending gears. A positive or beneficial effect on juvenile groundfish habitats is expected to have a positive or beneficial effect on associated groundfish stocks.

Specifically, improvements in habitat quality are expected to translate into improvements in survival and growth of young groundfish. These stock-level effects can be explained using a recruitment/spawning stock biomass (R/SSB) conceptual framework. One mechanism by which improved habitat quality may translate into improved stock productivity would be to increase the amount of young fish, or recruits. On a stock/recruit curve, this would be represented as an increase in the R/SSB slope at the origin. Depending on the degree of density dependence and how the species occupies marginal habitats at higher abundance, the greatest effect should be when spawning stock biomass and recruitment are low. Another alternate or complementary mechanism would be that a reduction in gear effects could improve the quality of marginal habitats, allowing young recruits to spread out into improved habitats. This latter response could allow recruitment to increase proportionally to the degree to which relevant habitat improvements are realized.

An example of these potential effects using actual recruitment and spawning stock biomass estimates is illustrated in the figure below. Generally, habitat improvements would increase survival of recruits at all population levels (green arrows shown for four example years). The greatest positive effect (represented by larger green arrows) would be expected when the population (and recruitment) is low, as it has been lately for Gulf of Maine cod. Recruitment in 2010 was the fourth lowest on record. In such a situation, a large amount of better quality essential habitat would allow for better survival and growth.

As a percent change, the expected benefit is more muted at higher population and recruitment levels (represented by smaller green arrows like the 1987 year class, for example). The essential habitat in this case may be fully saturated by the larger number of recruits. Improved habitat in this case may not significantly affect survival. On the other hand, more marginal habitats may become better suited for a given species to expand its range in years when recruitment is good.

Figure 7 – Illustration of potential impacts of habitat improvement on recruitment using actual spawning stock biomass and recruitment estimates for Gulf of Maine cod. Data are from NEFSC 2013; http://nefsc.noaa.gov/publications/crd/crd1311/.



4.1.3.1.3 Option 1 – restrictions on mobile bottom-tending gears

Generally, prohibiting mobile bottom-tending gear fishing (Option 1) in habitat management areas that have weighted groundfish hotspots (and to some extent in areas without hotspots that host age 0/1 groundfish and encompass vulnerable substrates) is expected to have a positive local effect on age 0/1 groundfish that are associated with coarse and hard substrates, presuming that those areas have previously been altered by fishing. Areas that overlap existing year-round groundfish closed areas would experience a smaller marginal increase in benefits than areas that are now intensively fished. Areas that are currently open but have had no or little fishing are expected to have a neutral or no effect if closed to these gears.

On a regional scale, prohibiting mobile bottom-tending gear fishing may produce positive, neutral, or negative impacts, depending on where and how effort is displaced. Shifts towards the use of non-mobile bottom-tending gears would be expected to reduce regional habitat impacts and have positive impacts on groundfish habitat. Negative regional habitat impacts may occur if more sensitive areas where fishing with mobile bottom tending gear is currently prohibited are

opened to fishing and are not replaced by areas with equivalent or better groundfish habitat characteristics, represented by the number of hotspots and habitat vulnerability.

4.1.3.1.4 Option 2 – Hydraulic clam dredge exemption

In the Gulf of Maine, Options 1 and 2 are expected to have equivalent impacts because little or no hydraulic clam dredging currently occurs in this region. This assumption is likely still valid despite possible reopening the Northern Temporary PSP Closure; see discussion in clam resource/fishery section (4.6.8) about this issue. In Georges Bank management areas, the local and regional impacts on groundfish habitat would be less positive under Option 2 than if clam dredges were prohibited (i.e. Option 1) from fishing in a habitat management area. However, it is known that dredge vessels target clams in areas with sand and/or small granule-pebble substrates. Therefore the impact on vulnerable groundfish habitat in proposed Georges Bank habitat management areas is likely to be only marginally negative under Option 2 relative to Option 1.

4.1.3.1.5 Options 3 and 4 – Ground cable modifications

There are three ways that gear modification areas may directly affect groundfish habitat, influenced by changes in fishing behavior and/or relative catchability.

- Direct reduction of habitat alteration by trawl gear, by reducing area physical interaction with substrates and bottom habitat.
- Changes in fishing time, i.e. area swept. Area swept may increase if the gear is less efficient in catching the target species, or it could decrease if the modified gear is more efficient.
- Changes in fishing behavior or location fished due to changes in fishing costs or the inability of the fishermen to use the modified gear.

Catchability is a measure of the proportion of fish in the path of a net and ground cables that are actually caught by the net. Less than 100% of these fish are caught because fish may escape capture by avoiding or out-swimming the oncoming net, by escaping the net through unintentional or designed 'loopholes' (i.e., escape panels, raised footrope), and by passing through the trawl mesh. If there is a reduction in catchability due to required gear modifications, then vessels might fish longer to catch the target species, which mitigates the direct reduction of habitat alteration. It may also cause a negative impact if the vessel fishes substantially longer with modified gear to catch the target species.

A gear modification may also lead to changes in fishing behavior. If the modified gear cannot be fished in more rugged bottom dominated by coarse and hard substrates, fishing effort could be redistributed into other habitat types within a proposed gear modification area. This effect is expected to be positive for groundfish habitat. Other fishermen that would normally fish in the proposed area may simply choose not to use the modified gear and fish in other open fishing areas where such gear is not required. This effect could be positive, neutral, or negative depending on the quality of age 0/1 groundfish habitat that exists in the open fishing area.

Due to the potential for fishing time to increase when catchability declines compared to unmodified nets and allowance of other mobile bottom-tending gear (i.e. dredge gear) that

impacts habitat, this management measure applied to any of the proposed habitat management measures is unlikely to have positive impacts on groundfish habitat, unless it substantially reduces the amount of fishing or its location through changes in fishing behavior. Regional impacts on groundfish habitat and on groundfish stocks are either unknown or possibly negative compared to Alternative 1 (No Action). Additional discussion of these gear modifications is included in section 4.1.2.3.

4.1.3.1.6 Option 5 – Restrictions on gears capable of catching groundfish

Eastern Gulf of Maine Alternative 2 and some of the Alternative 1 (No Action) management areas would prohibit fishing with gears capable of catching groundfish (Table 6). Impacts on groundfish stocks could be either positive or negative depending on the relative qualities of groundfish inside the proposed area and in adjacent areas where fishing would otherwise occur.

The purpose of this added restriction is to increase the potential for groundfish stock recovery in and around the area, complementing habitat protection measures and other recent conservation activities in the surrounding area. Closure to all gears capable of catching groundfish would reduce catch of (sub-legal and legal size) juvenile and adult groundfish. If the area has above average amounts of juvenile fish that would be retained by the fishing gear, the closure could decrease discard mortality and raise sustainable yield[12] from the stock; a positive impact on the groundfish resource. If the proposed area has fewer sub-legal fish as compared to a nearby area where fishing is displaced to, then the opposite would be true and impacts would be negative due to displacement of fishing effort.

In areas where localized spawning subpopulations exist and particularly where these subpopulations have been depleted, a localized reduction in groundfish mortality could increase the potential for recovery and rebuilding, particularly if non-fishing factors that affect growth and survival of groundfish have improved. Coupled with a reduction in effects on vulnerable habitat, this mortality reduction on localized subpopulations would be a positive impact, regardless of how and where fishing is redistributed.

4.1.3.2 ***Groundfish spawning analyses***

The impacts analysis in Section 4.3.2 (Alternatives to improve groundfish spawning protection) focuses on the expected direct effects of the groundfish spawning alternatives on the 20 large-mesh groundfish stocks. In general, the proposed areas are expected to reduce the negative effects of fishing on groundfish spawning success. With the exception of the Massachusetts Bay Spawning Protection Area, the proposed alternatives (Alternatives 2 and 3) to the current closed areas (Alternative 1), reduce the spatial and/or seasonal scope of the current closed areas and rolling closures. Therefore, by themselves, the action alternatives do not reduce the effects of fishing on spawning populations in relation to the no action alternative. While positive impacts are primarily focused on cod and haddock, the areas may also have benefits for other groundfish stocks.

[12] By increasing yield-per-recruit.

Fishing can interfere with spawning success and productivity in a number of ways including:

1. Removal of spawning fish before they have had the opportunity to spawn;
2. Dispersal of spawning fish; and
3. Disruption of spawning behavior.

The first effect is simple – catching developing and ripe fish before they have had the opportunity to spawn reduces spawning biomass. These removals (i.e. catch of mature fish) have the same effect whether the fish were removed well before or during spawning season. Even though groundfish catches and fishing mortality are limited by annual catch limits, fish concentrations associated with spawning tend to increase the availability of fish to the gear and increase catch per unit effort (CPUE).There is an incentive to target spawning fish to reduce fishing costs and thus preferentially remove larger mature fish from the population. While potentially reducing bycatch of sub-legal immature fish (a positive effect), targeting large spawning fish would have a negative effect on groundfish productivity by removing mature spawners, which could have more viable eggs. Selective removal of the largest and oldest fish could also truncate the age structure.

Dispersal of spawning fish, i.e. fish avoiding or leaving areas where fishing activity is concentrated, may have negative impacts if dispersed fish do not find mates elsewhere, if they move to other less-preferred spawning locations, or if they do not return to the spawning ground after fishing activity has declined. Any of these responses by spawning fish has the potential to reduce spawning success, negatively affecting productivity.

Some groundfish, particularly cod, have been observed to exhibit specific spawning behaviors (see discussion in the Affected Environment section of Volume 1). This behavior is sometimes manifested in diel separation and re-aggregation by sex, and has been observed in acoustic cod tagging by Massachusetts Division of Marine Fisheries in the Saturday Night Ledge area of the western Gulf of Maine, and in other areas (Dean et al 2014). Deployment of gillnet fishing gear appears to disrupt this behavior and it is possible that mobile fishing gear may have similar effects. In this case, spawning success and fertilization may be less successful as long as the fishing activity remains in preferred spawning locations.

Zemeckis et al. (2014) provides a timely and thorough discussion of what is known about the spatial dynamics of cod spawning and its implications for management. It appears that cod spawning is much more complicated than had been known, and the species exhibits a lekking mating system, where males are separated from females and comingle during nightly bouts of courtship and actual spawning activity. Some of these observations were made in laboratory settings, but recently have been confirmed with *in situ* observations using acoustic tags (Dean et al. 2014).

Zemeckis et al. (2014) discusses the potential for serial depletion of distinct spawning units in a population and the potential effects that fishing can have on spawning behavior. While reducing catches of large fish (by reducing total fishing mortality or with slot size limits) can address this need, Zemeckis et al. (2014) argues for spatially explicit management to protect complexes of spawning components that exhibit persistent spawning locations and seasons.

The paper recognizes the existence and potential effect on cod spawning from the Gulf of Maine Cod Spawning Protection Area (Whaleback) and the Massachusetts Winter and Spring Cod Conservation Zones. It also discusses the coincidental relationship between spring cod spawning over a broader area and the groundfish fishery rolling closures from March to June.

On one hand, small closures that protect well-defined spawning components should be very effective to reduce the impacts on spawning codfish. On the other hand, small closures of relatively short duration (to focus conservation on specific spawning components) carry a higher risk of missing annual spawning events when, for example, meteorological events in an abnormal year delay, advance, or cause spawning activity to develop elsewhere. Climate change may also play a role in changing spatial and temporal spawning characteristics. Smaller closures may place more fishing pressure on other unobserved spawning components than larger closers with longer durations, mitigating the intended benefit to spawning potential.

While specific cod spawning behavior has been observed in select locations, these informative but difficult to collect data are not available broadly where cod spawn. The extent and timing of cod spawning is generally only known for a few specific areas. Timing, location, and characteristics of spawning are also generally not well known for non-cod stocks, including other related gadid species like haddock, pollock, and hakes.

Looking at groundfish spawning from a broad, multispecies perspective over all areas of the Gulf of Maine and Georges Bank/Southern New England regions, the Closed Area Technical Team relied on groundfish size and maturity data to identify potential hotspots where large mature fish are concentrated. These results from spring, summer, fall, and winter survey data are used below to evaluate potential impacts on groundfish productivity.

A similar approach was used to identify hotspots of large, older, spawner groundfish, using survey weight per tow of the largest fish contributing to 20% of total biomass for each species during 2002-2012[13]. The hotspot totals were summed into grids and weighted in favor of more critical stocks, i.e. stocks that were at low biomass relative to B_{msy}, exhibit a higher degree of residency, and/or stocks that form sub-populations. All large-mesh groundfish stocks were included in the analysis, but some were given lower weight than others because either they are near or above the target biomass or are not characterized as forming distinct sub-populations that would be vulnerable. This ranking gave species like cod (both stocks) and Gulf of Maine haddock, as well as Atlantic halibut and ocean pout more influence on the analysis than other species like white hake and pollock.

Contiguous areas of grids that had high weighted hotspot scores were further evaluated as potential candidates for groundfish spawning management areas. <u>The number of weighted hotspots and the species composition of the total number of hotspots in various Spawning Management Areas were used to evaluate the relative positive or negative impacts that the proposed alternatives would have on the groundfish resources. Proposed spawning management</u>

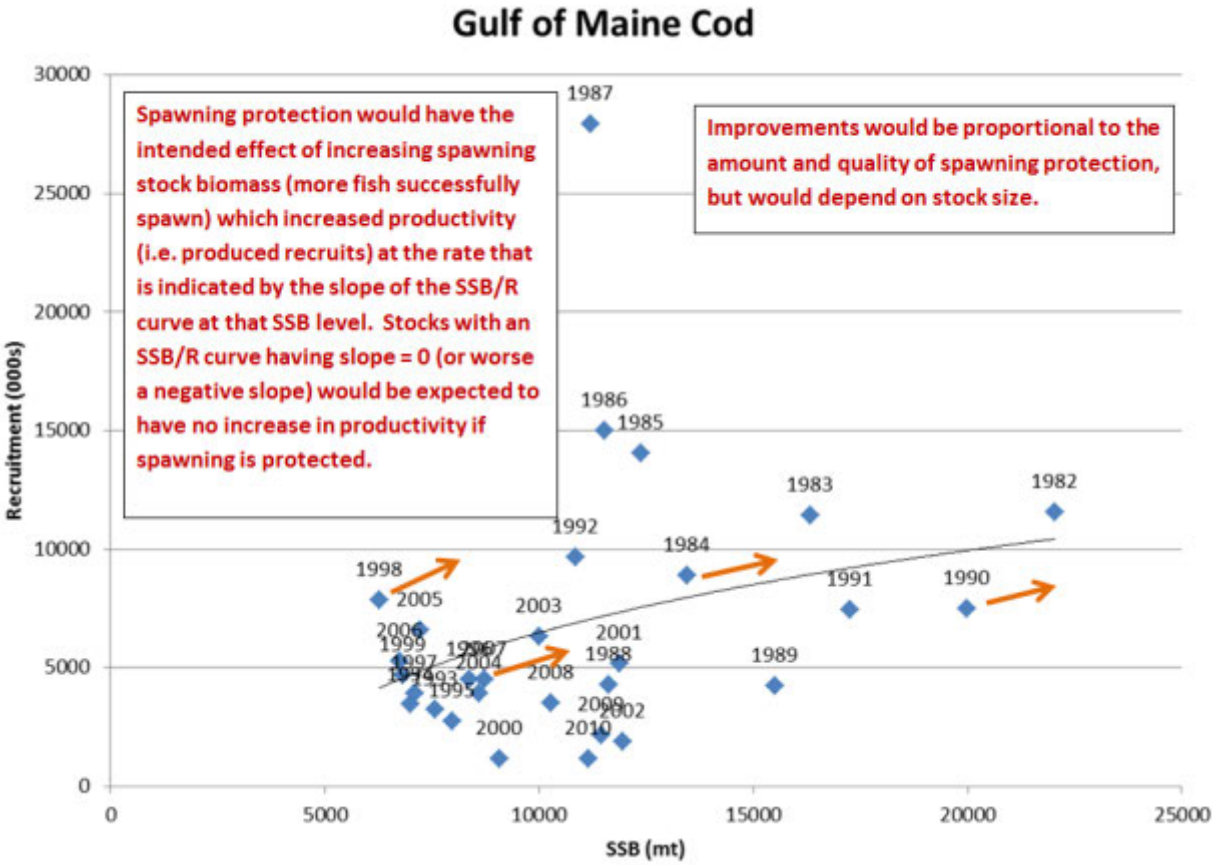
[13] The size at which larger fish contributes to 20% of total biomass changes over time due to variations in recruitment and trends in fishing mortality.

alternatives with a greater amount of weighted hotspots of large spawner groundfish were considered to have more favorable characteristics and have a more positive impact on spawning and groundfish stocks.

Where relevant, additional information about the distribution of developing or ripe fish was evaluated. While these data are sometimes informative, the results are influenced by the match (or mismatch) of spawning activity and the timing of the seasonal surveys. Many times, the surveys will catch high amounts of large, mature groundfish, but they are not yet in a ripe condition or have already been spent (i.e. post-spawning). This temporal mismatch is why hotspots were identified based on numbers of large fish, rather than using numbers of fish in spawning condition.

The illustration below shows how increases in spawning success could affect productivity, using estimated Gulf of Maine cod spawning stock biomass (SSB) and recruitment. A positive stock recruitment relationship indicates that improving spawning success should improve recruitment. If a reduction in fishing in spawning locations and seasons improves spawning success, it is as if there were more spawning fish in the population. Generally, unless there is a high degree of density dependence (such as in a cannibalistic species), recruitment will be higher and would produce a larger stock size (assuming that density dependent effects on growth and survival of recruits does not negate the effect). The actual amount of increased recruitment one would expect to see will vary according to the strength of the relationship between SSB and recruitment in a given stock.

Figure 8 – Illustration of potential effects of increasing spawning success and its effect on recruitment produced by that increase.



Because fishing with mobile bottom-tending gear tends to have lasting effects on vulnerable bottom habitat, seasonal restrictions to protect spawning are unlikely to have positive impacts on local habitat condition, since damage to such habitat could occur during times when an area is otherwise open to fishing. However, some prey and fast-recovering benthic species may be important to why large mature fish congregate, such that temporary reduction of fishing by mobile bottom-tending gear during a spawning closure could reduce impacts on these species. Thus, seasonal implementation of spawning areas could provide some level of protection for prey and fast-recovering benthic species that might translate into benefits for spawning groundfish.

While the habitat alternatives were not explicitly designed to improve spawning protection, they could provide spawning protection benefits; therefore, potential impacts of the habitat alternatives on spawning groundfishare also evaluated. The mechanisms noted above for negative fishing impacts on spawning success apply to these alternatives as well: (1) removal of spawning fish before they have the opportunity to spawn, (2) dispersal of spawning fish, and (3) disruption of spawning behavior. The seasonality, locations, and proposed fishing restrictions associated with the various habitat management areas all influence the potential for these areas to provide positive spawning benefits.

Regarding seasonality, all of the habitat management areas would be implemented on a year-round basis. This means that habitat management measures will be in effect regardless of the season during which groundfish are spawning.

Regarding location, habitat management areas would need to overlap spatially with spawning groundfish in order to protect them before or during spawning activities. Habitat management alternatives that have limited to no overlap with spawning groundfish are expected to have neutral to negative impacts, because these areas will not actively protect spawning activity, and could displace fishing effort onto nearby spawning aggregations. If none of the alternative areas in a sub-region overlap with groundfish spawning activity, then each of the sub-regional alternatives are likely to have similar, and probably neutral, impacts. This is the case in the eastern Gulf of Maine and Great South Channel/southern New England sub-regions. If only a subset of a sub-region's habitat management areas overlap with spawning groundfish, then displacement of effort could cause negative impacts. The large spawner hotspot analysis is used to qualitatively estimate the overlap between habitat management areas and spawning groundfish.

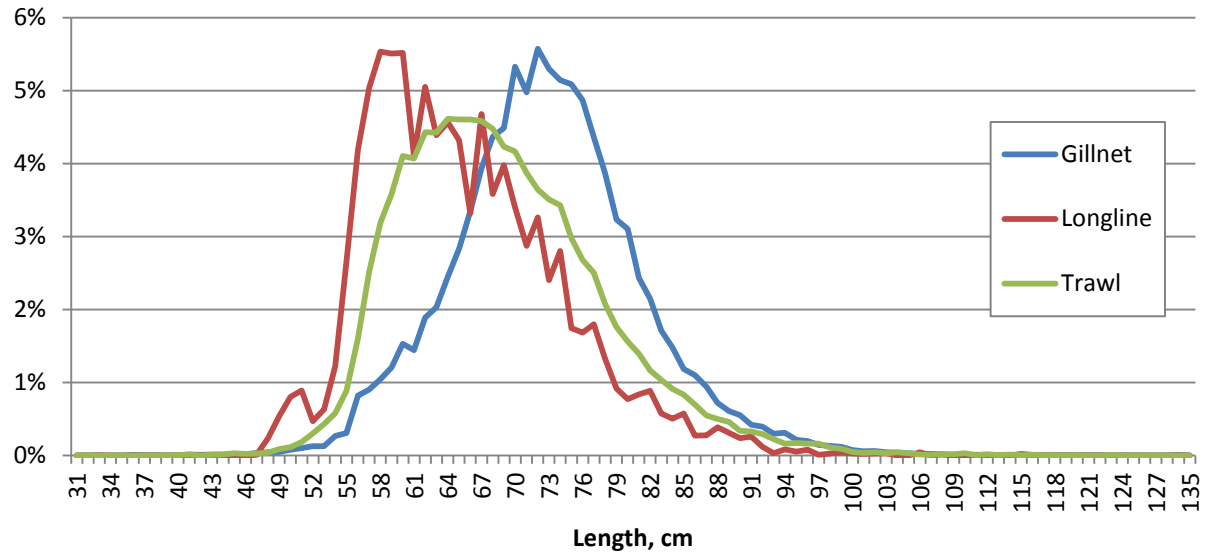
Potential fishing restrictions in habitat management areas are critically important to determining their spawning impacts. In general, the spawning protection alternatives in this amendment restrict most or all gears capable of catching groundfish, with potential exemptions for recreational gears and, on Georges Bank, scallop dredges. These more comprehensive restrictions on all gears that catch groundfish help to avoid all three of the mechanisms noted above (removal of fish, dispersal of fish, and disruption of behavior), and would provide a high positive benefit to spawning groundfish overlapping the spawning management areas spatially and seasonally. By contrast, the habitat management alternatives generally restrict mobile bottom-tending gears, but allow fixed gears and recreational gears capable of catching groundfish, including sink gillnets, demersal longlines, and demersal hook and line. Allowing gears that target groundfish to be used in habitat management areas limits the potential for positive spawning benefits of the habitat management alternatives. Further, habitat management areas that require modified trawl ground cables (Options 3 and 4) but allow use of trawl, dredges, and fixed gears that catch groundfish are assumed to have few to no spawning protection benefits. In contrast, more comprehensive restrictions on gears that catch groundfish (Option 5) would provide fairly comprehensive spawning protection; however these are only proposed in the areas included in eastern Gulf of Maine Habitat Alternative 2.

As noted above, there is specific evidence from the western Gulf of Maine that gillnet use disrupts cod spawning behavior (Dean et al 2014). In addition, gillnet gear selects for larger individuals (see below), which are assumed to contribute disproportionately to spawning production given their generally higher fecundity relative to smaller, younger, individuals. Although longlines select for smaller animals (again, see below), this gear type will also remove spawning animals from the population and could have a disruptive effect on behavior.

Fishery observer and at sea monitoring data were investigated to confirm the general selectivity patterns of various types of gear capable of catching groundfish. The figures below compare the length of cod caught in bottom trawls (including Ruhle and separator trawls), demersal longlines, and sink gillnets from 2009 to the present. While all gears catch a wide range of lengths, trawls

and longlines catch relatively smaller individuals than gillnets do. Standardizing the catches as percentages of total catch for a particular gear type shows these patterns most readily (Figure 9). The same patterns are evident across all areas (shown below), or taking the Gulf of Maine and Georges Bank statistical areas separately (not shown). As noted in the hotspot analysis section of Volume 1, the length at 80% female maturity for both stocks of cod was re-estimated by the Closed Area Technical Team to be 52 centimeters, and the "large" spawner size threshold used in the hotspot analysis was 75 centimeters. The catch rate of cod larger than 75 cm is relatively low in longline and trawl gears, but these large animals constitute a much more sizeable fraction of gillnet catch.

Figure 9 – Cod length frequency in fishery catches (2009-present), all areas



Thus, a consideration in determining the potential spawning impacts of habitat management areas is the extent to which these areas allow for the continued use of fixed gears capable of catching groundfish, particularly gillnets. Although mobile bottom-tending gears are responsible for a significant fraction of overall groundfish removals, the use of fixed gears in the habitat areas will limit their spawning protection benefits. Furthermore, it is at least possible that new mobile bottom-tending gear closures would lead to local increases in the use of fixed gears capable of catching groundfish, which could mitigate any benefits achieved through the mobile bottom-tending gear restriction.

Many factors contribute to the potential for effort shifts by gear type and projecting such changes in fishing behavior is not possible. Unfortunately, comparing fixed vs. mobile gear usage in current management areas does not provide much guidance in this regard. Because the existing (no action) habitat management areas tend to overlap existing year round groundfish closures, there are few examples of locations where mobile bottom-tending gears are currently prohibited while fixed gears that catch groundfish are allowed. In most cases, both mobile bottom-tending gears and fixed gears that catch groundfish are prohibited. Presently, the newly developed habitat

management areas that are not subsets of existing closures tend to be open to both mobile bottom-tending gears and fixed gears capable of catching groundfish.

The analyses of individual habitat management alternatives in section xxx include a brief assessment of their potential spawning impacts. In brief, the following factors contribute to determinations of positive, neutral, or negative impacts. In all cases, these determinations are fairly uncertain given that spawning locations remain imprecisely known, and the final patterns of fixed vs. mobile gear usage in habitat management areas are difficult to predict.

Factors contributing to potential positive impacts:

- Elimination of mobile bottom-tending gear use in the area removes one source of groundfish mortality and spawning disturbance
- Year round restrictions certain to overlap with spawning seasons
- Comprehensive restrictions on gears capable of catching groundfish (EGOM Alt 2)

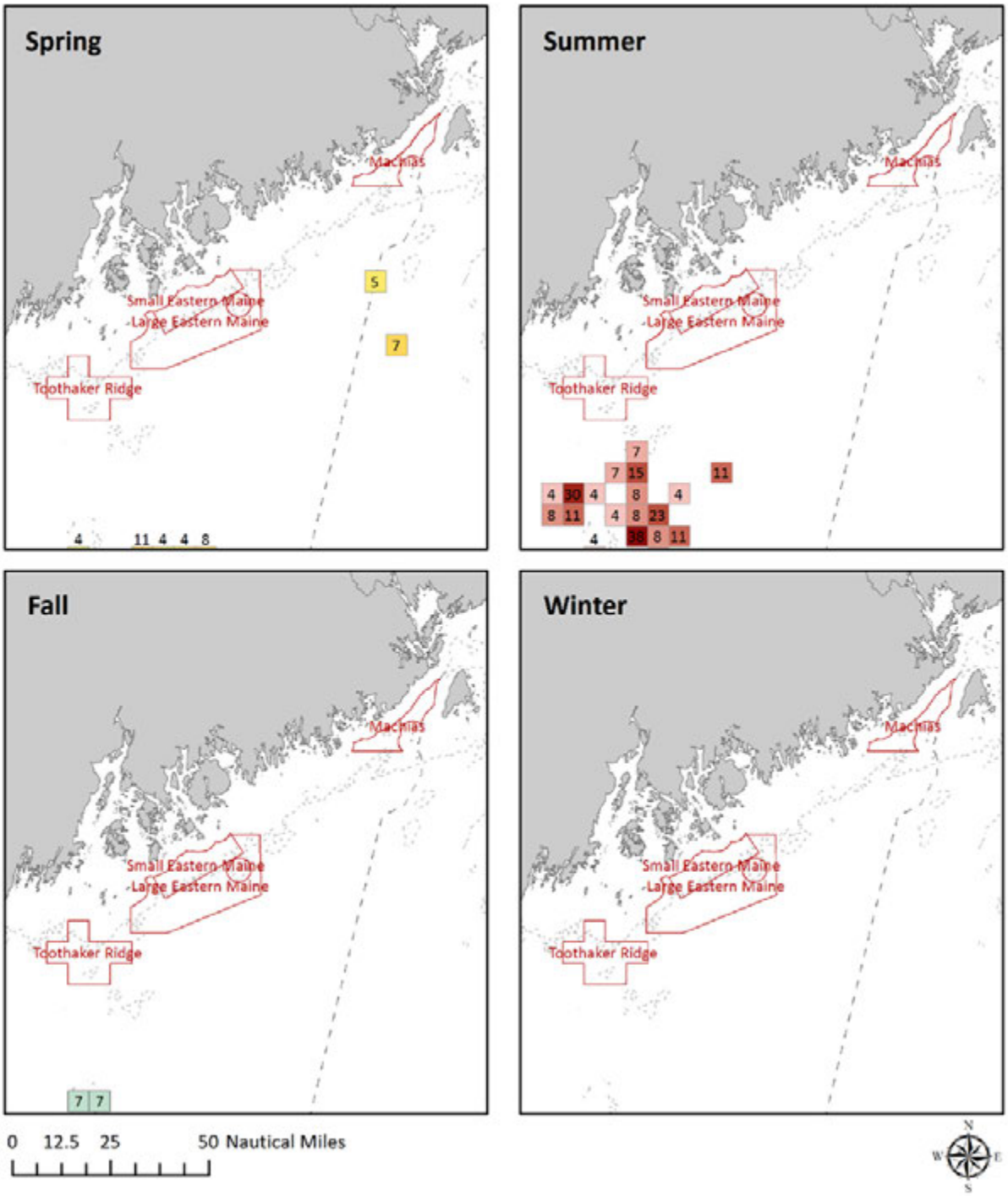
Factors contributing to potential neutral impacts:

- Little to no spawning activity in area
- Decrease in use of some gears that catch groundfish counterbalanced by increase in use of other gears that catch groundfish, particularly gillnets which catch larger animals
- In currently open areas, implementing gear modifications only
- Limited groundfishing opportunities in area such that habitat management area has small impact on groundfish catch

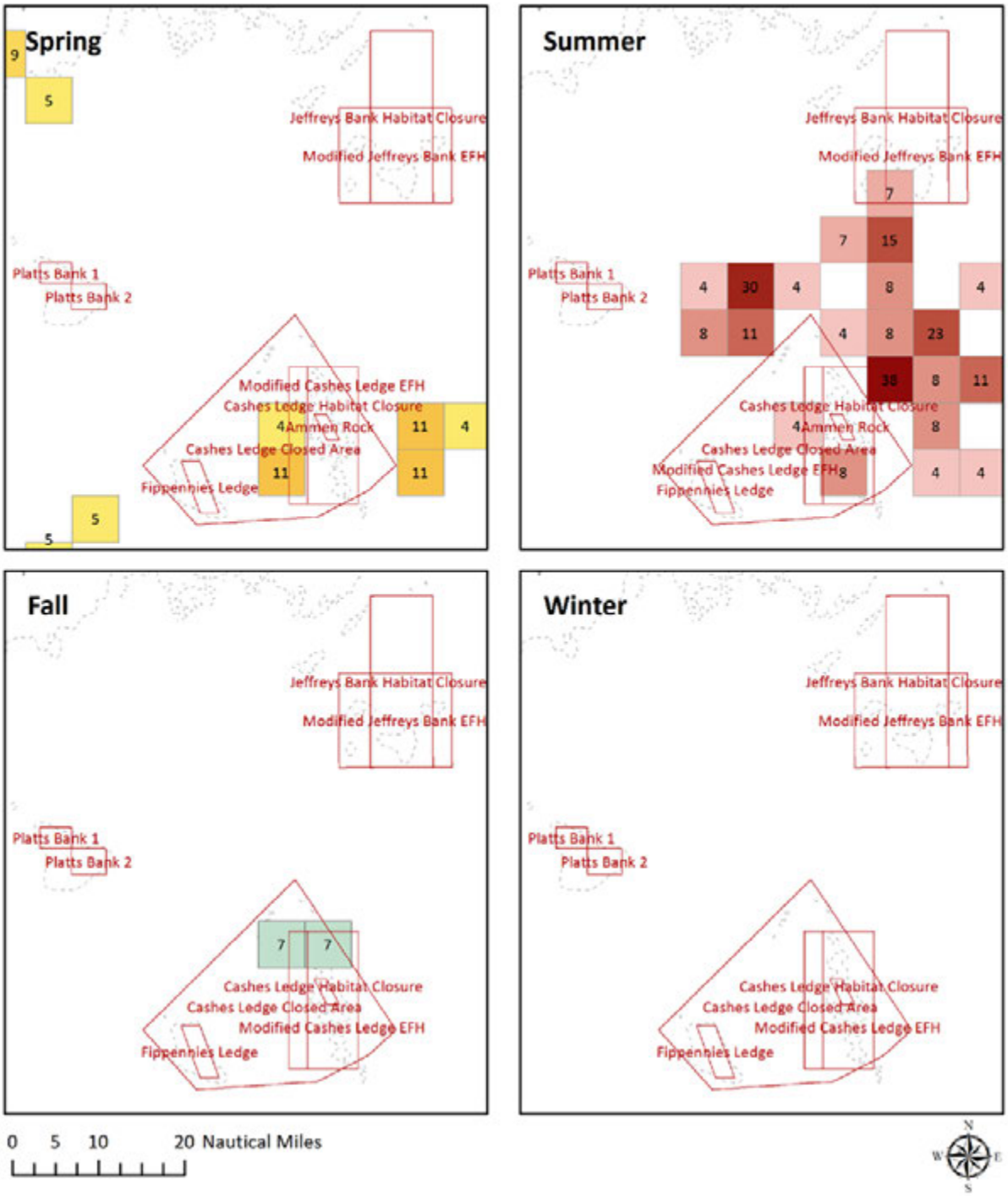
Factors contributing to potential negative impacts:

- Areas displace fishing effort onto spawning activity
- Alternative removes existing protections that benefit spawning groundfish (i.e. no habitat management area alternatives in each sub-region)

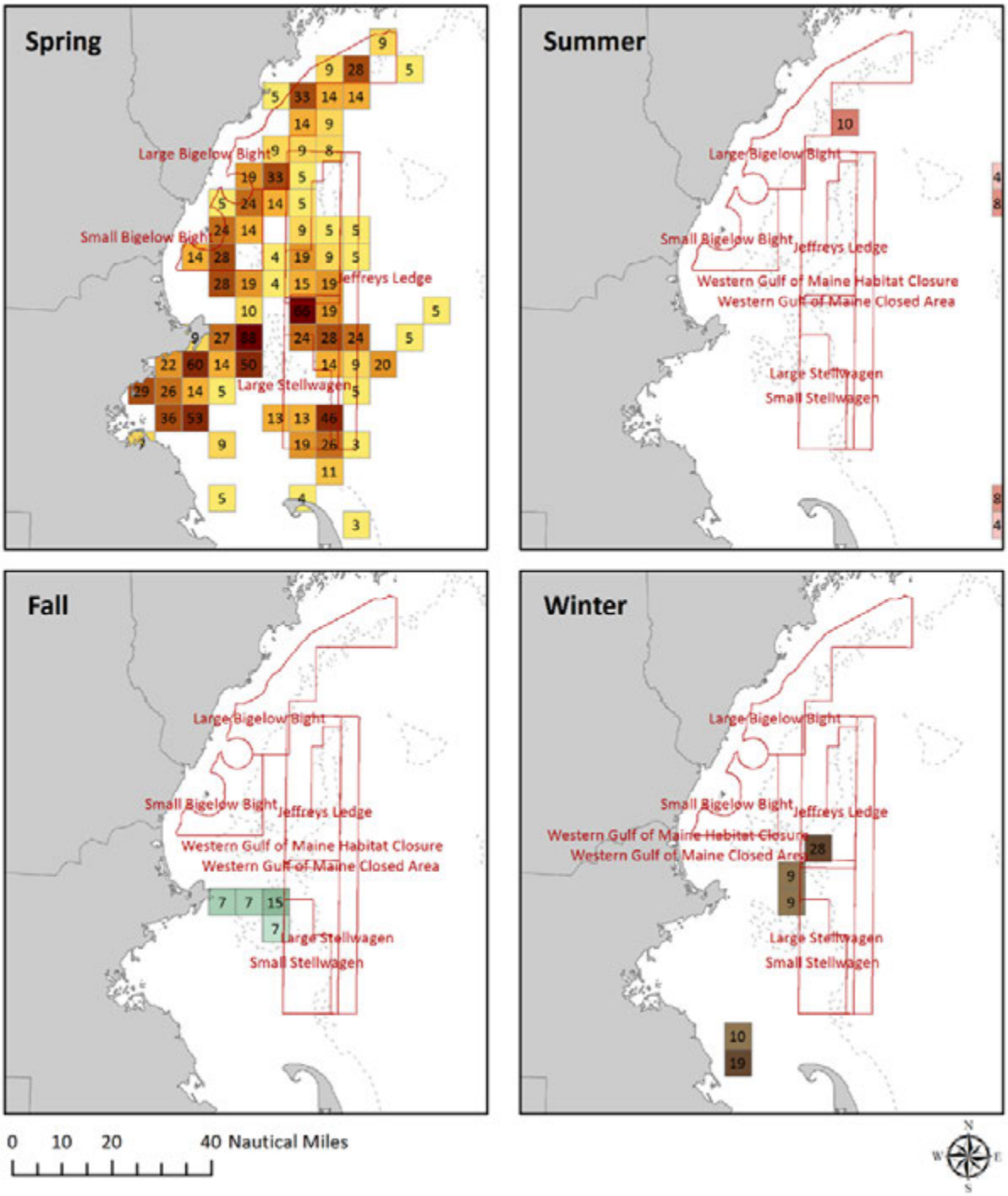
Map 39 – Weighted spawner hotspot overlap with eastern Gulf of Maine habitat management areas by season. Grids are labeled by weighted value.



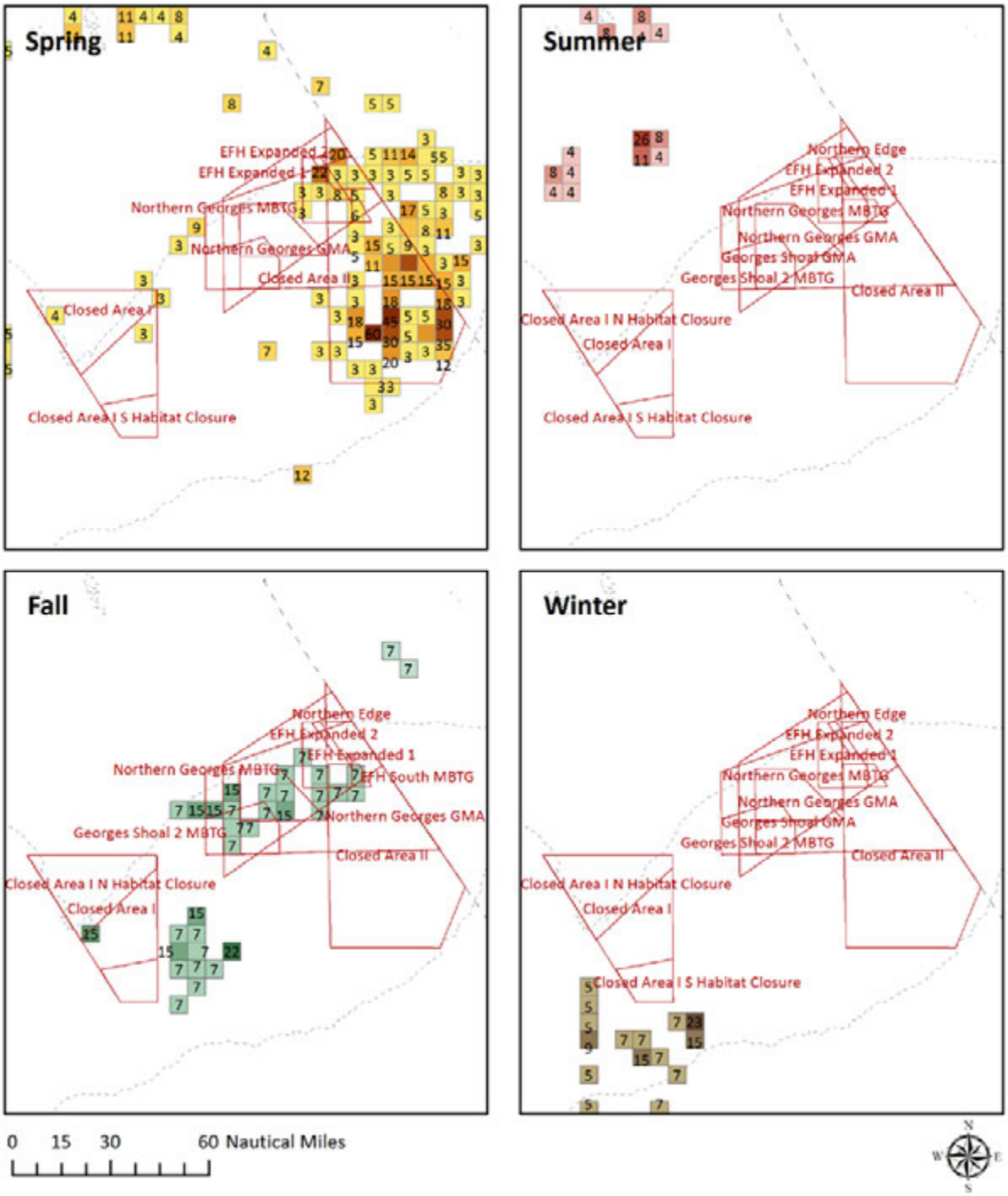
Map 40 – Weighted spawner hotspot overlap with central Gulf of Maine habitat management areas by season. Grids are labeled by weighted value.



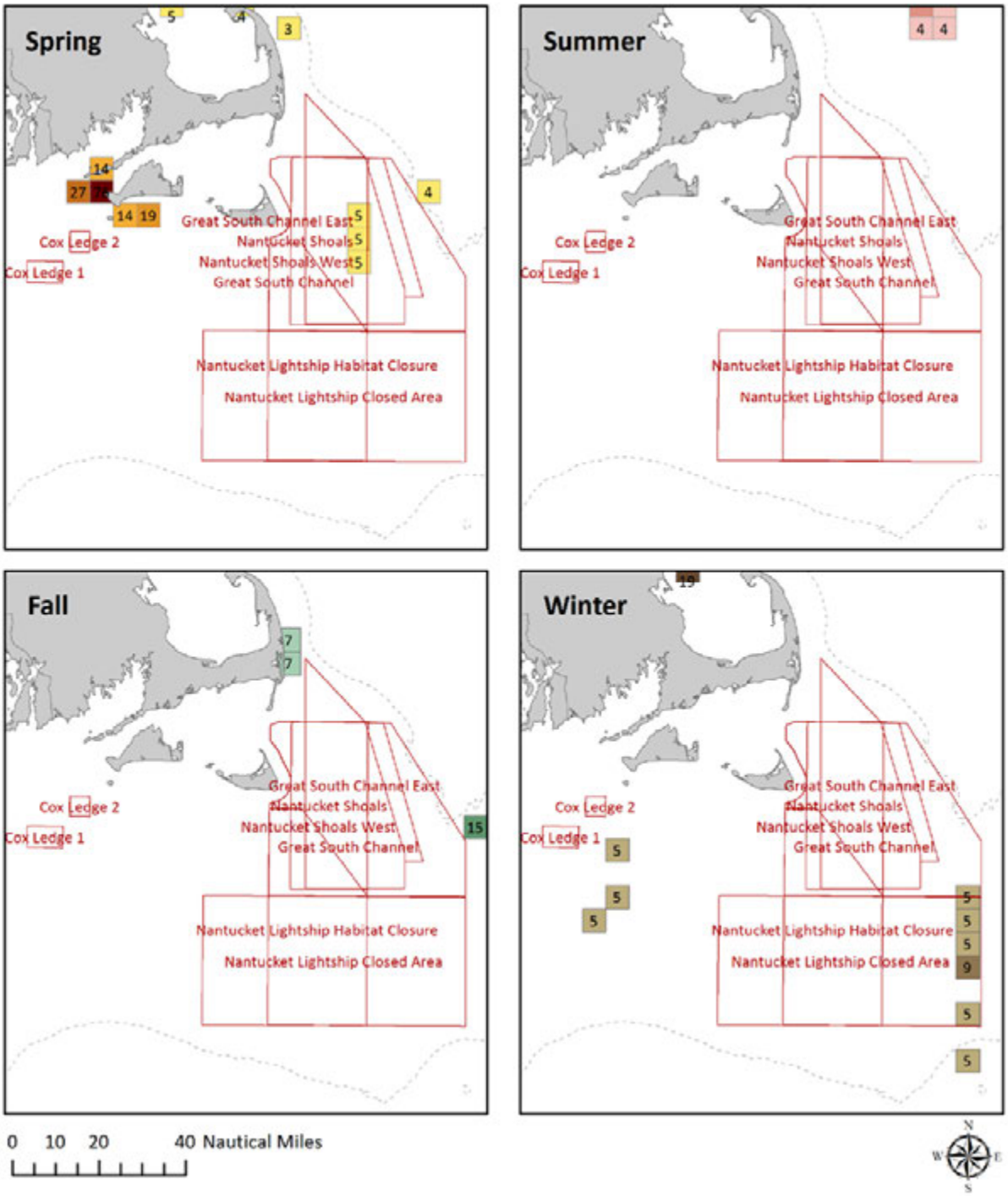
Map 41 – Weighted spawner hotspot overlap with western Gulf of Maine habitat management areas by season. Grids are labeled by weighted value.



Map 42 – Weighted spawner hotspot overlap with Georges Bank habitat management areas by season. Grids are labeled by weighted value.



Map 43 – Weighted spawner hotspot overlap with Great South Channel/Southern New England habitat management areas by season. Grids are labeled by weighted value.



4.1.4 Analysis of impacts to human communities and the fishery

4.1.4.1 *Economic analyses*

Benefit-cost analysis is a tool economists often use to assess management trade-offs such as those contained in this Omnibus Amendment. This type of analysis consists of adding up the discounted flow of expected benefits and subtracting the discounted flow of expected costs to generate an understanding of whether the net benefits generated from an alternative are positive or negative. Put another way, benefit-cost analysis answers the question "do the expected benefits from an alternative outweigh the expected costs of implementation?" In reality neither the benefits nor the costs of fishery management alternatives can be fully quantified in the rigorous manner necessary for comprehensive benefit-cost analysis. For example, changes in profits are the most accurate assessment of the benefits and costs of area management that accrue to fishermen, as they correspond to producer surplus and true welfare change. Economic tools by which these welfare measurements can be made exist, however the complexity of this Amendment precludes their implementation here. Gross revenues generated within an area of the ocean serve as an upper bound for the cost of closing areas to fishing, the degree to which this overstates the true costs of closure will depend on a fishermen's next best fishing alternative, a choice that may be difficult to forecast.

The benefits of area management to fishermen rely on increases in productivity due to protecting the most vulnerable and critical fish habitat. As stated in the Purpose and Need (Section 3.1 of Volume 1) the amendment aims to enhance the role area management plays in achieving optimum yield. Specifically, species productivity is assumed to be enhanced by protecting habitat both important to critical groundfish life stages and most susceptible to adverse effects from fishing. Critical life stages are defined within this document as juvenile and spawning individuals. Section 4.1 of Volume 1 discusses the linkages between habitat and fishery productivity. Although the general role that suitable habitat plays in enhancing recruitment has been established, there are at this time no quantifiable linkages between habitat and productivity. This means that there is no direct estimate of the net difference in the quantity of fish that would be available due to the alternatives under consideration, a critical component of quantifying the expected benefit of area management to fishermen. However, proxy measures are used to assess the relative importance of alternatives in their ability to generate the benefits of interest. Specifically, the SASI model identifies the relative susceptibility of bottom types to fishing disturbance, and can quantify actual impacts of current fishing pressure. The hotspot analysis identifies areas in which significant concentrations of juvenile and spawning groundfish occur. The confluence of these two analyses are assumed to identify the areas most likely to generate benefits in productivity from area management, in terms of stock enhancement, as summarized in sections 4.2.2 for juveniles and 4.3.2 for spawners.

A number of important assumptions underpin the translation of biological impacts to groundfish into economic impacts to the groundfish fishery, and these warrant specific discussion. First, it is assumed that the SASI and hotspot analyses combine to identify both the most important and the most vulnerable habitat for groundfish productivity. This is likely an appropriate assumption for federal waters, given the scientific review of each approach. However, the SASI analysis/spatial domain does not include state waters, and while the hotspot analysis does into state data, the juvenile groundfish habitat management areas identified explicitly excluded state waters as a

policy decision. Despite these analytical and policy choices, there is a real potential that effort will be shifted onto habitat in these inshore areas that are even more critical and vulnerable than those identified within these analyses. The exclusion of state waters was due to data quality issues in the case of the SASI model, and a strategic decision by the Council in the case of the hotspot analysis given the jurisdictional management bounds between state and federal waters. The second assumption is that the catch per unit effort is not starkly different inside versus outside alternative management areas. This assumption likely holds in the Eastern and Central Gulf of Maine sub-regions, given their relatively lower concentration of effort and landings, which in turn suggests a more marginal status as productive fishing grounds. This assumption likely does not hold for a subset of alternatives on Georges Bank and the Great South Channel, though this may not be problematic given that short-run revenues from the scallop fishery tend to overwhelm any long-run potential benefits from area management in these areas. In the Western Gulf of Maine this assumption likely does not hold for the southern half of the current Gulf of Maine closure, given the high concentration of groundfish landings and effort in statistical area 514. Maps 53 – 56 of Volume 1 provide a sense of the distribution of groundfish landings and observed effort in this sub-region. Although the shrimp fishery seems to be concentrated in waters encompassed by the Bigelow Bight alternatives, as indicated in the economic analyses in section 4.2.3.3, the shrimp fishery is currently under an indefinite moratorium. This means that there will be no displacement of effort for the foreseeable future. It is not possible to test how poorly the assumption of equal catch per unit effort approximates reality in the Western Gulf of Maine sub-region given existing data, and the final trade-off depends on both the size of effort shifted and catch per unit effort, which are also unquantifiable. Nevertheless, coupled with the linear damage function embedded within the SASI model, this assumption directly leads to a net positive impact on the groundfish fishery from properly sited management areas. A final assumption in sections 4.2.2 and 4.3.2 is that productivity gains are beyond what is achievable through existing mortality controls alone.

The overarching assumption within the economic analysis is that all these underpinning assumptions hold, and productivity gains directly correspond to future economic benefits of a commensurate magnitude. For example, a highly positive impact on groundfish productivity is assumed to generate a highly positive future impact on the groundfish fishery by increasing the rate of recruitment to the fishery and thus increasing the revenue generated by fishermen. Conversely, a highly negative impact on groundfish stocks is assumed to translate into highly negative future impacts to the groundfish fishery.

Benefits and costs of management decisions do not only accrue to fishermen. Society benefits more generally from both habitat protection and increased groundfish productivity, and is potentially negatively impacted by decreases in seafood availability due to area exclusions. These benefits are extremely hard to quantify. For example, Wallmo and Edwards (2008) find broad differences in how people value conservation associated with area management in New England. The values differ not only across individuals, in that they can be positive and negative, but also vary across allowable activities within conservation areas. Values such as these can thus only be estimated with very carefully crafted instruments that are specific to the circumstances under consideration, and even then are subject to hypothetical bias, in that the respondents understand and act upon the incentive to either overstate or understate their actual valuations (Wallmo and Edwards 2008, List and Gallet 2001, Harrison and Rutstrom 2008).

Impacts of area management ripple through the economy, with effects on suppliers of fishermen, including gas stations, bait and ice suppliers, and other service providers. Additionally, after the first point of sale, a host of other related industries, including seafood retailers, restaurants, transportation firms, and all of their suppliers, are also impacted by area management. Again, the lack of direct measures for the exact changes in landings, as well as the sheer number of area management permutations under consideration and fisheries affected within this amendment, preclude any discussion of these second-order impacts.

Consumers of fish would also benefit from increased groundfish productivity and may be negatively impacted by decreases in the supply of fish. The magnitude and sign of the net consumer benefit depends on the exact relationship between changes in quantities and prices, as well as substitutes for the species under consideration. See Lee and Thunberg (2013) for an example of how these relationships, and their corresponding welfare changes, can be estimated. However, without an estimate of the changes in landings directly due to area management, these models are inoperable. Even if specific estimates of changes in landings were available, models estimating consumer welfare do not currently exist for the full suite of impacted species.

The economic impacts of amendment alternatives thus represent a partial analysis using proxies for the true benefits and costs expected to accrue solely to fishermen. This naturally abstracts away from the broader societal benefits one would calculate under optimal circumstances.

The final piece of information necessary to estimate net benefits is a manner in which current costs and benefits can be compared to future costs and benefits. In economics this is achieved through selecting an appropriate discount rate, which casts current and future costs and benefits in terms of their present value. See Arrow et al. (2013) for a clear explanation of the reasoning for, assumptions underlying, and difficulty in choosing discount rates. Given that we have only proxies for the benefits and costs of area management, and that these proxies are highly qualitative, discounting is not possible in any rigorous manner. In this analysis, expected benefits and costs are therefore broken into short term and long term timeframes, without any netting between the time horizons. Timeframes here are defined differently than the short-run and long-run definitions traditionally used in economics. In this analysis, we use short term to identify the timeframe between the present and the full realization of the impact of the areas, while the long term starts when the full impacts are realized and continues indefinitely. For some alternatives this is not problematic, in that the sign of the impacts (positive or negative) are the same in both the short term and long term. However, for other alternatives discounting could play an important role in whether the net benefits are positive or negative. This is especially true when the magnitude of benefits and costs are large, and differ in sign between the short term and long term timeframes. In these circumstances, an explicit discussion of the role discounting could play is incorporated in the economic impacts of alternatives.

A number of steps taken for the sake of brevity are discussed here for completeness. Conflicts between different gear types as fishing effort shifts in response to changes in area management are an important concern for many stakeholders. Although not universally addressed, a discussion of potential increases or decreases in conflict is incorporated into alternatives with large expected shifts in effort. After a very brief overview of the census of fishing occurring in

and/or around areas of concern, the economic analyses focus on gears and modes (i.e. recreational vs. commercial fishing) directly impacted by the options under consideration for a specific alternative. This means that if a gear type or fishing mode is not identified and discussed directly, it is not directly managed under the specific options being considered.

The magnitude of expected impacts for an alternative are relative to all other alternatives being considered within the Omnibus Amendment, in order to ensure consistency and comparability across sub-regions. Each alternative also identifies the total revenue generated by a specific gear type, as well as the percentage of community level revenue currently being generated within the areas encompassed by an alternative, in order to understand any differential impacts of alternatives and options. Area management is ultimately implemented by restricting specific gear types from fishing in areas of concern. The economic analysis therefore focuses on impacts at the gear level. However, the Fishery Management Council system is structured by Fishery Management Plan, which considers individual stocks or stock complexes. Where differential impacts between species/FMP are clear, these are highlighted within the discussion of relevant alternatives.

The economic analysis is comprised of four main components. The first uses Vessel Trip Reports (VTR) and Clam Logbooks to identify the magnitude and composition of fishing revenues in areas currently open to fishing but being considered for area management in this amendment. The second uses the spatial data from the Vessel Monitoring System (VMS) polls to refine the estimate of fishing effort in area alternatives currently open to fishing, for those boats currently utilizing the VMS system. The third analyzes revenue currently being generated in each of the areas being considered for management by party and charter recreational vessels (this analysis does not include private recreational effort). The fourth looks at observed hauls adjacent to currently closed areas to assess the types of effort shifts that might be expected with a reopening of these areas, e.g., increased opportunities for harvest of particular stocks.

Given that this action has the potential to affect all federally managed FMPs, it is important to develop as complete a picture as possible of the spatial distribution of fishing effort by gear type. The self-reported VTR and Clam Logbook datasets have spatial fishing locations for federally managed fisheries within the New England and Mid-Atlantic regions, with individuals reporting a single spatial position that looks to represent the totality of fishing conducted on a trip. For reporting purposes these trips are defined as a single statistical area/gear combination, with individuals required to report a new VTR whenever either the gear or statistical area fished changes. Previous studies have identified that the self-reporting underreports these switches in gear and statistical area (Palmer and Wigley 2007, 2009). Furthermore, given that commercial fishing trips can be quite long, a single spatial point is unlikely to adequately represent the actual footprint of fishing on any given trip. Because of this, a statistical approach was developed for this amendment in order to better represent the footprint of fishing associated with the self-reported spatial data point.

The New England Fishery Observer Program (NEFOP) database records the spatial potion of haul/set beginning and end points. Fishermen file VTRs regardless as to whether they are carrying observers or not. By joining the observed haul positions with the VTR data, the cumulative distribution function (cdf) of the distance between observed hauls and self-reported

VTR points can be estimated. Furthermore, this cdf can be modeled as a function of variables that are reported on all VTRs. This means that the model estimates the probability that all the hauls associated with a trip fall within a given distance from the self-reported VTR location, as a function of variables that would be expected to influence the actual footprint of fishing. For example, it is likely that longer trips have hauls dispersed across larger geographical areas when compared to shorter trips. This in turn means that the VTR locations are less and less representative of the spatial footprint of a trip's fishing activity as trips increase in length. The model can then be used to estimate confidence intervals for the fishing footprint of each and every VTR point in the database, regardless of whether it was observed through the NEFOP program. This allows for a more realistic spatial footprint of trips to be represented, which in turn provides a better understanding of the fishing occurring in and around areas being considered for area management.

The cumulative distribution function was estimated using a three parameter gamma distribution (location = mean, shape = kappa, scale = sigma), which outperformed alternative specifications including log-normal and exponential functions, as determined by Akaiki's Information Criterion. Regression results can be found in Table 31.

Table 31 – Estimation of gamma distribution cumulative distribution function, for distance between observed hauls and self-reported VTR fishing location

Variables	Haul Distance Regression
Drift Gillnet	-0.521***
	(0.118)
Longline	-0.663***
	(0.0950)
Midwater Trawl	-0.333***
	(0.0886)
Scallop Dredge	-0.870***
	(0.0415)
Sink Gillnet	-0.382***
	(0.0526)
2 day trip	0.304***
	(0.0519)
3 day trip	0.717***
	(0.0562)
4 – 6 day trip	1.008***
	(0.0495)
7 – 8 day trip	1.171***
	(0.0522)
9 – 10 day trip	1.370***
	(0.0569)
11 – 14 day trip	1.609***
	(0.0602)
15 – 16 day trip	1.702***
	(0.0954)
17 + day trip	1.887***
	(0.127)
Non - S. NE/Mid-Atlantic	-0.124***
	(0.0343)
Constant	0.906***
	(0.0492)
ln(sigma)	0.287***
	(0.00625)
kappa	-0.0371*
	(0.0214)
Observations	417,535

Robust standard errors in parentheses, clustered at the permit level
*** p<0.01, ** p<0.05, * p<0.1

Gear type and days absent explain a large portion of the variability in reporting accuracy, as would be expected, while the area fished (Mid-Atlantic versus New England) has a small but significant effect on the estimated spatial footprint of a VTR trip. The parameter estimates were then used to estimate the 25th, 50th, 75th, and 90th percentile confidence intervals for all the VTR points from calendar years 2005 to 2012.

In order to assess the relative impact of area management alternatives, these confidence intervals were linked to trip-level gross revenues, generated from the VTR reported landings using a monthly average price at the four-digit NESPP4 species code (i.e., species plus market category). This revenue was then attributed spatially, assuming a uniform distribution for each confidence interval (25 percent of the revenue generated from each trip was attributed to that trip's 25th, 50th, 75th, and 90th percentile rings respectively). Although still an abstraction from reality, the distribution of revenue from a trip based on the statistical analysis of that trip's spatial footprint is more realistic than, and thus an improvement over, attributing all of a trip's revenue to a single point. Areas where fishing is known not to occur, for example on land, or bottom trawl effort within existing habitat management areas, were erased from the spatial footprint of a given trip. Finally, revenue was attributed to each area management alternative by taking the percentage of the confidence interval rings falling within a given alternative, on a trip-level basis, and summing across all trips.

Data from 2005 – 2012, broken into three, five, and 8 year time horizons, are presented in the VTR analysis. An eight year window was chosen to ensure focus was maintained on the most recent years, which is most analogous to the current biological and managerial environment, while still providing a sense of historical trends. The comparison of three separate time horizons highlights these longer term trends in the data.

The VTR analysis provides a high level overview of the types, and relative magnitude, of fishing occurring in management alternatives currently open to fishing. However, as previously mentioned it serves as an upper bound for the actual cost of a management alternative, and likely overestimates the final cost of a management alternative. A more refined spatial dataset exists in the form of VMS, which can provide a complementary analysis of fishing effort. Records and Demarest (2013) estimated a logit model which assesses a conditional probability of fishing, based on trip characteristics (including vessel size and primary gear used on trip) and VMS poll (including imputed speed, depth, depth change, and distance to known fishing hotspots). This model can then be used to assess the probability-weighted effort associated with each VMS poll. This approach was used to develop a complementary estimation of fishing effort by management area for those trips monitored by VMS and classified as Limited Access Scallop fishery, the Limited Access General Category Scallop fishery, Shrimp Trawl fishery, and Bottom Trawl fishery. It is important to note that this approach classifies a trip based on the primary gear/landed fish combination and is thus not a full census of trips which could be attributed to each FMP. However, this classification avoids double-counting of effort.

Recreational party and charter fishing was assessed using VTR data. Unlike the treatment of the commercial data, recreational VTR was analyzed using the traditional inside/outside approach. This means that if a VTR latitude/longitude position falls within an area of interest, the entirety of that report's gross revenue is attributed to that area. Although the caveats to this type of analysis previously highlighted still apply, party/charter recreational trips are not subject to observer monitoring, and thus a more rigorous analysis of their spatial footprint is not possible at this time. The revenue itself is generated as a function of the number of anglers reported to have fished on the VTR, because revenue in the charter/party fishery is a function of the number of paying customers on a given fishing trip. Average revenue per paying angler was estimated for each state from which recreational trips embarked, using NOAA's Marine Recreational

Information Program (MRIP) data. A value for a trip was then generated by multiplying the state-specific average revenue per paying customer by the number anglers reported to have fished on the VTR. There is no trip by trip location data for private recreational fishing activity, so private recreational trips are not included in the recreational revenue analyses.

Current management areas are subject to varying exclusions, exemptions, and regulations. Thus, it is not enough to just look at what fishing is currently being conducted if the goal is to characterize potential fishing activity should an area re-open. Observer data from both the At-Sea Monitoring and NEFOP programs from the waters adjacent to current closures were used in order to assess the net impacts expected to arise from the management alternatives under consideration. The data analyzed consisted of all haul and set beginning and end points falling within a ten nautical mile buffer of currently closed areas, a distance consistent with analyses previously developed for Northeast Multispecies Framework 48. Monthly average revenues by species were estimated by summing across all haul/set events. All species contributing > 5% of a haul's revenue in a single month were reported, in order to understand the potential for seasonal changes in species importance to a given gear type. The dominant species within these areas are then evaluated qualitatively in terms of their likelihood of generating additional benefits to fishermen. The analysis assumes that species composition within closed areas is similar to adjoining waters.

For each alternative, concluding statements related to net impacts rely on these four analyses, combined with impacts described in other sections of the document, especially impacts to groundfish and the scallop resources. Of particular importance were Scallop Plan Development Team analyses to estimate the costs and benefits of area management alternatives within Georges Bank, primarily in the Great South Channel and along the northern edge where there is significant sea scallop biomass and fishing effort.

The impact of alternatives is delineated by vessel length, in order to better understand the segments of the fishery most affected by each alternative. Vessels were binned into small (<50 ft), medium (50 ≥ ft and < 70 ft), large (≥ 70 ft) and unknown categories, when possible. These length categories are frequently used for analysis across fisheries (see for example, Steinback and Thunberg 2006; Georgianna, Cass, and Amaral 1999). These length categories differ slightly than those most recently used for the groundfish fishery. However, the < 30 ft category used in the groundfish fishery only contained 48 active vessels in 2012, and vessel categories differ across FMP, including the use of gross tonnage instead of length categories. Given the lack of universal standards applied within the Council, the vessel categories chosen are consistent with previous research conducted across all fisheries.

MSA section 402(b), 16 U.S.C. 1881a(b) states that no information gathered in compliance with the Act can be disclosed, unless aggregated to a level that obfuscates the identity of individual submitters. The economic analysis in the Omnibus Amendment is thus aggregated to at least three reporting units, in order to preserve confidentiality. Any data with less than three reporting units is censored to comply with this federal law.

4.1.4.2 ***Social impacts analyses***

National Standard 8 of the MSA demands that "Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of over fishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities" (16 U.S.C. §1851(2)(8)). This section provides a context for understanding possible social impacts resulting from the proposed measures in this amendment.

The current interpretation of National Standard 8, as described in the National Standard Guidelines (50 CFR part 600.345), requires the Council to consider the importance of fishery resources to affected communities and provide those communities with continuing access to fishery resources, but it does not allow the Council to compromise the conservation objectives of the management measures. *Sustained participation* is interpreted as continued access to the fishery within the constraints of the condition of the resource. The long-term conservation and rebuilding of stocks often require that limits be placed on particular gears and/or the harvest of specific stocks. Thus, the NMFS interprets National Standard 8 only as a consideration of continued overall access to fishery resources and not as a guarantee that fishermen will be able to use a particular gear type, harvest a particular species of fish, fish in a particular area, or fish during a certain time of the year.

The need to measure, understand and mitigate the social impacts of fisheries management is an essential part of the management process. Managers have an obligation to consider how policy changes affect the human context of the fishery, including the direct and indirect impacts on the safety, wellbeing, quality of life, fishery dependence, culture, and social structure of communities. These impacts can be felt at the individual, family, and community level which can make measuring and considering them difficult as the impact variables are typically differentially distributed. There is general consensus however, as to the types of impact to be considered, the section of the human environment where the impacts may be felt, likely social impacts, and the steps to enhance positive impacts while mitigating negative ones (ICPGSIA, 2003).

A fundamental difficulty exists in attributing social change to specific factors, such as management regulations when communities or other societal groups are constantly evolving in response to numerous additional external factors, such as market conditions and technology. Increasingly important influences in coastal communities include demands for recreational uses of the waterfront and tourism. Certainly, fishery management regulations influence the direction and magnitude of social change, but attribution is difficult with the tools and data available. Attribution is particularly difficult considering the dynamic and fluid nature of fishing communities. As a result, while this assessment focuses generally on the social impacts of the proposed fishing regulations, it is recognized that external factors are also influencing change, both positive and negative, in the affected communities. In many cases, these factors contribute to a community's *vulnerability* and ability to adapt to new or different fishing regulations.

Broadly defined, social impacts that need to be considered are the "social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as

members of society" (Burdge and Vanclay 1995). Identifying possible social impact variables is a topic of much debate, but the development of standard definitions for a set of the most common and consequential social impacts are underway. The current National Marine Fisheries Service "Guidelines for Social Impact Assessment," provides some assistance in defining relevant social factors/variables. It is suggested that the following five social factors/variables should be considered when comparing the preferred management alternative to the alternatives not selected:

- The *Size and Demographic Characteristics* of the fishery-related work force residing in the area; these determine demographic, income, and employment effects in relation to the work force as a whole, by community and region.
- The *Attitudes, Beliefs, and Values* of fishermen, fishery-related workers, other stakeholders and their communities; these are central to understanding behavior of fishermen on the fishing grounds and in their communities.
- The effects of proposed actions on *Social Structure and Organization*; that is, changes in the fishery's ability to provide necessary social support and services to families and communities.
- The *Non-Economic Social Aspects* of the proposed action or policy; these include life-style issues, health and safety issues, and the non-consumptive and recreational uses of living marine resources and their habitats.
- The *Historical Dependence on and Participation* in the fishery by fishermen and communities, reflected in the structure of fishing practices, income distribution and rights. (NMFS 2007)

Longitudinal data describing these social factors region-wide and in comparable terms are limited, though the new surveys currently being implemented will begin to alleviate this. The academic literature provides multiple lists of potential social variables, but such lists should not be considered "exhaustive" or "a checklist" (ICGPSIA, 1994; Vanclay, 2002; Burdge, 2004).

The analyses in this amendment evaluate the effects management alternatives may have on people's way of life, traditions, and communities. These social impacts may be driven by changes in fishery flexibility, opportunity, stability, certainty, safety, and/or other factors. While it is possible that the social impacts of some measures under consideration will be experienced solely by one community group or another, it is more likely that some impacts will be experienced across communities, fisheries, gear sectors, and vessel size classes.

While some management measures tend to produce certain types of social impacts it is not always possible to predict precise effects when there are multiple overlapping management measures, such as in this proposed action. There is also a wide variation in the acceptance of area closures among stakeholders based on the intended goals (reduce bycatch, protect spawning aggregations, protect habitats, etc.) of a possible closure and its duration (temporary, seasonally recurring, or permanent) (Pita et al. 2011). The difficulty in defining the social impacts of closed areas is inextricably tied to their variability and how they are perceived by stakeholders (Pomeroy et al. 2007).

The *Attitudes, Beliefs, and Values of* those members of the public who are concerned with ocean conservation need to be acknowledged as well. Management measures that are perceived to contribute to conservation of resources are generally expected to have indirect, positive impacts. In the discussion below, the general attitudes of the non-fishing public are described.

Also changes to the human environment often occur in small, incremental amounts and the character of a particular impact can be hidden by the gradual nature with which it occurs. As such there is high uncertainty in the relative strengths of the impacts. Therefore the discussion of social impacts for alternatives will indicate the likely directional impacts of specific measures e.g., positive, negative, or neutral. The analysis is generally qualitative in nature because of the limitations of determining effects over the large geographic areas under consideration and across many fisheries.

4.1.4.2.1 Habitat management alternatives

There are numerous social impacts associated with the habitat management alternatives. While each alternative includes distinct elements, impacts can be associated with four general actions: 1) maintaining the status quo/the no action alternative, 2) opening or modifying previously closed areas, 3) closing new areas, 4) gear modifications/exemptions. This section provides a discussion of the social impacts that are most likely to result from these four management tools.

4.1.4.2.1.1 Maintaining the Status Quo

The No Action alternatives would result in mainly neutral impacts as they would maintain the status quo. There may be some positive social impacts associated with the stability created by continuing current management strategies that allows for fishermen to keep consistent, long-term plans. In scenarios where there are currently no closed areas there could be possible small negative social impacts on the *Attitudes, Belief,s and Values* of the fishermen regarding management if they see this alternative as a missed opportunity to implement new management that could help improve fish populations. These negative impacts on the *Attitudes, Beliefs, and Values* of the fishermen may also occur in scenarios where the no action alternative will maintain current closed areas. In informational interviews conducted by the Council, fishermen questioned the success of the current closed areas, citing the continued decline of many groundfish stocks.

Moderate, indirect positive impacts on the *Attitude, Beliefs, and Values* of the non-fishing public who are concerned with the management of the ocean and living marine resources are expected from the majority of the status quo alternatives, when compared to the action alternatives that reduce the square mileage of closed areas. However, moderate, indirect negative impacts on this segment of society may also occur in scenarios where the *status quo* does not improve fisheries management or general ocean conditions as well as the action alternatives.

4.1.4.2.1.2 Opening previously closed areas

There are also a number of social impacts associated with opening all or a portion of a previously closed area. Opening additional areas for access to fishing can create opportunities for increased catch and revenue, leading to increased occupational opportunities and positive impacts on the *Historic and Present Participation* as well as the *Size and Demographics* in the affected fisheries. Fishermen often comment that once areas are closed, they are never opened again, so the opening of previously closed areas may have a positive impact on the *Attitudes, Beliefs, and*

Values of fishermen regarding the flexibility of management. Additionally, opening areas for fishing allows fishermen more flexibility in their harvesting behavior. This can have positive impacts on the *Non-Economic Social Aspects* of the fishing industry as it allows harvesters more freedom regarding when and where they fish, which may allow them to take fewer risks, fish more safely, and create schedules that are less constrained.

The increased flexibility in harvesting behavior associated with opening closed areas can also have positive social impacts on *Social Structures and Organizations* by relieving congestion and conflict associated with concentrated fishing efforts along the edges of closed areas. When the original seasonal and year-round groundfish closures were implemented in the Gulf of Maine, the shift in otter trawl fishing effort was highly concentrated to the borders of those closed areas (Murawski et al 2005). The shift in effort to marginal areas in an attempt to "fish the line" has been shown to be part of an optimal fishing strategy capitalizing on the biological "spillover" from a closed area (Kellner et al. 2007). Because closed areas do not reduce fishing effort, they only displace it, (Halpern et al. 2004, Greenstreet et al. 2009) the subsequent concentration of effort localized at the boundaries of closures has led to crowding and gear conflicts among fishermen (Suuronen et al. 2010). Re-opened closed areas would conversely reduce congestion next to these areas and remove the incentive to fish around the area's boundaries since the vessels would no longer capitalize on the biological "spillover." Relieving this congestion and conflict would have a positive social impact on *Social Structures and Organizations*. If the existing closed areas are seen as benefiting a particular segment of the fishery at the expense of another, their removal will also have a positive impact on *Social Structures and Organizations* through the increased perception of fairness across fisheries.

There are potential negative social impacts as well. First, if the current closed areas are improving fish stocks, creating a spillover benefit into fishable areas, this benefit is lost. Second, there is the potential for gear conflicts resulting from opening closed areas. Some gear types have been exempted from current closure areas and the addition of new, competing gears may cause conflicts between user groups which can exacerbate intra- and intercommunity conflicts, create additional perceptions of inequity, and weaken overall cohesion within communities. These conflicts can occur within a gear type as well, if the perception of larger available catches in a newly opened area creates a derby fishery, resulting in intense fishing effort concentrated in the area, landings that are too high, in too short a time period, causing lower prices and a waste of quota.

Minor to moderate, indirect negative impacts on the *Attitude, Beliefs, and Values* of the non-fishing public who are concerned with the management of the ocean and living marine resources are expected from the action alternatives, if the belief is that a larger amount of closed area is better for marine conservation. However, minor to moderate positive, indirect impacts on this segment of society may also occur in scenarios where the action alternatives provide equivalent or improved habitat protection (by shifting from less vulnerable to more vulnerable habitat), even in less area.

4.1.4.2.1.3 Closing new areas

Closing areas that are currently available to fishing will have numerous social impacts across various fisheries and communities. The most direct impacts will be on vessels currently fishing

in these areas that will no longer have access due to the closures. The addition of new habitat closed areas would force mobile bottom-tending gear users to modify where and how they fish, having a negative impact on the *Historic and Present Participation* in the affected fisheries. This would also have a negative social impact on the *Size and Demographics* of the affected fisheries because of a probable reduction in fishing opportunity, revenue, and employment. Negative social impacts would be expected in *Life-style/Non-economic social aspects* of the fishery, as fishermen would have less flexibility in choosing where to fish. The ability to adapt to closed areas is highly variable and largely dependent on the physical location of the closed areas. Less mobile fishermen may bear a heavier burden as they are less able to easily switch harvest areas (out of closed areas, or into reopened areas). Smaller vessels will be less able to adapt to closures of areas near shore as their range is limited and they cannot easily target offshore areas. Any change in fishing behavior that attempts to employ a more mobile fishing strategy will have additional social costs such as disruptions to family and community life as well as increasing the likelihood of safety risks. Increased risk can result when fishermen spend longer periods at sea in order to minimize steam time to and from fishing grounds, operate with fewer crew, and fish in poor weather conditions. Fishermen severely impacted by the new closed areas may leave fishing entirely or at least seek temporary opportunities in another fishery or gear type that is less affected by the management alternatives. Both possibilities would cause a change in the *Size and Demographics* of the different fisheries.

The tables in each sub-regional or regional section identify the communities impacted by each alternative. These communities were selected based on the port of landing or city of registration associated with vessels identified as impacted by the potential new closure areas by the economic analysis of VTR data described in section 4.1.4.1. For background information on these communities see the Human Communities and the Fishery section of the Affected Environment (Volume 1). In addition to the ports explicitly identified, other ports are impacted but could not be detailed due to confidentiality concerns.

Communities impacted both at the port of landing and city of registration are included because of the differing impacts associated with each community type. Potential impacts related to the port of landing include a loss of landings and revenue that can affect the fisheries infrastructure in the community. The city where the permit is registered is generally where the permit owner resides. Impacts to these communities may be widespread beyond fisheries related aspects of the communities. Permits are often registered in different cities than the ports where the vessels land so the number of vessels cannot be added across community type as this may result in double counting vessels. The communities listed in these tables are not the only communities that will be impacted by the addition of new closed areas. As fishermen change their behavior to attempt to adjust to the lack of access to a closed area there will likely be an impact on vessels currently fishing in areas in close proximity the proposed closed areas.

It is not likely that this action would affect all of these communities to the same extent. Those communities that are more dependent on fishing with the affected gear types would likely have more social impacts than those that participate in a range of fisheries and gear types. Even among communities with similar dependence, there are likely to be different impacts since some alternatives have localized impacts. Additionally, the general level of vulnerability and resilience of a community will determine the magnitude of the impact. Social Vulnerability Indicators of

each community are listed in the Affected Environment section (Volume 1). These indices correspond to different components of social vulnerabilities that may affect communities. For more information on these indices see Jepson and Colburn (2013) or http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/index. The number of vessels impacted is also included in the tables for a general representation of the impact to each community. This is not a representation of the magnitude of impact as each vessel may be impacted differently. It is important to remember that a single vessel can land in multiple ports so each vessel may be included in more than one community at the port level.

Additional impacts on the *Attitudes, Beliefs, and Values* of fishermen may be more widespread and affect communities not directly impacted by the new closures. Some fishermen generally question the efficacy of habitat closures. In informational interviews conducted by the Council, fishermen commented that natural disturbances such as storms and large-scale oceanic changes have a greater impact on the benthic environment than fishing gear and that small levels of benthic disturbance are beneficial. There are many instances in which fishermen have differing views than those held by ocean and fisheries scientists. A fisherman's view is based largely on personal experience and their own proximal environment, which can be at odds with the larger environment described by fisheries scientists. This continued lack of faith in the science used to direct management decisions could undermine the perceived legitimacy of future management actions and have a negative social impact on the formation of *Attitudes and Beliefs* about management. The impact of revising closed area management strategies on the *Attitudes, Beliefs, and Values* of fishermen is uncertain and is largely related to the level of acceptance and belief in the efficacy of closed area management by stakeholders, which varies considerably.

While the aforementioned impacts are generally negative, there is the potential for positive social impacts derived from closing new areas. These are generally associated with the potential future and long-term benefits created by the improvement of fish stocks generated from new closed areas. These benefits are difficult to analyze because of the uncertainty associated with the magnitude of the benefit, how these benefits would be distributed among fishing communities, and the timing of these impacts. For example, vessels that are unable to adapt to new restrictions in the short-term may not be able to benefit from the potential stock increases in the long-term. Additionally, the short-term impacts on markets, processing capability, and other infrastructure during the period of adjustment to new closed areas may be such that these shoreside resources are lost and unable to recover in the future when potential stock increases occur.

Moderate, indirect Positive impacts on the *Attitude, Beliefs, and Values* of the non-fishing public who are concerned with the management of the ocean and living marine resources are expected from the majority of the action alternatives that result in additional area being closed. However, minor, indirect, negative impacts on this segment of society may also occur in these situations if those stakeholders feel that the reduction in size of the footprint of closed areas is too great.

4.1.4.2.1.4 Gear modifications and exemptions

Several gear modifications are being proposed in the action alternatives. In terms of the social impact assessment, gear modifications affect *changes in occupational opportunities and community infrastructure* and *Attitudes, Beliefs and Values* the most. Gear modifications can compromise business planning for shoreside support services and impose an economic burden on

a large number of vessels. The social impacts likely to result from changes to gear restrictions are related to the cost for vessels to comply with and the ability of gear suppliers to adapt to the new gear restrictions. If the new gear required is not readily available, gear suppliers must order the gear well in advance of the effective date of the new regulation. In addition, new gear requirements can sometimes leave gear suppliers with a significant amount of the "old gear" that may no longer be marketable if it cannot be used in the fishery anymore (or in other fisheries). This results in a more significant loss of income for the gear suppliers.

Gear modifications place an additional economic burden on all affected fishing vessels. The ability to adapt to the new gear regulations will depend on vessels' current economic situation and ability to cover the short-term costs of the gear. If the new gear requirement is significantly different from current gear requirements, it is likely that the most marginal vessels will not be able to cover the costs of the new gear and will be forced to seek alternative fisheries or stop fishing altogether. For the vessels that can cover the short-term costs of the gear, long-term impacts are related more to the loss of revenues from fishing that may occur because of the new gear. For example, the ground cable modifications may affect the catch per unit effort of affected vessels. Thus a vessel may have to increase effort, such as longer tows or more tows to achieve the same amount of catch. Over the long-term, this may result in more significant economic impacts and, ultimately, more severe dislocation of vessels in the fishery.

Modifications to daily routines can make long-term planning difficult. New gear and equipment must be ordered months in advance resulting in changes to daily routines when these modifications cannot be met in a time and cost efficient manner. Additionally, the gear modifications will have differing impacts on vessels depending on their size class. According to informational interviews held by the Council, the requirement that bottom trawl vessels use ground cables modified with elevating disks was estimated by participants to have a more significant impact on smaller vessels that may not have enough horse power to pull the gear through rugged bottom. In contrast, the requirement for shorter ground cables or eliminating ground cables entirely may have greater impacts on larger vessels that are more difficult to operate with smaller cables.

The gear modification and exemptions apply differently to different fisheries with varying levels of restriction. Option 2 would exempt hydraulic clam dredges, while the gear restrictions (Options 3 and 4) would only apply to bottom trawl vessels. The differing levels of restrictions on different fisheries could have a negative social impact, exacerbating conflicts between fisheries and negatively affecting the *Social Structures and Organizations* of a community, as well as having a negative impact on formation of *Attitudes and Beliefs* about management if users of particular gear types feel they are being unfairly restricted in comparison to others.

The magnitude and nature of the impacts of the gear restrictions under consideration in the Omnibus Amendment will depend on the cost and catch efficiency of the new gear, the current availability of the new gear, and vessels' choices as to whether or not to fish in the areas where the new gear is required. There are potential long-term positive social impacts of gear restrictions if they have significant benefits on habitat conservation, resulting in higher, sustained levels of catch; however these benefits are highly uncertain.

The impacts on the *Attitudes, Beliefs, and Values* of the non-fishing public concerned about marine conservation from the alternatives that would implement gear modifications or restrictions instead of closures are likely to be indirect and moderately negative. It is likely that this would equivalent to the impacts from removing the closed areas, but without the mitigation that smaller, better sited closures would be just as or more effective.

4.1.4.2.2 Groundfish spawning alternatives

Although the purposes of these actions differ (i.e., protecting habitat and spawning groundfish, respectively), the general social impacts of the groundfish spawning protection alternatives are similar to those associated with habitat management alternatives. Additional social impacts specific to the groundfish spawning protection alternatives generally impact the *Attitudes, Beliefs, and Values* of fishermen. Negative impacts on *Attitudes, Beliefs, and Values* may be based on perceptions of differing levels of impact to particular gear types or fisheries. For example, the spawning protection areas are identified to improve groundfish spawning protection; however the restrictions impact a wide range of vessels capable of catching groundfish, including those where groundfish may not be the primary target and where retention and sale of groundfish is prohibited. This may cause resentment among fishermen using gear types that are capable of catching groundfish and will be affected by the restrictions, but do not target groundfish and are thus unlikely to benefit from future groundfish spawning improvement, negatively affecting the *Social Structures and Organizations* of a community.

The options to exempt recreational fishing may also have impacts on *Attitudes, Beliefs, and Values* of fishermen. These are likely to be positive impacts on the recreational fishery and negative impacts on the commercial fishery. These differing impacts may also affect the *Social Structures and Organizations* of a community. The social impacts of the proposed alternatives that include recreational fisheries are difficult to discern, in part because many participants are not associated with a primary or secondary port group; passengers on party/charter vessels come from a wide area and are often not specifically associated with a fishing community.

There may also be positive impacts on the *Attitudes, Beliefs, and Values* of members of the groundfish fishery related to the shift in management from a focus on mortality closures, which are viewed as no longer necessary due to output controls in the fishery, to spawning protection. However, some members of the fishery that participated in informational interviews conducted by the Council mentioned that due to these output controls there is no need for additional spawning protection.

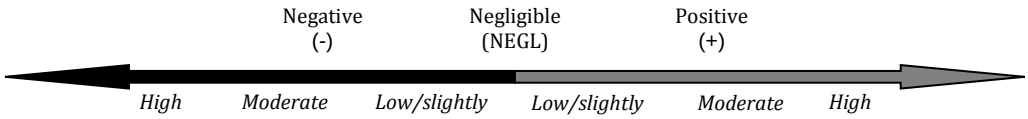
Indirect, moderate positive impacts on the *Attitude, Beliefs, and Values* of the non-fishing public who are concerned with the management of the ocean and living marine resources are expected from the spawning alternatives that improve fisheries management and improve the likelihood of successful rebuilding of culturally and historically important species, such as cod. Moderate, negative indirect impacts would be expected if the general belief was that management has missed an opportunity to protect fish stocks and other marine resources.

4.1.5 Terminology used to describe the relative impacts of the alternatives

Throughout the following sections, the following terminology is used to describe the impacts of the alternatives on the valued ecosystem components (VECs).

Table 32 – Impact definitions

Impact Definition			
	Direction		
VEC	**Positive (+)**	**Negative (-)**	**Negligible (Negl)**
Allocated target species, other landed species, and protected resources	Actions that increase stock/population size	Actions that decrease stock/population size	Actions that have little or no positive or negative impacts to stocks/populations
Physical Environment/ Habitat/EFH	Actions that improve the quality or reduce disturbance of habitat	Actions that degrade the quality or increase disturbance of habitat	Actions that have no positive or negative impact on habitat quality
Human Communities	Actions that increase revenue and social well-being of fishermen and/or associated businesses	Actions that decrease revenue and social well-being of fishermen and/or associated businesses	Actions that have no positive or negative impact on revenue and social well-being of fishermen and/or associated businesses
Impact Qualifiers			
Low/Slightly (as in low positive or low negative)	To a lesser degree		
Moderate (as in moderately positive or moderately negative)	To an average degree (i.e., more than "low", but not "high")		
High (as in high positive or high negative)	To a substantial degree		
Likely	Some degree of uncertainty associated with the impact		



4.2 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats

This section evaluates the impacts of the habitat management alternatives on the physical and biological environment, large mesh groundfish stocks and their habitats, human communities and the fishery, and protected resources. Additional discussion of the impacts of these alternatives on non-large mesh groundfish resources, and fishery-specific human impacts, are discussed in section 4.6.

4.2.1 Physical and biological environment

The tables, figures, and maps in the sections below summarize habitat vulnerability and habitat type by management area. These results can be used to evaluate the impacts of the habitat management alternatives on the physical and biological environment. All of these data are described in greater detail in the affected environment section, and in the SASI appendix. Mobile gear results are the focus of these tables, figures, and maps because these gears were estimated to have a greater impact on seabed habitats as compared to fixed gears, and as such are the focus of adverse effects minimization management measures.

- The first table in each section shows the coverage of each dominant substrate (mud, sand, granule-pebble, cobble, and boulder) as a percentage of total area, according to the unstructured SASI substrate grid. A grid was considered overlapping if its center point (centroid) fell inside the management area. Coverage is grouped by high and low energy (the SASI model uses different parameters for high vs. low energy habitats). These values can be compared to values for the region overall, which are shown in the last row.
- The second table shows the level of data support/data quality associated with those substrate grids (see Volume 1 and Appendix D for details on how the data support values were assigned). Higher percentages for the larger data support values (5-7) indicate full sampling of all substrate types and progressively smaller grid sizes. Lower data support values (1-4) indicate sampling of only mud, sand, and granule-pebble size classes, with values of 1 indicating the largest cell size. Again, values in individual areas can be compared to regional values in the last row.
- The third table shows the minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area. As above, a grid was considered overlapping if its center point (centroid) fell inside the management area. The associated figures are kernel density plots, which show a smoothed distribution of trawl vulnerability scores by area, and are similar to histograms. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. Note that the scale on the horizontal (X) axis varies by region. A density plot cannot be created when there is only a single grid cell overlapping a particular management area, so some management areas are not shown on these plots.
- The maps show the spatial distribution of (1) dominant substrate, (2) data support, and (3) trawl vulnerability scores and LISA clusters, overlaid by the various alternative areas. The meaning of the LISA clusters is described in Volume 1, Section 4.2.2.1, and also in Appendix D. Briefly, these clusters represent 100 km^2 SASI model grid cells that meet two conditions: (1) they have vulnerability scores that are well above average, and (2) they are in a neighborhood of above-average vulnerability grids. The LISA clusters were used as a starting point for identifying some of the management areas proposed in this amendment.

As noted above, substrate, data support, and vulnerability information is summarized by region for comparison with the management areas. Regional boundaries are the ecological production

units identified by the Northeast Fisheries Science Center (Ecosystem Assessment Program 2012), with the Scotian Shelf and Gulf of Maine units combined for this analysis.

4.2.1.1 *Eastern Gulf of Maine*

There are three habitat management alternatives for the Eastern Gulf of Maine sub-region: (1) no action/no HMAs, (2) Machias and Eastern Maine Large areas, and (3) Machias, Eastern Maine Small, and Toothaker Ridge areas. For Alternative 2, each area could have any one of management options 1-5, and for Alternative 3, each area could have any one of management options 1-4.

Table 33 – EGOM: dominant substrate coverage within each management area.

Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
Habitat management areas											
Large Eastern Maine (112, #2)	85%	-	8%	7%	-	-	-	-	-	-	1,697
Small Eastern Maine (50, #3)	59%	-	19%	21%	-	-	-	-	-	-	529
Machias (48, #2 and 3)	-	-	27%	-	-	34%	34%	3%	1%	-	322
Toothaker Ridge (8, #3)	79%	-	21%	-	-	-	-	-	-	-	748
GOM/Scotian Shelf Region (5,772)	**66%**	**20%**	**7%**	**1%**	**1%**	**1%**	**3%**	**1%**	**<1%**	**<1%**	**58,036**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 34 – EGOM: data support within each management area.

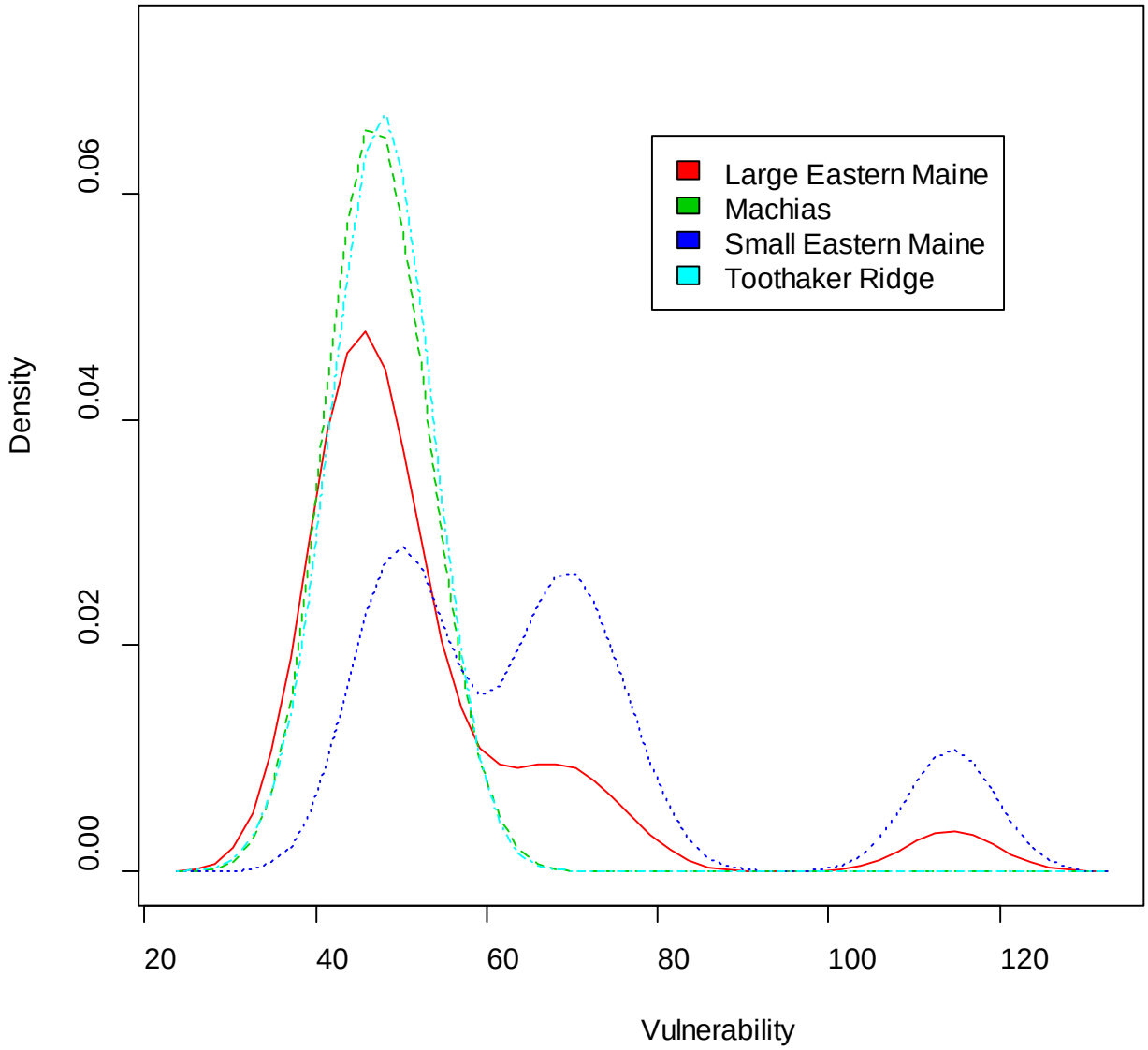
Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
Habitat management areas								
Large Eastern Maine (112, #2)	-	89%	11%	<1%	-	-	-	1,697
Small Eastern Maine (50, #3)	-	81%	19%	1%	-	-	-	529
Machias (48, #2 and 3)	-	57%	42%	1%	-	-	-	322
Toothaker Ridge (8, #3)	78%	23%	-	-	-	-	-	748
GOM/Scotian Shelf Region (5,772)	**38%**	**45%**	**11%**	**1%**	**2%**	**2%**	**<1%**	**54,640**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

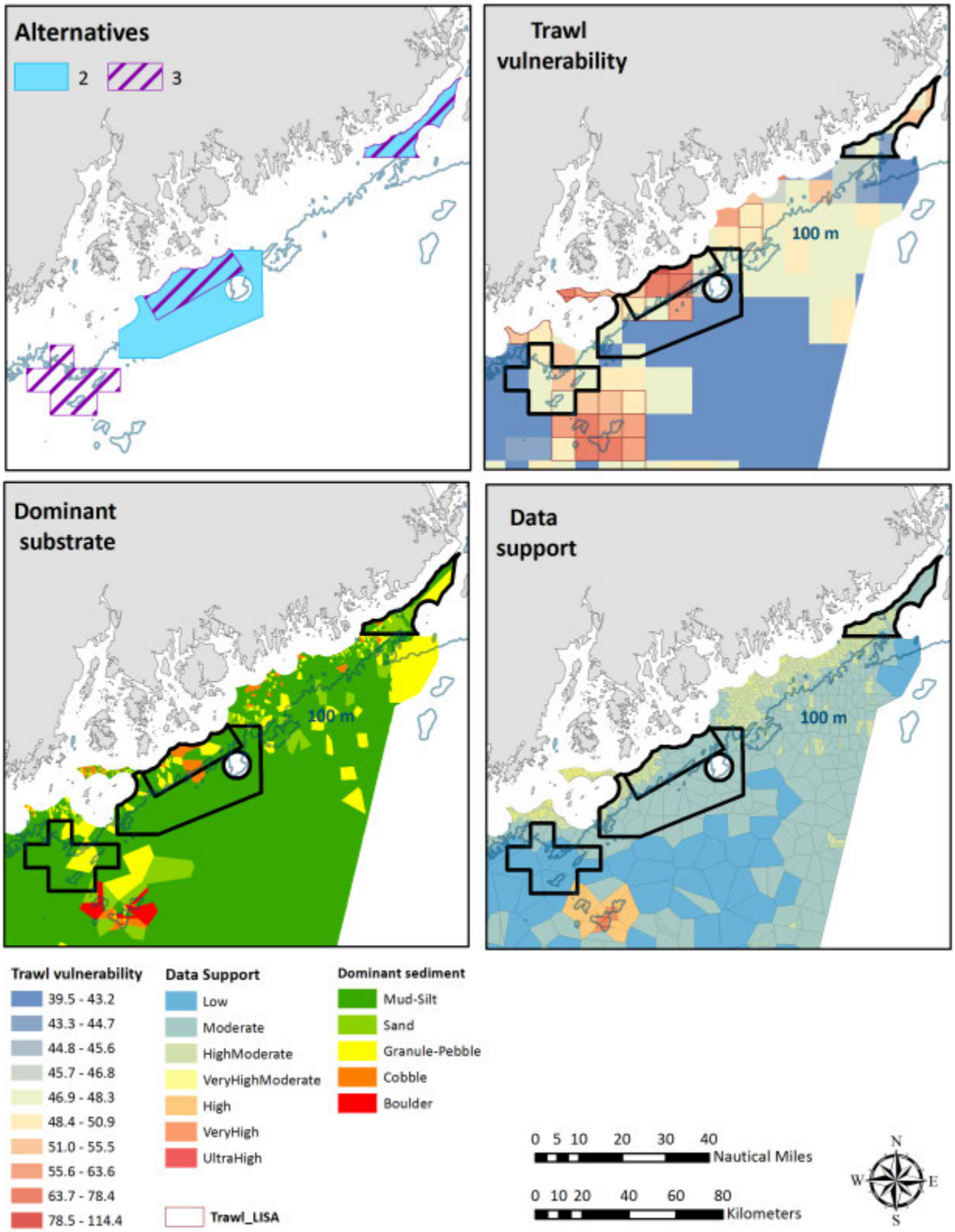
Table 35 – EGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear (83m).

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
Habitat Management Area (Alternative #)									
Small Eastern Maine (#3)	48.1	114.4	*7*	48.0	115.6	*5*	147.9	156.1	*6*
Large Eastern Maine (#2)	41.8	114.4	*21*	48.0	115.6	*5*	147.9	156.1	*11*
Machias (#2 and 3)	44.5	53.6	*9*	46.0	56.0	*8*	108.1	157.3	*9*
Toothaker Ridge (#3)	41.9	52.3	*7*	-	-	-	142.6	156.5	*6*
GOM/Scotian Shelf region	**41.2**	**100.4**	***575***	**44.5**	**91.7**	***56***	**108.0**	**159.9**	***146***

Figure 10 – EGOM: distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.



Map 44 – EGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear).



4.2.1.1.1 Alternative 1 (No Action/No Habitat Management Areas)

Under Alternative 1/No Action, fishing with mobile bottom-tending gears would continue in the region without any restrictions related to adverse effects minimization. There would be no specific protection provided for benthic habitats through limits on the use of these gears. This alternative would be expected to have neutral impacts, compared to the baseline environmental condition because, while no additional habitat protection would be implemented, the relatively small amount of mobile gear fishing that occurs in this sub-region means that the realized impacts from the action alternatives would be less than in other sub-regions, which have more mobile bottom-tending gear fishing. Alternative 1/No Action has slightly negative impacts relative to Alternative 2 Options 1, 2, and 5, and relative to Alternative 3 Options 1 and 2, all of which do provide specific protections to vulnerable habitat types from mobile bottom-tending gear impacts. Alternative 1/No Action has neutral impacts relative to Alternatives 2 and 3. Options 3 and 4, which have uncertain impacts that are likely small in magnitude but could be positive or negative. In general, because there is not a substantial amount of mobile bottom-tending gear fishing effort within the habitat management areas in this sub-region, there is a smaller difference in impacts between the no action and action alternatives in this sub-region relative to the other sub-regions.

4.2.1.1.2 Alternative 2 (Preferred, Options 1 and 5)

Alternative 2 includes the Large Eastern Maine and Machias HMAs. Both the Large Eastern Maine HMA in this alternative and the Small Eastern Maine Area in Alternative 3 cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 44, as well as regional substrate maps in Volume 1). Based on these substrate distributions and the SASI vulnerability results (Table 35, trawl vulnerability panel in Map 44) , the Large Eastern Maine HMA is less efficient at encompassing vulnerable habitats as compared to the Small Eastern Maine HMA, which is a subset of the larger area. Specifically, although the absolute amount of complex habitats encompassed may be larger, the additional area covered by the Large Eastern Maine HMA as compared to the Small Eastern Maine HMA appears to contain less vulnerable seabed types. However, this assessment is uncertain because data support in this region is relatively poor (data support panel in Map 44).

The Machias HMA also contains rocky substrates, but currents along the seabed in this area are high, and the area is classified as high energy (Table 33). According to the SASI vulnerability assessment, this means habitats in the Machias area are likely somewhat less vulnerable to accumulating adverse effects of fishing due to more rapid recovery times associated with high energy habitats vs. low energy habitats. Data support values in the Machias HMA are low, so dominant substrate maps and therefore vulnerability estimates are uncertain. Another consideration is that the Machias HMA overlaps the Machias Seal Island Grey Zone, which is the result of completing exclusive economic zone boundary claims between the U.S. and Canada. Thus, even if the Machias HMA is designated as a mobile bottom-tending gear closure that applies to U.S. vessels, Canadian trawl and dredge vessels could still operate in the area, which would undermine the effectiveness of the mobile bottom-tending gear closure.

Alternative 2 Options 1 and 2 are expected to reduce the adverse effects of fishing on the seabed in the identified areas, and improve habitat protection, resulting in slightly to moderately positive

impacts, relative to the no action alternative (Alternative 1). The impacts of Options 1 and 2 are equivalent in this sub-region because there is currently no hydraulic clam dredging, although there is dredging with toothed clam dredges in this part of the Gulf of Maine, which would not be exempted under Option 2. In terms of mobile bottom-tending gear activity, there is relatively limited use of generic otter trawls, shrimp trawls, scallop dredges, and clam dredges in this sub-region as compared to other sub-regions (see the realized adverse effects maps in the affected environment section). Therefore, as noted above, the magnitude of this positive impact may be somewhat less than in other sub-regions where mobile bottom-tending gears generate more adverse effects.

Alternative 2 Options 1 and 2 are expected to have fewer positive impacts on seabed habitats than Alternative 3 Options 1 and 2. Although the Eastern Maine area in Alternative 2 is larger, the portions of this area that are further offshore are expected to be somewhat less vulnerable to mobile bottom-tending gear fishing impacts and the alternative provides no protection for the habitats and species within the Toothaker Ridge area.

The impacts of Alternative 2 Options 3 and 4 are uncertain. They could be slightly negative relative to Alternative 1/No Action if catch efficiency declines with the modified gear (Option 3 or 4). Alternately, impacts could be slightly positive if some trawl effort is displaced from the areas because vessels choose not to adopt the modified gear, or if the ground cables with rollers effectively reduce contact of the gear with the seabed. Because it is difficult to estimate the impacts of Alternative 2 Option 3 or 4, it is difficult to compare these impacts with Alternative 3, Options 3 or 4.

The addition of Option 5 (closure to all gear capable of catching groundfish) would make little difference in terms of reduction of fishing impacts on the seabed relative to selection of Option 1 alone. As described below in the economic impacts section (4.2.3.1.2), the vast majority of additional effort that would be restricted under this option is from purse seine gear, which is not considered to be bottom-tending and therefore is not expected to cause adverse impacts on seabed habitats.

4.2.1.1.3 Alternative 3

Alternative 3 includes the Small Eastern Maine, Machias, and Toothaker Ridge HMAs. All three areas cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 44).

Similar to Alternative 2, Alternative 3 Options 1 or 2 would be expected to reduce the adverse effects of fishing on the seabed in the identified areas, and improve habitat protection, resulting in slightly to moderately positive impacts relative to Alternative 1/No Action. The impacts of Options 3 and 4 are uncertain, but are likely small in magnitude. The Eastern Maine Small area that is part of this alternative more efficiently overlaps with highly vulnerable habitats identified by the SASI approach. Inclusion of the Toothaker Ridge area with Option 1 or 2 fishing restrictions would improve seabed habitat protection in the sub-region, although it appears that the habitat type within the Toothaker Ridge area is relatively less vulnerable and consists mainly of mud-dominated areas. However, data quality for Toothaker is relatively low, and does not

include sampling that could detect cobble and boulder substrates, so our understanding of seabed characteristics in this area is very uncertain.

As noted in the previous section, Alternative 3 is expected to have a slightly greater positive impact on seabed habitats as compared to Alternative 2 because the Small Eastern Maine area contains a greater proportion of vulnerable habitats than the Large Eastern Maine area, and Alternative 3 provides protection for the habitats and species within the Toothaker Ridge area.

4.2.1.1.4 Overlap with preferred alternative EFH designations

The eastern Gulf of Maine HMAs are fairly close to shore in relatively shallow waters, which influences their overlap with particular species and lifestages. For example, juvenile redfish and witch flounder EFH designations generally have high overlap with the areas, but adult redfish and witch flounder EFH is generally in deeper waters and has less overlap. The areas correspond well with cod and halibut EFH, and also with EFH for red, white, and silver hake. The deeper Large Eastern Maine and Toothaker areas have high overlap with monkfish EFH. There is some overlap with herring egg EFH, which is noteworthy as herring egg EFH is only designated in small areas throughout the region. The areas also overlap with EFH for various skate species, particularly thorny skate. There is more limited overlap with the EFH for some other stocks, including American plaice, haddock, ocean pout, pollock, windowpane flounder, winter flounder, and yellowtail flounder. The exception is that there is high or full overlap between designated pollock EFH and the Toothaker Ridge HMA. There is a high degree of overlap between scallop and wolffish EFH and the management areas in this sub-region, but both designations are very general as discussed in section 4.1.2.4.

Alternative 2 includes the Small Eastern Maine and Machias HMAs, and Alternative 3 includes the Large Eastern Maine and Machias HMAs. The Small Eastern Maine area (Alternative 2) is a subset of the Large Eastern Maine area (Alternative 3), so they have similar overlap with the various EFH designations. Adding the Toothaker Ridge HMA via Alternative 3 improves overlap with pollock, witch flounder, and adult haddock EFH. Otherwise, the two alternatives appear to be similar in terms of their EFH conservation benefits, which is evident from the three quantitative metrics (total score, total species, total designations), which are similar across the four management areas. Relative to other sub-regions, the numeric metrics for the eastern Gulf of Maine areas are relatively high.

Table 36 – Preferred alternative EFH designations within Eastern GOM HMAs.

Species and lifestage (those in red occupy complex hard bottom seabed types that are more vulnerable to fishing)	Machias Alt 2, 3	Small Eastern Maine Alt 3	Large Eastern Maine Alt 2	Toothaker Ridge Alt 3
Acadian redfish juvenile	High	High	High	High
Acadian redfish adult	Slight	Slight	Slight	Slight
American plaice juvenile	Moderate	**Full**	Moderate	High
American plaice adult	Slight	**Full**	High	**Full**
Atlantic cod juvenile	High	**Full**	Moderate	Moderate
Atlantic cod adult	High	**Full**	High	High
Atlantic halibut - all stages	High	High	Moderate	High
Atlantic wolffish - all stages	**Full**	**Full**	**Full**	**Full**
Haddock juvenile	High	**Full**	Moderate	High
Haddock adult	Slight	Moderate	Moderate	High
Ocean pout egg	High	Moderate	Slight	Slight
Ocean pout juvenile	High	Moderate	Slight	Moderate
Ocean pout adult	Slight	Slight	Slight	Moderate
Pollock juvenile	Moderate	**Full**	High	**Full**
Pollock adult	Slight	*None*	Slight	High
Red hake egg, larvae, and juvenile	High	**Full**	High	High
Red hake adult	Slight	High	High	**Full**
Silver hake juvenile	High	**Full**	**Full**	**Full**
Silver hake adult	High	**Full**	**Full**	**Full**
White hake juvenile	High	**Full**	**Full**	**Full**
White hake adult	High	High	High	High
Windowpane flounder juvenile	Moderate	High	Moderate	Slight
Windowpane flounder adult	Slight	Moderate	Slight	Slight
Winter flounder egg	Moderate	Slight	Slight	Slight
Winter flounder larvae and adult	High	High	Moderate	Slight
Winter flounder juvenile	High	High	Moderate	Slight
Witch flounder juvenile	Slight	**Full**	**Full**	**Full**
Witch flounder adult	Slight	Moderate	Moderate	High
Yellowtail flounder juvenile	Slight	Slight	Slight	Slight
Yellowtail flounder adult	Moderate	Moderate	Moderate	Moderate
Monkfish juvenile	High	**Full**	High	**Full**
Monkfish adult	Slight	Moderate	High	**Full**
Smooth skate juvenile	High	Slight	Moderate	High
Smooth skate adult	Slight	Slight	Slight	Slight
Thorny skate juvenile	High	Moderate	High	High
Thorny skate adult	Slight	High	High	High
Barndoor skate – juv/adu	*None*	Slight	Slight	Slight
Little skate juvenile	High	Moderate	Moderate	Moderate
Little skate adult	High	High	Moderate	Moderate
Winter skate juvenile	High	Moderate	Moderate	Slight
Winter skate adult	*None*	Slight	Slight	Slight
Atlantic sea scallop - all	High	**Full**	High	**Full**
Atlantic herring egg	Moderate	*None*	Slight	*None*
Total score	**91**	**97**	**91**	**96**
Count of species represented (out of 23)	**22**	**22**	**23**	**22**
Count of designations represented (out of 43)	**41**	**41**	**43**	**42**

4.2.1.1.5 Species diversity

Table 37 shows groundfish diversity, regulated species diversity, and all species diversity for the eastern Gulf of Maine habitat management alternatives. Alternatives with the highest diversity values (75th percentile of each season) for each diversity index across all alternatives in all sub-regions are shaded (red=groundfish, yellow=regulated species, green=all species).

In the spring, diversity of each species group is higher in Alternative 3 areas than in Alternative 2 areas. This implies that Alternative 3 areas could have more positive effects for all species groups than Alternative 2 areas.

In the summer, groundfish diversity in Alternative 2 areas was one of the highest in the sub-region, implying a greater potential for groundfish species conservation as compared to Alternative 3 areas. Regulated species and all species diversity were lower in Alternative 2 areas than Alternative 3 areas, however. This indicates Alternative 3 areas could be more beneficial for a broader range of species beyond groundfish.

Fall diversity of each species group in Alternative 2 and 3 areas are nearly equal, indicating a marginal difference in the potential positive benefits for each species group. Groundfish and all species diversity were slightly higher in Alternative 3 areas, while regulated species diversity was slightly higher in Alternative 2 areas.

Overall, diversity of each species group in the eastern Gulf of Maine is highest in the winter. Alternative 3 areas are more diverse with respect to groundfish and regulated species while all species diversity in Alternative 2 areas was greater than in Alternative 3 areas. This implies that Alternative 3 could potentially have the greatest amount of positive benefits for groundfish and regulated species, while Alternative 2 could best benefit all species.

These diversity index values can be compared to the diversity indices for areas in other sub-regions by reviewing the species diversity summary (Section 4.2.3) in Volume 1. The red, yellow, and green highlighted values for each index are above the 75th percentile for that index across all habitat management alternatives in all sub-regions. Thus, the large number of highlighted values indicates a relatively high species diversity within the eastern Gulf of Maine sub-region management alternatives relative to other alternatives proposed in this amendment.

Table 37 – Average diversity indices within the eastern Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted.

		Alternative		
		1	2	3
Spring	*Tows*	*0*	*44*	*26*
	Lg mesh groundfish ISI	0.000	0.609	0.633
	Regulated spp. ISI	0.000	0.626	0.651
	All spp. SDI	0.000	1.611	1.632
Summer	*Tows*	*0*	*9*	*17*
	Lg mesh groundfish ISI	0.000	0.682	0.616
	Regulated spp. ISI	0.000	0.405	0.521
	All spp. SDI	0.000	1.462	1.537
Fall	*Tows*	*0*	*17*	*11*
	Lg mesh groundfish ISI	0.000	0.510	0.538
	Regulated spp. ISI	0.000	0.593	0.591
	All spp. SDI	0.000	1.519	1.522
Winter	*Tows*	*0*	*4*	*2*
	Lg mesh groundfish ISI	0.000	0.637	0.716
	Regulated spp. ISI	0.000	0.756	0.814
	All spp. SDI	0.000	2.063	1.952

4.2.1.2 ***Central Gulf of Maine***

There are four habitat management alternatives for the Central Gulf of Maine sub-region: (1) no action Cashes Ledge and Jeffreys Bank Habitat Closure Areas and no action Cashes Ledge Groundfish Closed Area, (2) no HMAs, (3) modified Cashes Ledge, Ammen Rock, modified Jeffreys Bank, Fippennies Ledge, and Platts Bank and (4) Modified Cashes Ledge, Ammen Rock, and Modified Jeffreys Bank. For alternatives 3 and 4, each area except Ammen Rock, which would be closed to all fishing except lobster trapping, could have any one of the four options.

In this sub-region, the management areas tend to have coarser substrates, higher levels of data support, and higher vulnerability than the Gulf of Maine region as a whole.

Table 38 – CGOM: dominant substrate coverage within each management area

Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Cashes Ledge EFH (90, #1)	36%	29%	22%		9%					4%	392
Jeffreys Bank EFH (35, #1)	41%	20%	21%	14%	5%						504
No action groundfish											
Cashes Ledge GF (188, #1)	65%	20%	10%		3%					1%	1,428
Habitat management areas											
Ammen Rock (14, #3 and 4)		7%		7%	7%		8%		7%	65%	14
Modified Cashes Ledge (86, #3 and 4)	37%	22%	25%		11%					4%	335
Fippennies Ledge (41, #3)		40%	32%	11%	16%						41
Modified Jeffreys Bank (39, #3 and 4)	9%	36%	20%	13%	22%						521
Platts Bank (54, #3)		34%	15%	9%	14%		11%	5%	5%	8%	63
GOM/Scotian Shelf Region (5,772)	**66%**	**20%**	**7%**	**1%**	**1%**	**1%**	**3%**	**1%**	**<1%**	**<1%**	**58,036**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 39 – CGOM: data support within each management area.

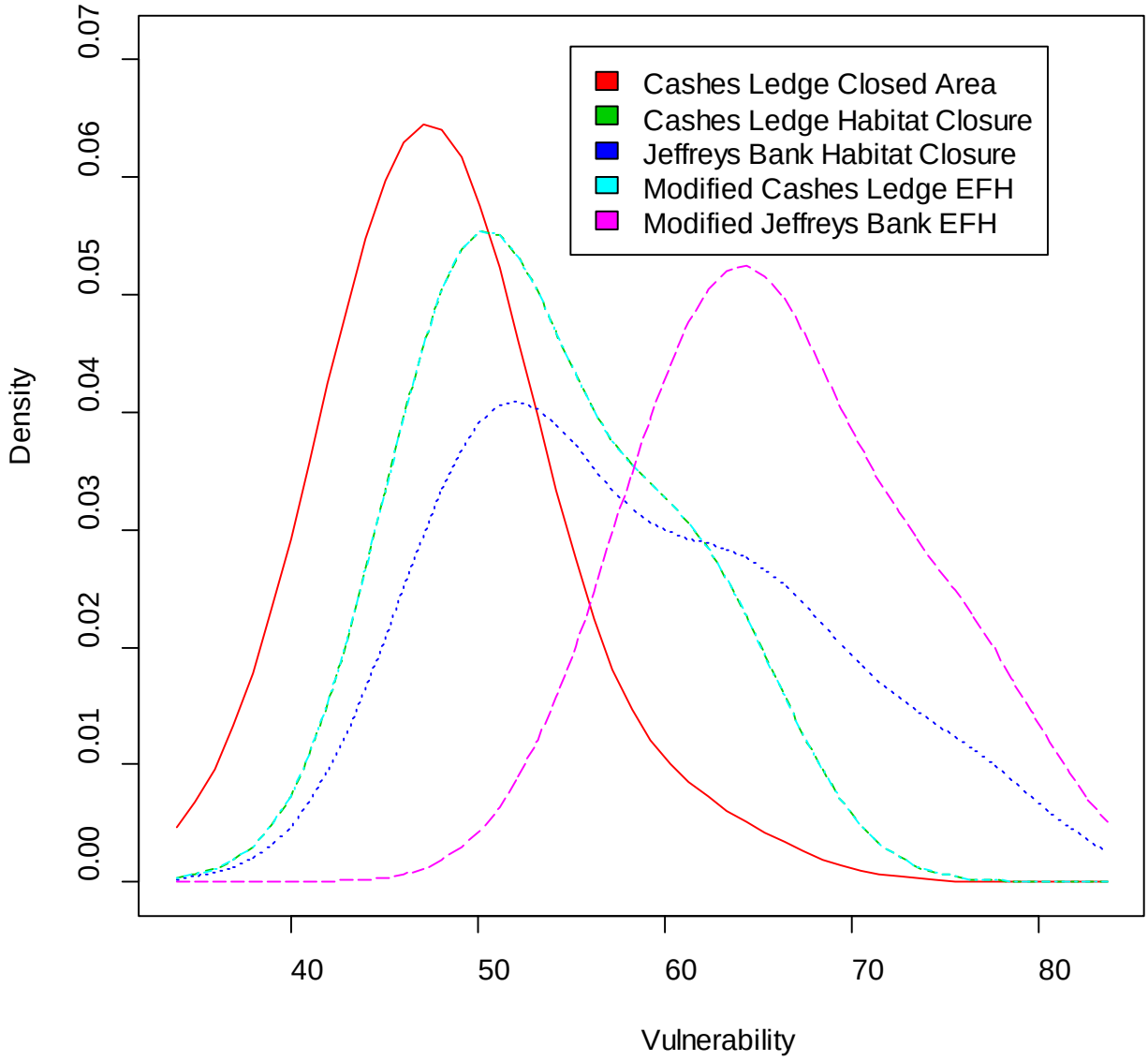
Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Cashes Ledge EFH (90, #1)	-	53%	11%	1%	8%	23%	5%	392
Jeffreys Bank EFH (35, #1)	27%	28%	-	-	32%	12%	1%	504
No action groundfish								
Cashes Ledge GF (188, #1)	15%	53%	5%	<1%	11%	13%	3%	1,428
Habitat management areas								
Ammen Rock (14, #3 and 4)	-	-	-	-	-	30%	70%	14
Modified Cashes Ledge EFH (86, #3 and 4)	-	56%	13%	1%	-	24%	6%	335
Fippennies Ledge (41, #3)	-	-	-	3%	-	44%	54%	41
Modified Jeffreys Bank EFH (39, #3 and 4)	-	18%	-	-	69%	12%	1%	521
Platts Bank (54, #3)	-	-	-	-	-	65%	35%	63
GOM/Scotian Shelf Region (5,772, n/a)	**38%**	**45%**	**11%**	**1%**	**2%**	**2%**	**<1%**	**54,640**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

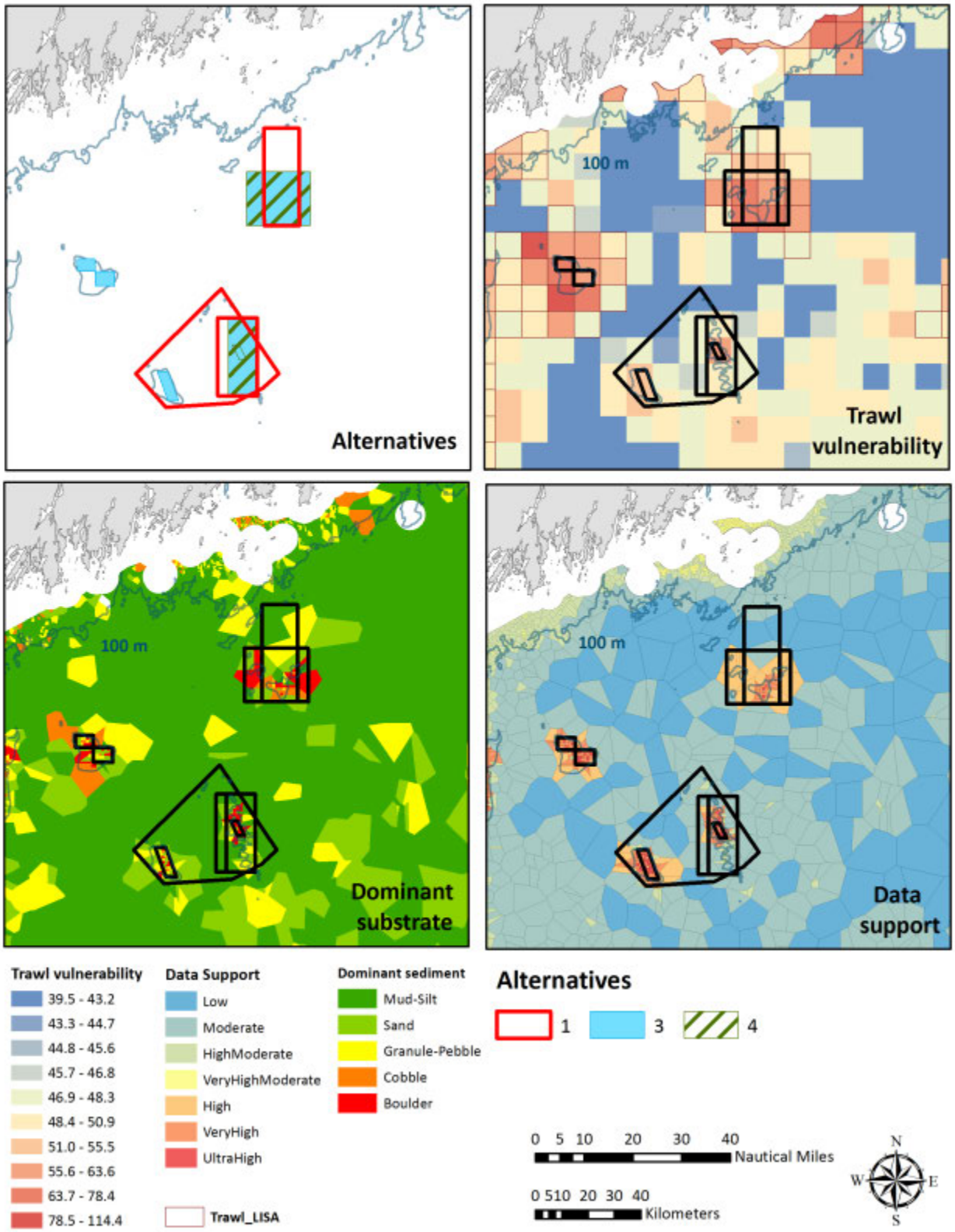
Table 40 – CGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
EFH closure (Alt #)									
Cashes Ledge EFH (#1)	49.7	61.2	*3*	-	-	-	133.5	148.1	*3*
Jeffreys Bank EFH (#1)	47.9	75.3	*8*	-	-	-	134.5	155.3	*7*
Groundfish closure (Alt #)									
Cashes Ledge GF (#1)	42.1	61.2	*15*	-	-	-	132.6	148.1	*7*
Habitat Management Area (Alt #)									
Ammen Rock (#3 and 4)	61.2	61.2	*1*	-	-	-	145.2	145.2	*1*
Modified Cashes Ledge EFH (#3 and 4)	49.7	61.2	*3*	-	-	-	133.5	148.1	*3*
Fippennies Ledge (#3)	52.9	52.9	*1*	-	-	-	139.1	139.1	*1*
Modified Jeffreys Bank EFH (#3 and 4)	59.1	75.3	*4*	-	-	-	134.5	140.4	*4*
Platts Bank (#3)	63.0	63.0	*1*	65.2	65.2	*1*	142.0	142.0	*1*
Gulf of Maine region	**41.2**	**100.4**	***575***	**44.5**	**91.7**	***56***	**108.0**	**159.9**	***146***

Figure 11 – CGOM: Distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. The Ammen Rock, Platts Bank, and Fippennies Ledge areas are not shown because only a single grid overlaps them and therefore a density distribution cannot be generated. The Cashes Ledge Habitat Closure and Modified Cashes Ledge EFH area overlap the same set of SASI grid cells and therefore their vulnerability distributions overlap completely in the figure below.



Map 45 – CGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear).



4.2.1.2.1 Alternative 1 (No Action)

The three no action areas encompass a mix of shallower hard substrate areas containing granule-pebble, cobble, and boulder-dominated habitats on top of Cashes Ledge, Fippennies Ledge, and Jeffreys Bank, as well as deeper muddy habitats between Cashes and Fippennies Ledges and north of Jeffreys Bank (Map 45). In the shallow, relatively hard bottomed areas where sampling of all substrate types was possible with video, data support is relatively higher (lower right panel of Map 45). The deep mud habitats were sampled at a relatively low rate, and data support was classified as low or moderate (Map 45). However, these deeper waters substrate classifications are relatively accurate according to general knowledge of sediment distributions in the Gulf of Maine. In general, the areas around the shallow ledge and bank features are predominantly muddy, and the ledges and banks themselves are relatively gravelly; it is the distribution of grids in the sediment map (dominant substrate panel of Map 45) that is imprecise.

The ledge and bank features included in Alternative 1/No Action areas contain habitat types highly vulnerable to fishing (Map 45, Table 40). However, some of the large cobble, and boulder grids at the edges of Jeffreys Bank have an influence on the vulnerability results, such that the vulnerability scores for this area are probably biased high, and the size and shape of the highly vulnerable area is somewhat inflated. This is obvious on Map 45, and also in the density plot (Figure 11), where the curves for Jeffreys Bank (both the existing EFH area and especially the modified area in Alternatives 3 and 4) are shifted to the right as compared to the other areas in this region. The deeper mud habitats around the ledges and banks are estimated to be less vulnerable to impact than the cobble- and boulder-dominated habitats on the banks and ledges (i.e., see the lower vulnerability scores for the Cashes Ledge GF area (Table 40, Figure 11), which includes a greater proportion of mud than the Cashes Ledge EFH area (Table 38).

<u>Overall, Alternative 1/No Action reduces the adverse effects of fishing and generates a highly positive impact on seabed habitats</u> because the existing habitat and groundfish areas cover vulnerable seafloor and are currently closed to many types of fishing with mobile bottom tending gears. Although it is difficult to assess the extent to which they displace the fishing effort to other vulnerable habitats, the ledge and bank features encompassed by these management areas are among the most highly vulnerable in the sub-region. Historically, there was a greater magnitude of generic otter trawl fishing effort and adverse effects in the central Gulf of Maine region, including within these areas (see realized adverse effects maps in Volume 1), but it seems unlikely that effort would return quickly to pre-closure levels under current conditions given lower levels of groundfishing effort region-wide. Although the habitat closure areas are off limits to all mobile-bottom tending gears, sea scallops and scallop dredge adverse effects are limited in their distribution in the Central Gulf of Maine given the distribution of the scallop resource. Clam dredge adverse effects are probably non-existent within these management areas, since in this sub-region, clam dredging appears to only occur in areas closer to shore.

<u>Alternative 1/No Action has highly positive impacts on seabed habitats relative to Alternative 2 and relative to Alternatives 3 and 4 Options 3 and 4 (see discussion in the following sections). Alternative 1/No Action has slightly negative impacts relative to Alternative 3 Options 1 and 2, and neutral impacts relative to Alternative 4 Options 1 and 2, assuming the objective is to protect the most vulnerable seabed habitat types (see additional discussion below).</u>

4.2.1.2.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Alternative 2 would allow mobile bottom-tending gear fishing effort over vulnerable habitats. It is expected that otter trawling would be the primary fishing activity since the scallop and clam fisheries are fairly limited in extent in the Central GOM as noted above, although in 2013 there was an increase in scallop effort on Platts Bank (see section 4.6.4 below for scallop fishery impacts discussion). Alternative 2 would be expected to increase adverse effects and therefore have moderately to highly negative impacts relative to Alternative 1/No Action, and relative to Alternatives 3 and 4, Options 1 and 2. Alternative 2 would likely have neutral to slightly negative impacts relative to Alternatives 3 and 4 Options 3 and 4, because the impacts of these alternatives are generally uncertain but may not be much different from a no-closure scenario, except for enhanced protections of Ammen Rock.

4.2.1.2.3 Alternative 3

The HMAs included in Alternative 3 were designed to efficiently encompass areas of vulnerable seabed while allowing fishery access to adjacent habitats. This alternative includes modified versions of the existing Cashes Ledge and Jeffreys Bank Habitat Closure Areas that were designed to encompass areas shallower than approximately 100 m depth known to contain gravel (granule-pebble, cobble, and boulder) substrates. Generally, the portions of the ledge and bank features included in Alternative 3 have high data support values of 5, 6, or 7 (Table 39). Ammen Rock, Fippennies Ledge, Modified Jeffreys Bank, and Platts Bank have 95-100% areal coverage of high data support grids. The areal coverage of high data support grids is lower (65%) for the Modified Cashes Ledge HMA, as the southern part of the ledge was not sampled with video gear.

Because the sampling resolution around these bank and ledge features tends to drop off rapidly moving into deeper water, the shapes of the bank and ledge features are not well resolved spatially in the sediment map. Knowing these limitations, the Habitat PDT identified 100 m as the approximate depth at which the shallow gravel habitats transition to soft sediment types. This depth was used to define the modified Cashes Ledge and Jeffreys Bank HMAs. The Platts Bank and Fippennies Ledge HMAs are narrower subsets of the gravel habitats shallower than 100 m, focusing on just the shallowest parts of the features with cobble- and boulder-dominated grids. The Ammen Rock area was defined based on bathymetry, and based on a survey of benthic macroalgae (McGonigle et al 2011).

Vulnerability estimates for the existing (Alternative 1) and modified (Alternatives 3 and 4) Cashes Ledge habitat areas are equivalent because the same set of structured SASI grids overlap both areas. Values for the Cashes Ledge habitat areas are intermediate between those for the Cashes Ledge Closure Area and the Jeffreys Bank Habitat Closure Area (existing and modified versions). As discussed above, some large boulder substrate grids within the Jeffreys Bank areas result in inflated vulnerability scores for these areas, especially the modified area. There is no particular reason to think that seabed vulnerability is substantially different between the modified Cashes and Jeffreys areas. Given the resolution of the vulnerability maps (10 km x 10 km grids), it is difficult to draw conclusions about the Platts Bank and Fippennies Ledge areas based on

these results, and the presence of cobble- and boulder-dominated unstructured grids is a better metric for inferring the presence of vulnerable benthic habitats in these areas.

All of these management areas are considered low energy, with the exception of the shallower portions of Platts Bank and Ammen Rock, which were identified as high energy on the basis of depth. Structure-forming organisms adapted to high energy habitats were estimated to have somewhat shorter recovery times, and therefore slightly lower vulnerability to fishing impacts. That being said, Ammen Rock is a unique feature, being the only offshore kelp habitat in the Gulf of Maine, which is why it was singled out for increased protection via closure to all types of fishing.

Overall, the HMAs included in Alternative 3 encompass a large fraction of the highly structured, gravel habitats in the central Gulf of Maine sub-region, and closing these areas to mobile-bottom tending gears (all gears in the Ammen Rock HMA) would have a slightly positive impact on seabed habitats in this sub-region relative to the No Action alternative. Much of Alternative 3 overlaps with the Alternative 1/No Action areas, but Platts Bank and additional portions of Jeffreys Bank would be protected with this alternative, and some deeper water mud habitats estimated to have lower vulnerability to fishing are not included in Alternative 3. Options 1 and 2 are functionally equivalent in this region because there is no hydraulic clam dredging in this part of the Gulf of Maine; this appears unlikely to change even if the Northern Temporary PSP Closure is lifted. Options 3 and 4 would have a negative impact relative to Alternative 1/No Action because mobile bottom-tending gears would be allowed to operate in previously closed areas vulnerable to fishing. As discussed in Section 4.1.2.3, the potential for these measures to result in benefits to seabed habitats are highly uncertain, but they are likely close to open fishing areas in their impact, perhaps having a slightly negative or positive effect relative to no closure, and having a negative impact relative to the current management restrictions in these areas. Alternative 3 Options 3 and 4 would likely have a neutral impact on Platts Bank, which is currently open to fishing.

4.2.1.2.4 Alternative 4 (Preferred)

Alternative 4 areas also efficiently encompass vulnerable seabed types, but the alternative does not provide any protection for Fippennies Ledge or Platts Bank. Alternative 4, Options 1 and 2 would have a moderately positive impact on seabed habitats overall, and a slightly negative impact relative to Alternative 1/No Action or Alternative 3 because these areas are not included. Alternative 4 Options 3 and 4 would have highly negative impacts relative to Alternative 1/No Action. Alternative 4 would have positive impacts relative to Alternative 2.

4.2.1.2.5 Overlap with preferred alternative EFH designations

Species that are not common in the offshore Gulf of Maine have little overlap with the central Gulf of Maine habitat areas generally. These species include ocean pout, offshore hake, windowpane, winter, and yellowtail flounders, and skates other than smooth and thorny skate.

Overlap between the central Gulf of Maine No Action and alternative habitat management areas is strongly related to depth and also to substrate distribution. The Ammen Rock HMA, which is much shallower than any other areas, overlaps with a narrower range of species. Similarly, a slightly different mix of species overlaps the Fippennies Ledge and Platts Bank HMAs, which

are relatively shallow and focused on cobble/boulder-dominated habitat types. The Cashes Ledge [Groundfish] Closure Area includes Fippennies and Cashes Ledges, as well as the surrounding deeper mud habitats, which influences its overlap with the preferred EFH designations. The existing Jeffreys Bank Habitat Closure Area (Alternative 1) and Jeffreys Bank Modified HMA (Alternatives 3 and 4) are very similar in terms of overlap with the preferred alternative EFH designations, which makes sense given that they overlap by approximately 50%. The No Action Jeffreys Bank area overlaps more with adult redfish and smooth skate, while the alternative area overlaps better with halibut. This is not unexpected given that the northern part of the existing area that was not included within the modified area is somewhat deeper and muddier. There is a high degree of overlap between scallop and wolffish EFH and the management areas in this sub-region, but both designations are very general as discussed in the introduction.

The difference between Alternatives 3 and 4 is that Alternative 3 includes the Fippennies Ledge and Platts Bank areas. These two areas improve overlap with adult ocean pout (Platts) and adult yellowtail flounder (Platts and Fippennies), which indicates that Alternative 3 would benefit a slightly expanded range of species. However, overall, most of the species with designated EFH in the Platts and Fippennies areas also have designated EFH in the Cashes and Jeffreys areas.

Table 41 – Preferred alternative EFH designations within Central GOM No Action areas and HMAs.

Species and lifestage (those in red occupy hard bottom complex seabed types that are more vulnerable to fishing)	Cashes Ledge Closure Area Alt 1	Cashes Ledge Habitat Closure Area Alt 1	Cashes Ledge Modified Alt 3, 4	Ammen Rock HMA Alt 3, 4	Fippennies Ledge HMA Alt 4	Platts Bank HMA Alt 4	Jeffreys Bank Habitat Closure Area Alt 1	Jeffreys Bank Modified Alt 3, 4
Acadian redfish juvenile	High	Moderate	Moderate	*None*	Slight	Slight	High	High
Acadian redfish adult	Moderate	Slight	Slight	*None*	*None*	*None*	Moderate	Slight
American plaice juvenile	High	High	High	Moderate	**Full**	**Full**	Moderate	High
American plaice adult	High	High	High	Slight	Moderate	Moderate	**Full**	**Full**
Atlantic cod juvenile	Slight	Slight	Slight	*None*	**Full**	**Full**	Moderate	Moderate
Atlantic cod adult	Moderate	High	High	High	**Full**	**Full**	**Full**	**Full**
Atlantic halibut - all stages	Moderate	Moderate	High	Slight	**Full**	Moderate	Moderate	High
Atlantic wolffish - all stages	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**
Haddock juvenile	Moderate	High	High	High	**Full**	**Full**	High	High
Haddock adult	Moderate	High	High	Moderate	**Full**	**Full**	**Full**	**Full**
Ocean pout egg	*None*	*None*	*None*	*None*	*None*	*None*	Slight	Slight
Ocean pout juvenile	Slight	*None*	*None*	*None*	**Full**	High	Moderate	Moderate
Ocean pout adult	Slight	*None*	*None*	*None*	*None*	High	*None*	Slight
Pollock juvenile	Moderate	Moderate	Moderate	Moderate	*None*	High	**Full**	**Full**
Pollock adult	High	High	High	Slight	Slight	Slight	**Full**	**Full**
Red hake egg, larvae, juv.	Moderate	Moderate	High	**Full**	**Full**	*None*	**Full**	**Full**
Red hake adult	High	High	High	Moderate	**Full**	**Full**	**Full**	**Full**
Silver hake juvenile	High	High	High	Moderate	**Full**	**Full**	**Full**	**Full**
Silver hake adult	High	High	High	Slight	Moderate	Moderate	**Full**	**Full**
White hake juvenile	High	High	High	High	**Full**	**Full**	**Full**	**Full**
White hake adult	High	Moderate	Moderate	*None*	*None*	Slight	High	High
Windowpane juvenile	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Windowpane adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Winter flounder egg	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Winter fl. larvae/adult	*None*	*None*	*None*	*None*	Slight	*None*	*None*	*None*
Winter flounder juvenile	*None*	*None*	*None*	*None*	Slight	*None*	*None*	*None*
Witch flounder juvenile	High	High	High	Slight	Slight	Slight	**Full**	**Full**
Witch flounder adult	High	High	High	Slight	Slight	Slight	High	High
Yellowtail flounder juvenile	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Yellowtail flounder adult	Slight	*None*	*None*	*None*	High	High	*None*	Slight
Monkfish juvenile	High	High	High	Moderate	**Full**	Moderate	**Full**	**Full**
Monkfish adult	High	High	High	Slight	**Full**	*None*	**Full**	**Full**
Smooth skate juvenile	High	High	Moderate	*None*	*None*	Slight	High	Moderate
Smooth skate adult	High	High	Moderate	*None*	*None*	Slight	Moderate	Slight
Thorny skate juvenile	High	High	High	Slight	Moderate	Moderate	**Full**	**Full**
Thorny skate adult	High	High	High	Slight	Slight	Slight	**Full**	**Full**
Barndoor skate – juv/adu	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Little skate juvenile	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Little skate adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	Slight
Winter skate juvenile	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Winter skate adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Atlantic sea scallop - all	Moderate	Moderate	Moderate	**Full**	**Full**	**Full**	**Full**	High
Atlantic herring egg	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Total score	**74**	**71**	**71**	**39**	**61**	**60**	**79**	**81**
Count of species represented (out of 23)	**17**	**15**	**15**	**11**	**18**	**17**	**16**	**18**
Count of designations represented (out of 43)	**30**	**27**	**27**	**21**	**26**	**27**	**29**	**32**

4.2.1.2.6 Species diversity

Table 42 shows groundfish diversity, regulated species diversity, and all species diversity for the central Gulf of Maine habitat management alternatives. Alternatives with the highest diversity values (75th percentile of each season) for each diversity index across all alternatives in all sub-regions are shaded (red=groundfish, yellow=regulated species, green=all species).

In the spring, the No Action closures have the highest diversity values across all indices. Diversity of each species group in the Alternative 3 areas is lower than No Action. Diversity of all species groups in Alternative 4 areas is greater than in the Alternative 3 areas, but is also less than the Alternative 1/No Action areas.

In the summer, the No Action closures have the highest diversity values across all indices. Groundfish diversity indices in the Alternative 3 and 4 areas are equal, and less than the groundfish diversity index in the Alternative 1/No Action areas. The same applies for regulated species diversity and all species diversity.

In the fall, the No Action closures again have the highest diversity values across all indices. Diversity of each species groups is lowest in the Alternative 3 areas. While diversity of each species groups is slightly higher in Alternative 4 areas, it is still lower than in the Alternative 1/No Action closures.

In the winter, Alternative 3 areas have higher diversity of each species group than the Alternative 1/No Action closures. Diversity of groundfish, regulated species and all species are highest in Alternative 4 areas.

These diversity index values can be compared to the diversity indices for areas in other sub-regions by reviewing the species diversity summary (Section 4.2.3) in Volume 1. The red, yellow, and green highlighted values for each index are above the 75th percentile for that index across all habitat management alternatives in all sub-regions. Thus, the number of red highlighted values indicates a relatively large mesh groundfish diversity in the central Gulf of Maine sub-region management alternatives relative to other alternatives proposed in this amendment. The Cashes Ledge Groundfish Closure Area in the No Action alternative has high diversity across all species, which indicates that it would protect a relatively broad array of biological resources.

Table 42 – Average diversity indices within the central Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted.

		Alternative				
		1 Habitat closures	1 Groundfish closure	2	3	4
Spring	*Tows*	*28*	*18*	*0*	*39*	*34*
	Lg mesh groundfish ISI	0.547	0.351	0.000	0.523	0.538
	Regulated spp. ISI	0.626	0.437	0.000	0.602	0.626
	All spp. SDI	1.454	1.109	0.000	1.386	1.446
Summer	*Tows*	*22*	*26*	*0*	*10*	*10*
	Lg mesh groundfish ISI	0.532	0.271	0.000	0.373	0.373
	Regulated spp. ISI	0.495	0.518	0.000	0.474	0.474
	All spp. SDI	1.460	1.538	0.000	1.376	1.376
Fall	*Tows*	*24*	*12*	*0*	*29*	*26*
	Lg mesh groundfish ISI	0.528	0.220	0.000	0.488	0.505
	Regulated spp. ISI	0.594	0.636	0.000	0.571	0.586
	All spp. SDI	1.323	1.513	0.000	1.252	1.278
Winter	*Tows*	*16*	*7*	*0*	*29*	*28*
	Lg mesh groundfish ISI	0.511	0.161	0.000	0.546	0.553
	Regulated spp. ISI	0.568	0.167	0.000	0.593	0.601
	All spp. SDI	1.281	0.389	0.000	1.340	1.361

4.2.1.3 ***Western Gulf of Maine***

There are eight habitat management alternatives for the Central Gulf of Maine sub-region: (1) no action Western Gulf of Maine Habitat Closure Area and Western Gulf of Maine Closure Area, (2) no HMAs, (3) Large Stellwagen HMA and Large Bigelow Bight HMA, (4) Small Stellwagen HMA, Jeffreys Ledge HMA and Large Bigelow Bight HMA, (5) Small Stellwagen HMA, Jeffreys Ledge HMA and Small Bigelow Bight HMA, (6) Large Stellwagen HMA, (7A/7B) which would implement roller gear restrictions as a habitat management measure in the existing area (A) or a modified area (B), and could be combined with one of the other alternatives, and (8) which would exempt shrimp trawls from the northwestern corner of the WGOM Habitat Closure Area, if Alternative 1/No Action was selected. For Alternatives 3-6, each management area could be implemented with Option 1, 2, 3, or 4.

In this sub-region, the management areas tend to have coarser substrates, higher levels of data support, and higher vulnerability than the Gulf of Maine region as a whole.

Table 43 – WGOM: dominant substrate coverage within each management area.

Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Western Gulf of Maine EFH (848, #1)	33%	43%	13%	1%	1%	1%	5%	1%	1%	1%	2,256
No action groundfish											
Western Gulf of Maine GF (876, #1)	39%	36%	16%	1%	1%	1%	4%	1%	1%	1%	2,941
Habitat management areas											
Large Bigelow Bight (471, #3 and 4)	53%	8%	13%	4%	-	2%	7%	10%	4%	-	1,696
Large Stellwagen (639, #3 and 6)	10%	70%	11%	1%	-	-	7%	1%	-	-	1,185
Small Bigelow Bight (146, #5)	56%	8%	16%	3%	-	1%	8%	6%	2%	-	560
Small Stellwagen (540, #4 and 5)	2%	68%	14%	-	-	-	13%	3%	-	-	650
Jeffreys Ledge (158, #4 and 5)	36%	26%	18%	3%	2%	4%	4%	2%	3%	2%	714
Inshore Roller Gear Area (3480, #7a)	42%	25%	11%	1%	-	2%	12%	5%	1%	-	8,384
Alternate Roller Gear Area (2376, #7b)	31%	29%	11%	2%	-	1%	17%	5%	2%		4,107
Shrimp Trawl Exemption Area (59, #8)	89%	-	10%	1%	-	-	-	-	-	-	441
GOM/Scotian Shelf Region (5,772)	**66%**	**20%**	**7%**	**1%**	**1%**	**1%**	**3%**	**1%**	**<1%**	**<1%**	**58,036**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 44 – WGOM: data support within each management area.

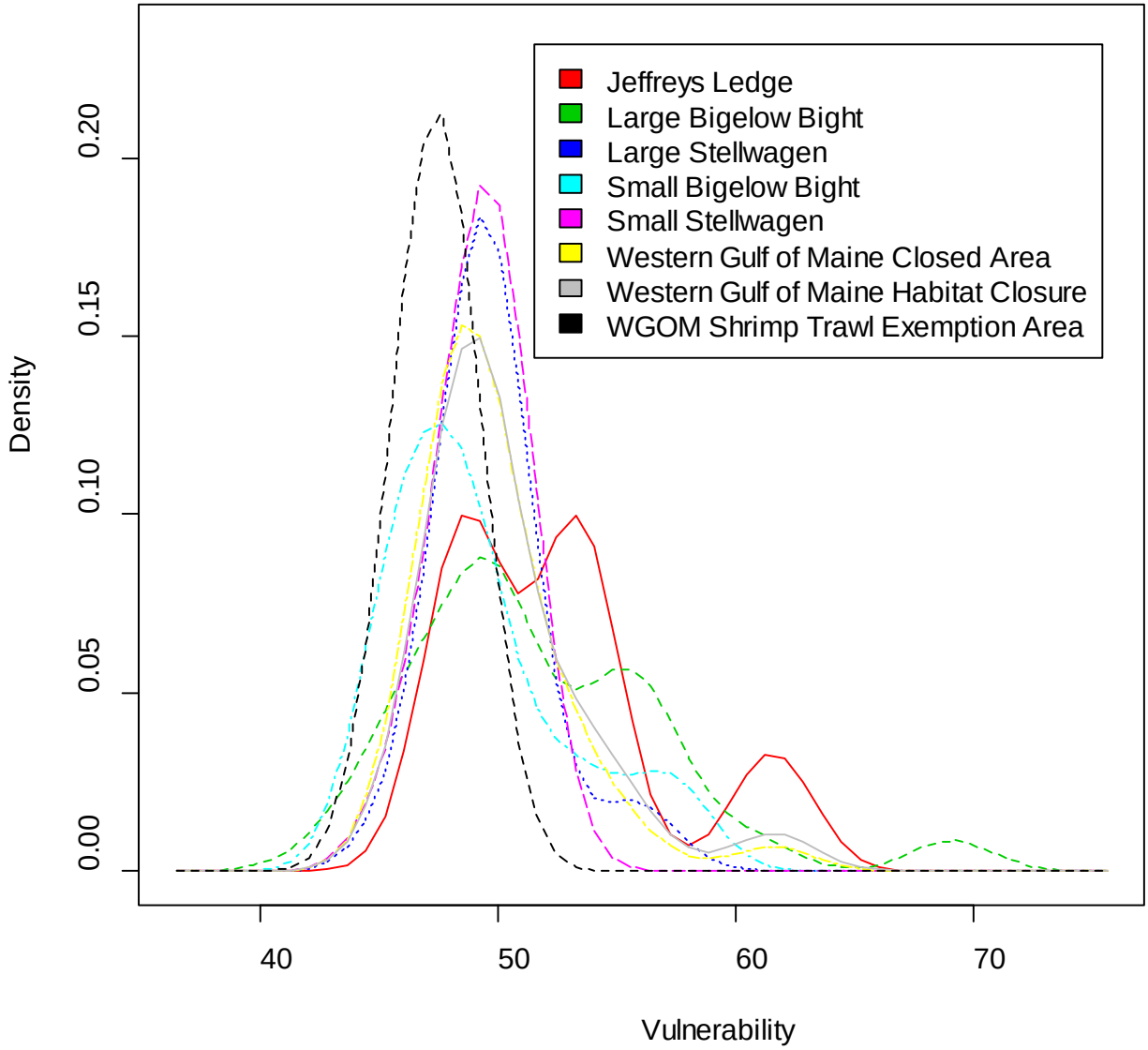
Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Western Gulf of Maine EFH (848, #1)	-	29%	57%	7%	-	5%	1%	2,256
No action groundfish								
Western Gulf of Maine GF (876, #1)	-	45%	45%	6%	-	4%	1%	2,941
Habitat management areas								
Large Bigelow Bight (471, #3 and 4)	-	12%	90%	1%	-	-	-	1,696
Large Stellwagen (639, #3 and 6)	-	18%	67%	13%	-	1%	<1%	1,185
Small Bigelow Bight (146, #5)	-	19%	79%	1%	-	-	-	560
Small Stellwagen (540, #4 and 5)	-	-	74%	23%	-	2%	1%	650
Jeffreys Ledge (158, #4 and 5)	-	45%	37%	1%	-	15%	2%	714
Inshore Roller Gear Area (3480, #7a)	1%	28%	58%	8%	-	3%	1%	8,384
Alternate Roller Gear Area (2376, #7b)	-	16%	66%	12%	1%	3%	6%	4,107
Shrimp Trawl Exemption Area (59, #8)	-	46%	54%	-	<1%	-	-	441
GOM/Scotian Shelf Region (5,772)	**38%**	**45%**	**11%**	**1%**	**2%**	**2%**	**<1%**	**54,640**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

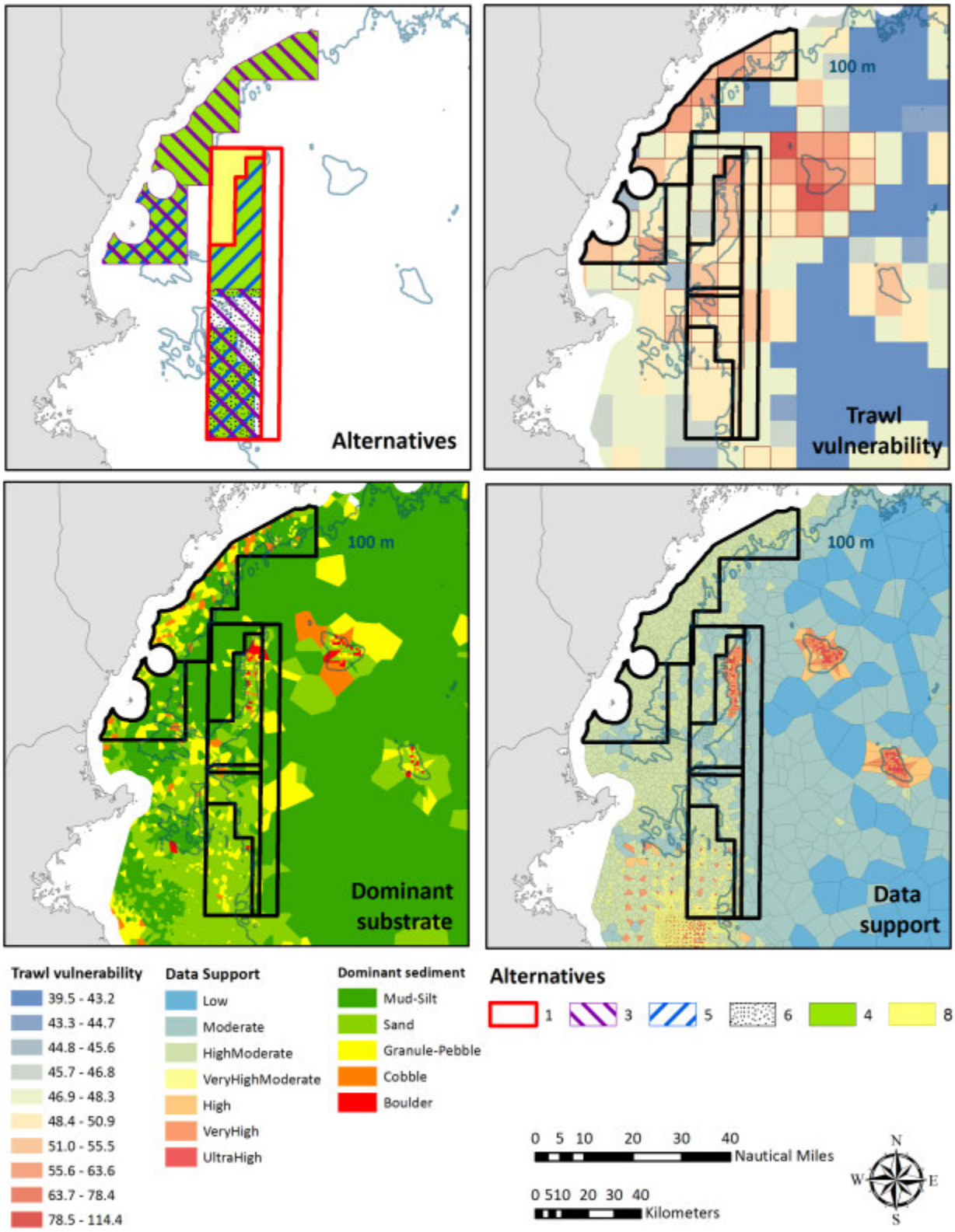
Table 45 – WGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop or clam dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
EFH closure (Alt #)									
Western Gulf of Maine EFH	46.4	61.6	*22*	49.3	52.7	*3*	120.7	148.5	*18*
Groundfish closure (Alt #)									
Western Gulf of Maine GF	46.4	61.6	*33*	49.3	52.7	*3*	120.7	148.5	*19*
Habitat Management Area (Alt #)									
Large Bigelow Bight (#3 and 4)	43.0	69.1	*27*	44.5	70.3	*18*	110.0	159.9	*27*
Large Stellwagen (#3 and 6)	46.4	55.8	*12*	49.3	52.7	*3*	120.7	140.7	*12*
Small Bigelow Bight (#5)	45.5	57.2	*9*	47.1	55.3	*5*	110.0	154.8	*9*
Small Stellwagen (#4 and 5)	46.4	50.8	*8*	49.3	52.7	*3*	120.7	140.7	*8*
Jeffreys Ledge (#4 and 5)	48.3	61.6	*7*	-	-	-	134.3	148.5	*6*
Inshore Roller Gear Restricted Area (#7a)	42.4	69.1	*100*	44.5	70.3	*48*	108.0	156.9	*83*
Alternate Roller Gear Restricted Area (#7b)	43.0	69.1	*55*	44.5	70.3	*30*	108.0	159.9	*54*
Shrimp Trawl Exemption Area (#8)	46.4	47.9	*3*	-	-	-	-	-	-
GOM/Scotian Shelf region	**41.2**	**100.4**	***575***	**44.5**	**91.7**	***56***	**108.0**	**159.9**	***146***

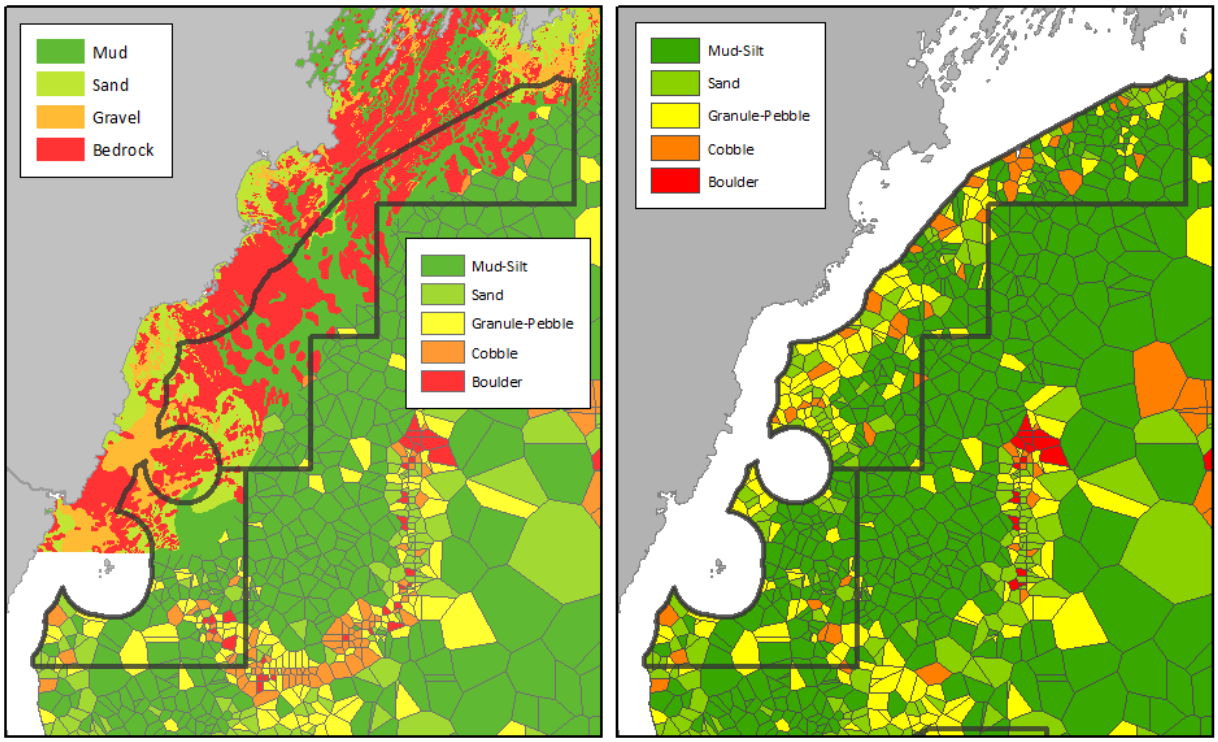
Figure 12 – WGOM: distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. Alternatives 7a and 7b are not shown.



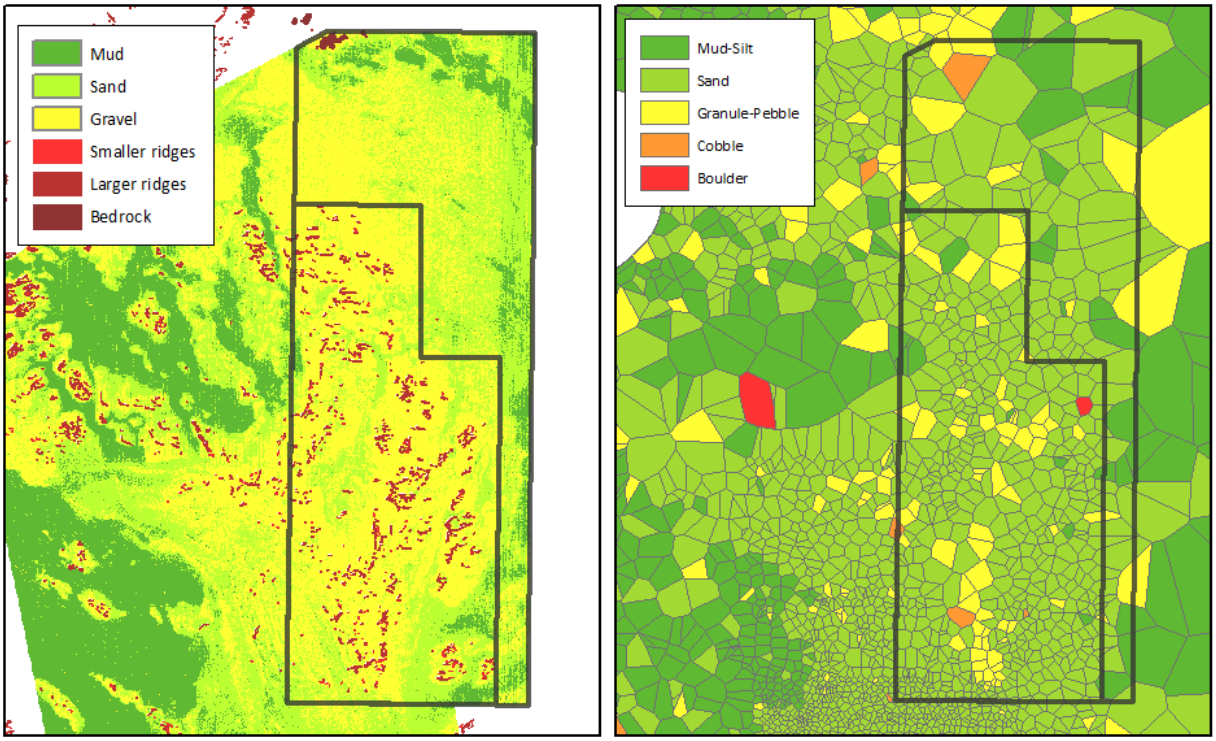
Map 46 – WGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Alternatives 7a and 7b (roller gear restricted areas) are not shown on these figures.



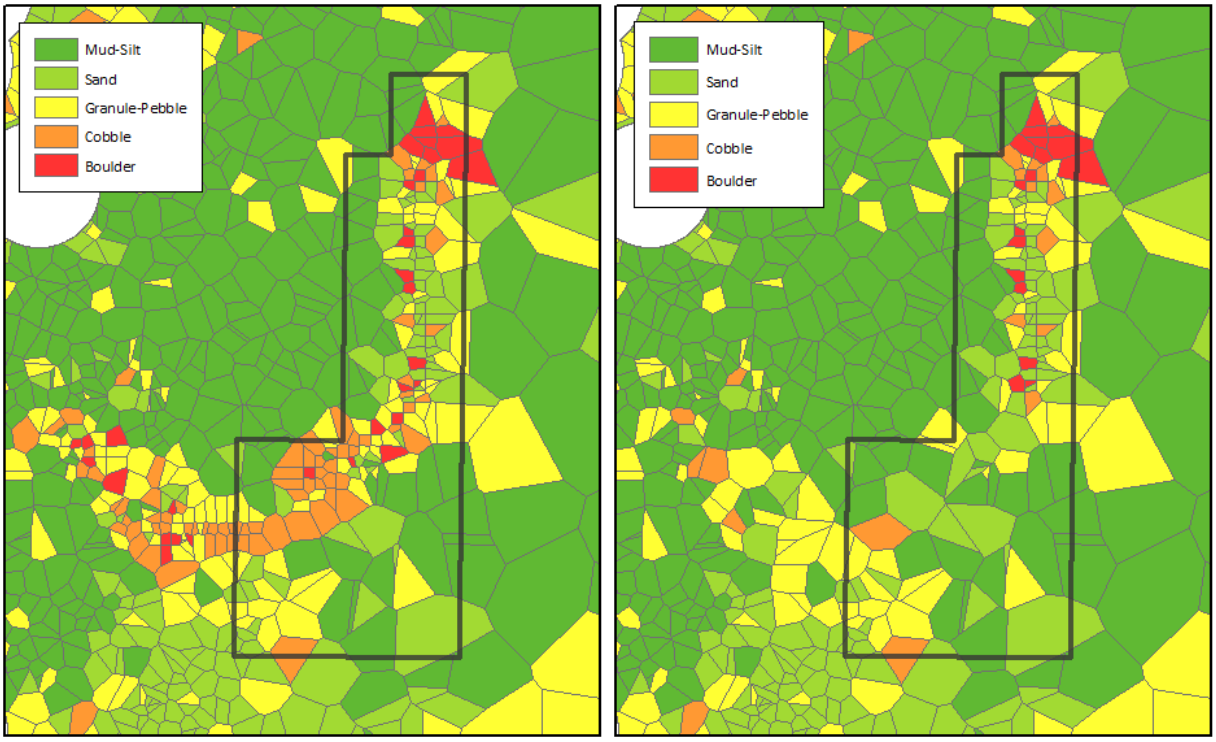
Map 47 – Bigelow Bight substrate distribution comparison. Left panel – Maine Bottom Type data along coast (legend in upper left) overlaid on updated SASI grid with additional Jeffreys Ledge data (legend at right). Right panel – SASI grid on which vulnerability model runs are based.



Map 48 – Stellwagen substrate distribution comparison. Left panel – multibeam backscatter (mud, sand, and gravel) overlaid with boulder ridges and bedrock outcrops in red. Right panel – SASI grid on which vulnerability model runs are based.



Map 49 – Jeffreys Ledge substrate distribution comparison. Left panel – updated SASI grid. Data were collected using video and analyzed to match SASI methods. Right panel – SASI grid on which vulnerability model runs are based.



4.2.1.3.1 Alternative 1 (No Action, preferred)

The overlapping areas that comprise this alternative encompass the eastern part of Stellwagen Bank and most of Jeffreys Ledge, as well as smaller features including Tillies Bank and Wildcat Knoll. These areas are generally low energy, except for the tops of Stellwagen Bank and Jeffreys Ledge, and include a mix of sediment types. According to the SASI substrate map, the dominant substrate type is predominantly mud and sand, with about 15% of the area dominated by granule-pebble, and small fractions of cobble- and boulder-dominated areas (Table 43, Map 46). Since the eastern sliver of the Western Gulf of Maine Closure Area that does not overlap with the Western Gulf of Maine Habitat Closure Area tends to be deeper and generally muddy, the habitat closure on average contains coarser sediments than the groundfish closure. Data support values are moderate in this region, with only about 9% of the areas mapped with a sampling gear capable of detecting cobble and boulder sediments. Cobble and boulder habitat types are under-represented in these data sets, and sampling on Jeffreys Ledge subsequent to the development of SASI identified additional cobble- and boulder-dominated areas (Map 49). Multibeam data that could not be readily integrated with the SASI grid better resolve the substrate distribution in the southern part of the areas overlapping Stellwagen Bank (Map 48) and in the Bigelow Bight Area (Map 47).

Vulnerability estimates are moderate to high for these and other management areas in this region relative to other locations not proposed for habitat management (Table 45). Due to spatial

overlaps between the various management areas in this sub-region, the relatively coarse 100 km^2 resolution of the vulnerability grid, and the overall moderate level of data support in the underlying substrate distribution, it is difficult to distinguish between the various management areas on the basis of vulnerability scores. As in the central Gulf of Maine, substrate distributions serve as a more reliable metric for identifying areas of vulnerable habitat. As compared to the Alternative 1/No Action areas, scores are somewhat higher (i.e., density plot shifted to the right) within the Jeffreys Ledge HMA (Alternatives 4 and 5, Figure 12). This is expected based on the outcomes of the SASI vulnerability assessment, as parts of the No Action EFH and groundfish closures in the WGOM sub-region include deeper mud habitats expected to be less vulnerable to fishing. The Small Stellwagen HMA (Alternatives 4 and 5) and Large Stellwagen HMA (Alternatives 3 and 6), cannot be readily distinguished from the No Action areas of which they are subsets on the basis of vulnerability scores. It is likely that vulnerability is underestimated in these Stellwagen areas, given the discrepancy between the multibeam-based map (Map 48) and the SASI map (Map 46). The Small Stellwagen HMA in particular should have a higher average vulnerability to fishing based on the mix of habitat types present, as compared to the No Action areas.

Overall, Alternative 1/No Action has moderately to highly positive impacts on seabed habitats. Although the Alternative 1/No Action areas are less efficient at encompassing vulnerable habitats as compared to the alternative areas within them, they do include vulnerable seabed types, and the fishing restriction measures associated with the existing closures are sufficient for protecting these habitats from the impacts of the most damaging gear types, i.e. mobile bottom-tending gears. In addition, under No Action, fixed bottom tending gears capable of catching groundfish are also excluded because of the groundfish closure. Fixed gears have a much lower magnitude of impact on the seabed, so these restrictions provide an incremental benefit to seabed habitats as compared to the mobile bottom-tending gear restrictions associated with the habitat closure area. Note that two mobile bottom-tending gears, clam dredges and shrimp trawls, are exempted from the No Action groundfish closure, such that they could be used in the eastern sliver that doesn't overlap the habitat area. However, it is unlikely that these gears have been used much if at all in this area since shrimping tends to occur further west, and most of the area overlaps with a food safety (PSP) shellfish closure. While the PSP closure may be lifted in the near term, substantial clam biomass east of the existing habitat closure is not known to exist.

Alternative 1/No Action has highly positive impacts on seabed habitats relative to Alternative 2, and relative to Alternatives 3-6, Options 3 and 4. Alternative 1/No Action also has positive impacts relative to Alternative 6, Options 1 and 2. Alternative 1/No Action has neutral impacts relative to Alternatives 3, 4, and 5 Options 1 and 2. Alternatives 7 and 8 are analyzed as add-on alternatives so they are not compared to Alternatives 1-6.

4.2.1.3.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Habitats within the Western Gulf of Maine Closure Area that are vulnerable to adverse effects would be fished by mobile bottom-tending gears for the first time since 1998 when the closure was enacted. Alternative 2 would have a highly negative impact overall, relative to Alternative 1/No Action, and relative to

Alternatives 3-6, Options 1 and 2, on seabed habitats. Alternative 2 would have neutral impacts relative to Alternatives 3-6, Options 3 and 4.

4.2.1.3.3 Alternative 3

Alternative 3 includes the Large Bigelow Bight and Large Stellwagen HMAs. Both of these areas include seabed types that are vulnerable to fishing relative to the region as a whole (Table 45). The distribution of rocky substrates including bedrock, boulder ridges, and cobble-dominated areas is more clearly identified in extra-SASI data sources (Map 47 and Map 48). In general, the SASI substrate grid under-represents gravel substrates in the coastal Gulf of Maine. Higher vulnerability scores relative to the regional average may have resulted if these additional data sets had been incorporated into the model.

The Large Stellwagen area is currently closed to mobile bottom-tending gear as part of the Western Gulf of Maine Habitat Closure Area. Options 1 and 2 are equivalent in terms of their impacts because there is no hydraulic clam dredging in this part of the Gulf of Maine, so these options would maintain existing habitat conservation measures in this HMA. The Large Bigelow Bight area is currently open to mobile-bottom tending gear fishing, and there are relatively high levels of fishing activity in the area currently, such that application of Option 1 or 2 in that area would be expected to have highly positive impacts on seabed habitats in that area. However, this alternative would allow mobile bottom-tending gear fishing on Jeffreys Ledge, which is currently closed.

It is difficult to estimate the net benefits of shifting habitat closures in this manner. One consideration is that Jeffreys Ledge has been closed to many types of fishing since 1998, such that recovery of benthic habitats has been allowed to occur since that time, while Bigelow Bight has been continuously fished, excepting seasonal rolling closures. Another is how mobile bottom-tending gear effort would redistribute if Jeffreys Ledge was opened to it and Bigelow Bight was closed. If all the mobile bottom-tending gear fishing (mainly trawling, in this region) shifted from the Bigelow Bight to Jeffreys Ledge, net benefits would likely be neutral to negative, given habitat recovery that has already occurred on Jeffreys Ledge. If maintaining the current closure is valued more highly than switching to the new Bigelow Bight area, Alternative 3 would likely have slightly negative impacts on seabed habitats relative to Alternative 1/No Action, assuming Option 1 or 2 is selected for each of the areas. Given uncertainties about how fishing effort would shift if this change were implemented, this impact assessment is somewhat uncertain.

If Option 3 or 4 is selected for the Large Stellwagen HMA, negative impacts on seabed habitats are expected because this decreases protection from what is currently in place. If these options are selected for the Large Bigelow Bight area, they would probably have a neutral impact within that HMA. Overall, if Option 3 or 4 is selected for both areas, highly negative impacts are expected relative to Alternative 1/No Action. Alternative 3 would have a highly positive impacts relative to Alternative 2 if Options 1 or 2 are selected, and a neutral impact if Options 3 or 4 are selected.

Alternative 3 would likely have slightly negative impacts relative to Alternatives 4 and 5, which also include protection for Jeffreys Ledge; Alternatives 3 and 5 are perhaps more similar in

conservation value as Alternative 3 includes the large of the Bigelow Bight areas, but not Jeffreys Ledge, and Alternative 5 includes the smaller Bigelow Bight area. Alternative 3 would have positive impacts relative to Alternative 6 provided the same management options are selected, because it include additional areas not protected by Alternative 6.

Other considerations, in particular juvenile groundfish habitat conservation benefits and economic/social impacts, will be more useful for contrasting among Alternatives 3, 4, 5, and 6 in this sub-region.

4.2.1.3.4 Alternative 4

Alternative 4 includes the Large Bigelow Bight, Small Stellwagen, and Jeffreys Ledge HMAs. The Large Bigelow Bight area is discussed above. The Small Stellwagen and Jeffreys Ledge HMAs were each selected to efficiently encompass vulnerable seabed while allowing access to deeper water mud habitats. Similar to the Bigelow Bight and Stellwagen HMAs, vulnerability of the Jeffreys Ledge HMA is probably underestimated, based on the discrepancy between the updated SASI grid and the grid used in modeling (Map 49). Because these two areas cover the majority of vulnerable seabed areas in the existing Western Gulf of Maine Habitat Closure Area, redefining these areas into the Small Stellwagen and Jeffreys Ledge HMAs probably has neutral impacts to the seabed relative to the current Western Gulf of Maine Habitat Closure Area, assuming they remain closed to mobile bottom-tending gears (Option 1 or 2). The addition of habitat management measures in the Large Bigelow Bight Area would result in highly positive habitat impacts of this alternative overall relative to Alternative 1/No Action, especially if Option 1 or 2 is selected. If Options 3 or 4 are selected for all three areas, highly negative impacts are expected overall, because less protection would be afforded to currently closed areas.

Alternative 4 would likely have slightly positive impacts relative to Alternatives 3 and 5, and positive impacts relative to Alternative 6. Alternative 4 would have a highly positive impact relative to Alternative 2 if Options 1 or 2 are selected, and a neutral impact of Options 3 or 4 are selected.

4.2.1.3.5 Alternative 5

Alternative 5 includes the Small Bigelow Bight, Small Stellwagen, and Jeffreys Ledge HMAs. The Small Bigelow Bight HMA is not as well mapped as the larger area because the Maine Bottom Type coverage does not overlap the area very well, and SASI data support is moderate. However, the area definitely contains complex and vulnerable substrate types closer to the coast/state waters boundary, and on Old Scantum, in the southeastern corner (Map 47). Overall, habitat impacts would likely be moderately positive relative to Alternative 1/No Action if all areas are managed as mobile bottom-tending gear closures (Option 1 or 2), and moderately negative relative to Alternative 1/No Action if Option 3 or 4 is selected.

Alternative 5 would likely have slightly negative impacts relative to Alternative 4, neutral to positive impacts relative to Alternative 3, and highly positive impacts relative to Alternative 6, provided the same management options are selected. Alternative 5 would have a positive impact relative to Alternative 2 if Options 1 or 2 are selected, and a neutral impact of Options 3 or 4 are selected.

4.2.1.3.6 Alternative 6

Alternative 6 includes the Large Stellwagen HMA only. Because this alternative removes habitat protections on Jeffreys Ledge, and does not add any protections in the Bigelow Bight region, there would be moderately to highly negative impacts on habitat relative to Alternative 1/No Action, Alternative 3, Alternative 4, or Alternative 5 if any management option is selected, but especially if Options 3 or 4 are selected. Alternative 6 would have a positive impact relative to Alternative 2 if Options 1 or 2 are selected, and a neutral impact of Options 3 or 4 are selected.

4.2.1.3.7 Alternatives 7A and 7B (7A preferred)

This alternative would designate the existing inshore roller gear restriction as a habitat management measure (7A), or implement this restriction in an alternate area as a habitat management measure (7B). In theory, limiting roller size to 12 inches is expected to limit the seabed types in which bottom trawl vessels can fish to areas dominated by smaller substrates and less complex attached biota, and thus this type of restriction can be viewed as a habitat conservation measure.

Unfortunately given the spatial resolution of seabed data and fishing effort data, it is challenging to evaluate conclusively whether or not limiting roller size to 12 inches affects the distribution of fishing effort with respect to habitat type. The multi-beam backscatter and boulder ridge data in the vicinity of Stellwagen Bank is of sufficient resolution for comparison with observed hauls, but there is not a comparable substrate distribution data set outside the Inshore Roller Gear Restricted Area. Nonetheless, patterns of trawl effort can be examined relative to these data (Map 50). Based on straight line tow paths (an oversimplification of how fishing effort is actually distributed), it appears that trawls avoid boulder ridge areas. Given the lack of high resolution substrate data to compare outside the roller gear area, it isn't clear that the roller size limit itself is responsible for this avoidance, although it is a possible contributing factor. It could be that these same spatial patterns (i.e., avoidance of the most complex seabed habitats) would be observed even in areas where roller size is not restricted.

Given the caveats above, assuming that the roller gear size limit does contribute to habitat conservation, Alternative 7A (current roller gear area footprint) would improve habitat protection slightly relative to the existing conditions because the requirement would apply to all bottom trawl vessels. Currently, the inshore roller gear restriction only applies to Northeast Multispecies vessels, and not to vessels fishing under other permits (for example, shrimp trawl vessels). The increase in habitat conservation would likely be small in magnitude, because many shrimp trawl vessels already use roller gear sizes of 12 inches or less (Figure 13). Alternative 7B would probably have neutral impacts to slightly positive impacts when combined with the No Action roller gear area as it is currently implemented. The Alternative 7B area covers additional areas of complex seabed in the Bigelow Bight region, and might be expected to improve habitat conservation in this location. Alternative 7B would apply to all trawl vessels, including shrimp vessels, and the additional area covered by Option B as compared to Option A is a relatively important fishing area for the shrimp trawl fishery. Other types of bottom trawls would also need to use 12 inch rollers in this location. Simply trading off this area for other locations not covered by the Option B areas might have neutral impacts, but given that the current roller gear restriction would continue, Option B should have slightly positive impacts for habitat protection.

Map 50 – Observed trawl fishing effort by target species in the Western Gulf of Maine during 2008-2013 compared to SASI trawl vulnerability (darker grids represent higher substrate vulnerability) and substrate type. A red outlined area represents the proposed roller gear restriction in Alternative 7A, while the black outlined area is proposed in Alternative 7B.

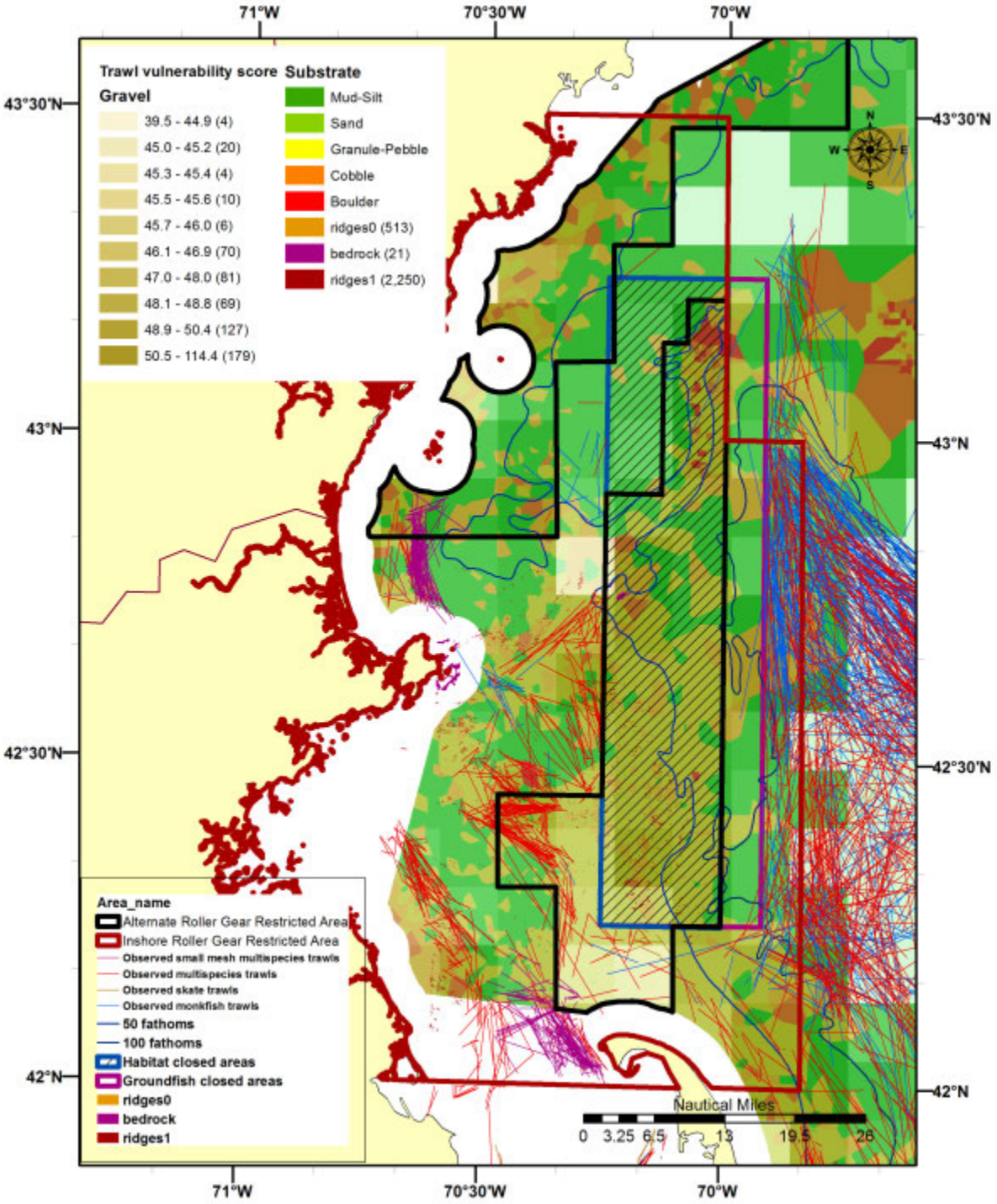
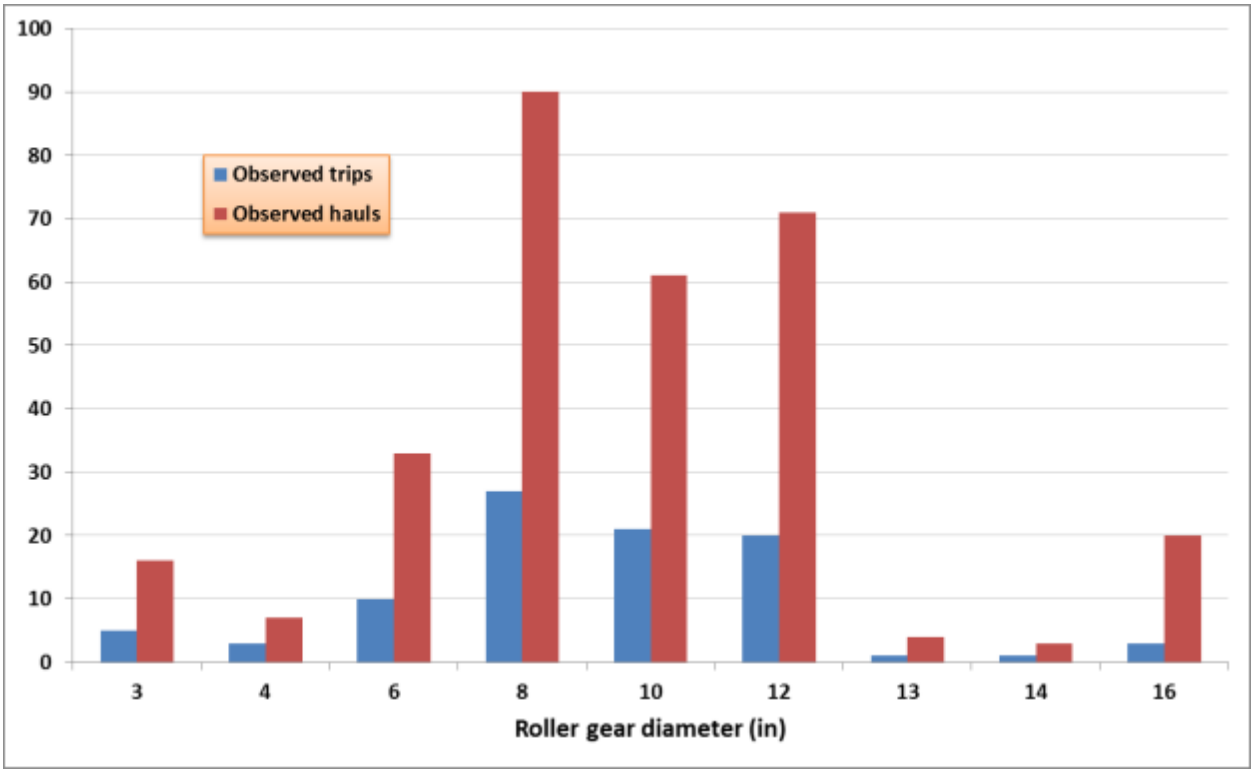
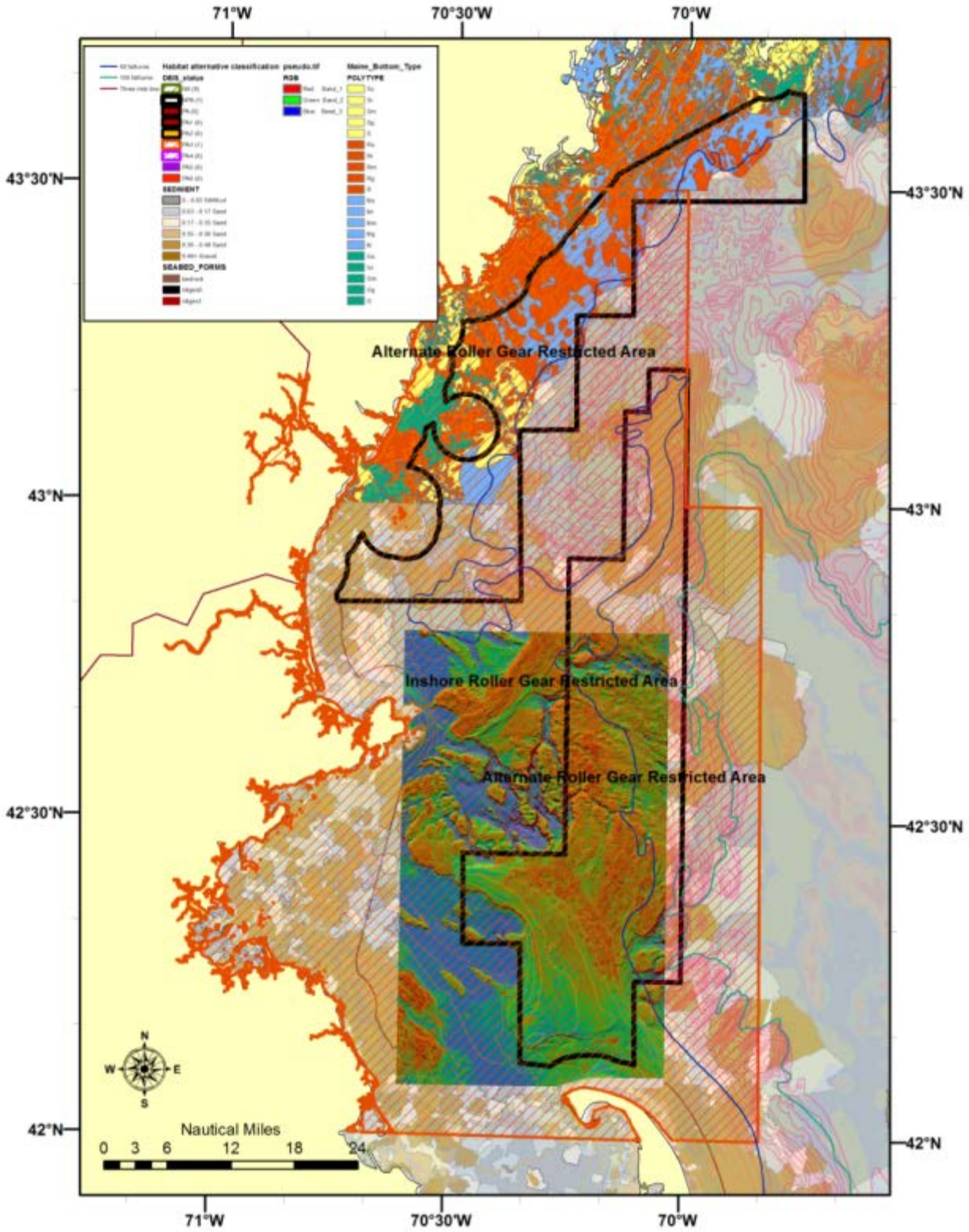


Figure 13 – Number of observed trips and hauls during 2008-2013 on vessels using shrimp trawls within the Inshore Roller Gear Restricted Area. Five percent of trips and nine percent of observed hauls used a roller size greater than 12 inches.



Map 51 – Alternative 7A (hatched area) and Alternative 7B (shaded area) overlaid with substrate data.



4.2.1.3.8 Alternative 8 (Preferred)

Alternative 8 would exempt shrimp trawl vessels from the northwestern part of the Western Gulf of Maine Habitat Closure Area, and only makes sense as an add-on to Alternative 1/No Action because Alternatives 2-6 eliminate the exemption area entirely. This alternative probably does not have a negative impact on the positive conservation benefits of Alternative 1 (i.e. the alternative has neutral impacts) for two reasons. First, the exemption area contains soft sediments, which are somewhat less vulnerable to fishing than the more complex seabed types on the adjacent banks and ledges. Second, shrimp trawling does not generally occur this far offshore. The shrimp are further inshore when the shrimp season begins in December, gradually moving offshore as the season progresses. Given the status of the shrimp stock, shrimp fishing seasons have been fairly short in recent years (there was no season in 2014), so significant fishing effort within this area has not occurred in the recent past, and is unlikely to occur in the near future.

4.2.1.3.9 Overlap with preferred alternative EFH designations

Relative to the central Gulf of Maine areas, the western Gulf of Maine No Action and alternative habitat management areas overlap with a greater number of species/lifestages, and are comparable in this regard to the eastern Gulf of Maine areas. This likely reflects the relatively inshore nature of the eastern and western Gulf of Maine sub-regions. The Bigelow Bight areas, which are furthest inshore, have the highest total scores in the western Gulf of Maine. These higher total scores are due not so much to having more species or designations overlapping the Bigelow Bight areas, but rather due to a higher rate of overlap (more scores of 'high' or 'full').

The Western Gulf of Maine Closure Area, Western Gulf of Maine Habitat Closure Area, Jeffreys Ledge HMA, Large Stellwagen HMA, Small Stellwagen HMA, and Shrimp Trawl Exemption Area all overlap with one another, so they have similar overlaps with EFH. The two Stellwagen areas are shallow relative to the other areas, and therefore they overlap less fully with EFH for red, white, and silver hake, and monkfish. The deeper water shrimp trawl exemption area, conversely, has the greatest overlap with redfish juveniles, witch flounder, and smooth and thorny skate. The Small and Large Bigelow Bight areas have greater overlap with redfish, winter flounder, and yellowtail flounder EFH.

All of the areas have limited overlap with windowpane flounder, which generally occurs on Georges Bank and further south. The same is true for barndoor, little, and winter skate, which are more common on Georges Bankthan in the Gulf of Maine. There is a high degree of overlap between scallop and wolffish EFH and the management areas in this sub-region, but both designations are very general as discussed above.

The Alternative 1/No Action areas have some degree of overlap with all 23 species with benthic lifestages, and encompass 41 of the 43 designations included in the analysis. In Alternatives 3, 4, or 5, including either the Large or Small Bigelow Bight area improves overlap with winter flounder, juvenile yellowtail flounder, and juvenile smooth skate. Alternatives 1, 4, and 5, which cover Jeffreys Ledge, have the highest degree of overlap with herring egg EFH due to egg beds that are known to occur on the ledge. Alternative 6 includes the Large Stellwagen area only, but

this area alone encompassee designations for all species and 41 out of the 43 lifestages included in this analysis.

Table 46 – Preferred alternative EFH designations within Western GOM No Action areas and HMAs.

Species and lifestage (those in red occupy complex hard bottom seabed types that are more vulnerable to fishing)	WGOM Closure Area Alt 1	WGOM Habitat Closure Area Alt 1	Jeffreys Ledge HMA Alt 4, 5	Large Stellwagen HMA Alt 3, 6	Small Stellwagen HMA Alt 4, 5	Large Bigelow Bight HMA Alt 3, 4	Small Bigelow Bight HMA Alt 5	Shrimp Trawl Exemption Area Alt 8
Acadian redfish juvenile	Moderate	Moderate	Moderate	Moderate	Slight	High	High	High
Acadian redfish adult	Moderate	Slight	Slight	Slight	Slight	Moderate	High	Moderate
American plaice juvenile	High	High	High	High	High	High	**Full**	High
American plaice adult	High	High	High	High	High	High	High	**Full**
Atlantic cod juvenile	Moderate	Moderate	High	High	High	High	High	Slight
Atlantic cod adult	Moderate	High	High	High	High	**Full**	**Full**	Moderate
t - Atlantic halibuall stages	Moderate	Moderate	High	High	High	High	High	Moderate
Atlantic wolffish - all stages	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**
Haddock juvenile	Moderate	High	High	High	High	High	High	Moderate
Haddock adult	Moderate	High	High	High	High	High	High	Moderate
Ocean pout egg	Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate	*None*
Ocean pout juvenile	Moderate	Moderate	Moderate	High	High	Moderate	Moderate	Slight
Ocean pout adult	Moderate	Moderate	Moderate	High	High	Moderate	High	Slight
Pollock juvenile	High	High	High	High	High	High	**Full**	High
Pollock adult	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	**Full**
Red hake egg, larvae, juv.	Moderate	Moderate	High	Slight	Slight	High	**Full**	**Full**
Red hake adult	High	High	High	High	High	High	High	**Full**
Silver hake juvenile	High	High	**Full**	Moderate	Moderate	High	High	**Full**
Silver hake adult	Moderate	Moderate	High	Slight	Slight	High	**Full**	**Full**
White hake juvenile	High	High	**Full**	High	High	High	**Full**	**Full**
White hake adult	Moderate	Moderate	Moderate	Moderate	Slight	High	High	High
Windowpane fl. juvenile	Slight	Slight	*None*	Slight	Slight	Moderate	Slight	*None*
Windowpane flounder adult	*None*	*None*	*None*	*None*	*None*	Slight	Slight	*None*
Winter flounder egg	Slight	Slight	Slight	Slight	Slight	Moderate	Moderate	*None*
Winter flounder larvae/adult	Slight	Slight	Slight	Slight	Slight	High	High	*None*
Winter flounder juvenile	Slight	Slight	Slight	Slight	Slight	High	**Full**	*None*
Witch flounder juvenile	High	High	Moderate	High	Moderate	High	High	**Full**
Witch flounder adult	Moderate	Moderate	Moderate	Moderate	Slight	High	High	**Full**
Yellowtail flounder juvenile	Slight	Slight	Slight	Slight	Moderate	High	**Full**	Slight
Yellowtail flounder adult	Moderate	Moderate	Moderate	Moderate	High	High	**Full**	Slight
Monkfish juvenile	High	High	High	Moderate	Moderate	High	**Full**	**Full**
Monkfish adult	High	High	High	Moderate	Moderate	High	**Full**	High
Smooth skate juvenile	Moderate	Moderate	Moderate	Moderate	Slight	Moderate	High	High
Smooth skate adult	Moderate	Moderate	Moderate	Moderate	Slight	Moderate	Moderate	High
Thorny skate juvenile	High	High	High	High	High	High	High	High
Thorny skate adult	Moderate	Moderate	Slight	Moderate	Moderate	Moderate	Moderate	High
Barndoor skate – juv/adu	Slight	Slight	Slight	Slight	Slight	*None*	*None*	*None*
Little skate juvenile	*None*	*None*	*None*	*None*	*None*	Moderate	Slight	*None*
Little skate adult	Slight	Slight	*None*	Slight	Slight	Moderate	Slight	*None*
Winter skate juvenile	Slight	Slight	*None*	Moderate	High	Moderate	Moderate	*None*
Winter skate adult	Slight	Slight	*None*	Slight	Moderate	Slight	Slight	*None*
Atlantic sea scallop - all	High	**Full**	**Full**	**Full**	**Full**	High	**Full**	High
Atlantic herring egg	Slight	Slight	Moderate	Slight	*None*	Slight	*None*	Slight
Total score	**85**	**87**	**85**	**86**	**84**	**107**	**106**	**79**
Count of species represented (out of 23)	**23**	**23**	**20**	**23**	**22**	**23**	**22**	**18**
Count of designations represented (out of 43)	**41**	**41**	**37**	**41**	**40**	**42**	**41**	**32**

4.2.1.3.10 Species diversity

Table 47 shows groundfish diversity, regulated species diversity, and all species diversity for the western Gulf of Maine habitat management alternatives. Alternatives with the highest diversity values (75th percentile of each season) for each diversity index across all alternatives in all sub-regions are shaded (red=groundfish, yellow=regulated species, green=all species).

In the spring, diversity of each species group for the Alternative 3 and 4 areas were almost equal and are greater than the Alternative 1/No Action closures. Each species group was also more diverse in the Alternative 5 areas. Diversity of each species group in the Alternative 6 area was higher than Alternative 1/No Action, but lower than in Alternatives 3, 4, and 5. Spring diversity of the regulated and all species groups was highest in the Alternative 7A area, which is consistent with the broad spatial coverage of this area. Diversity in the Alternative 7B area was also high. Diversity of each species group in the Alternative 8 area was relatively low.

In the summer, diversity indices for each species group in the No Action closures were the lowest in the region, aside from the Shrimp Trawl Exemption Area in Alternative 8. Diversity of groundfish, regulated species and all species are all highest in Alternative 6.

Regulated species and all species diversity were highest in the fall in the Western Gulf of Maine. Diversity of each species group in the Alternative 3 vs. Alternative 4 areas was again nearly equal. Groundfish diversity was higher than in the Alternative 1/No Action areas, yet regulated species diversity and all species diversity were both lower. Diversity of each species group in the Alternative 5 areas was less than in the No Action areas. Overall diversity is higher in the Alternative 6 area as compared to the No Action areas. Average diversity indices for of each species group in the Inshore Roller Gear Restricted Area (Alternative 7A) were lower indices in the No Action area. Groundfish diversity was higher in the Alternate Roller Gear Area than in the No Action areas, while regulated and all species diversity was lower. Groundfish diversity was lowest in the Shrimp Trawl Exemption Area (Alternative 8). This area had lower regulated and all species diversity than the No Action areas.

In the winter, average diversity indices in the Alternative 3 and Alternative 4 areas was higher than No Action across all species groups. In the Alternative 5 areas, groundfish and regulated species diversity indices were lower than the No Action indices, while all species diversity was higher. Groundfish and regulated species diversity indices were also higher in Alternative 6, while all species diversity was equal to No Action. Groundfish diversity was lower in Alternative 7A relative to the No Action areas, while regulated and all species diversity indices were higher. Diversity of all species groups in Alternative 7B areas is higher than No Action. No winter survey tows occurred in Alternative 8 areas so no diversity values were calculated.

These diversity index values can be compared to the diversity indices for areas in other sub-regions by reviewing the species diversity summary (Section 4.2.3) in Volume 1. Similar to the EFH overlap results, the diversity indices are generally similar across the alternatives because the management areas are so overlapping between alternatives.

Table 47 – Average diversity indices within the western Gulf of Maine sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted.

		Alternative									
		1 Habitat closure	1 Groundfish closure	2	3	4	5	6	7A	7B	8
Spring	*Tows*	*109*	*120*	*0*	*146*	*140*	*90*	*59*	*776*	*233*	*18*
	Lg mesh groundfish ISI	0.478	0.475	0.000	0.508	0.509	0.521	0.484	0.492	0.509	0.455
	Regulated spp. ISI	0.522	0.530	0.000	0.575	0.578	0.578	0.535	0.605	0.572	0.436
	All spp. SDI	1.234	1.265	0.000	1.363	1.364	1.343	1.261	1.495	1.324	1.165
Summer	*Tows*	*43*	*64*	*0*	*39*	*40*	*29*	*10*	*163*	*47*	*26*
	Lg mesh groundfish ISI	0.285	0.279	0.000	0.448	0.410	0.399	0.508	0.338	0.424	0.199
	Regulated spp. ISI	0.514	0.539	0.000	0.643	0.614	0.607	0.697	0.580	0.618	0.450
	All spp. SDI	1.346	1.428	0.000	1.502	1.480	1.479	1.555	1.475	1.489	1.254
Fall	*Tows*	*51*	*66*	*0*	*56*	*77*	*56*	*17*	*487*	*123*	*5*
	Lg mesh groundfish ISI	0.451	0.408	0.000	0.465	0.470	0.471	0.501	0.423	0.485	0.298
	Regulated spp. ISI	0.667	0.673	0.000	0.613	0.611	0.630	0.729	0.627	0.614	0.631
	All spp. SDI	1.569	1.581	0.000	1.497	1.428	1.460	1.892	1.555	1.422	1.419
Winter	*Tows*	*44*	*46*	*0*	*51*	*59*	*43*	*23*	*188*	*102*	*0*
	Lg mesh groundfish ISI	0.499	0.499	0.000	0.562	0.511	0.466	0.521	0.490	0.522	0.000
	Regulated spp. ISI	0.537	0.540	0.000	0.642	0.594	0.534	0.554	0.559	0.591	0.000
	All spp. SDI	1.143	1.162	0.000	1.416	1.338	1.179	1.143	1.209	1.277	0.000

4.2.1.4 ***Georges Bank***

There are eight habitat management alternatives for the Georges Bank sub-region: (1) no action Closed Area I and Closed Area II Habitat Closure Areas and [Groundfish] Closed Areas, (2) no HMAs, (3) Northern Edge HMA (4) Northern Edge HMA and Georges Shoal Gear Modification Area, (5) Georges Shoal 1 MBTG HMA and Northern Georges Gear Modification Area, (6a) EFH Expanded 1 HMA, (6b) a smaller version of 6a, EFH Expanded 2 HMA, with an open buffer along the EEZ boundary, (7) EFH South HMA and Georges Shoal 2 MBTG HMA, and (8) Northern Georges MBTG HMA.

Table 48 – GB: dominant substrate coverage within each management area.

Area name, type, and region (number of overlapping unstructured grids, Alternative #)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Closed Area I EFH N (607, #1)	-	4%	-	-	-	2%	82%	12%	<1%	-	2,028
Closed Area I EFH S (263, #1)	-	-	-	-	-	<1%	92%	7%	1%	-	617
Closed Area II EFH (1,175, #1)	1%	1%	<1%	-	-	<1%	32%	53%	12%	<1%	650
No action groundfish											
Closed Area I GF (2,628, #1)	-	2%	-	-	-	1%	81%	14%	2%	<1%	4,063
Closed Area II GF (2,904, #1)	<1%	5%	1%	-	-	1%	84%	8%	2%	<1%	6,826
Habitat management areas											
Northern Edge (949, #3 and 4)	2%	8%	<1%	-	-	<1%	26%	51%	12%	<1%	435
Georges Shoal Gear Mod Area (538, #4)	-	-	-	-	-	<1%	49%	26%	24%	<1%	1,050
Georges Shoal 1 MBTG (212, #5)	-	-	-	-	-	1%	78%	16%	5%	-	946
Northern Georges Gear Mod Area (3876, #5)	1%	3%	-	-	-	1%	65%	19%	9%	<1%	6,930
EFH Expanded 1 (1,757, #6A)	1%	7%	<1%	-	-	<1%	31%	47%	15%	<1%	1,138
EFH Expanded 2 (963, #6B)	-	8%	-	-	-	<1%	32%	44%	15%	<1%	794
EFH South MBTG (195, #7)	-	-	-	-	-	1%	53%	38%	8%	1%	277
Georges Shoal 2 MBTG (277, #7)	-	-	-	-	-	-	66%	17%	16%	-	1,039
Northern Georges MBTG (3,229, #8)	2%	16%	1%	-	-	<1%	43%	25%	13%	<1%	4,808
Georges Bank/GSC region (17,663, n/a)	**2%**	**21%**	**1%**	**<1%**	**-**	**1%**	**64%**	**8%**	**3%**	**<1%**	**48,992**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 49 – GB: data support within each management area.

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Closed Area I EFH N (607, #1)	-	40%	7%	<1%	15%	30%	8%	2,028
Closed Area I EFH S (263, #1)	-	-	4%	<1%	-	87%	9%	617
Closed Area II EFH (1,175, #1)	-	-	2%	2%	-	38%	58%	650
No action groundfish								
Closed Area I GF (2,628, #1)	-	20.18%	5%	<1%	7%	47%	20%	4,063
Closed Area II GF (2,904, #1)	-	2%	5%	<1%	8%	78%	7%	6,826
Habitat management areas								
Northern Edge (949, #3 and 4)	-	3%	2%	1%	3%	13%	78%	435
Georges Shoal Gear Mod Area (538, #4)	-	-	8%	4%	5%	81%	3%	1,050
Georges Shoal 1 MBTG (212, #5)	-	-	19%	1%	38%	42%	<1%	946
Northern Georges Gear Mod Area (3876, #5)	1%	1%	6%	1%	17%	62%	11%	6,930
EFH Expanded 1 (1,757, #6A)	-	-	2%	2%	1%	44%	51%	1,138
EFH Expanded 2 (963, #6B)	-	-	2%	2%	2%	56%	38%	794
EFH South MBTG (195, #7)	-	-	2%	2%	-	90%	6%	277
Georges Shoal 2 MBTG (277, #7)	-	-	21%	4%	62%	12%	<1%	1,038
Northern Georges MBTG (3,229, #8)	-	12%	6%	2%	16%	49%	16%	4,807
Georges Bank/GSC region (17,663, n/a)	**4%**	**19%**	**9%**	**1%**	**14%**	**47%**	**5%**	**48,992**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 50 – GB: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
EFH closure									
Closed Area I EFH N (#1)	43.9	48.6	*18*	-	-	-	107.1	120.9	*14*
Closed Area I EFH S (#1)	44.8	48.7	*5*	47.7	51.7	*5*	107.9	113.5	*5*
Closed Area II EFH (#1)	48.3	57.2	*6*	50.7	59.4	*6*	119.2	126.4	*6*
Groundfish closure									
Closed Area I GF (#1)	43.9	51.4	*37*	47.0	54.1	*18*	107.1	120.9	*33*
Closed Area II GF (#1)	41.7	57.2	*75*	47.4	59.4	*65*	106.5	133.3	*73*
Habitat Management Area									
Northern Edge (#3 and 4)	46.5	57.2	*6*	51.2	59.4	*4*	120.3	132.4	*6*
Georges Shoal Gear Mod Area (#4)	44.7	72.7	*9*	46.7	75.9	*9*	110.0	129.4	*9*
Georges Shoal 1 MBTG (#5)	44.2	58.3	*10*	46.6	61.1	*10*	108.0	114.3	*10*
Northern Georges Gear Mod Area (#5)	44.2	72.7	*76*	46.6	75.9	*74*	106.9	133.1	*76*
EFH Expanded 1 (#6A)	47.3	57.2	*11*	50.1	59.4	*11*	115.7	126.4	*11*
EFH Expanded 2 (#6B)	47.3	54.5	*7*	50.1	56.8	*7*	115.7	122.9	*7*
EFH South MBTG (#7)	48.0	48.3	*2*	50.6	50.7	*2*	112.6	120.1	*2*
Georges Shoal 2 MBTG (#7)	44.2	70.6	*10*	46.6	73.3	*10*	109.6	117.2	*10*
Northern Georges MBTG (#8)	44.2	72.7	*50*	46.6	75.9	*41*	107.1	132.5	*45*
GB/GSC region	**41.7**	**72.7**	**486**	**45.7**	**75.9**	**382**	**105.8**	**140.2**	**464**

Figure 14 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, No Action areas (Alternative 1). A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.

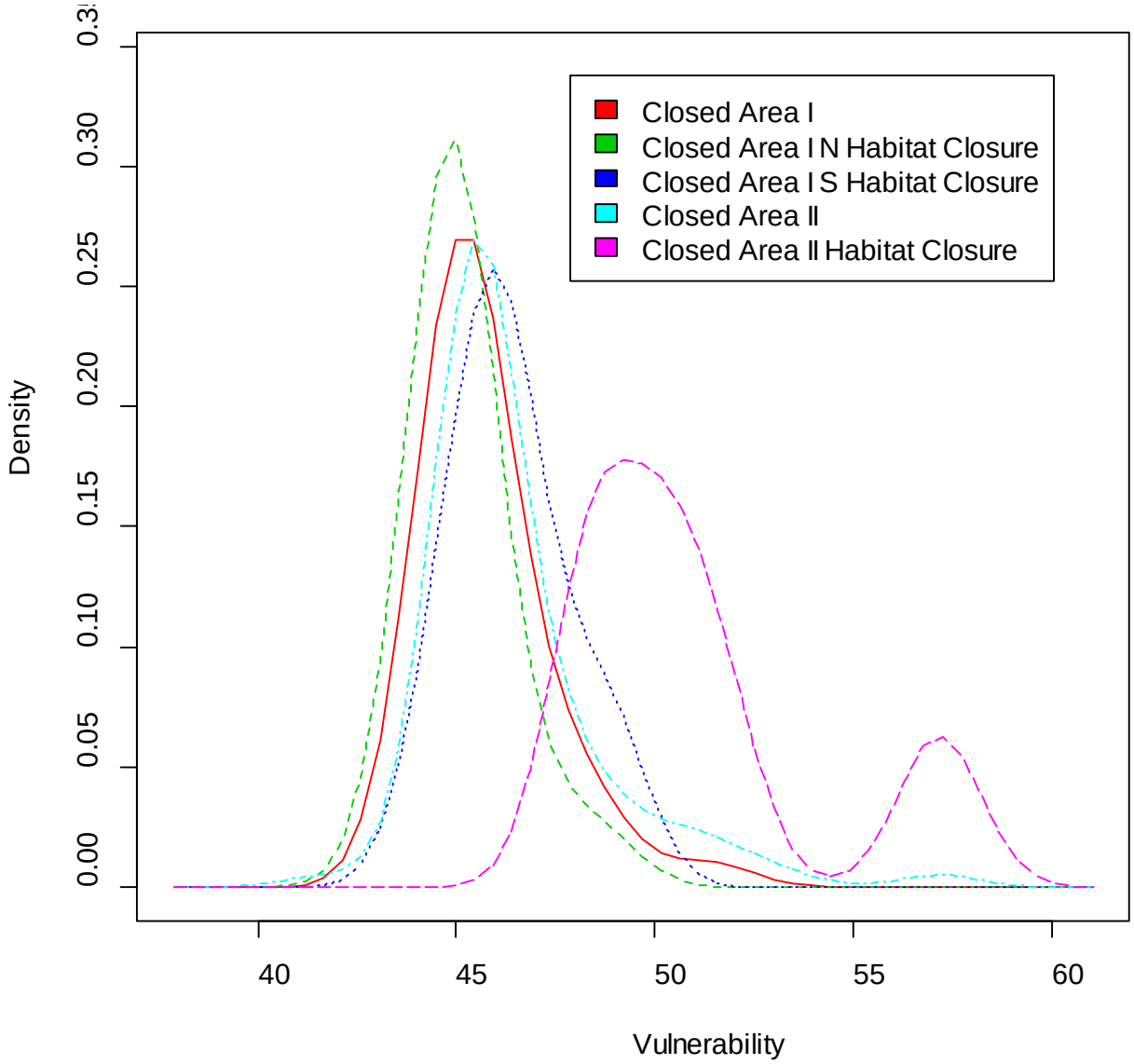
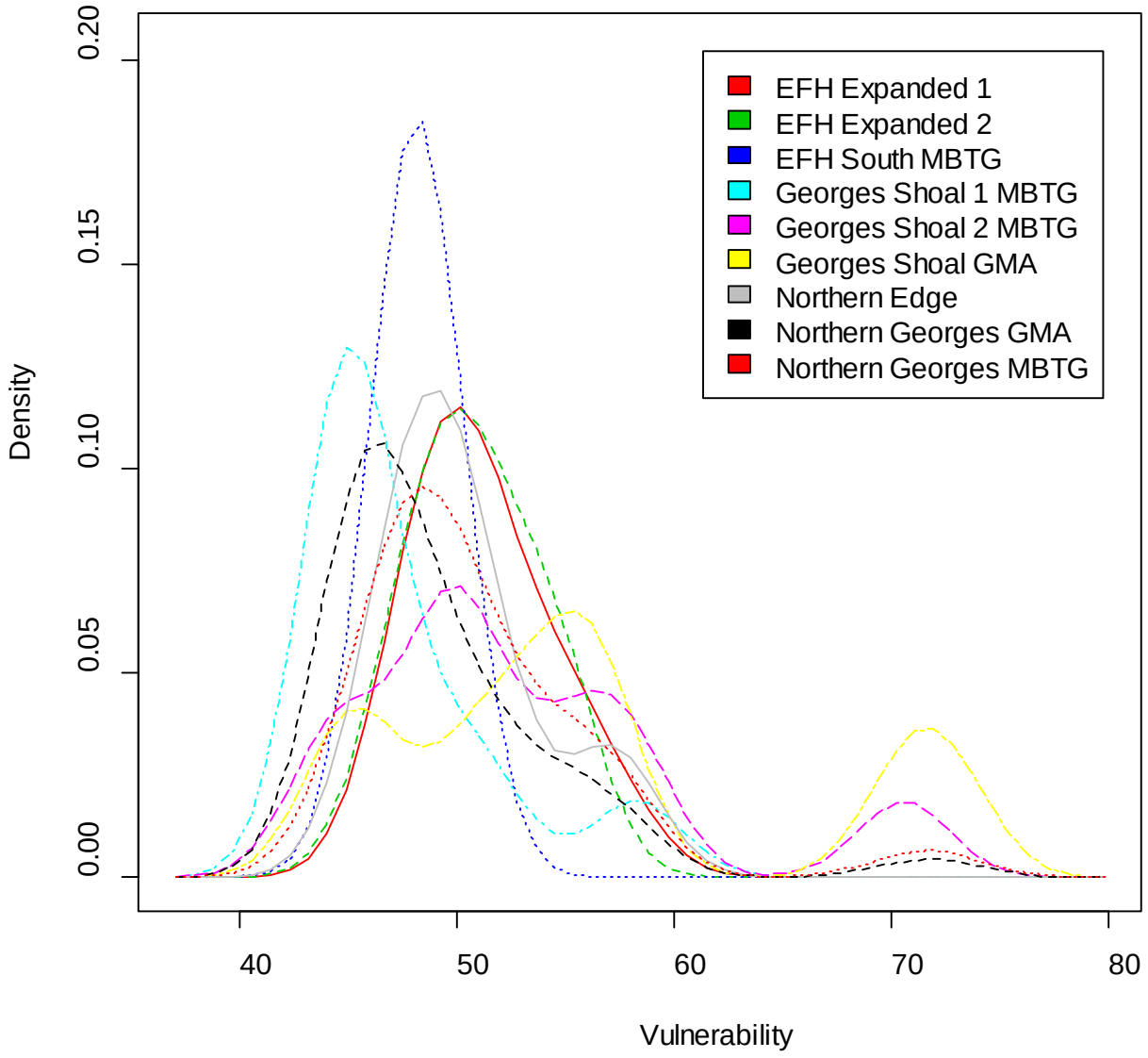
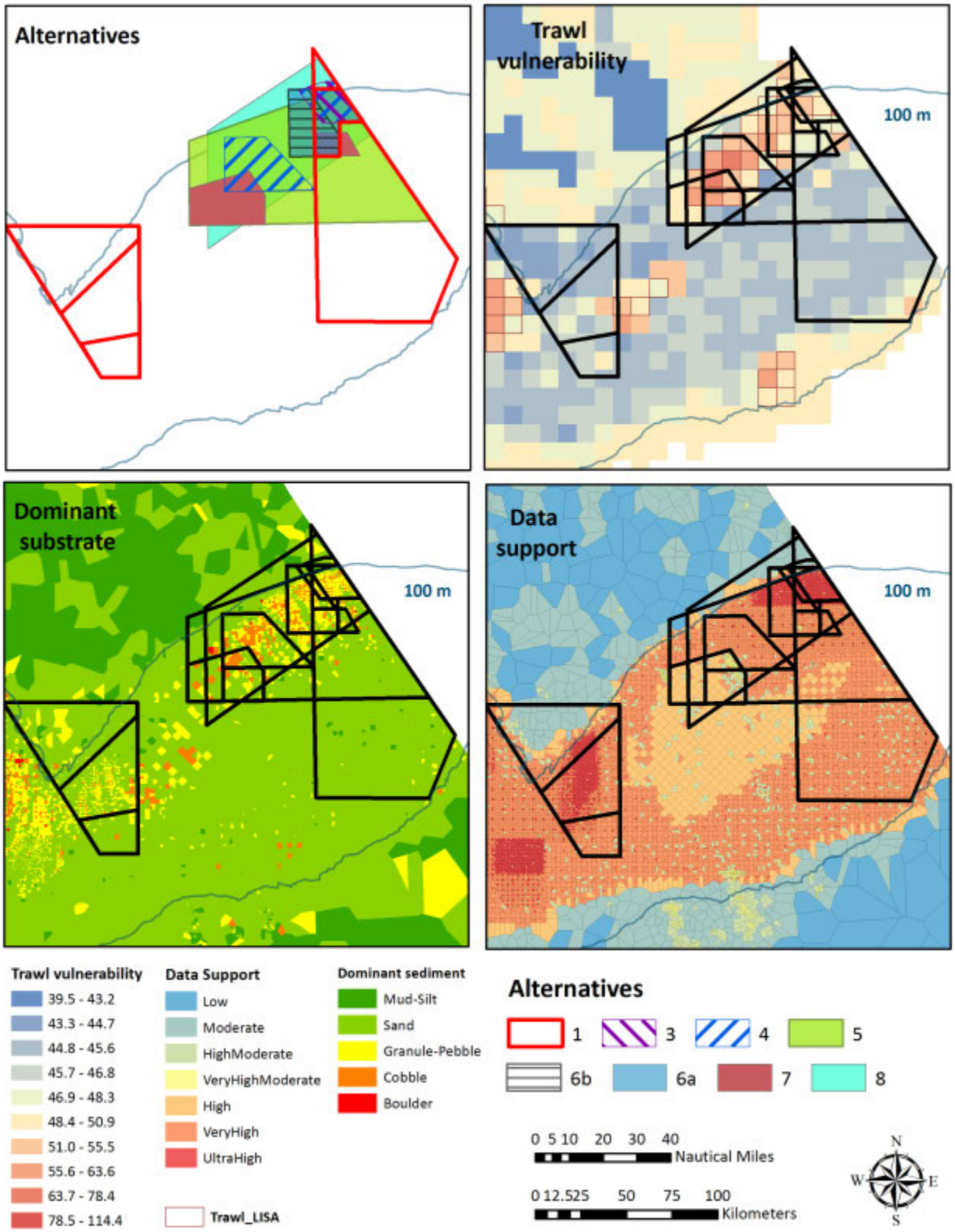


Figure 15 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, new or modified areas (Alternatives 3-8). A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.



Map 52 – GB: SASI dominant substrate, data support, and vulnerability outputs (trawl gear).



4.2.1.4.1 Alternative 1 (No Action)

As in other sub-regions, the Closed Area I and II Habitat Closure Areas are off-limits to mobile bottom-tending gears. Alternative 1/No Action also includes the Closed Area I and II year-round groundfish closed areas, which are generally closed to gears capable of catching groundfish. Portions of these areas not overlapping the habitat closures are fished by mobile bottom-tending gears. The portion of Closed Area II south of 41° 30' and the central part of CAI between the two habitat closures are fished with scallop dredges as scallop access areas. The southern part of CAII is also fished with bottom trawls as part of a groundfish Special Access Program. The portion of CAII north of 42° 10' is also accessible to otter trawl gear as part of a SAP. Because these areas are already fished with mobile bottom-tending gears, these portions of the closed areas provide limited habitat benefits. The northern portion of CAI is fished with demersal longline gear but this gear type does not cause significant adverse effects on seabed habitats. There is generally no fishing in the Closed Area II Habitat Closure Area with the exception of lobster trapping.

Seabed vulnerability within these areas is highly variable. The distribution of vulnerability scores is similar within the Closed Area I areas and Closed Area II (Figure 14, Table 50), and the overall distribution of values is shifted to the right for the Closed Area II Habitat Closure (Figure 14). Because it encompasses the habitat closure, Closed Area II includes these high values (Table 50), but on average the habitats in the groundfish closure are lower vulnerability.

Dominant substrate composition (Table 48) and the structural features associated with these substrates drive the vulnerability scores. High vs. low energy habitat type is not driving the differences in vulnerability, as all of the no action management areas are predominantly high energy (94-100%, depending on the area). Nearly all of the areas are dominated by sand substrates (83-92% sand), with the exception of the Closed Area II Habitat Closure (only 32% sand). The fraction of gravel-pebble substrates ranges from 7-14% for areas other than the Closed Area II Habitat Closure, while this area has 53% granule-pebble coverage and is the only area with substantial cobble-dominated habitat (12%, vs. 0-2% for the other areas).

While the resolution of the unstructured grid does influence vulnerability scores in this sub-region (this is further discussed below), all of the areas in this region are relatively well sampled in terms of their substrate type, especially relative to some areas in the Gulf of Maine. At most, in the Closed Area I North Habitat Closure, only 11% of the areas were sampled with gears not capable of detecting cobble and boulder substrates. In other areas, 95-97% of each area was sampled with video gear capable of detecting cobble and boulder substrates. Thus, there is high certainty that the habitat types described for each area do occur there, and that the substrate maps are identifying geologic features with relative accuracy. Sampling resolution is somewhat lower in the center of the bank (Map 53), but there is not a great deal of overlap between the center of Georges Bank and the Alternative 1/No Action areas.

<u>Overall, the Alternative 1 areas in combination are relatively low vulnerability, and are generally inefficient in terms of encompassing vulnerable habitat types that warrant protection from mobile bottom-tending gears.</u> <u>The exception to this is the CAII habitat closure, which has much coarser substrates on average as compared to the other areas and as a result much higher estimated vulnerability.</u> This area specifically has a highly positive impact on seabed habitats. In general,

the coarse substrates and higher vulnerability areas on Georges Bank occur within this habitat closure and extend west/southwest along the margin of the bank (Map 53). To the extent that the other lower vulnerability areas (Closed Area I areas, Closed Area II) result in redistribution of effort onto vulnerable habitat types outside the Closed Area II Habitat Closure, these areas could be having a negative impact on seabed habitats. It is difficult to weigh the positive impacts associated with protection of vulnerable habitats in the Closed Area II Habitat Closure with the negative impacts associated with effort redistribution to assess the performance of Alternative 1/No Action overall. Given that there are various access programs occurring within these areas, this alternative probably has positive impacts overall, despite being inefficient in terms of encompassing vulnerable habitat types. However, the action alternatives afford an opportunity to increase the relative vulnerability of habitats within habitat management areas.

Overall, Alternative 1/No Action has moderately positive impacts relative to Alternative 2, which does not include any specific habitat protection measures, and relative to Alternative 5, which includes a large gear modification with uncertain habitat benefits, and a smaller mobile bottom-tending gear closure that is relatively less vulnerable to fishing as compared to the Closed Area II Habitat Closure. This alternative also has moderately positive impacts relative to Alternatives 3, 4, 6A and 6B if gear modification Options 3 and 4 are selected. Alternative 1/No Action probably has neutral seabed impacts relative to Alternatives 3, 4, and 6B if Options 1 or 2 are selected, and also relative to Alternative 7. Alternative 1/No Action would have slightly negative impacts on seabed habitats relative to Alternatives 6A and 8.

4.2.1.4.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Closed Areas I and II could remain in place seasonally as spawning areas, or year-round under the No Action spawning alternative. In the absence of specific habitat management areas where mobile bottom-tending gear use is managed directly, minimization of adverse effects would rely on fishing as efficiently as possible, with the greatest catches for the least swept area. As noted above, the habitat closure portions of the no action areas prohibit mobile bottom-tending gear fishing in habitat types that are not especially vulnerable, specifically in the CAI habitat closure areas. This alternative, as well as the other action alternatives in this sub-region, afford an opportunity to increase flexibility in terms of fishing location on Georges Bank. This would hopefully increase efficiency somewhat, and could relieve pressure on more vulnerable habitat types. However, habitat types that are more vulnerable to accumulating fishing impacts, i.e. those along the northeastern flank of the bank, would not receive any specific protections under this alternative. Given this, it is estimated that Alternative 2 would have a moderately negative impact on seabed habitats relative to the other habitat management alternatives in this sub-region, including the No Action alternative.

Even if there are no year-round habitat closure areas on Georges Bank, the overall amount of fishing effort would still be capped using catch limits and other management tools. For example, going forward under any of the action alternatives, rotational scallop fishing in the existing Closed Area I and II access areas would not be expected to change significantly. While access area boundaries in CAI could shift if an action alternative is selected for this sub-region or a new access area in northern CAII could be added, the overall levels of fishing would be limited to

optimize yield and fishing will continue to occur on a periodic basis within the access areas. Other locations that are no longer part of a habitat closure, groundfish closure, or scallop access area could be fished under open area Days-at-Sea in various fisheries, or under a northeast multispecies sector allocation.

4.2.1.4.3 Alternative 3

This alternative would designate the Northern Edge HMA with one of the four mobile bottom-tending gear restrictions, and remove the Closed Area I and II habitat and groundfish closures (unless the groundfish areas are maintained seasonally or year-round for spawning protection). The 476 km^2 Northern Edge HMA overlaps with the existing Closed Area II Habitat Closure Area, and has similar characteristics in terms of substrate composition (Table 48) and similar vulnerability (Table 50, i.e. the area is highly vulnerable to impact. The Northern Edge area eliminates the southern part of the habitat closure, but extends further west and north. The existing habitat closure is somewhat larger at 641 km^2.

Relative to No Action for this sub-region, Alternative 3 with Option 1 or 2 offers a similar level of habitat conservation benefits, while increasing flexibility in terms of choice of fishing location. This is because with the exception of the Closed Area II Habitat Closure, the Alternative 1/No Action areas afford limited habitat conservation benefits because they contain lower vulnerability habitat types or are already fished by mobile bottom-tending gears.

Option 1, complete closure to mobile bottom-tending gears, offers the highest level of habitat conservation benefit. Option 2 for this area is going to have similar benefits as there are relatively fewer clams within the Northern Edge HMA, and hydraulic clam dredges cannot operate in very coarse substrates, so little hydraulic dredging would be expected within the HMA, even if that gear type is exempted. Options 3 and 4 would likely have limited habitat conservation benefits and would have a moderately negative impact relative to Alternative 1/No Action. Scallop dredges would be allowed to fish unrestricted in the area under Option 3 or 4, and there would likely be substantial levels of scallop fishing (probably via a rotational access program) within the HMA, given the high abundance of scallops in the area. Trawl gears would have restricted length and elevated ground cables (Option 3) or no ground cables (Option 4), but the catchability tradeoff and therefore net change in area swept are not well understood and cannot be estimated.

If Option 1 or 2 is selected, Alternative 3 would have moderately positive impacts relative to Alternative 2, and neutral impacts relative to Alternative 4, given Alternative 4 is Alternative 3 plus a gear modification area with very uncertain habitat benefits. Alternative 3 would also have a moderately positive impact relative to Alternative 5, which consists of a gear modification area and a mobile bottom-tending gear closure overlapping less vulnerable habitat types than the Northern Edge HMA contains. Again, assuming Option 1 or 2 is selected for all areas/alternatives, Alternative 3 would have negative impacts relative to Alternative 6A or 8 because the Northern Edge HMA is encompasses a smaller area of vulnerable seabed. Estimating impacts of Alternative 3 relative to Alternatives 6B and 7 is more difficult as these two alternatives represent a tradeoff between currently managed structured habitats (Alternative 3, and parts of Alternative 6B and 7) and newly managed structured habitats (small areas of

Alternative 3, most of Alternative 6B and 7). The Alternative 6A, 6B, 7, and 8 HMAs will be further discussed below.

4.2.1.4.4 Alternative 4

Alternative 4 is similar to Alternative 3, except that it includes an additional gear modification area west of Closed Area II. The direction of impacts associated with the gear modification area as compared to the area's current status as an open fishing area are not known, but are probably relatively small in magnitude. Impacts could be slightly positive if reductions in gear width lead to reduced area swept by trawl vessels, or impacts could be slightly negative if there is reduced catchability with the modified gear that outweighs reduced gear width. Given the substrate composition of the gear modification area, it is well-sited to encompass more vulnerable seabed types, but it is not clear that the gear modification measures will provide much conservation benefit. Overall, impacts of Alternative 4 should be similar to those for Alternative 3, above, given the small magnitude of impacts associated with the gear modification area.

4.2.1.4.5 Alternative 5

Alternative 5 includes a much larger Northern Georges Gear Modification Area that covers most of the northeastern portion of the bank. This 6,838 km^2 area is well located to encompass much of the vulnerable seabed on Georges Bank, but the impacts associated with gear modification areas are uncertain (see Alternative 4 discussion above). The alternative also includes a smaller mobile bottom-tending gear closure towards the center of the bank.

Of the various action alternative areas, the mobile bottom-tending gear closure has the lowest vulnerability (Figure 15). This is because the area is generally sandier than other action alternative habitat management areas in this sub-region (Table 48). Relative to Alternative 1/No Action, Alternative 5 would have moderately negative impacts. It would largely eliminate conservation measures in the existing Closed Area II Habitat Closure, trading the existing area for a gear modification area with uncertain but likely slight positive or negative impacts and a mobile bottom-tending gear closure that is not very well located to encompass vulnerable seabed types. Alternative 5 would have moderately negative impacts relative to Alternatives 3, 4, 6A, and 6B, assuming these alternatives are implemented with Options 1 or 2, and relative to Alternatives 7, and 8. Alternative 5 would have neutral impacts relative to Alternatives 3, 4, 6A, and 6B if these alternatives are implemented as gear modification areas (Options 3 and 4).

4.2.1.4.6 Alternatives 6A and 6B

Alternative 6A would extend the Closed Area II Habitat Closure to the west and increase its size by roughly 80%. Alternative 6B also shifts the area to the west, but removes an 8nm corridor along the EEZ. This adjustment increases the existing area's size by about 25%. Both modifications have similar percent coverage of granule-pebble and cobble substrate relative to sand as compared with the existing Closed Area II Habitat Closure and the Northern Edge HMA, which is not unexpected as they all overlap, and therefore all four areas have similar vulnerability to impact.

If Alternative 6A is implemented with Option 1 or 2, there would be slightly positive impacts relative to Alternative 1/No Action, given that the 6A area encompasses a larger area containing

vulnerable seabed habitats as compared to the existing closure. As discussed under Alternative 3, the remaining portions of the existing areas are not particularly vulnerable to fishing. If Alternative 6A is implemented with Options 3 or 4, there would be moderately negative impacts relative to Alternative 1/No Action, as discussed above.

If Alternative 6B is implemented with Option 1 or 2, there would be neutral to slightly negative impacts relative to No Action. While there would be a slight increase in overall area protected, the 6B area eliminates continued protection of an area that has been closed to mobile bottom-tending gear fishing for nearly 20 years in exchange for areas further west that are currently open to fishing. Given that habitat recovery of some features in cobble-dominated environments may take 10 years or longer, continued protection of recovered biological epifauna in an existing area is probably of greater benefit vs. new conservation measures in a currently open area containing similar geological structures. If Alternative 6B is implemented with Options 3 or 4, there would be moderately negative impacts relative to Alternative 1/No Action, as discussed above.

Both 6A and 6B would have positive impacts relative to Alternatives 2 and 5, and relative to Alternatives 3 and 4 as gear modification areas (Options 3 and 4). 6A would have positive impacts relative to Alternatives 3 and 4, assuming Option 1 or 2 is selected for the 6A and Northern Edge HMAs. Both 6A and 6B would have neutral impacts relative to Alternative 7, and negative impacts relative to Alternative 8.

4.2.1.4.7 Alternative 7

Alternative 7 includes two HMAs, both of which would be closed to mobile bottom-tending gears (Option 1 or 2). The EFH South HMA overlaps with the southern part of the existing Closed Area II Habitat Closure, and includes some areas to the east of the existing area as well. It is a relatively small area that is well-surveyed (Table 49) and is 53% sand, 38% granule-pebble, and 8% cobble (Table 48). Given a relatively higher coverage of sand substrate as compared to some of the other management areas in the sub-region, it has slightly lower vulnerability scores, although they are still higher than the No Action areas, with the exception of the Closed Area II Habitat Closure.

The Georges Shoal 2 HMA is a larger area that compares favorably with other HMAs in terms of having a high percent cobble coverage (Table 48) and therefore overlaps with higher vulnerability grids (Table 50 and Figure 15). However, the data support values are somewhat lower (Table 49), so these estimates of substrate coverage and vulnerability are less certain.

In combination, the two areas cover about 1,400 km^2, which is more than double the existing Closed Area II Habitat Closure, and is larger than the potential mobile bottom-tending gear closures associated with Alternatives 3, 4, 5, 6A, and 6B. However, the two areas do eliminate current protections for the northern part of the existing Closed Area II Habitat Closure (see discussion under Alternative 6). Thus, the Alternative 7 areas in combination may not constitute an improvement in conservation relative to Alternative 1/No Action, and probably have slightly negative impacts. Alternative 7 probably has neutral impacts to Alternatives 3, 4, 6A, and 6B despite the larger area covered by Alternative 7. Alternative 7 is estimated to have negative impacts relative to Alternative 8.

4.2.1.4.8 Alternative 8

Alternative 8 includes a single large HMA that covers most of Northern Georges Bank and much of the vulnerable habitat identified in the sub-region. Because it covers such a broad area, the HMA includes a wide range of dominant-substrate (Table 48) and data support (Table 49) values, including some low energy areas off the edge of the bank in deeper waters. Because the area so comprehensively covers the vulnerable seabed types on Georges Bank, it would have a larger magnitude of positive habitat impacts relative to all the other alternatives, although it is not the most efficient area in terms of encompassing vulnerable seabed. Because the most vulnerable habitat types on Georges Bank are included in this area, it is unlikely to displace fishing effort onto more vulnerable substrates within the sub-region. However, the area will displace significant amounts of fishing effort, as discussed in the economic impacts analysis. To the extent that this fishing is conducted less efficiently elsewhere, with higher area swept per amount of fish landed, this could increase the habitat impacts associated with some Georges Bank fishing trips.

4.2.1.4.9 Overlap with preferred alternative EFH designations

Closed Area II and its associated habitat closure (Alternative 1/No Action) have good correspondence with EFH for cod, haddock, red hake, windowpane flounder, winter flounder, yellowtail flounder, barndoor skate, little skate, and winter skate. In general, these same species also have substantial overlap with Closed Area I and its habitat closures (also included in Alternative 1/No Action), particularly the central and southern part of Closed Area I and the southern habitat closure. In Closed Area I, the northern habitat closure tends to overlap with a different and smaller set of species, since much of it is off the edge of the bank in deeper waters. This northern area has high overlap with pollock, silver hake, white hake, monkfish, smooth skate, and thorny skate, which is more similar to some of the Gulf of Maine areas described above than the other Georges Bank areas.

The action alternative areas are concentrated on the northern half of the bank and many of them are spatially overlapping, so there are many similarities in terms of the EFH designations they encompass. Generally juvenile and adult cod EFH is well-represented, with higher juvenile EFH coverage in the eastern areas (Northern Edge, EFH Expanded 1 and 2, and EFH South) vs. those further west on Georges Shoals (Georges Shoal gear modification area, Georges Shoal mobile bottom-tending gear closure 1 and 2). The eastern areas also have better coverage for juvenile and adult haddock EFH and adult ocean pout EFH. Windowpane, winter flounder, and yellowtail flounder EFH designations tend to be well represented in the management areas as well, as are little and winter skate. The two mobile bottom-tending gear closures on Georges Shoal overlap the fewest number of species (13 out of 23) and designations (22 and 19 out of 43) of any of the Georges Bank areas.

Because both the Northern Georges gear modification area (Alternative 5) and mobile-bottom tending gear closure (Alternative 8) are very large and overlap a greater range of seabed types and depths relative to other management areas, their overlap with designated EFH is somewhat patchier, consisting of areas of lower and higher importance for various species, which translates into lower total scores of 69 and 72 as compared to the areas that focus on the northeastern corner of the bank within U.S. waters. Although these areas are much larger, they only

encompass a slightly higher diversity of species and number of designations as compared to many of the smaller areas.

All Georges Bank areas have substantial overlap with wolffish, herring, and scallop EFH, noting the caveats associated with these designations. This appears to result from the areas being relatively shallow and closer to the center of the bank, such that they do not encompass deeper water species such as pollock, witch flounder, or monkfish.

Table 51 – Preferred alternative EFH designations within No Action areas on Georges Bank.

Species and lifestage (those in red occupy complex hard bottom seabed types that are more vulnerable to fishing)	Closed Area II Alt 1	Closed Area II Habitat Closure Area Alt 1	Closed Area I Alt 1	Closed Area I Habitat Closure Area N Alt 1	Closed Area I Habitat Closure Area S Alt 1
Acadian redfish juvenile	Slight	*None*	Moderate	High	*None*
Acadian redfish adult	Slight	*None*	Slight	Moderate	*None*
American plaice juvenile	*None*	*None*	Slight	Moderate	*None*
American plaice adult	*None*	*None*	Slight	Moderate	*None*
Atlantic cod juvenile	High	High	Moderate	Moderate	Moderate
Atlantic cod adult	High	**Full**	**Full**	**Full**	**Full**
Atlantic halibut - all stages	Moderate	Slight	Moderate	Moderate	Moderate
Atlantic wolffish - all stages	**Full**	**Full**	Moderate	**Full**	*None*
Haddock juvenile	High	High	High	Moderate	High
Haddock adult	High	High	High	**Full**	High
Ocean pout egg	Slight	Slight	Slight	Slight	Slight
Ocean pout juvenile	Slight	*None*	Slight	Slight	*None*
Ocean pout adult	Moderate	High	Moderate	Moderate	Moderate
Pollock juvenile	Slight	Moderate	Moderate	High	Slight
Pollock adult	Slight	Slight	Moderate	High	*None*
Red hake egg, larvae, and juvenile	Moderate	Moderate	Moderate	Moderate	Moderate
Red hake adult	High	Moderate	High	High	Moderate
Silver hake juvenile	Moderate	Moderate	Moderate	High	Slight
Silver hake adult	Slight	Slight	Moderate	High	*None*
White hake juvenile	High	**Full**	High	**Full**	Moderate
White hake adult	Slight	*None*	Moderate	High	*None*
Windowpane flounder juvenile	Moderate	High	Moderate	*None*	Moderate
Windowpane flounder adult	Moderate	High	Moderate	*None*	High
Winter flounder egg	High	High	Moderate	*None*	High
Winter flounder larvae and adult	Moderate	High	Moderate	*None*	High
Winter flounder juvenile	Moderate	High	Moderate	*None*	Moderate
Witch flounder juvenile	Slight	Slight	*None*	*None*	*None*
Witch flounder adult	Slight	Slight	Moderate	Moderate	*None*
Yellowtail flounder juvenile	Moderate	Moderate	Moderate	Slight	High
Yellowtail flounder adult	High	High	Moderate	Slight	High
Monkfish juvenile	Slight	*None*	*None*	*None*	*None*
Monkfish adult	Slight	*None*	Moderate	High	Slight
Smooth skate juvenile	Slight	*None*	Moderate	High	*None*
Smooth skate adult	Slight	Slight	Moderate	High	*None*
Thorny skate juvenile	Slight	*None*	Moderate	High	*None*
Thorny skate adult	Slight	Slight	Moderate	High	*None*
Barndoor skate – juv/adu	Moderate	High	Moderate	High	Moderate
Little skate juvenile	High	Moderate	Moderate	Slight	**Full**
Little skate adult	High	High	Moderate	Slight	**Full**
Winter skate juvenile	High	High	Moderate	Slight	**Full**
Winter skate adult	High	High	Moderate	Slight	**Full**
Atlantic sea scallop - all	High	**Full**	High	High	High
Atlantic herring egg	Slight	**Full**	*None*	*None*	*None*
Total score	**79**	**77**	**81**	**80**	**61**
Count of species represented (out of 23)	**22**	**20**	**22**	**20**	**16**
Count of designations represented (out of 43)	**41**	**33**	**40**	**35**	**26**

Table 52 – Preferred alternative EFH designations within Alternative 3-8 Georges Bank HMAs. Areas are arranged on the table so that overlapping/adjacent areas can be compared more easily.

Species and lifestage (those in red occupy complex hard bottom seabed types that are more vulnerable to fishing)	Northern Edge HMA Alt 3, 4	EFH Expnded 1 Alt 6A	EFH Expnded 2 Alt 6B	EFH South MBTG Closure Alt 7	Georges Shoal GMA Alt 4	Georges Shoal MBTG Closure 1 Alt 5	Georges Shoal MBTG Closure 2 Alt 7	Northern Georges GMA Alt 5	Northern Georges MBTG Closure Alt 8
Acadian redfish juvenile	Slight	Slight	Slight	*None*	*None*	*None*	*None*	Slight	Slight
Acadian redfish adult	Slight	Slight	Slight	*None*	*None*	*None*	*None*	Slight	Slight
American plaice juvenile	*None*	*None*	*None*	*None*	Slight	*None*	*None*	Slight	Slight
American plaice adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	Slight	Slight
Atlantic cod juvenile	High	High	High	**Full**	Moderate	Slight	Moderate	Moderate	Moderate
Atlantic cod adult	High	High	High	**Full**	High	High	High	High	High
Atlantic halibut - all stages	Slight	Slight	Slight	Slight	Slight	Slight	*None*	Slight	Slight
Atlantic wolffish - all stages	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**	**Full**
Haddock juvenile	High	High	High	High	Slight	Slight	*None*	Moderate	Moderate
Haddock adult	Moderate	Moderate	Moderate	High	Slight	Slight	Slight	Moderate	Moderate
Ocean pout egg	Slight	Slight	Slight	*None*	*None*	*None*	*None*	Slight	Slight
Ocean pout juvenile	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Ocean pout adult	High	High	High	**Full**	Slight	*None*	*None*	Slight	Moderate
Pollock juvenile	High	Moderate	Slight	*None*	Slight	*None*	*None*	Slight	Slight
Pollock adult	Moderate	Slight	Slight	*None*	Slight	*None*	*None*	Slight	Slight
Red hake egg, larvae, j.	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Red hake adult	Moderate	Moderate	Moderate	Moderate	Slight	Slight	*None*	Moderate	Moderate
Silver hake juvenile	Moderate	Moderate	Moderate	Moderate	Moderate	*None*	*None*	Moderate	Moderate
Silver hake adult	Slight	*None*	*None*	*None*	Slight	*None*	*None*	Slight	Slight
White hake juvenile	**Full**	High	High	High	High	Moderate	Moderate	High	**Full**
White hake adult	Slight	*None*	*None*	*None*	*None*	*None*	*None*	Slight	Slight
Windowpane fl. juvenile	Moderate	High	High	High	High	High	**Full**	Moderate	Moderate
Windowpane fl. adult	Moderate	High	High	**Full**	High	High	**Full**	Moderate	Moderate
Winter flounder egg	Moderate	High	High	**Full**	High	High	**Full**	Moderate	Moderate
Winter fl. larvae/adult	Moderate	High	High	**Full**	High	High	**Full**	Moderate	Moderate
Winter flounder juvenile	Moderate	High	High	High	High	High	**Full**	Moderate	Moderate
Witch flounder juvenile	Slight	Slight	Slight	*None*	Slight	*None*	*None*	Slight	Slight
Witch flounder adult	Slight	Slight	Slight	*None*	Slight	*None*	*None*	Slight	Slight
Yellowtail fl. juvenile	Moderate	Moderate	Moderate	Moderate	Moderate	Slight	Slight	Moderate	Moderate
Yellowtail flounder adult	Moderate	High	High	**Full**	High	High	Moderate	High	Moderate
Monkfish juvenile	Slight	*None*	*None*	*None*	*None*	*None*	*None*	*None*	Slight
Monkfish adult	Slight	*None*	*None*	*None*	Slight	*None*	*None*	Slight	Slight
Smooth skate juv	Slight	Slight	Slight	*None*	*None*	*None*	*None*	*None*	Slight
Smooth skate adu	Slight	Slight	Slight	*None*	*None*	*None*	*None*	*None*	Slight
Thorny skate juv	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Thorny skate adult	Slight	Slight	Slight	*None*	Slight	*None*	*None*	Slight	Slight
Barndoor juv/adu	High	High	High	Moderate	Slight	Slight	*None*	Moderate	Moderate
Little skate juv	Moderate	Moderate	Moderate	**Full**	High	**Full**	**Full**	High	Moderate
Little skate adult	High	High	High	**Full**	High	High	High	High	High
Winter skate juv	High	High	High	**Full**	High	High	**Full**	**Full**	High
Winter skate adult	High	High	High	**Full**	High	High	High	High	High
Atlantic sea scallop	High	**Full**	**Full**	**Full**	**Full**	High	Moderate	High	High
Herring egg	High	High	Moderate	**Full**	Slight	*None*	Moderate	Slight	Moderate
Total score	**78**	**78**	**76**	**68**	**65**	**50**	**47**	**69**	**72**
Count of species represented (out of 23)	**22**	**21**	**21**	**17**	**21**	**13**	**13**	**22**	**23**
Count of designations represented (out of 43)	**39**	**35**	**35**	**25**	**33**	**22**	**19**	**38**	**41**

4.2.1.4.10 Species diversity

Table 53 shows groundfish diversity, regulated species diversity, and all species diversity for the Georges Bank habitat management alternatives. Alternatives with the highest diversity values (75th percentile of each season) for each diversity index across all alternatives in all sub-regions are shaded (red=groundfish, yellow=regulated species, green=all species).

In the spring, average diversity indices for all groups are lowest in areas affected by Alternative 3, and the Alternative 4 indices are all lower than the No Action indices. Average diversity indices for each species group are higher in Alternative 5 areas than in Alternative 1/No Action areas. In the Alternative 6A and 6B areas, groundfish diversity indices were higher than No Action, while regulated and all species diversity indices were lower than No Action. Groundfish diversity in the Alternative 7 areas was lower than No Action, while regulated and all species diversity indices were higher. Average diversity indices for the Alternative 8 area were higher than the No Action values across all species groups.

Groundfish diversity appears to be lowest during summer in Georges Bank, which may be explained by the fact that the summer survey is conducted with a scallop dredge. In areas affected by Alternatives 3 and 4, diversity indices of each species group were lower than the No Action indices. Groundfish diversity was lower in Alternative 5 areas as compared to the No Action area, but regulated and all species diversity indices were higher. Diversity indices across all species groups were lower in the Alternative 6A area than No Action. Groundfish diversity in the Alternative 6B area was higher than No Action, while regulated and all species diversity indices were lower. Diversity indices for each species group were higher in Alternative 7 areas than in the No Action areas. In the Alternative 8 are, groundfish diversity was lower than No Action while regulated and all species diversity indices were higher.

All species diversity is highest in the fall on Georges Bank. All alternative areas were higher with respect to all species diversity than the No Action areas. Groundfish diversity was higher in the Alternative 3 area than in the No Action areas, but regulated species diversity was lower. All diversity indices were higher in the Alternative 4 areas than in the No Action areas. Both groundfish and regulated species diversity indices were lower in the Alternative 5 areas than in the No Action areas. In areas affected by Alternatives 6A, 6B and 7, groundfish diversity was lower than No Action and regulated species diversity was higher. Average diversity indices were higher in the Alternative 8 area than in the No Action areas across all species groups.

Average diversity across all species groups appears to be highest in the winter on Georges Bank. However, the lower number of tows could be affecting the results. In the winter, none of the areas affected by Alternatives 3 or 4 were sampled. Diversity of each species group is lower in areas affected by Alternative 5 than in the No Action areas. The Alternative 6A and 6B areas were more diverse with respect to all species than No Action, but less diverse with respect to groundfish and regulated species. Diversity of each species group was lower in the Alternative 8 area than in the No Action areas.

These diversity index values can be compared to the diversity indices for areas in other sub-regions by reviewing the species diversity summary (Section 4.2.3) in Volume 1.

Table 53 – Average diversity indices within the Georges Bank sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted.

		Alternatives									
		1 Habitat closure	1 Groundfish closure	2	3	4	5	6A	6B	7	8
Spring	*Tows*	*119*	*363*	*0*	*37*	*66*	*215*	*67*	*39*	*16*	*163*
	Lg mesh groundfish ISI	0.329	0.361	0.000	0.297	0.324	0.366	0.333	0.372	0.291	0.365
	Regulated spp. ISI	0.373	0.434	0.000	0.195	0.346	0.440	0.240	0.277	0.464	0.394
	All spp. SDI	1.060	1.175	0.000	0.718	1.005	1.165	0.832	0.879	1.233	1.1
Summer	*Tows*	*163*	*546*	*0*	*54*	*77*	*231*	*94*	*45*	*7*	*192*
	Lg mesh groundfish ISI	0.275	0.258	0.000	0.24	0.233	0.26	0.264	0.283	0.324	0.249
	Regulated spp. ISI	0.266	0.345	0.000	0.084	0.240	0.396	0.128	0.182	0.337	0.337
	All spp. SDI	0.805	0.997	0.000	0.459	0.732	1.077	0.606	0.762	1.081	0.955
Fall	*Tows*	*45*	*150*	*0*	*10*	*22*	*106*	*19*	*12*	*17*	*68*
	Lg mesh groundfish ISI	0.321	0.255	0.000	0.359	0.397	0.299	0.293	0.268	0.274	0.324
	Regulated spp. ISI	0.584	0.564	0.000	0.574	0.648	0.579	0.596	0.621	0.589	0.598
	All spp. SDI	1.460	1.407	0.000	1.533	1.704	1.467	1.501	1.47	1.613	1.545
Winter	*Tows*	*4*	*11*	*0*	*0*	*0*	*4*	*3*	*3*	*0*	*4*
	Lg mesh groundfish ISI	0.641	0.502	0.000	0	0	0.568	0.629	0.629	0	0.58
	Regulated spp. ISI	0.617	0.545	0.000	0	0	0.553	0.605	0.605	0	0.612
	All spp. SDI	1.601	1.329	0.000	0	0	1.305	1.662	1.662	0	1.381

4.2.1.5 *Great South Channel/Southern New England*

There are six habitat management alternatives for the Georges Bank sub-region: (1) no action Nantucket Lightship Habitat Closure Area and Groundfish Closed Area, (2) no HMAs, (3) Great South Channel East HMA and Cox Ledge HMA, (4) Great South Channel HMA and Cox Ledge HMA, and (5) Nantucket Shoals HMA and Cox Ledge HMA, and (6) Nantucket Shoals West HMA as a mobile bottom-tending gear closure and Great South Channel Gear Modification Area. Any areas in Alternatives 3, 4, or 5 could have any of the options applied to them.

Table 54 – GSC-SNE: Dominant substrate coverage within each management area.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Nantucket Lightship EFH (603, #1)	3%	32%	-	-	-	1%	62%	2%	1%	-	3,354
No action groundfish											
Nantucket Lightship GF (3509, #1)	12%	28%	-	-	-	2%	54%	3%	-	-	6,066
Habitat management areas											
Cox Ledge (37, #3-6)	-	-	-	-	-	6%	73%	6%	6%	8%	199
Great South Channel East (2,186, #3)	-	-	-	-	-	-	54%	27%	17%	2%	3,334
Great South Channel (1,518, #4)	-	-	-	-	-	-	60%	22%	16%	2%	2,545
Nantucket Shoals (1,134, #5)	-	-	-	-	-	-	68%	19%	12%	1%	2,319
Nantucket Shoals, west (1,244, #6)	-	-	-	-	-	-	74%	15%	9%	1%	2,936
Great South Channel Gear Mod Area (1,656, #6)	-	-	-	-	-	-	52%	31%	14%	2%	2,328
Georges Bank/GSC region (17,663)	**2%**	**21%**	**1%**	**<1%**	**0%**	**1%**	**64%**	**8%**	**3%**	**>1%**	**48,992**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Table 55 – GSC-SNE: Data support within each management area.

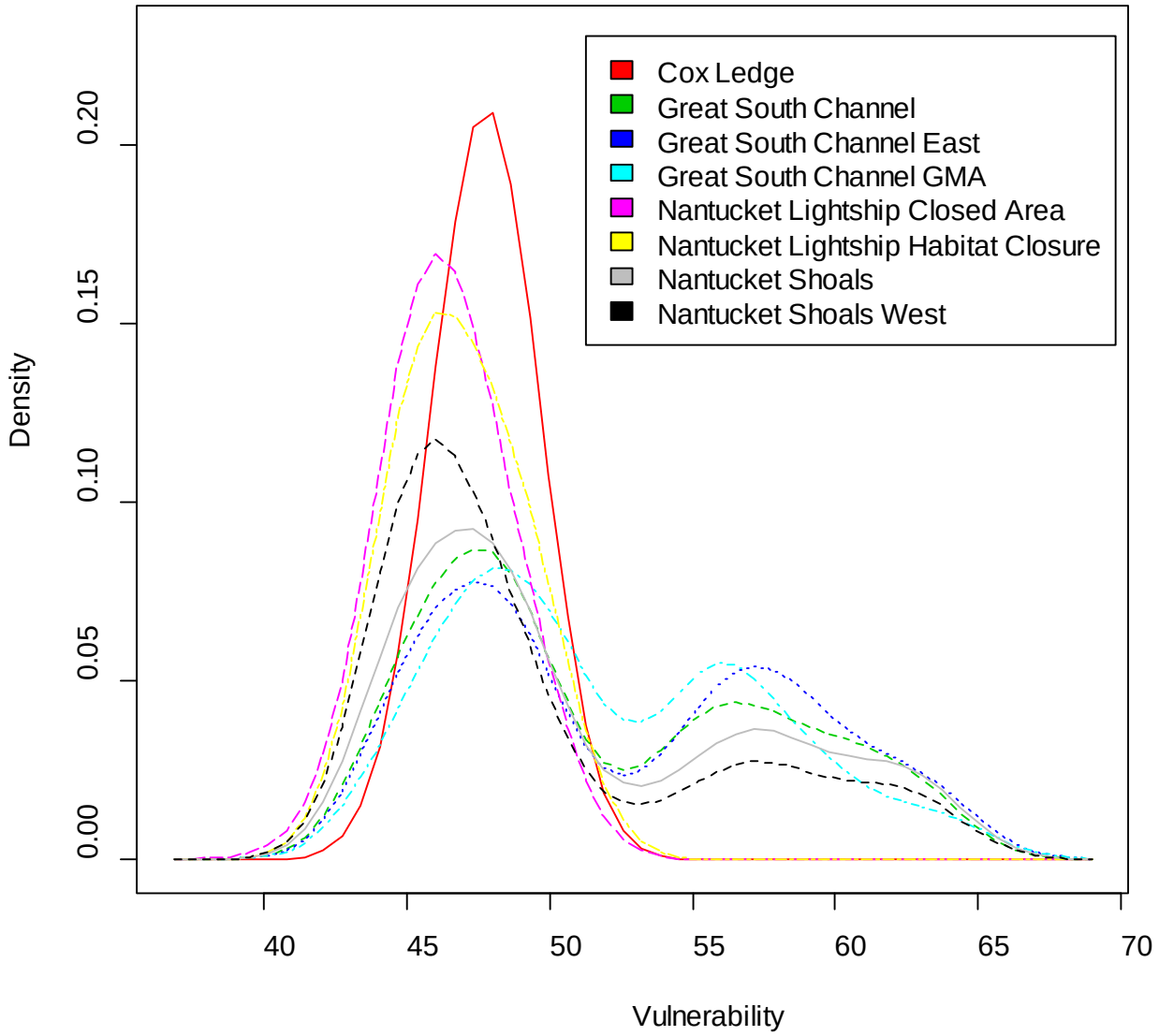
Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Nantucket Lightship EFH (603, #1)	4%	28%	13%	<1%	9%	45%	1%	3,354
No action groundfish								
Nantucket Lightship GF (3,509, #1)	4%	31%	4%	<1%	9%	42%	11%	6,066
Habitat management areas								
Cox Ledge (37, #3-6)	-	24%	22%	-	6%	48%	1%	199
Great South Channel East (2,186, #3)	-	1%	17%	4%	<1%	69%	8%	3,334
Great South Channel (1,518, #4)	-	2%	21%	4%	<1%	67%	6%	2,545
Nantucket Shoals (1,134, #5)	-	8%	33%	4%	2%	51%	3%	2,319
Nantucket Shoals, west (1,244, #6)	-	18%	32%	4%	1%	43%	3%	2,936
Great South Channel Gear Mod Area (1,656, #6)	-	-	5%	3%	-	82%	11%	2,328
Georges Bank/GSC Region (17,663)	**4%**	**19%**	**9%**	**1%**	**14%**	**47%**	**5%**	**48,992**

Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

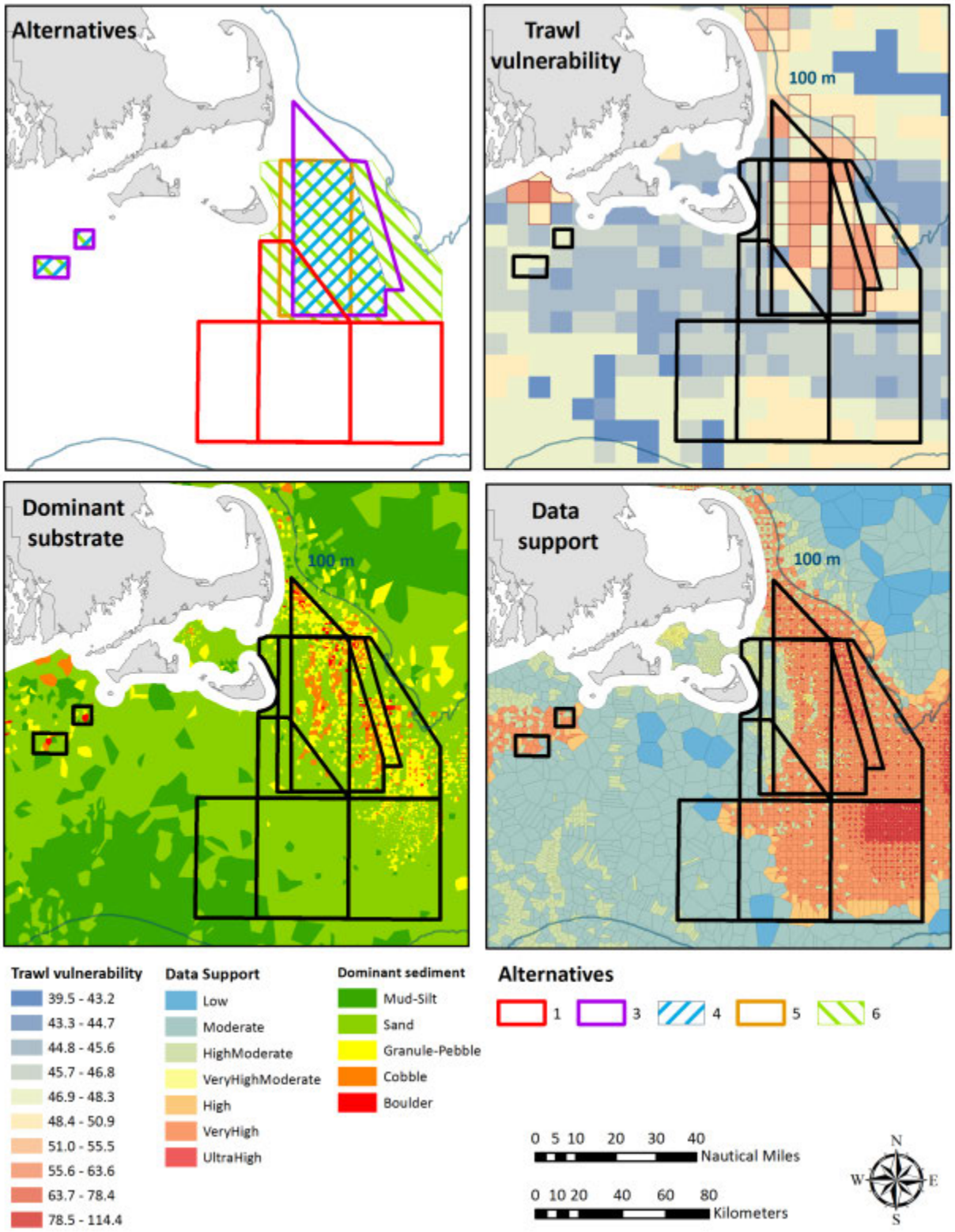
Table 56 – Minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area in the Great South Channel/Southern New England sub-region, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
EFH closure									
Nantucket Lightship EFH (#1)	44.4	50.0	*31*	47.1	52.4	*31*	107.2	133.6	*31*
Groundfish closure									
Nantucket Lightship GF (#1)	42.2	49.2	*66*	46.3	51.8	*62*	107.2	136.0	*65*
Habitat Management Area									
Cox Ledge (#3-6)	47.0	48.3	*3*	48.8	50.7	*3*	109.1	111.9	*3*
Great South Channel East (#3)	44.4	63.6	*34*	47.1	66.1	*34*	108.3	122.8	*34*
Great South Channel (#4)	44.4	63.2	*26*	47.1	65.5	*26*	108.3	119.2	*26*
Nantucket Shoals (#5)	44.4	63.2	*22*	47.1	65.5	*22*	107.3	119.2	*22*
Nantucket Shoals West (#6)	44.4	63.2	*29*	47.1	65.5	*29*	107.3	119.2	*29*
Great South Channel Gear Modification Area (#6)	44.7	63.6	*20*	47.7	66.1	*19*	109.6	122.8	*20*
GB/GSC region	**41.7**	**72.7**	***486***	**45.7**	**75.9**	**382**	**105.8**	**140.2**	***464***

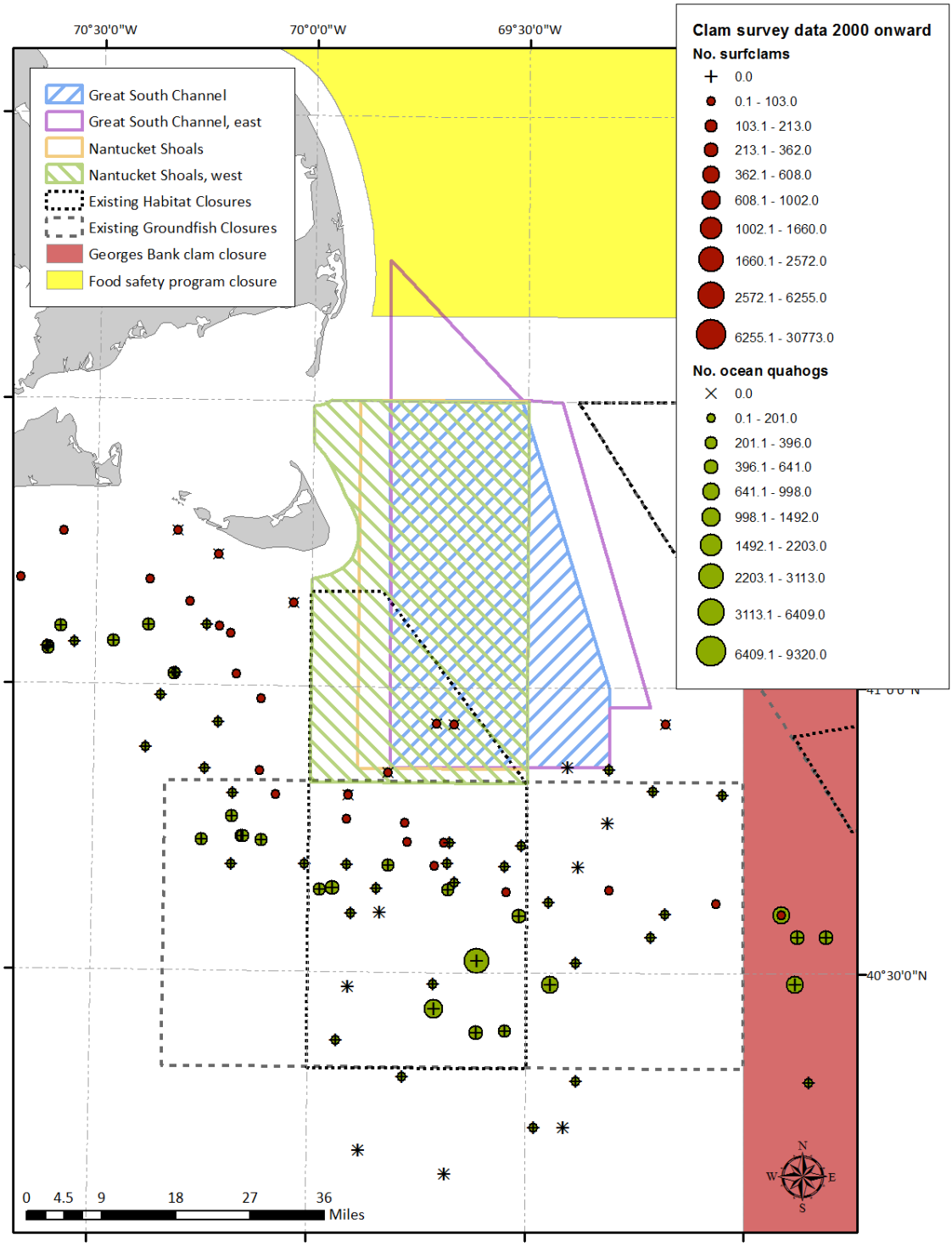
Figure 16 – GSC: Distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.



Map 53 – GSC-SNE: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



Map 54 – Distribution of surfclams and ocean quahogs in clam dredge surveys since 2000 relative to the boundaries of existing and proposed habitat areas in the Great South Channel region.



4.2.1.5.1 Alternative 1 (No Action)

The only portion of this alternative currently off limits to mobile bottom tending gear is the Nantucket Lightship Habitat Closure; scalloping is allowed in an access area in the eastern part of the Nantucket Lightship Closed Area, and clam dredging is allowed in both the eastern and western portions, so these areas offer limited habitat conservation benefits. Relative to the various action alternative areas, the Nantucket Lightship Habitat Closure is not as vulnerable to fishing gear impacts (vulnerability distribution shifted to the left in Figure 16), and consists mainly of high and low energy sand-dominated habitats (Table 54) as compared to the various action alternative areas which have higher percentages of gravel habitats. (The vulnerability scores for all areas covered by the SASI model are distributed over a relatively narrow range, so the distinction between the no action and alternative areas in Figure 16 may appear subtle.) Overall, Alternative 1/No Action has neutral to slightly negative impacts on seabed habitats, if closure of the existing areas to various types of fishing effort results in a displacement of effort onto more vulnerable habitat types. If displacement is not occurring due to differences in species composition in the existing vs. alternative areas, then the current areas and measures are likely more neutral in terms of their impacts on habitat. This means that Alternative 1 is likely to have neutral to slightly negative impacts relative Alternative 2 (no HMAs). All of the newly developed HMAs in this sub-region (Alternatives 3-6) better encompass vulnerable habitats, and Alternative 1 would have negative impacts relative to Alternatives 3-5 if implemented as mobile bottom-tending gear closures (Options 1 or 2), or relative to Alternative 6. If gear modification options are selected for Alternatives 3-5, they would have neutral impacts relative to Alternative 1/No Action.

4.2.1.5.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Because the No Action areas in this sub-region are not very effective in terms of encompassing vulnerable habitats, Alternative 2 would have a neutral to slightly positive impact on seabed habitats in this sub-region relative to Alternative 1/No Action, to the extent that it removes existing areas and allows greater flexibility in choice of fishing location and could shift fishing effort from more vulnerable habitat types to less vulnerable habitats that are currently closed. Alternative 2 has negative impacts relative to Alternatives 3, 4, and 5 if Options 1 or 2 are selected and also relative to Alternative 6, because unlike those alternatives, Alternative 2 offers no specific protection for vulnerable habitat types north of the currently closed areas.

4.2.1.5.3 Alternative 3

Alternative 3 includes the Great South Channel East HMA and Cox Ledge HMA (2 sub-areas). The Great South Channel East is the largest of the alternative areas in the sub-region at 3,356 km^2, and roughly comparable in size to the existing Nantucket Lightship EFH closure (3,387 km^2). This area also has the largest fraction by area of cobble- and boulder-dominated habitat, with 17% cobble and 2% boulder coverage (Table 54). Data support is high for 77% of the area, meaning that these larger grain sizes are detectable in the substrate data overlapping most of the management area (Table 55). Greater uncertainty in substrate classification due to lower data support occurs in the western portion of the area (Map 53). Habitat vulnerability in this area, and the other action alternative areas, is much higher than for the existing Nantucket Lightship EFH

closure. Therefore, implementation of the Great South Channel East HMA with Option 1 is expected to have a moderately positive impact on seabed habitats relative to No Action.

In general, clam dredges are used frequently in this sub-region as compared to other sub-regions, so their exemption from the HMA restrictions (Options 2, 3, or 4) or not (Option 1) has an influence on the habitat conservation benefits of any particular area. This is different from other sub-regions where the habitat impacts of Options 1 and 2 are probably equivalent to one another due to little overlap with the clam resource or clam fisheries. As shown in the economic impacts sections, clam dredging represents an increasing fraction of overall revenues across all gear types from the Great South Channel East HMA (Alternative 3) to the Nantucket Shoals West HMA (Alternative 6). Clam dredges have an adverse effect on the seabed and therefore Alternative 3 Option 2 has lesser positive impacts as compared to Alternative 3 Option 1. However, the areas in which clams occur are probably the lower vulnerability portions of the Great South Channel East HMA and other alternative HMAs in Alternatives 4, 5, and 6. Specifically, the clam survey is conducted and shows the presence of clams in the southwestern portion of these areas (Map 54), and these locations tend to be relatively sand dominated and less vulnerable to adverse effects as compared to the northern and eastern parts of these HMAs (Map 53). The clam survey does not cover areas further north in the action alternative HMAs, but it is assumed that the clam fishery these unsurveyed areas occurs in sands and fine gravels that are less vulnerable to impact.

Selecting Option 3 or 4 for the Great South Channel East HMA will have neutral impacts relative to Alternative 1/No Action, but slightly negative impacts relative to Alternative 3, 4, or 5 Option 1 or 2, and negative impacts relative to Alternative 6. While the existing No Action areas are not particularly vulnerable to fishing, removing these areas and implementing a gear modification area that has uncertain impacts (probably slightly negative to slightly positive) should have roughly neutral impacts overall.

The Cox Ledge HMA is the same for Alternatives 3-6. The two sub-areas in combination are much smaller in scale as compared to the Great South Channel/Nantucket Shoals HMAs at 213 km^2. The southern of the two areas overlaps Cox Ledge itself, while the northern area overlaps a feature known as 19 Fathom Bank. The areas overlap the edge of the video survey sampling region as it existed when the SASI base grid was developed, so while the presence of cobble- and boulder-dominated habitats is well known, the actual substrate map is not very well resolved spatially, especially along the northern edge of the 19 Fathom Bank area and the southern edge of the Cox Ledge area. Therefore, while it can be stated confidently that the full range of grain sizes are present in the areas, it is difficult to compare the percent coverage of various substrates between the Cox Ledge HMA and the Great South Channel/Nantucket Shoals HMAs. Various types of fishing effort and realized adverse effects overlap these HMAs, but lower impact gillnet and trap gears are prevalent in recent years. Bottom trawl effort also overlaps the areas, and designation of the Cox Ledge HMA would primarily serve to mitigate trawl gear impacts. Other mobile bottom-tending gear effort including scallop dredging, clam dredging, and squid trawling appear to overlap to a lesser extent. Designation of the Cox Ledge HMA is expected to have slightly positive habitat impacts if implemented with Option 1 or 2, and these options are probably similar in terms of impacts as hydraulic clam dredging appears to be limited in the area. Designation of the HMA if implemented with Option 3 or 4 is expected to have neutral impacts on habitats, for reasons previously discussed.

4.2.1.5.4 Alternative 4

Alternative 4 includes the Great South Channel HMA and Cox Ledge HMA (2 sub-areas). The Great South Channel HMA is a subset of the Great South Channel East HMA and overall has a similar distribution of habitat types (i.e. similar percent coverage of cobble and boulder areas). Given that the habitat types in these two areas are similar, the smaller Alternative 4 area affords less protection for vulnerable seabed in the sub-region and therefore has a lesser positive impact relative to Alternative 3, but still a positive impact relative to Alternative 1/No Action or Alternative 2, if Alternative 4 is implemented with Option 1 or 2. If implemented with Option 3 or 4, impacts are expected to be neutral relative to Alternative 1/No Action or Alternative 2. Alternative 4 would have positive impacts relative to Alternative 5 if the same options are selected, and would have a positive impact relative to Alternative 6 if Option 1 or 2 is selected. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well.

4.2.1.5.5 Alternative 5

Alternative 5 includes the Nantucket Shoals HMA and Cox Ledge HMA (2 sub-areas). The Nantucket Shoals HMA overlaps with the Great South Channel East and Great South Channel HMAs, and overall is somewhat sandier than these two areas (Table 54, Map 53). Given that the area is similar in size to the Great South Channel HMA (Alternative 4) but has a lower percent coverage of cobble and boulder habitats, Alternative 5 affords less protection for vulnerable seabed in the sub-region and therefore has a lesser positive impact relative to Alternative 4 (and 3), but still a positive impact relative to Alternative 1/No Action, if implemented with Option 1 or 2. If implemented with Option 3 or 4, impacts are expected to be neutral relative to Alternative 1/No Action. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well.

4.2.1.5.6 Alternative 6

Alternative 6 includes the Nantucket Shoals West HMA as a mobile bottom-tending gear closure, and the Great South Channel Gear Modification Area. The Nantucket Shoals West HMA overlaps with the Great South Channel East, Great South Channel, and Nantucket Shoals HMAs and overall is somewhat sandier (Table 54, Map 53). Given that the area is essentially a larger version of the Nantucket Shoals HMA, but the extension is into sandy, lower vulnerability habitat types, impacts are probably similar to those for Alternative 5, Option 1 or 2. The gear modification component of this alternative is expected to result in neutral impacts relative to Alternative 1/No Action. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well; the Nantucket Shoals West HMA appears to have the greatest overlap with clams and the clam fishery of any of the Alternatives 3-6.

4.2.1.5.7 Overlap with preferred alternative EFH designations

The habitat areas in this region and the Georges Bank areas overlap a similar range of EFH designations, although the number of species and designations, as well as the total scores, as slightly lower for this sub-region as compared to Georges Bank. Either the Alternative 1/No Action Nantucket Lightship Closed Area or its overlapping habitat closure, or both, have full or

high overlap with adult cod EFH; adult windowpane, winter, and yellowtail flounder EFH; juvenile and adult winter and little skate EFH; juvenile and adult herring EFH, and sea scallop EFH. These areas have a moderate degree of overlap with juvenile and/or adult EFH for halibut, haddock, ocean pout, red hake, white hake, monkfish, and barndoor skate.

Four of the habitat management areas included in Alternatives 3 to 6 (Great South Channel East, Great South Channel, Nantucket Shoals, Nantucket Shoals West) are highly overlapping and therefore have similar overlaps with designated EFH. Thus, the EFH designations alone are not an especially useful metric for contrasting the conservation benefits of these areas, although there is a general downward trend in the numeric total score/number of species/number of designations metrics moving from Alternative 3 to Alternative 6. Relative to the Alternative 1/No Action areas, there is a higher degree of overlap with juvenile winter flounder EFH, and a lesser degree of overlap with juvenile and adult yellowtail flounder EFH. There is also a lesser degree of overlap with adult little skate EFH. Moving from Alternative 3 to Alternative 6, the Nantucket Shoals West area has only a slight overlap with adult cod EFH. Also, the overlaps with scallop and herring EFH decrease moving from Alternative 3 to Alternative 6. Because the scallop EFH designation in particular is very general (presence in any survey approach), a 'slight' overlap with the westernmost Nantucket Shoals West area indicates fairly reliably that there is very little correspondence between this area and important scallop habitat.

The Great South Channel HMA which lies to the east of the areas described above includes habitats for a somewhat different array of species, and has the highest numeric scores of any area in the sub-region. However, this area is only envisioned as a trawl gear modification area and not as a mobile bottom-tending gear closure. Relative to the areas listed above, there is a higher degree of overlap with EFH for juvenile and adult Atlantic cod and yellowtail flounder; juvenile haddock, pollock, and white hake; and with adult ocean pout. There is also full overlap between this area and sea scallop EFH.

The two Cox Ledge subareas comprising the Cox Ledge HMA also have a somewhat different overlap with designated EFH relative to the other areas. Relative to the other HMAs in the sub-region, the areas have a higher degree of overlap with EFH for haddock, ocean pout, silver hake, and windowpane flounder. The Cox Ledge HMA is included with Alternatives 3-6, so it would provide additional protection for the above species' habitats when combined with the Great South Channel/Nantucket Shoals areas.

Table 57 – Preferred alternative EFH designations within Great South Channel/Southern New England No Action areas and HMAs.

Species and lifestage (those in red occupy complex hard bottom seabed types that are more vulnerable to fishing)	Nantucket Lightship Closed Area Alt 1	Nantucket Lightship Habitat Closure Area Alt 1	Great South Channel East HMA Alt 3	Great South Channel HMA Alt 4	Nantucket Shoals HMA Alt 5	Nantucket Shoals West HMA Alt 6	Great South Channel GMA Alt 6	Cox Ledge HMA Alt 3-6
Acadian redfish juvenile	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Acadian redfish adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
American plaice juvenile	*None*	*None*	Slight	*None*	*None*	*None*	*None*	*None*
American plaice adult	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Atlantic cod juvenile	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	High
Atlantic cod adult	High	Moderate	Moderate	Moderate	Moderate	Slight	High	High
Atlantic halibut - all stages	Moderate	Moderate	Slight	*None*	*None*	*None*	Moderate	*None*
Atlantic wolffish - all stages	*None*	Slight	High	High	High	High	High	Moderate
Haddock juvenile	Moderate	Moderate	Slight	Slight	Slight	Slight	High	High
Haddock adult	Moderate	Slight	Slight	*None*	*None*	*None*	Moderate	*None*
Ocean pout egg	Moderate	Moderate	Slight	Slight	*None*	*None*	Moderate	**Full**
Ocean pout juvenile	Slight	Slight	Slight	*None*	*None*	*None*	Slight	High
Ocean pout adult	Moderate	Moderate	Slight	Slight	Slight	Slight	High	**Full**
Pollock juvenile	Slight	Slight	Slight	Slight	Slight	Slight	High	Slight
Pollock adult	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Red hake egg/lar./juv.	Moderate	Moderate	Slight	Slight	Slight	Slight	Slight	Moderate
Red hake adult	Moderate	Moderate	Slight	*None*	*None*	*None*	Moderate	Slight
Silver hake juvenile	*None*	*None*	Slight	*None*	*None*	*None*	*None*	Slight
Silver hake adult	Slight	*None*	*None*	*None*	*None*	*None*	Slight	Slight
White hake juvenile	Moderate	Moderate	Moderate	Slight	Slight	Slight	High	Slight
White hake adult	*None*	*None*	Slight	*None*	*None*	*None*	Slight	*None*
Windowpane fl. r juv.	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	**Full**
Windowpane fl. adult	High	High	High	High	High	High	High	**Full**
Winter flounder egg	Slight	Slight	Moderate	Moderate	Moderate	Moderate	Slight	*None*
Winter fl. lar./adult	High	High	High	High	High	High	High	**Full**
Winter flounder juvenile	Moderate	Moderate	High	High	High	High	Moderate	**Full**
Witch flounder juvenile	Slight	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Witch flounder adult	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Yellowtail fl. juvenile	High	High	Moderate	Moderate	Moderate	Moderate	High	High
Yellowtail fl. adult	High	High	Moderate	Moderate	Moderate	Moderate	High	High
Monkfish juvenile	Slight	Slight	Slight	*None*	*None*	*None*	*None*	Slight
Monkfish adult	Moderate	Moderate	Slight	*None*	*None*	*None*	Slight	Slight
Smooth skate juvenile	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Smooth skate adult	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Thorny skate juvenile	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Thorny skate adult	*None*	*None*	*None*	*None*	*None*	*None*	Slight	*None*
Barndoor skate juv/adu	Moderate	Moderate	Slight	Slight	Slight	Slight	Moderate	*None*
Little skate juvenile	High	High	Moderate	High	High	High	Moderate	**Full**
Little skate adult	High	High	Moderate	Moderate	Moderate	Moderate	High	Moderate
Winter skate juvenile	**Full**	High	High	High	High	High	High	**Full**
Winter skate adult	High	High	High	High	High	High	High	High
Atlantic sea scallop - all	**Full**	Moderate	Moderate	Moderate	Moderate	Slight	**Full**	**Full**
Atlantic herring egg	*None*	Slight	Slight	Slight	Slight	Slight	Slight	*None*
Total score	**62**	**59**	**54**	**45**	**44**	**42**	**75**	**61**
Count of species represented (out of 23)	**17**	**17**	**19**	**15**	**14**	**14**	**22**	**16**
Count of designations represented (out of 43)	**29**	**29**	**32**	**23**	**22**	**22**	**37**	**26**

4.2.1.5.8 Species diversity

Table 58 shows groundfish diversity, regulated species diversity, and all species diversity for the Great South Channel/Southern New England habitat management alternatives. Alternatives with the highest diversity values (75th percentile of each season) for each diversity index across all alternatives in all sub-regions are shaded (red=groundfish, yellow=regulated species, green=all species).

In the spring, groundfish and regulated species diversity is highest in the No Action areas. All species diversity is lowest in the No Action areas, while the Alternative 5 areas had the highest average all species diversity value.

In the summer, the No Action areas had the lowest groundfish diversity and the highest regulated species diversity. Areas affected by Alternatives 3, 5, and 6 had higher all species diversity. Mean all species diversity indices were higher for Alternative 4 than for the No Action areas.

Average regulated and all species diversity indices were lowest in the No Action areas in the fall. Groundfish diversity was lower in areas affected by Alternatives 3 and 4. Areas affected by Alternative 5 and 6 were both more diverse with respect to groundfish than No Action.

In the winter, average diversity of each species group was lowest in the No Action areas. The average groundfish diversity index was highest in Alternative 4 areas, the regulated species diversity index was highest in the Alternative 6 areas, and the all species diversity index was highest in the Alternative 5 areas.

These diversity index values can be compared to the diversity indices for areas in other sub-regions by reviewing the species diversity summary (Section 4.2.3) in Volume 1. In general, the low number of colored cells in the table below indicates that species diversity in these alternatives is relatively low as compared to diversity in other habitat management alternatives.

Table 58 – Average diversity indices within the Great South Channel/Southern New England sub-region habitat management alternatives. Indices exceeding the 75th percentile for each species group across all habitat management areas in all sub-regions are highlighted.

		Alternative						
		1 Habitat closure	1 Groundfish closure	2	3	4	5	6
Spring	*Tows*	*108*	*245*	*0*	*98*	*40*	*26*	*142*
	Large mesh groundfish ISI	0.348	0.358	0.000	0.343	0.296	0.311	0.325
	Regulated spp. ISI	0.505	0.509	0.000	0.36	0.392	0.413	0.34
	All spp. SDI	1.075	1.123	0.000	1.26	1.36	1.391	1.176
Summer	*Tows*	*48*	*162*	*0*	*88*	*16*	*9*	*157*
	Large mesh groundfish ISI	0.156	0.311	0.000	0.346	0.319	0.345	0.334
	Regulated spp. ISI	0.452	0.352	0.000	0.271	0.407	0.412	0.261
	All spp. SDI	1.158	1.024	0.000	0.93	1.248	1.15	0.924
Fall	*Tows*	*101*	*221*	*0*	*47*	*34*	*24*	*61*
	Large mesh groundfish ISI	0.302	0.292	0.000	0.299	0.281	0.313	0.352
	Regulated spp. ISI	0.428	0.44	0.000	0.536	0.521	0.508	0.576
	All spp. SDI	1.069	1.107	0.000	1.421	1.376	1.356	1.478
Winter	*Tows*	*15*	*35*	*0*	*8*	*5*	*4*	*7*
	Large mesh groundfish ISI	0.356	0.357	0.000	0.416	0.441	0.44	0.404
	Regulated spp. ISI	0.403	0.474	0.000	0.535	0.522	0.518	0.54
	All spp. SDI	1.149	1.225	0.000	1.405	1.535	1.613	1.455

4.2.2 Large mesh groundfish stocks and their habitats

This section describes impacts of habitat management measures on large mesh groundfish. These species are discussed separately because their conservation is a particular focus of the amendment. Impacts on other managed resources may be found in section 4.6.

4.2.2.1 *Gulf of Maine Preferred Alternatives*

This section describes the impacts of the preferred alternatives in combination for all three Gulf of Maine sub-regions, eastern, central, and western. The preferred alternatives include Alternative 2 Options 1 and 5 in the eastern Gulf of Maine, Alternative 4 Option 1 in the central Gulf of Maine, and Alternatives 1, 7A and 8 in the western Gulf of Maine. These alternatives are also discussed in the individual sub-regional sections that follow, but this combined discussion is provided to demonstrate how stocks that occur across the three sub-regions may benefit from the alternatives. Additional integrated impacts analysis of the preferred alternatives on all valued ecosystem components can be found in the cumulative effects section of Volume 4.

In the eastern Gulf of Maine, the preferred alternative would add two new habitat management areas, Machias and Large Eastern Maine. Groundfish gears would be prohibited in the Large Eastern Maine and Machias areas to improve the potential for groundfish recovery there. Existing habitat closures in the central Gulf of Maine would be reconfigured to make them more efficient at protection of vulnerable habitat and more practicable. In the western Gulf of Maine sub-region, the preferred alternative would primarily continue the status quo regulations on fishing gear use, adopting the 12” roller gear restriction (Alternative 7A) as a gear modification area to reduce habitat impacts with trawls. It would also implement a shrimp trawl exemption in the northwestern corner of the Western Gulf of Maine Habitat Closure Area. Otherwise, the

habitat closure area would continue, prohibiting fishing with mobile bottom-tending gear to protect vulnerable habitats. To increase the potential for groundfish stock recovery in the western Gulf of Maine, the Western Gulf of Maine Groundfish Closure Area would be maintained. As is currently the case, vessels could use mobile bottom-tending gears that do not catch groundfish in the eastern 3.6 nautical miles of the closed area that does not overlap the habitat closure.

Using weighted age 0/1 juvenile groundfish hotspots as an indicator, the preferred alternative (Table 59) appears to be more effective at protecting age 0/1 juvenile groundfish habitat than Alternative 1/No Action (Table 60), even given uncertainty about the effectiveness (see discussion below) of the Inshore Roller Gear Restriction Area. The weighted age 0/1 juvenile groundfish hotspots total 502.8 vs 288.1 for No Action in the spring (a 75% increase) and 890.7 vs. 386.8 in the fall (a 130% increase).

Groundfish fishing effort in some of these areas, particularly the Large Eastern Maine and Machias Areas, has recently been relatively light, compared to compared to groundfish fishing effort in the Bigelow Bight, Massachusetts Bay, and immediately offshore of the Western Gulf of Maine Closure Area. Historically when groundfish stocks were in better condition, the Large Eastern Maine area had been fished more intensively. Closing these areas to mobile bottom-tending gear (and in some cases groundfish gears) would prevent fishermen from refocusing fishing effort into the proposed habitat management areas, hindering recovery of habitat and local groundfish populations.

The preferred alternative management areas and grids of weighted groundfish hotspots by season are shown in Map 55. Although more age 0/1 juvenile groundfish hotspots occur in Massachusetts Bay and the Bigelow Bight, there is a reasonably high degree of overlap with the proposed Habitat Management Areas in the preferred alternative, and the preferred alternative appears to improve protection of age 0/1 juvenile groundfish habitat compared to No Action. Since the preferred alternative includes the existing Western Gulf of Maine Habitat Closure and the Western Gulf of Maine Closure Area, no redistribution or changes in fishing modes are expected in the western Gulf of Maine. Therefore, no new impacts are expected on age 0/1 juvenile groundfish habitat in Massachusetts Bay and along the coastlines of New Hampshire and Maine.

Some negative impacts are associated with modifications of the Cashes Ledge and Jeffreys Bank Habitat Closure Areas, but this appears to be more than compensated for by implementation of the Large Eastern Maine and Machias Habitat Management Areas.

In the eastern Gulf of Maine, prohibiting fishing with gears capable of catching groundfish (Option 5) in addition to a mobile bottom-tending gear restriction (Option 1) compliments the habitat protection measures and increases the potential for localized groundfish recovery. The effect of Option 5 on groundfish stocks depends on whether there is an overall reduction of discards of sublegal fish by fishing elsewhere (or with alternative groundfish gears) and whether there is a positive or negative change in size selectivity caused by vessels switching gear or fishing methods when they fish in different areas.

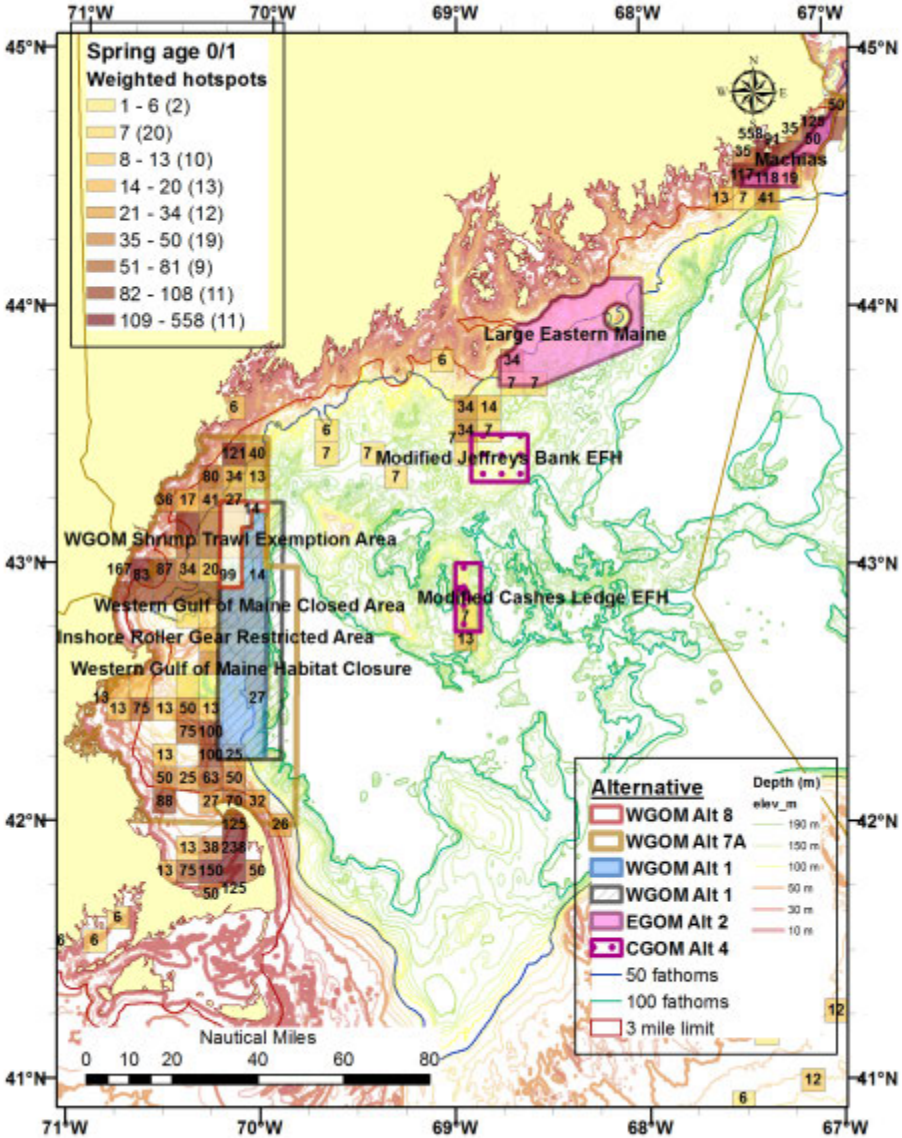
The 12-inch roller size limit in the Inshore Roller Gear Restricted Area is thought to prevent vessels from fishing on coarse bottom substrates, thereby protecting vulnerable age 0/1 juvenile groundfish habitats. This conclusion is difficult to demonstrate analytically given the resolution of fishing location and substrate data presently available, but observed tows suggest that the gear restriction may be effective in this way. Public comment on this subject suggests that this restriction may be effective in protecting hard and coarse substrates (which is critical for some juvenile groundfish), but it may be less effective for larger, high horsepower vessels.

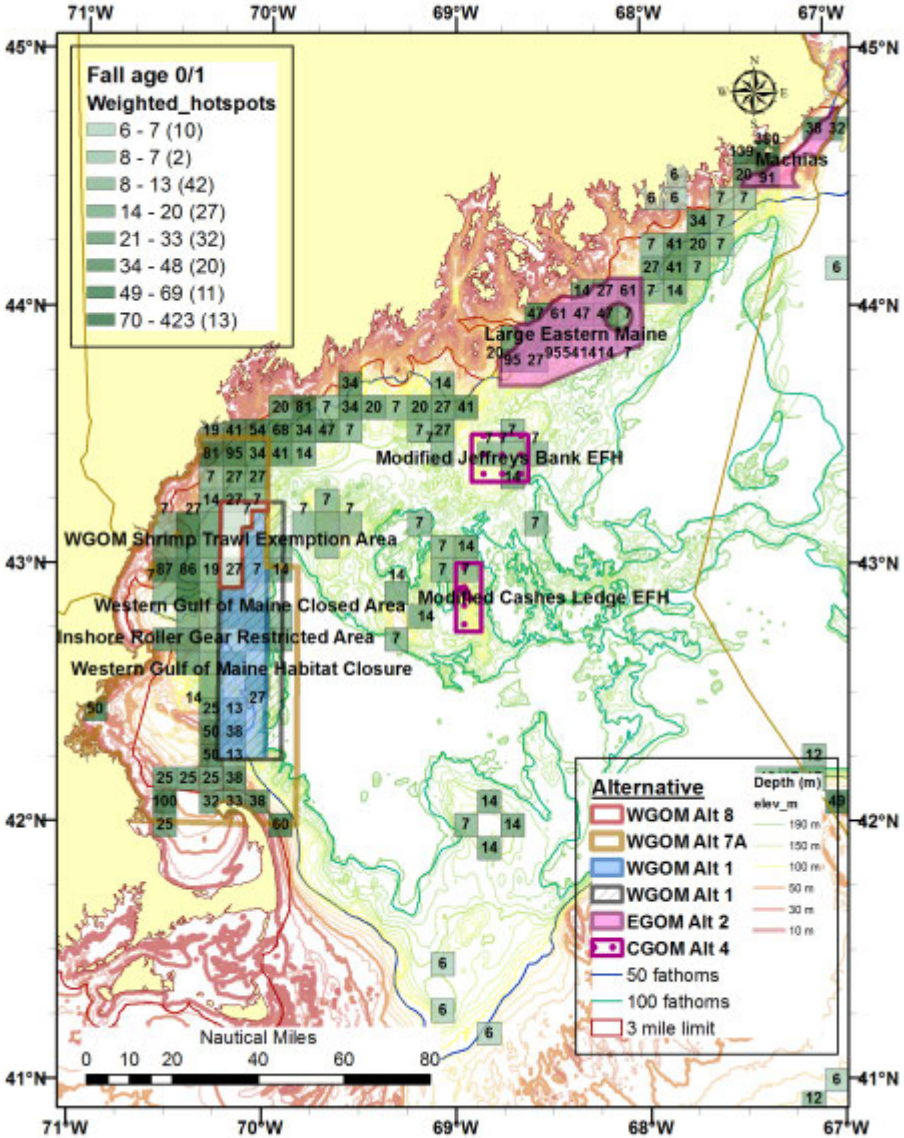
In summary, compared to Alternative 1/No Action, the impacts on age 0/1 juvenile groundfish habitat and on Gulf of Maine groundfish stocks are expected to be positive from the combined preferred alternative. The impacts relative to other Gulf of Maine alternatives is expected to range from slightly negative (compared with alternatives that include a mobile bottom-tending gear closure of one of the Bigelow Bight areas; i.e. western Gulf of Maine Alternatives 3 and 4) to strongly positive (compared to alternatives that include no Habitat Management Areas, Alternative 2 in the Western Gulf of Maine and Central Gulf of Maine sub-regions and Alternative 1 in the Eastern Gulf of Maine sub-region).

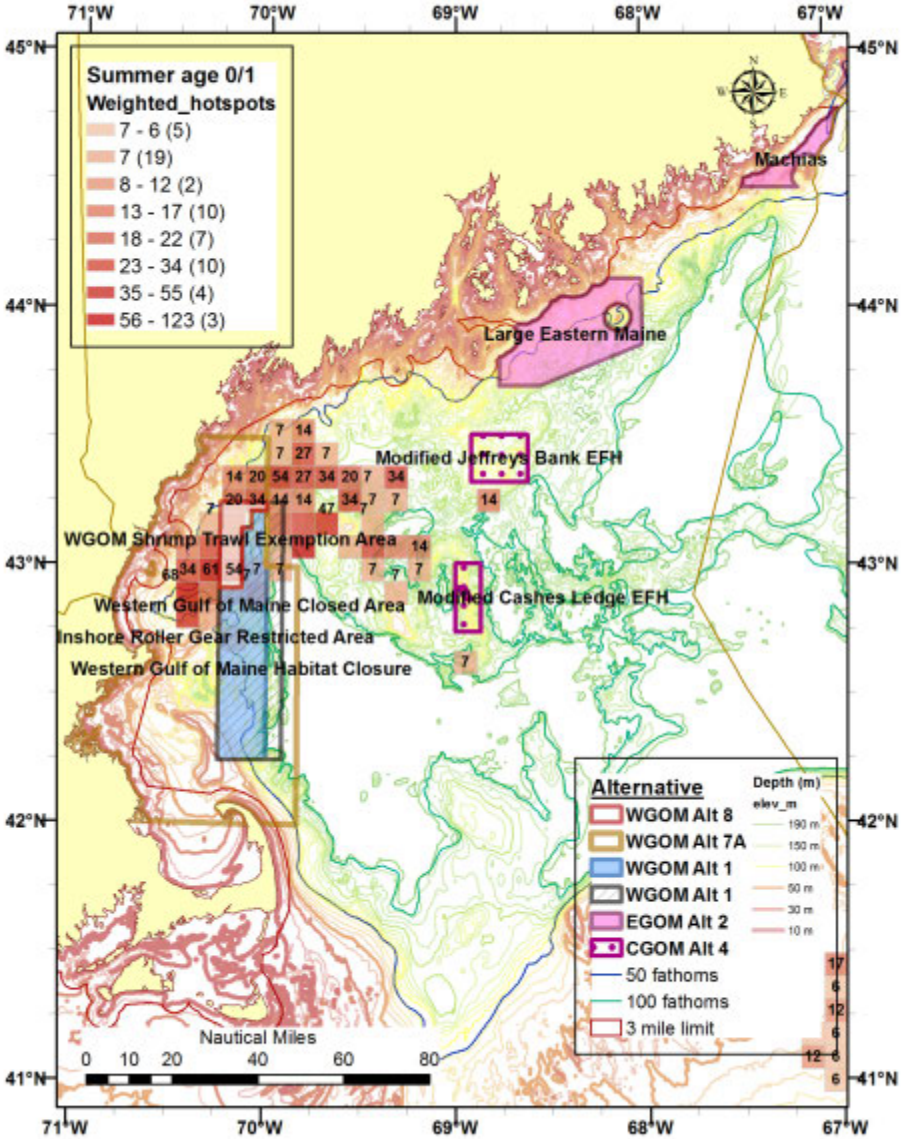
Table 59 – Total unweighted and weighted hotspots in preferred alternative habitat management areas for the Gulf of Maine region.

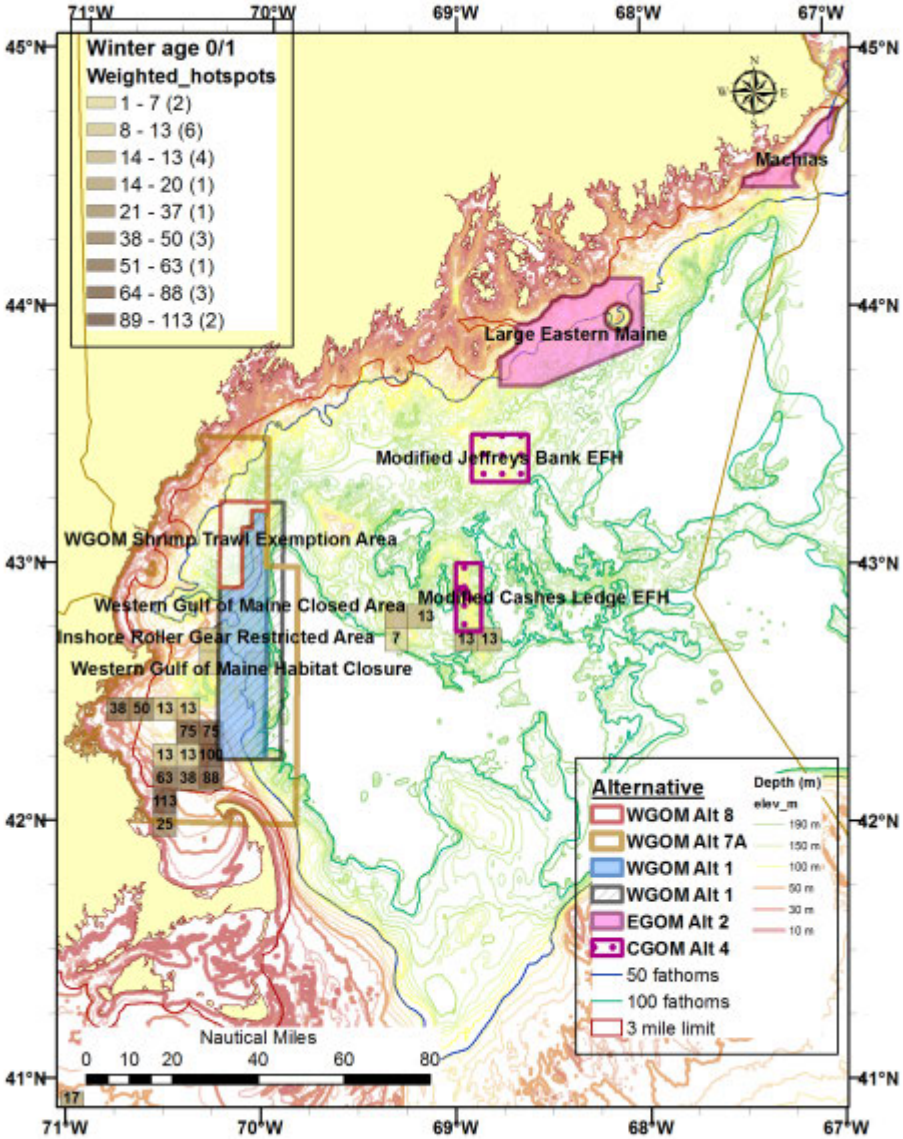
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine total	1355	3450.7	305	790.9	1432	3083.1	135	734.3
Areas where Option 1 applies	221	502.8	43	128.4	347	890.7	1	6.7
Option 1 excluding shrimp exemption area	201	482.5	22	33.8	336	856.9	1	6.7
Areas where Option 5 applies	199	308.4	53	162.2	330	806.0	1	6.7
WGOM Alternative 7A	1050	2686.9	213	500.2	1018	1886.8	133	720.9
Sub-region area totals								
Eastern GOM	150	235.0	4	0.0	274	591.7	0	0.0
Habitat Management Area								
Machias	35	187.7	0	0.0	11	91.5	0	0.0
Large Eastern Maine	115	47.3	4	0.0	263	500.2	0	0.0
Central GOM	1	6.7	8	0.0	17	33.8	0	0.0
Habitat Management Area								
Ammen Rock	0	0.0	1	0.0	0	0.0	0	0.0
Modified Cashes Ledge EFH	1	6.7	2	0.0	2	6.8	0	0.0
Modified Jeffreys Bank EFH	0	0.0	5	0.0	15	27.0	0	0.0
Western GOM	1224	3229.3	315	885.6	1152	2491.4	135	734.3
EFH closure								
Western Gulf of Maine Habitat Closure	70	261.1	32	128.4	56	265.2	1	6.7
Groundfish closure								
Western Gulf of Maine Closed Area	84	261.1	49	162.2	67	305.7	1	6.7
Habitat Management Area								
Inshore Roller Gear Restricted Area	1050	2686.9	213	500.2	1018	1886.8	133	720.9
WGOM Shrimp Trawl Exemption Area	20	20.3	21	94.6	11	33.8	0	0.0

Map 55 - Overlap of Preferred Alternative Habitat Management Areas in the Gulf of Maine region with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 - 6 (5)
7 (19)
8 - 12 (2)
13 - 17 (10)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Machias
Large Eastern Maine
Modified Jeffreys Bank EFH
Modified Cashes Ledge EFH
WGOM Shrimp Trawl Exemption Area
Western Gulf of Maine Closed Area
Inshore Roller Gear Restricted Area
Western Gulf of Maine Habitat Closure
Alternative
WGOM Alt 8
WGOM Alt 7A
WGOM Alt 1
WGOM Alt 1
EGOM Alt 2
CGOM Alt 4
50 fathoms
100 fathoms
3 mile limit
Depth (m)
Nautical Miles
0 10 20 40 60 80
71°W 70°W 69°W 68°W 67°W
45°N 44°N 43°N 42°N 41°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
14 - 20 (1)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Machias
Large Eastern Maine
Modified Jeffreys Bank EFH
Modified Cashes Ledge EFH
WGOM Shrimp Trawl Exemption Area
Western Gulf of Maine Closed Area
Inshore Roller Gear Restricted Area
Western Gulf of Maine Habitat Closure
Alternative
WGOM Alt 8
WGOM Alt 7A
WGOM Alt 1
WGOM Alt 1
EGOM Alt 2
CGOM Alt 4
50 fathoms
100 fathoms
3 mile limit
Depth (m)
Nautical Miles
0 10 20 40 60 80
71°W 70°W 69°W 68°W 67°W
45°N 44°N 43°N 42°N 41°N

4.2.2.2 ***Gulf of Maine Alternative 1 (No Action, preferred in the western Gulf of Maine)***

This section describes the impacts of Alternative 1/No Action for all Gulf of Maine sub-regions combined. This is appropriate given that groundfish stocks are managed at a regional vs. sub-regional scale. Alternative 1/No Action would continue mobile bottom-tending gear prohibitions in the Western Gulf of Maine, Cashes Ledge, and Jeffreys Bank Habitat Closure Areas, which partially overlap the Western Gulf of Maine and Cashes Ledge Groundfish Closure Areas. Fishing with gears capable of catching groundfish (including large-mesh trawls, sink gillnets, and bottom longlines) would continue to be prohibited in the groundfish closures.

The groundfish gear prohibition was originally intended to supplement input controls on fishing (i.e. DAS limits, trip limits, gear restrictions, etc.), are now viewed as obsolete given annual catch limits that cap total catch. While groundfish trawls are classified as mobile bottom-tending gear and would be prohibited in areas with vulnerable bottom habitat, the effects of groundfish sink gillnets and bottom longline gear is considered minimal and temporary. Portions of the Western Gulf of Maine and Cashes Ledge Closure Areas not overlapping the habitat closures tend to cover deeper and softer bottom substrates that are less vulnerable to damage by mobile bottom-tending gears.

Alternative 1/No Action would protect vulnerable bottom habitats within the existing habitat closures. The prohibition on fishing with gears capable of catching groundfish in the Western Gulf of Maine and Cashes Ledge Closure Areas could improve the potential for local groundfish stock recovery (e.g., localized sub-populations where they exist) as a compliment to habitat protection measures. An example of this effect is where habitat protection improves the survival and growth of forage fish which would support a larger population of juvenile and adult groundfish, locally increasing productivity of the system.

The analysis of the impacts of Alternative 1/No Action must consider impacts associated with continued fishing effort redistribution to the surrounding areas outside the current closures. If the juvenile groundfish habitat quality is better outside the existing closures than within them, then higher fishing activity in the surrounding area would increase adverse impacts on age 0/1 juvenile groundfish habitat. Similarly, if catches of juvenile and sub-legal groundfish are higher outside the closed areas than within them, then higher groundfish fishing effort in the surrounding area would increase adverse impacts on groundfish stocks. Increasing effort on small fish would reduce yield-per-recruit and sustainable yield.

The amount of unweighted and weighted hotspots in each survey season is summarized in Table 60, with the distribution of weighted hotspot shown in Map 56. Summer and winter hotspots in the Gulf of Maine are few, reflecting the limited amount of survey samples during these seasons (see the summer and winter survey distribution maps in the hotspot analysis section of Volume 1). The total weighted hotspots in the Alternative 1/No Action habitat closures were 288.1 in the spring, 175.8 in the summer, and 386.8 in the fall. During the spring, most of the weighted hotspots occur inshore of and partially overlapping the Western Gulf of Maine Habitat Closure. Most of the hotspots in Massachusetts, Cape Cod, and Ipswich Bays occur due to the presence of heavily weighted age 0/1 cod. Most of the hotspots off southern Maine and northwest of Jeffreys Bank occur due the presence of Acadian redfish, American plaice, and silver hake, although only

redfish were positively weighted. Most of the hotspots inshore and southwest of the Western Gulf of Maine Habitat Closure during the winter are from cod and winter flounder, although only cod were positively weighted. There were relatively few groundfish hotspots outside of the existing habitat and groundfish closures. In the case of Cashes Ledge, this low amount of hotspots is probably due to low sampling intensity in this specific area, but not elsewhere.

Alternative 1/No Action could improve habitat quality over time if the existing habitat closures and, to a lesser extent, the groundfish closed areas are still recovering, i.e. habitat quality is continuing to improve. Although recent assessments of existing closed areas (for example, see Northeast Multispecies Framework 48) indicated insignificant changes in stock productivity relative to adjacent fished areas, it could take several generations to see improvements. On the other hand, the Gulf of Maine areas have been closed since 1998/2000, during which time detectable changes should have occurred.

Continuation of Alternative 1/No Action is likely to have positive impacts on the groundfish resource, but population level impacts have been so far difficult to detect. No formal before-after-control-impact analysis of relative changes of biomass in Gulf of Maine closed areas was done in Northeast Multispecies Framework Adjustment 48, except for the Western Gulf of Maine Closed Area. Differences in survey CPUE of groundfish species inside and immediately adjacent to closed areas was difficult to detect, although more concentrated fishing activity particularly around the Western Gulf of Maine and Cashes Ledge Closed Areas is evident from the fishery data (see maps in the fishery sections in Volume 1). The before-after-control-impact analysis (Kerr et al 2012) showed that the Western Gulf of Maine Closed Area had positive effects on biomass of winter flounder in the closed area, but not for other species, including cod and haddock.

There are currently no habitat management areas in the eastern Gulf of Maine sub-region, which would continue under Alternative 1/No Action. The distribution of unweighted and weighted hotspots in each survey season is shown on Map 56. Only the spring and fall figures are shown in this section as the summer and winter surveys do not cover the eastern Gulf of Maine sub-region. <u>Given the positive presence of weighted juvenile groundfish hotspots in this sub-region, continuing Alternative 1/No Action is unlikely to substantially improve habitat quality associated with age 0/1 large mesh groundfish species because no special protection would be afforded for these juvenile groundfish populations.</u>

Despite these hotspot analysis results, it is still possible that the existing closed areas have a positive impact on the groundfish resource. The effects on groundfish survival and growth while in the closed areas may be realized by the fishery operating outside the boundary of the closed areas, instead of causing a biomass buildup in the closed area or a measureable increase of productivity for the stock as a whole. In essence, if there are increases of productivity inside a closed area, the benefit may be realized by fishing on the border with or adjacent to the closed area, such that biomass changes within the area may be undetectable, even over long periods such has been the case in existing groundfish and EFH closures.

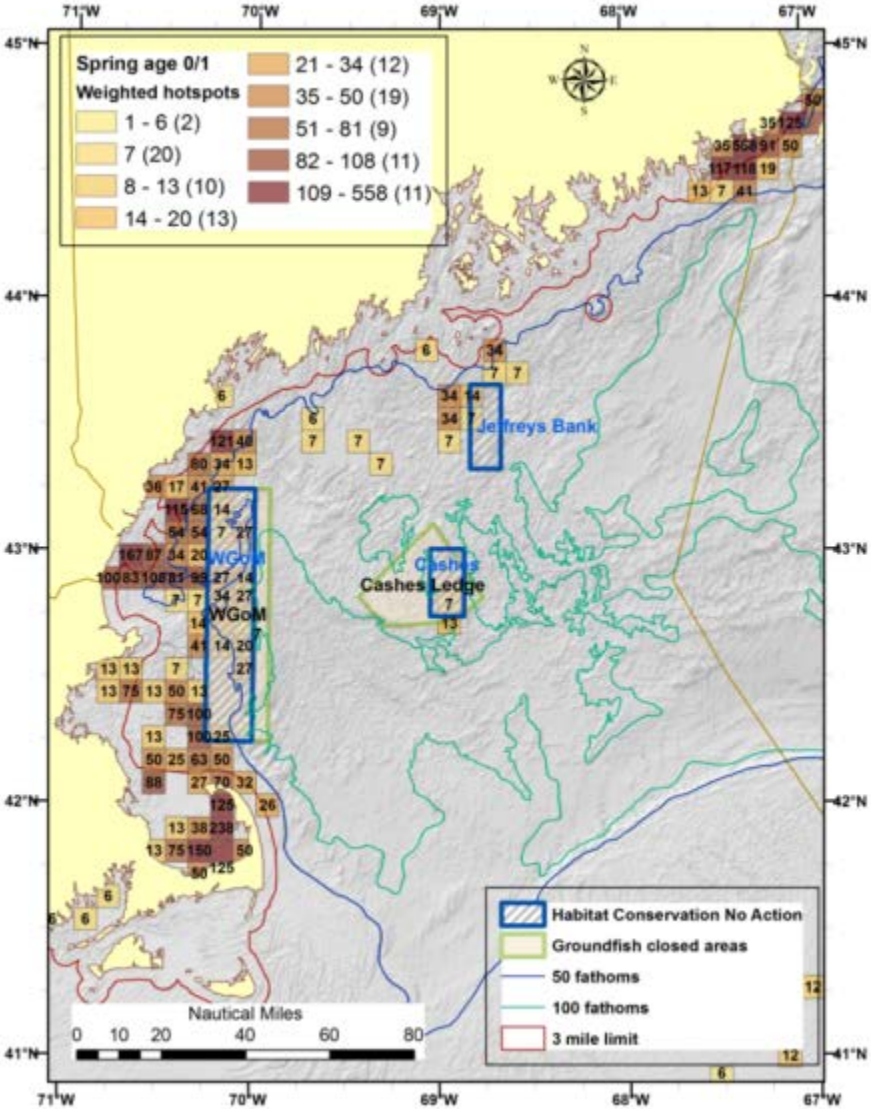
Therefore, the impacts of Alternative 1/No Action on groundfish stocks in the Gulf of Maine are slightly positive, but is unlikely to substantially improve habitat quality associated with age 0/1 large mesh groundfish species.

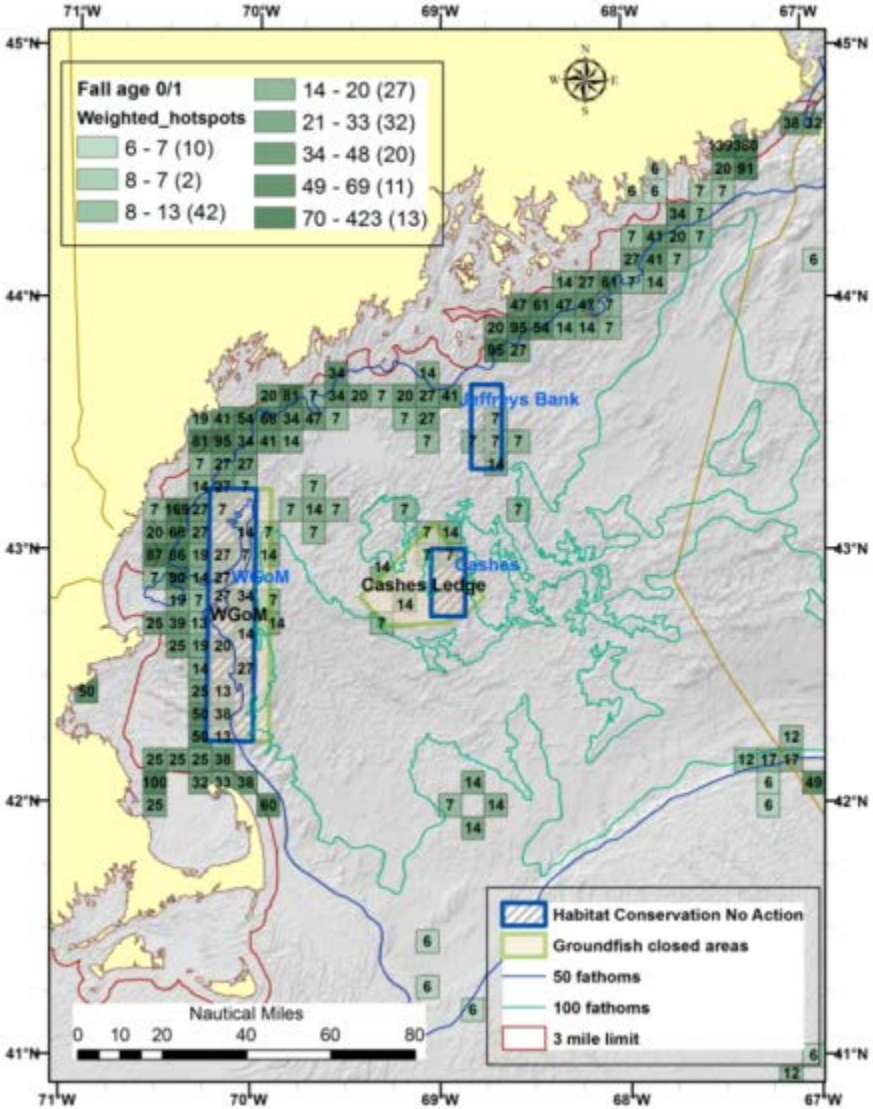
Table 60 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Gulf of Maine region.

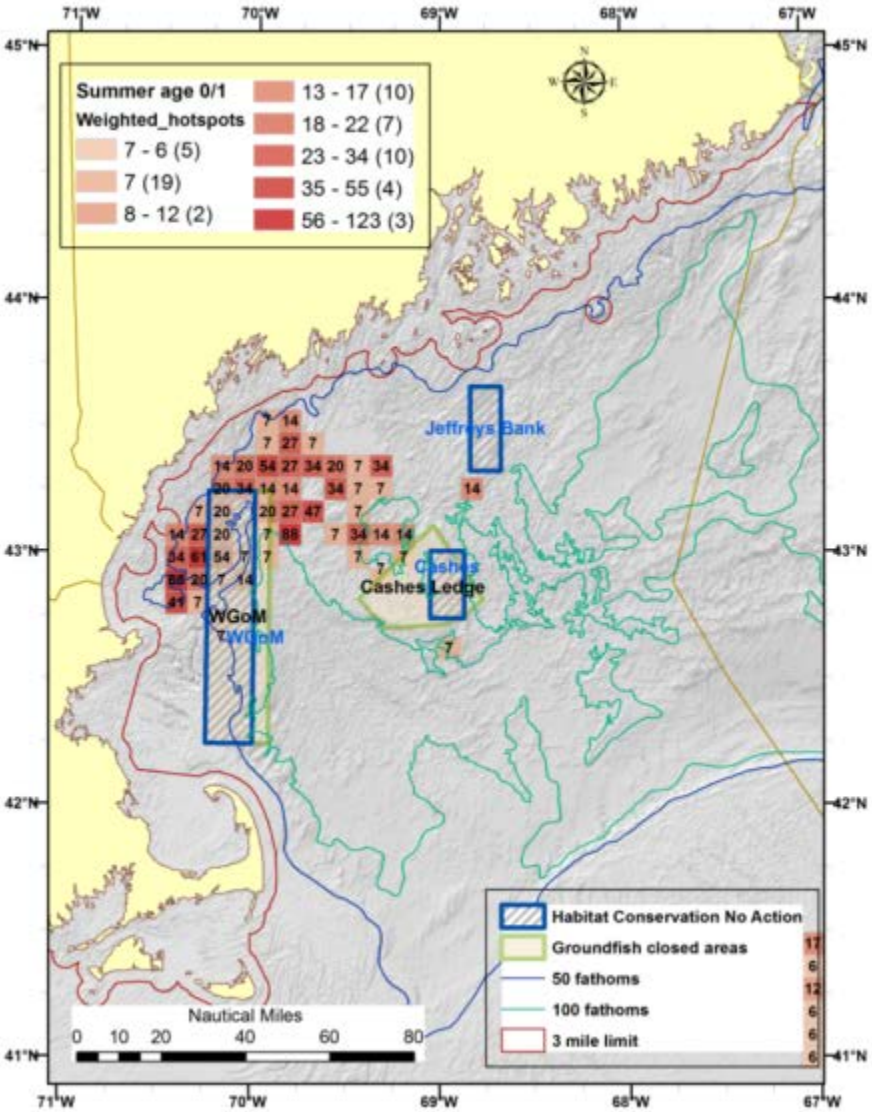
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine	92	288.05	104	175.76	101	386.83	5	33.55
EFH closure								
Cashes Ledge EFH	1	6.7	2	0.0	2	6.8	0	0.0
Jeffreys Bank EFH	7	20.3	39	0.0	22	33.8	0	0.0
Western Gulf of Maine EFH	70	261.1	32	128.4	56	265.2	1	6.7
Groundfish closure								
Cashes Ledge GF	1	6.7	16	13.5	12	47.3	4	26.8
Western Gulf of Maine GF	84	261.1	49	162.2	67	305.7	1	6.7

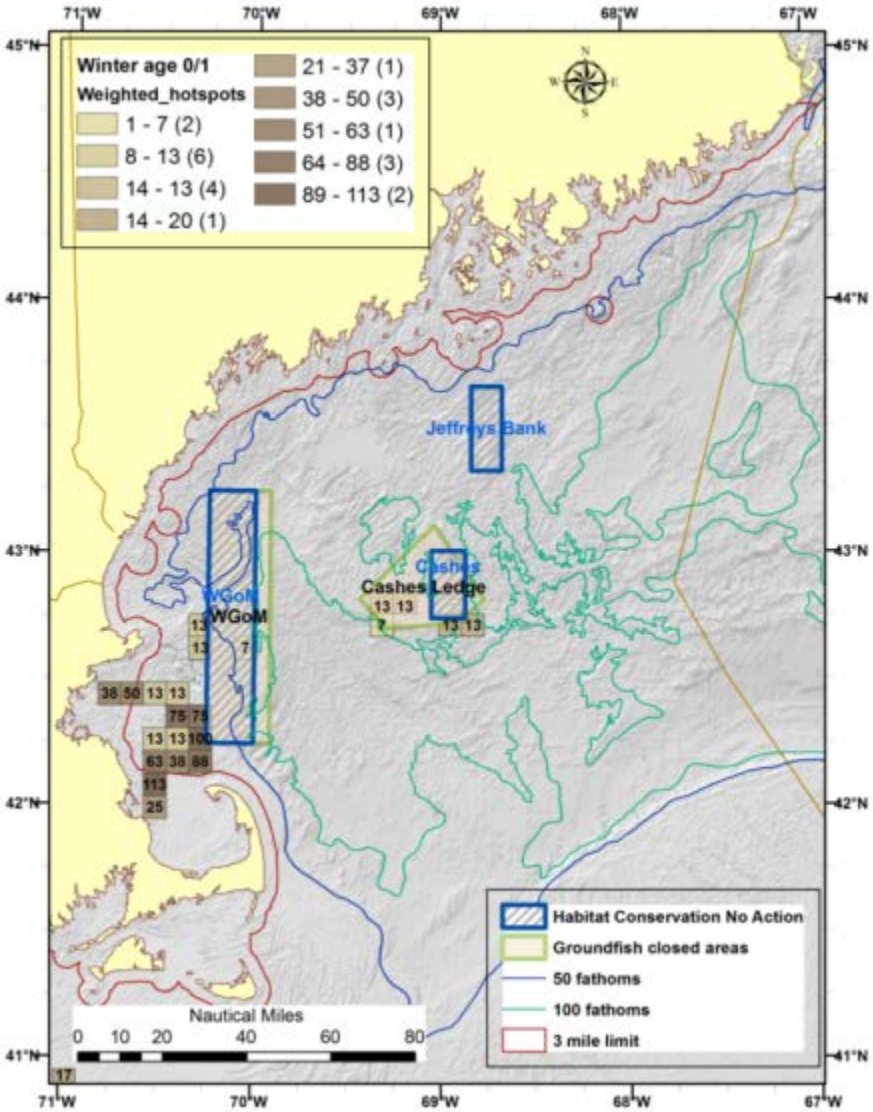
In the Gulf of Maine region, Alternative 1/No Action is expected to have positive impacts on spawning groundfish via the Western Gulf of Maine And Cashes Ledge Groundfish Closure Areas, which include broad restrictions on gears capable of catching groundfish. Given that the existing habitat closures are mostly within the boundaries of the groundfish closures, the habitat closure elements of the No Action alternatives do not really afford any additional groundfish spawning benefits beyond those provided by the groundfish closures. The Jeffreys Bank Habitat Closure Area in the central Gulf of Maine is outside the groundfish closures, but this area has limited overlap with large spawner hotspots. The spawning benefits associated with these areas are discussed more fully in the analysis of the spawning alternatives on large mesh groundfish.

Map 56 - Overlap of No Action habitat closures and year round groundfish closed areas in the Gulf of Maine region with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 - 6 (5)
7 (19)
8 - 12 (2)
13 - 17 (10)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Jeffreys Bank
Cashes Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
71°W 70°W 69°W 68°W 67°W
45°N 44°N 43°N 42°N 41°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
14 - 20 (1)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Jeffreys Bank
Cashes Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
71°W 70°W 69°W 68°W 67°W
45°N 44°N 43°N 42°N 41°N

4.2.2.3 ***Eastern Gulf of Maine***

4.2.2.3.1 Alternative 2 (Preferred)

Total unweighted and weighted hotspots in the areas proposed for habitat management in eastern Gulf of Maine Alternatives 2 and 3 are summarized in Table 61. Only spring and fall surveys are conducted in this sub-region, a NEFSC trawl survey and a coastal Maine/New Hampshire trawl survey. The spatial distribution of the hotspots changes seasonally; in the spring, more groundfish hotspots overlap the Machias HMA and in the fall more hotspots overlap the Large Eastern Maine HMA (Map 57). The areas combined have a weighted hotspot total of 235 in the spring and 591.7 in the fall (the weighted totals are similar to those for Alternative 3). All of the cod, haddock, and Atlantic halibut hotspots were in the Machias area. The number of redfish and witch flounder hotspots was somewhat higher in Alternative 2 than Alternative 3 (Table 62). The number of hotspots in the Alternative 2 areas was also higher for species given a zero weight, such as silver hake and white hake. The higher number of hotspots for these hakes suggests that the Large Eastern Maine HMA in Alternative 2 has, on average, softer substrates than the Small Eastern Maine HMA in Alternative 3.

Habitat protection in the Large Eastern Maine HMA could be important to cod and other species when coupled with restoration activities in the area. There were no age 0/1 cod hotspots in the Large Eastern Maine HMA, but age 0/1 cod and herring hotspots were identified inshore of this area within Maine state waters. The Penobscot River Restoration Project is intended to restore the river to more natural conditions for diadromous migratory fish, including herring and shad. Dam removal and fish passage construction has begun and will continue into 2014 (NOAA Fisheries Navigator, Commercial Fisheries News, Nov 2013 p4). It is thought that restoration of these forage fish around Penobscot Bay will promote restoration of important coastal fish stocks, including cod. Additional protection of cod habitat in this region could act synergistically to boost cod recovery in areas that had historic cod populations (Ames 2004). The Large Eastern Maine HMA could provide more protection to cod habitats in this region than the smaller area proposed in Alternative 3.

<u>Alternative 2 is expected to improve habitat benefits for age 0/1 groundfish, relative to Alternative 1/No Action (which contains no areas or hotspots), by preventing fishermen from refocusing fishing effort if and when groundfish populations recover.</u> The weighted hotspots in particular indicate use of these areas by juvenile groundfish that are vulnerable and prefer hard and coarse substrates. The preferred options would prohibit use of both mobile bottom-tending gear (Option 1) and gear capable of catching groundfish (Option 5). Although there is a relatively small amount of groundfish fishing area in the proposed Alternative 3 closures, application of Option 5 would prevent vessels from targeting groundfish subpopulations if and when they recover. Evidence suggests that in this area distinct populations of cod and possibly other groundfish species exist (or once existed). <u>A localized reduction in juvenile and adult groundfish mortality could work synergistically with efforts to restore the forage base, and make the groundfish stocks more robust, diverse, and resilient, having a positive impact compared to both Alternative 1/No Action and Alternative 3 on the groundfish resources as a whole, even though the proposed closure would not change the overall fishing mortality rate.</u>

Overall, this alternative is expected to have neutral to low positive impacts on groundfish spawning. There are no large spawner groundfish hotspots overlapping the areas in any season, and very few large spawner groundfish hotspots in the sub-region generally (see sub-regional map in approach to analysis section). Currently, there is little revenue from gillnet and longline fishing in these areas (see pie charts in economic impacts section and fishing effort maps in the affected environment section of Volume 1). Given the low magnitude of current fishing effort and lack of overlap with hotspots, any positive impacts associated with fishing restrictions in this sub-region would be slight, but the highest positive impacts would be associated with Option 5, followed by Options 1 and 2, with likely no positive benefits (neutral impacts) associated with Options 3 and 4.

4.2.2.3.2 Alternative 3

Alternative 3 includes the Small Eastern Maine, Machias, and Toothaker Ridge HMAs. As noted above, only spring and fall surveys overlap the areas. The areas combined have a weighted hotspot total of 268.8 in the spring and 449.8 in the fall (Table 61). The spatial distribution of the hotspots changes seasonally: in the spring, more groundfish hotspots overlap the Machias HMA and in the fall more hotspots overlap the Small Eastern Maine HMA and Toothaker Ridge HMA (Map 58). Compared to Alternative 2, for species associated with hard and coarse substrates, the total number of hotspots was lower for redfish and witch flounder but the same for cod (Table 62).

There were no age 0/1 cod hotspots in the proposed Small Eastern Maine HMA, but age 0/1 cod and herring hotspots were identified inshore within Maine state waters. As noted under Alternative 2, habitat protection in the Small Eastern Maine HMA could be important to cod and other species when coupled with the synergistic effects of the Penobscot River Restoration Project. The smaller HMA may provide benefits of similar magnitude because the hotspots are concentrated inshore and are well captured by the smaller Eastern Maine area. Existing survey data for groundfish catches do not provide a level of precision to distinguish between the Large and Small Eastern Maine HMAs.

Alternative 2 has higher hotspot scores for hard-bottom associated species and a higher hotspot score overall compared to Alternative 3. However, part of the score is driven by a higher prevalence of hakes which are associated with softer bottoms less vulnerable to the adverse effects of fishing. Therefore, existing groundfish data do not provide a level of precision to clearly distinguish which Alternative (2 or 3) is expected to have more habitat protection value for juvenile groundfish. <u>Based on the available data, because the number of weighted hotspots are about the same for Alternative 2 and Alternative 3, they would be expected to have similar conservation benefits for age 0/1 juvenile groundfish that are vulnerable and/or are associated with coarse and hard substrates. Like Alternative 2, Alternative 3 is expected to have positive benefits for these species relative to Alternative 1/No Action.</u>

Overall, this alternative is expected to have neutral to low positive impacts on groundfish spawning. There are no large spawner groundfish hotspots overlapping the areas in any season, and very few large spawner groundfish hotspots in the sub-region generally (see sub-regional map in approach to analysis section). Currently, there is little revenue from gillnet and longline fishing in these areas (see pie charts in economic impacts section and fishing effort maps in the

affected environment section of Volume 1). Given the low magnitude of current fishing effort and lack of overlap with hotspots, any positive impacts associated with fishing restrictions in this sub-region would be slight and would occur with restrictions on mobile bottom-tending gears (Options 1 and 2), with likely no positive benefits (neutral impacts) associated with Options 3 and 4.

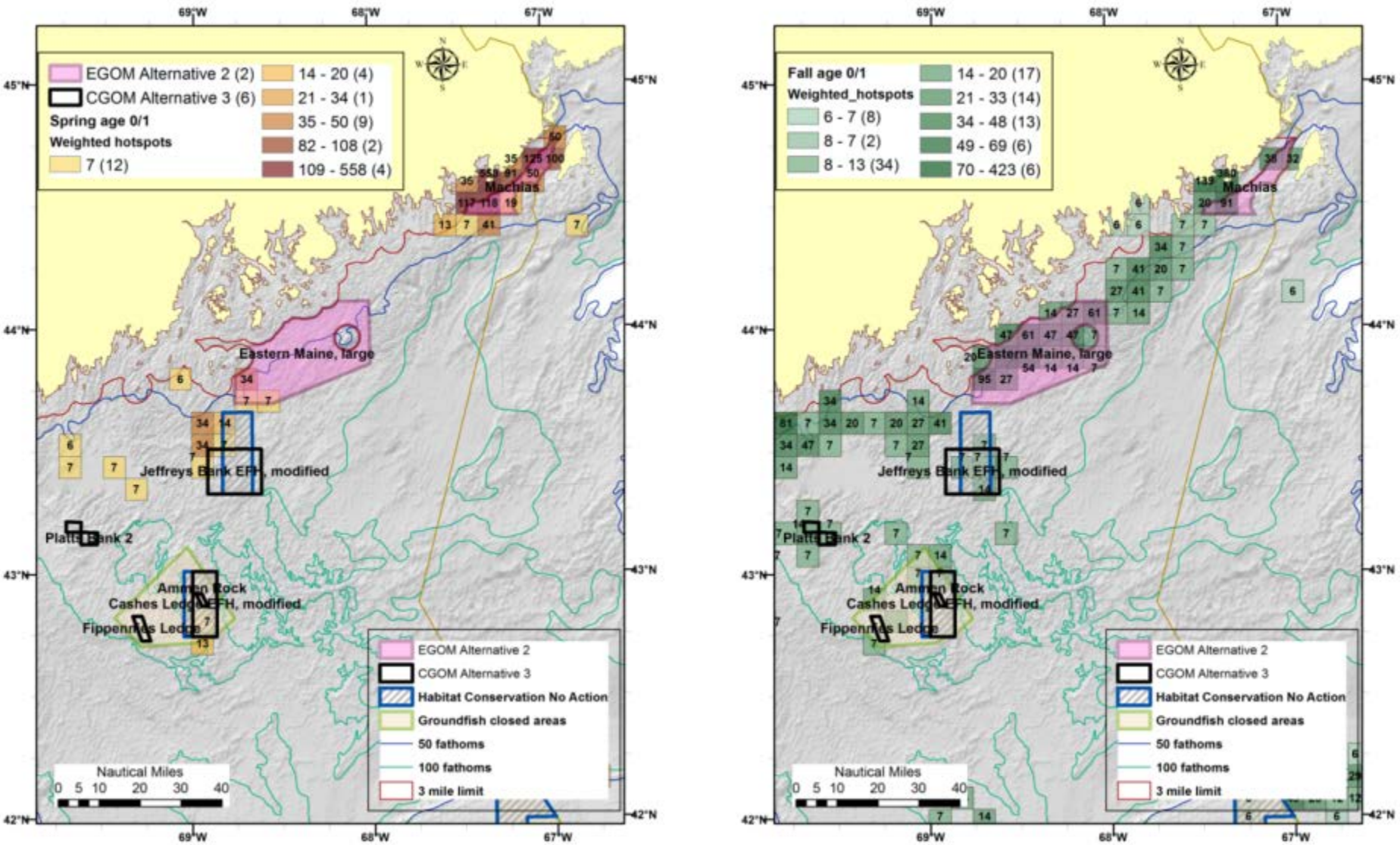
Table 61 – Total unweighted and weighted hotspots in eastern Gulf of Maine habitat management area alternatives, compared to Alternative 1/No Action.

	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Eastern GOM								
No Action	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
EFH closure	0	0.0	0	0.0	0	0.0	0	0.0
GF closure	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 2	150	235.0	4	0.0	274	591.7	0	0.0
Alternative 3	119	268.8	33	0.0	190	449.8	0	0.0

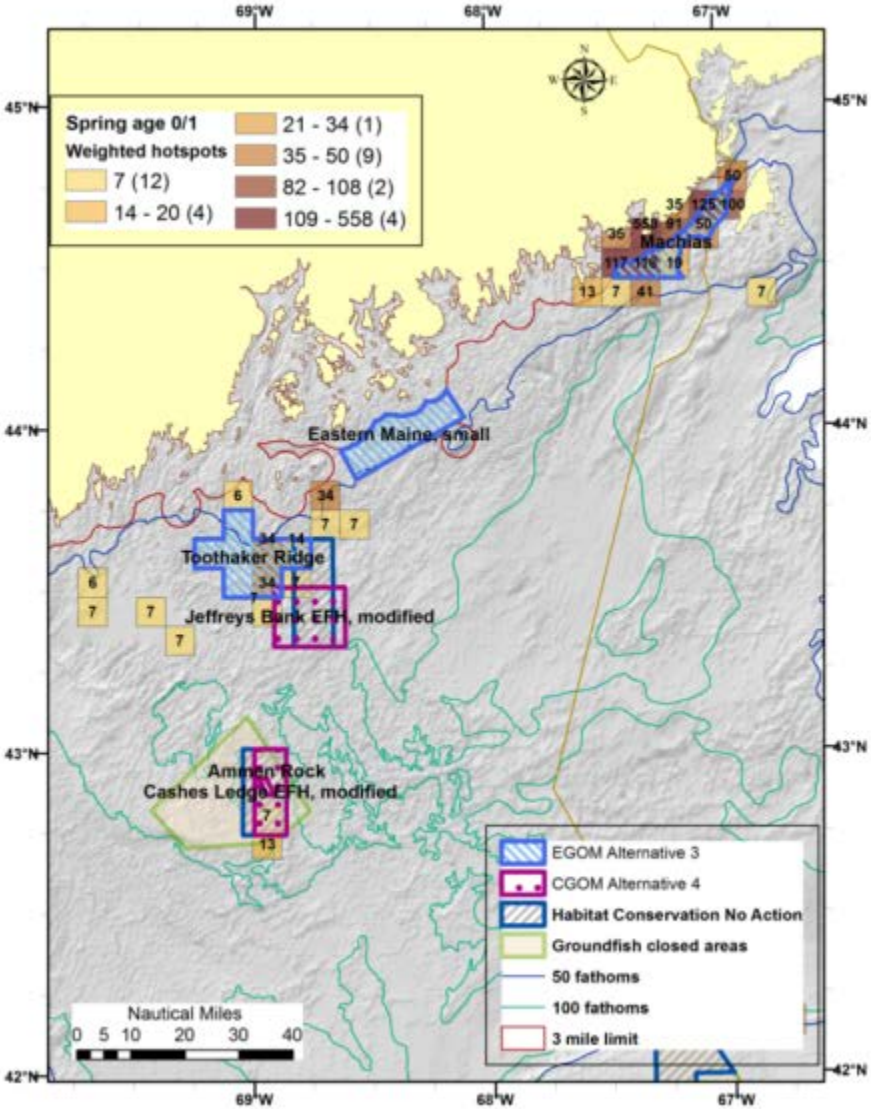
Table 62 – Total hotspots by species for eastern Gulf of Maine habitat management area alternatives, compared to Alternative 1/No Action.

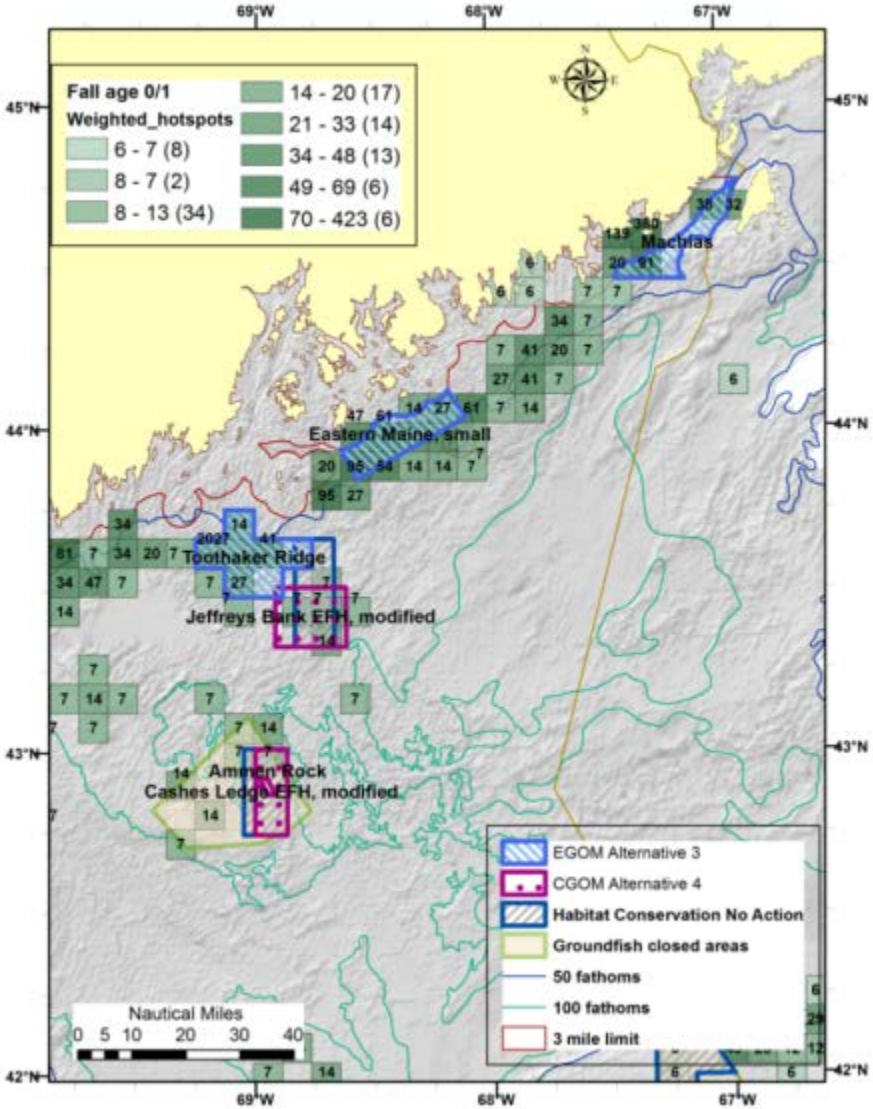
	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Eastern Gulf of Maine																		
Alternative 1 (No Action)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 2	81	0	0	2	0	13	0	7	0	0	7	143	98	13	20	44	0	428
Alternative 3	65	1	0	2	0	13	0	7	0	0	30	109	57	13	18	27	0	342

Map 57 – Eastern Gulf of Maine Alternative 2 (red shading with red outline) and central Gulf of Maine Alternative 3 (black outline) overlap with spring (left), and fall (right) weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC and ME-NH survey data.



Map 58 – Eastern Gulf of Maine Alternative 3 (hatching with blue outline) and central Gulf of Maine Alternative 4 (dots with red outline) overlap with spring (left) and fall (right) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC, MADMF, ME-NH, and IBS survey data. There are no summer or winter weighted hotspots in this area.





4.2.2.4 ***Central Gulf of Maine***

Note – maps are provided in the eastern Gulf of Maine section above.

4.2.2.4.1 Alternative 2 (No Habitat Management Areas)

Alternative 2 proposes no habitat management areas for the central Gulf of Maine sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is expected to provide less groundfish habitat conservation and lower benefits for groundfish stocks compared to Alternative 1/No Action, or Alternatives 3 and 4, as any benefits of a no closure alternative rely on other groundfish management measures such as catch limits, mesh size, etc. Relative to Alternative 1/No Action and Alternatives 3 and 4, Alternative 2 would therefore have negative impacts on age 0/1 juvenile groundfish habitat and could reduce groundfish productivity.

Overall, this alternative is expected to have slightly negative impacts on groundfish spawning. There are some large spawner groundfish hotspots overlapping the Alternative 1/No Action areas in the spring, summer, and fall, and removal of these areas and their associated restrictions on gears capable of catching groundfish would eliminate some current spawning benefits. Removal of the existing Jeffreys Bank Habitat Closure Area would have a slight negative impact if any, given limited overlap of this area with hotspots and the fact that it is currently managed as a mobile bottom-tending gear closure, which limits the potential for spawning benefits given that fixed and recreational gears capable of catching groundfish are currently allowed.

4.2.2.4.2 Alternative 3

Alternative 3 proposes Modified Jeffreys Bank and Cashes Ledge HMAs, the Ammen Rock HMA (Map 57) which would be closed to all fishing gears except lobster traps, and the Platts Bank and Fippennies Ledge HMAs (Platts Bank contains two sub-areas).

Total weighted and unweighted groundfish hotspots are summarized in Table 63. In addition to spring and fall trawl surveys, the summer shrimp trawl survey and the winter Inudustry Based Survey cod surveys partially overlap the areas proposed for habitat management in the central Gulf of Maine. The hotspots in this sub-region are likely to be underestimated because of the reduced survey tows in the immediate vicinity of Cashes Ledge, Fippennies Ledge, and Platts Bank. The small sizes of these proposed habitat management areas would be less effective than larger areas for groundfish stocks that generally have much larger ranges of movement. Additionally, detection of any potential effect on stock productivity would be very difficult.

Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable, but both are generally lower than those for Alternative 1/No Action. There are no age 0/1 cod hotspots for any alternative, but this is probably due to the undersampling of the areas noted above (Table 64). Both Platts Bank and Fippennies Ledge have some catches of age 0/1 cod surrounding them, and these additional HMAs could convey some additional habitat conservation for cod and other groundfish species, despite the presence of age 0/1 hotspots.

Based on the number and distribution of hotspots, Alternative 3 has fewer conservation benefits than Alternative 1/No Action and impacts on age 0/1 juvenile groundfish habitat and on the groundfish resource are therefore expected to be slightly negative compared to No Action. However, Alternative 1/No Action does not include any habitat closures around Platts Bank and Fippennies Ledge, which have some survey catches of age 0/1 cod and other groundfish. While Fippennies Ledge is protected by the Cashes Ledge Groundfish Closure Area, Platts Bank is not. Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable and therefore the impacts of Alternative 3 on age 0/1 groundfish habitat and the groundfish resource are neutral compared to Alternative 4.

Overall, this alternative is expected to have neutral to slightly negative impacts on groundfish spawning relative to Alternative 1/No Action. There are some groundfish hotspots overlapping and adjacent to the modified Cashes Ledge HMA during the spring, summer, and fall, and overlapping the modified Jeffreys Bank HMA during the summer, but given that these areas would be closed to mobile bottom-tending gears only under Options 1 and 2, positive benefits would be somewhat limited. It is not possible to predict whether the use of fixed gears such as longlines and gillnets would increase in areas currently managed that would remain as habitat closures (i.e. Fippennies Ledge, Cashes Ledge) if the Cashes Ledge Groundfish Closure Area is lifted. If fixed gears capable of catching groundfish are used in the groundfish closure as a result of this alternative lifting that closure, then negative impacts to spawning groundfish could result. The magnitude of these impacts would relate to the magnitude of fishing activity in the area, which is uncertain. There is currently gillnet use on Platts Bank, which would become a mobile bottom-tending gear closure under this alternative, Options 1 and 2, so any spawning protection benefits of the Platts Bank areas would be mitigated by gillnet use in the area, which would presumably continue under this alternative. Given that the measures in the Jeffreys Bank area would remain the same under Option 1, and would be similar under Option 2, and that overlap with spawner groundfish hotspots is limited, shifting the boundaries of this area would be expected to have neutral impacts on groundfish spawning. Options 3 and 4 are not expected to produce any positive benefits for spawning groundfish. This, coupled with the potential negative impacts of removing the existing groundfish closure, could lead to slightly negative impacts overall if this alternative is adopted with Option 3 or Option 4. The Ammen Rock area would offer fairly comprehensive protection to groundfish stocks year round, but the small size of this area reduces the magnitude of positive benefits to spawning.

4.2.2.4.3 Alternative 4 (Preferred)

Alternative 3 proposes Modified Jeffreys Bank and Cashes Ledge HMAs, and the Ammen Rock HMA, which would be closed to all fishing gears except lobster traps. Unlike Alternative 3, HMAs around Platts Bank and Fippennies Ledge are not included.

Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable (Table 63), but both are generally lower than those for Alternative 1/No Action. Based on the number and distribution (Map 58) of hotspots, Alternative 4 has less conservation benefits than Alternative 1/No Action. Alternative 1/No Action does not include any habitat closures around Platts Bank and Fippennies Ledge however, two areas with some survey catches of age 0/1 cod and other groundfish, but not enough to produce hotspots probably due to undersampling of these features. Compared to No Action, impacts on the habitat used by age 0/1 groundfish and on

the groundfish resource are slightly negative. Alternative 4 would have positive impacts relative to Alternative 2 and neutral impacts relative to Alternative 3.

This alternative is expected to have neutral to slightly negative impacts on groundfish spawning relative to Alternative 1/No Action, and would have similar impacts as those discussed above for Alternative 3. This alternative would not include the Platts Bank HMA, but this area likely has neutral impacts on spawning groundfish as discussed above. This alternative also does not include the Fippennies Ledge HMA, but the potential for groundfishing activity on Fippennies is uncertain.

Table 63 – Total unweighted and weighted hotspots in CGOM habitat management area alternatives compared to No Action.

	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Central GOM								
No Action	**1**	**6.7**	**16**	**13.5**	**12**	**47.3**	**4**	**26.8**
EFH closure	1	6.7	2	0.0	2	6.8	0	0.0
GF closure	1	6.7	16	13.5	12	47.3	4	26.8
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	1	6.7	8	0.0	18	40.6	2	13.4
Alternative 4	1	6.7	8	0.0	17	33.8	0	0.0

Table 64 – Total hotspots by species for central Gulf of Maine habitat management area alternatives, compared to No Action.

	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Central Gulf of Maine																		
Alternative 1 (No Action)	18	0	15	0	0	0	1	6	0	0	9	36	20	0	0	1	0	106
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	6	0	3	0	0	0	0	3	0	0	4	8	5	0	0	0	0	29
Alternative 4	5	0	3	0	0	0	0	1	0	0	4	8	5	0	0	0	0	26

4.2.2.5 ***Western Gulf of Maine***

4.2.2.5.1 Alternative 2 (No Habitat Management Areas)

Alternative 2 proposes no habitat management areas for the Western Gulf of Maine sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have negative impacts for groundfish stocks as compared to Alternative 1/No Action, or any of the other alternatives for this sub-region. Any benefits would derive from other management measures such as catch limits and mesh size, and not from area closures. Under this alternative it is assumed that the existing Inshore Roller Gear Restricted Area (Alternative 7A) would continue, although it might not be explicitly recognized as a habitat protection measure and would only apply to Northeast Multispecies sector or DAS vessels. Thus, Alternative 2 and Alternative 7A would provide very similar conservation benefits. In summary, the overall impact of this alternative on managed large mesh groundfish is expected to be highly negative relative to Alternative 1/No Action and all other proposed alternatives, except 7A, and is likely to reduce groundfish productivity.

This alternative is expected to have negative impacts on groundfish spawning relative to Alternative 1/No Action as it would remove the Western Gulf of Maine Groundfish Closure Area, although the extent of this impact is highly dependent on the spawning management alternatives selected in the Gulf of Maine. At a minimum, Gulf of Maine Spawning Alternative 2 would maintain restrictions on gears capable of catching groundfish in the sector rolling closures, which overlap various parts of the western Gulf of Maine during April, May, and June, such that the negative impacts of year-round groundfish closure removal would be restricted to species that spawn outside the spatial and temporal windows covered by the sector rolling closures. For further discussion of this issue, see the spawning alternatives section of this section on groundfish resource impacts.

4.2.2.5.2 Alternative 3

Alternative 3 proposes the Large Bigelow Bight HMA coupled with the Large Stellwagen HMA, the latter overlapping the southern half of the existing Western Gulf of Maine Habitat Closure Area (Map 59).

These two areas contain considerably more age 0/1 groundfish hotspots than areas included in Alternative 1/No Action, weighted more heavily for stocks that have low biomass and have a high affinity for coarse and hard substrates. The total weighted hotspots (Table 65) are similar to Alternative 4, but higher than Alternatives 5 and 6. (Comparison to the number of hotspots in the much larger existing or alternative roller gear management areas in Alternative 7A/7B is not appropriate because the Alternative 3 HMAs would have different and more restrictive management measures, possibly including prohibition on the use of all mobile bottom-tending gears).

Most of the age 0/1 groundfish hotspots in the Alternative 3 areas include redfish, plaice, red hake, and silver hake (Table 66). There are 19 age 0/1 cod hotspots, which is nearly the same as 16 hotspots for Alternative 1/No Action, but the 20 age 0/1 haddock hotspots is about half the Alternative 1 number (38). The number of cod hotspots is nearly the same for all of the action

alternatives, except for the much larger existing (Alternative 7A) or modified (Alternative 7B) roller gear restricted areas, which encompass the large number of cod hotspots in Massachusetts Bay and west of the Western Gulf of Maine Closure Area.

Based on the number and prevalence of weighted hotspots being nearly two to three times those for Alternative 1/No Action in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and are strongly associated with coarse and hard substrates. Therefore, compared to Alternative 1 (No Action) and other alternatives in this sub-region, the overall impact of Alternative 3 on managed large mesh groundfish is expected to highly positive.

It is difficult to assess the impacts of this alternative on groundfish spawning activity. On the one hand, the area would restrict trawl gears that catch groundfish in the Large Bigelow Bight HMA, but, on the other hand, restrictions on these gears would be lifted on Jeffreys Ledge. As discussed elsewhere in this document, Jeffreys Ledge historically had a relatively high amount of gillnet activity, which would have negative impacts on groundfish spawning in the area. Gillnet and other fixed gear fishing for groundfish could expand in the Large Stellwagen HMA as well, given that this area would be managed as a mobile bottom-tending gear closure only under Options 1 and 2. Any effects would likely accrue to spring spawning stocks, as most of the large spawner hotspots in this sub-region are found in the spring. Adopting the Large Bigelow Bight and Large Stellwagen HMAs with Options 3 or 4 would lead to negative impacts on groundfish spawning, as this would allow gears capable of catching groundfish to be used throughout the sub-region. As for Alternative 2 above, any negative effects would be mitigated by the spawning management alternative selected.

4.2.2.5.3 Alternative 4

Alternative 4 includes the Large Bigelow Bight HMA from Alternative 3, but proposes two areas (Jeffreys Ledge and Small Stellwagen) instead of one within the existing Western Gulf of Maine Habitat Closure Area (Map 59).

Alternative 4 areas also contain considerably more age 0/1 groundfish hotspots than areas included in Alternative 1/No Action, weighted more heavily for stocks that have low biomass and/or have a high affinity for coarse and hard substrates. The total weighted hotspots (Table 65) are similar to the totals for Alternative 3, but higher than those for Alternatives 5 and 6. As noted above, comparison to the number of hotspots in the Alternative 7A and 7B areas is not appropriate.

The hotspot species composition for Alternative 4 is similar to Alternative 3, with high numbers of hotspots for redfish, plaice, red hake, and silver hake (Table 66). The number of age 0/1 cod hotspots (19) is identical to that for Alternative 3, and similar to Alternative 1/No Action (16). There are more age 0/1 haddock hotspots in the Jeffreys Ledge area, so the number of haddock hotspots is nearly the same as Alternative 1/No Action and double that for Alternative 3.

Based on the number and prevalence of weighted hotspots being nearly 2 to 3 times those for Alternative 1/No Action in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse

and hard substrates. Therefore, compared to Alternative 1 (No Action) and other alternatives in this sub-region, the overall impact of Alternative 4 on managed large mesh groundfish is expected to be highly positive.

The impacts of Alternative 4 on groundfish spawning would likely be similar to those associated with Alternative 3. Mobile bottom-tending gear restrictions would be maintained on Jeffreys Ledge, but gillnet usage in this area could limit any positive impacts of this HMA on spawning groundfish.

4.2.2.5.4 Alternative 5

The proposed HMAs in Alternative 5 are the same as Alternative 4 except that Alternative 5 includes a much smaller Bigelow Bight area (Map 60), which of course contains fewer age 0/1 groundfish hotspots than Alternatives 3 and 4, but nearly double the total weighted hotspots for Alternative 1/No Action in the spring and fall surveys (Table 65). The total weighted hotspots are also somewhat less than Alternatives 3 or 4, and less than Alternative 1/No Action.

Compared to Alternatives 3 and 4, Alternative 5 contains fewer age 0/1 hotspots for redfish, plaice, red hake, silver hake, and white hake (Table 66). It has fewer redfish and haddock hotspots than Alternative 1/No Action, but more plaice hotspots. As noted above, the number of cod hotspots are nearly the same as in other alternatives, with the notable exception of Alternatives 7A and 7B, where cod hotspots occur inshore of Stellwagen Bank in the spring and on the offshore side of the Bank in the fall.

Based on the number and prevalence of weighted hotspots being nearly double those for Alternative 1/No Action in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates. Alternative 5 however includes roughly one-fourth of the weighted hotspots identified in areas associated with Alternatives 3 and 4. Thus, Alternative 5 is likely to have slightly to moderately negative impacts on age 0/1 juvenile groundfish habitat and on the groundfish resource relative to Alternatives 3 and 4.

The impacts of Alternative 5 on groundfish spawning would likely be similar to those associated with Alternatives 3 and 4. Mobile bottom-tending gear restrictions would be maintained on Jeffreys Ledge, but gillnet usage in this area could limit any positive impacts of this HMA on spawning groundfish.

4.2.2.5.5 Alternative 6

This alternative proposes only one area, the Large Stellwagen HMA (Map 60), which is a subset of the existing Western Gulf of Maine Habitat Closure Area. It is similar to Alternative 3, but does not include either of the Small or Large Bigelow Bight HMA, both of which contain many weighted hotspots. This alternative has the lowest amount of total weighted hotspots as any alternative in the western Gulf of Maine (Table 65), including Alternative 1/No Action. This alternative has fewer age 0/1 hotspots than any other alternative, including Alternative 1/No Action, for redfish, plaice, cod, haddock, red hake, silver hake, white hake, and winter flounder (Table 66).

Based on the number and prevalence of weighted hotspots being a third to a half of those for Alternative 1/No Action in the spring and fall surveys, this alternative is expected to have considerably less conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates. Therefore, compared to Alternative 1 (No Action) and other alternatives in this sub-region, the overall impact of Alternative 6 on managed large mesh groundfish is expected to moderately to highly negative.

It should be noted however that the analysis in Section 4.1.3.1.1 shows that age 2+ sub-legal juvenile cod are present further offshore than for age 0/1 cod. The distribution of these older codfish has substantial overlap with the Large Stellwagen Bank HMA. To the extent that cod between 25 and 55 cm (about 10 to 22 inches)[14] rely on coarse and hard substrates for survival and growth, this alternative may have some benefits to Gulf of Maine cod.

This alternative would likely have slightly negative impacts on spawning groundfish. There would not be closures in the Small Bigelow Bight or Jeffreys Ledge areas that would protect groundfish spawning through restrictions on mobile bottom-tending gear, and fixed gear usage could increase in the Jeffreys Ledge area due to removal of the year-round groundfish closure.

4.2.2.5.6 Alternative 7A and 7B (7A preferred)

This alternative adapts the Inshore Roller Gear Restricted Area (shown hatched in Map 63) to recognize its potential habitat conservation benefits. As a preferred alternative it is considered to be a management measure integrated with Alternative 1 which retains the Western Gulf of Maine Habitat Closure and the Western Gulf of Maine Groundfish Closure Area. Under either alternative 7A or 7B, all vessels using trawls to target any species would be required to use rollers no larger than a 12” diameter. This measure differs from No Action, because the existing roller gear restriction applies only to sector vessels and vessels on a day-at-sea (including vessels using a day-at-sea to target skates and monkfish). However, adopting this measure for all trawl vessels will probably not represent a substantial change in roller gear configuration, since the non-groundfish trawl fishing in this region is dominated by shrimp and other small-mesh trawlers, who generally already use rollers smaller than 12”.

According to fishermen, vessels with low to moderate horsepower are restricted to areas with softer bottoms and sand when they use nets with smaller roller gear than used outside of the 12” roller gear restriction area. Fishermen also report that high horsepower vessels are able to fish the harder bottoms within the 12” roller gear restricted area, despite the restriction. Vessels with higher horsepower are more able to pull through the harder bottom and are therefore not as constrained by the roller gear restriction.

Although not summarized by vessel horsepower, there is some indication in the observer data that vessels using certain types of trawls in the restricted roller gear area fish in areas having fewer coarse and hard substrates. Map 61 shows the geographic distribution of observed trawl hauls since 2008 by fishery, compared to the existing restricted roller gear area, outlined by a red border, and the Alternative 7B area, which is outlined with a black border. The bottom type

[14] The minimum legal limit for cod was 22 inches from Aug 1, 2002 to Aug 29, 2013.

shown in the map is the same information used in the SASI analysis, showing the top 30% of trawl vulnerability scores (100 km^2 cells that are outlined).

Vessels targeting shrimp, herring, and small-mesh multispecies are using small-mesh trawls. This type of effort appears to occur mainly on mud-silt and sand substrates within the roller gear area. One possible exception is some overlap with granule-pebble and cobble substrates in the Ipswich Bay area, within the southwestern portion of the Large and Small Bigelow Bight HMAs. However, inferring effort according to habitat type is challenging because both fishing effort and substrate maps are not finely resolved spatially. Observed hauls are plotted using beginning and ending haul locations, which could miss the fine scale changes in tow direction to avoid these harder substrates. Also, the local spatial accuracy of the substrate map is relatively uncertain in the western Gulf of Maine region, given the underlying data (see the physical environment description in Volume 1 for details).

Vessels targeting large-mesh multispecies, monkfish, and skates are typically fishing on a day-at-sea or under sector rules and are using large-mesh trawls. Vessels targeting large-mesh multispecies and monkfish offshore of the Western Gulf of Maine Closure Area are fishing on mud-silt and sand bottom, which is less vulnerable to adverse effects caused by trawl fishing. Although some of this fishing occurs within the restricted roller gear area, many tows continue outside of the roller gear area and the rate of compliance with the roller gear restriction on the eastern side of the Western Gulf of Maine Closure Area is questionable.

On the other hand, multispecies and monkfish trawl fishing inshore of the Western Gulf of Maine Closure Area in Massachusetts Bay appears to occur mainly on granule-pebble and cobble substrates. This area is interspersed with hard substrate ridges and bedrock outcroppings. In particular, observed trawl fishing occurs in hard bottom off Scituate, Massachusetts, on the northwestern corner of Stellwagen Bank, and on the southern flank of Jeffreys Ledge. According to the sediment data, these areas have granule-pebble substrates.

In terms of impacts on age 0/1 groundfish, it is more important whether fishing with these gears favors or avoids areas where age 0/1 groundfish occur, especially those associated with coarse and hard substrates, rather than avoidance of hard substrates per se. Using the weighted hotspot results that favor these species, the overlap of observed trawling effort is shown relative to the hotspots derived from the spring and fall NEFSC, MA DMF, ME-NH, and IBS cod surveys. The observed hauls were not separated by season, because the effects of using mobile bottom-tending gear on coarse and hard substrates are not seasonal, although juvenile groundfish may use these important habitats during specific seasons.

Because Alternative 7A encompasses a much bigger area, which overlaps Massachusetts and Cape Cod Bays where the IBS cod and winter trawl surveys have taken place, the total number of age 0/1 weighted groundfish hotspots is considerably higher than any other alternative (Table 65), including five to ten times the number for Alternative 1/No Action. It includes far more age 0/1 hotspots than Alternative 1 and most other alternatives for redfish, alewife, plaice, cod, haddock, ocean pout, pollock, red hake, silver hake, winter flounder, witch flounder, and yellowtail flounder (Table 66).

Compared with the weighted age 0/1 groundfish hotspots in the spring (Map 62, left), there is some overlap with shrimp and herring pair trawl fishing off the southern Maine coastline. A considerable amount of small-mesh fishing in Ipswich Bay does not coincide with the groundfish hotspots. Conversely, there is a fairly high amount of correspondence between large-mesh multispecies trawl fishing and some herring pair trawl fishing northwest of Cape Cod, particularly on the inshore side of Stellwagen Bank. Compared to the fall age 0/1 groundfish hotspots (Map 62, right), there has been some scattered shrimp and herring pair trawl fishing in the northern portion of the western Gulf of Maine, but not as much large-mesh multispecies trawling that coincides with the fall age 0/1 groundfish hotspots.

It generally appears that fishing with small-mesh trawls for whiting, herring, and shrimp tends to already occur on mud-silt and sand bottom and does not generally correspond with the age 0/1 groundfish hotspots. Additionally, the large-mesh trawl fishing offshore of the Western Gulf of Maine Closure Area does not correspond with the hard substrate types, nor with the age 0/1 groundfish hotspots. Requiring these vessels to use roller gear less than 12" would produce neutral effects on groundfish habitat.

Because it covers a larger area containing more juvenile groundfish habitat, if this measure were as effective as a mobile bottom-tending gear closure area in reducing the use of mobile bottom-tending gears on vulnerable substrates, it could be almost equally as effective as a mobile bottom-tending gear closure, reducing adverse impacts to age 0/1 juvenile groundfish habitat associated with vulnerable substrates. <u>However, large-mesh trawl fishing for groundfish and monkfish south and west of the Western Gulf of Maine Closure Area does seem to correspond with areas having harder substrates and with age 0/1 groundfish hotspots, even though these vessels are currently required to use small roller gear. Identifying this roller gear requirement as a habitat measure is unlikely to change their fishing behavior to avoid areas of harder substrates, and therefore will not improve groundfish habitat. Thus, relying solely on an expanded roller gear restriction in the area is likely have highly negative impacts on groundfish habitat, compared to Alternative 1/No Action, which closes a large area of vulnerable substrates to mobile bottom-tending gear fishing. As a complementary measure to mobile bottom-tending gear closure area, this alternative is likely to have slightly positive benefits as compared to the existing implementation of the roller gear restricted area.</u>

Alternative 7B proposes a smaller area than Alternative 7A as a restricted gear area to protect vulnerable habitat. The existing roller gear area would remain in place and apply to Northeast Multispecies vessels, so the difference is that Alternative 7B would extend the roller gear restriction to the northeast off the central Maine coastline in Federal waters and apply the restriction to all trawl vessels. Implementing both areas simultaneously but applying them to different gears could be somewhat confusing.

The area encompassed by this alternative contains fewer age 0/1 weighted groundfish hotspots (Table 65) than Alternative 7A, but more than Alternative 1/No Action. This is true for redfish, plaice, cod, haddock, red hake, silver hake, winter flounder, and yellowtail flounder (Table 66). Compared to Alternative 7A, there are more hotspots for alewife and monkfish due to the proposed northeast extension of the existing restricted roller gear area (Map 63).

Similar to Alternative 7A, it does not appear that requiring 12" or less diameter roller gear in a smaller area of the western Gulf of Maine will change fishing behavior to avoid areas with vulnerable habitat. It would encompass an area around Stellwagen Bank where large-mesh multispecies trawl fishing occurs (Map 63), but these vessels are already required to use small roller gear on the net. Compared to Alternative 1/No Action which prohibits fishing with mobile bottom-tending gear in an area that has vulnerable groundfish habitat, this alternative is likely to have a highly negative impact on groundfish habitat if it were implemented as a stand-alone measure. As a complementary measure to mobile bottom-tending gear closure area, this alternative is likely to have slightly positive benefits as compared to the existing implementation of the roller gear restricted area because it would extend the 12" restriction into the northernmost portions of the Large Bigelow Bight area.

Either of these alternatives is expected to have neutral impacts on spawning groundfish, as these alternatives maintain or modify a trawl gear restriction only.

4.2.2.5.7 Alternative 8 (Preferred)

Alternative 8 would allow shrimp trawl vessels to fish within the northwest corner of the Western Gulf of Maine Habitat Closure Area (Map 55). Shrimp trawls are estimated to have an equivalent impact per unit area swept on vulnerable substrates to groundfish and other trawls (see seabed vulnerability section of Volume 1 and Appendix D). However, the fishery is conducted during a short winter season, often four to six weeks depending on how long it takes to catch the annual quota, and effort tends to occur on softer substrates given the distribution of northern shrimp. Although shrimp fishing may cause some damage to these soft sediment habitats, the short season allows for some recovery during the remainder of the year.

Furthermore, during the spring and fall, the exemption area accounts for a very small number of age 0/1 juvenile groundfish hotspots (Table 59). There were 20.3 total weighted hotspots in the exemption area in the spring vs. 261.1 in the Western Gulf of Maine Habitat Closure. In the fall, the area accounted for 33.8 weighted hotspots vs. 265.2 for the larger habitat closure. The shrimp exemption area in the summer accounted for a high fraction of total weighted age 0/1 groundfish hotspots, 94.6 vs. 128.4, although most of this hotspots value arises from presence of age 0/1 redfish and American plaice. The summer shrimp survey tows do appear to cover areas of harder substrates.

Thus the impacts of the shrimp fishery on age 0/1 juvenile groundfish habitat in the proposed exemption area are likely to be minimal and temporary. Also, allowing shrimp fishing in this exemption area may also spread some fishing effort out away from adjacent areas where age 0/1 groundfish hotspots and hard and coarse substrates are more prevalent. The distribution of effort in the shrimp fishery is also influenced by timing within the season, as the shrimp move from inshore to offshore from winter to summer.

In summary, the fraction of age 0/1 juvenile groundfish habitat affected by this alternative (low in the spring and fall, high in the summer for redfish and American plaice) coupled with the potential for spreading out shrimp fishing effort away from areas inshore along coastal New Hampshire and Maine suggests that the impacts on age 0/1 juvenile groundfish habitat and on the groundfish stock by Alternative 8 would be slightly positive.

This alternative likely has a neutral or very slightly negative impact on groundfish spawning relative to Alternative 1/No Action. While shrimp trawl gears have low groundfish bycatch rates, the use of these trawls could disrupt spawning activity, and the exemption area does contain large spawner hotspots in the spring. However, the magnitude of shrimp trawling in the exemption areas is likely to be low, especially in the short term, which mitigates any negative effects.

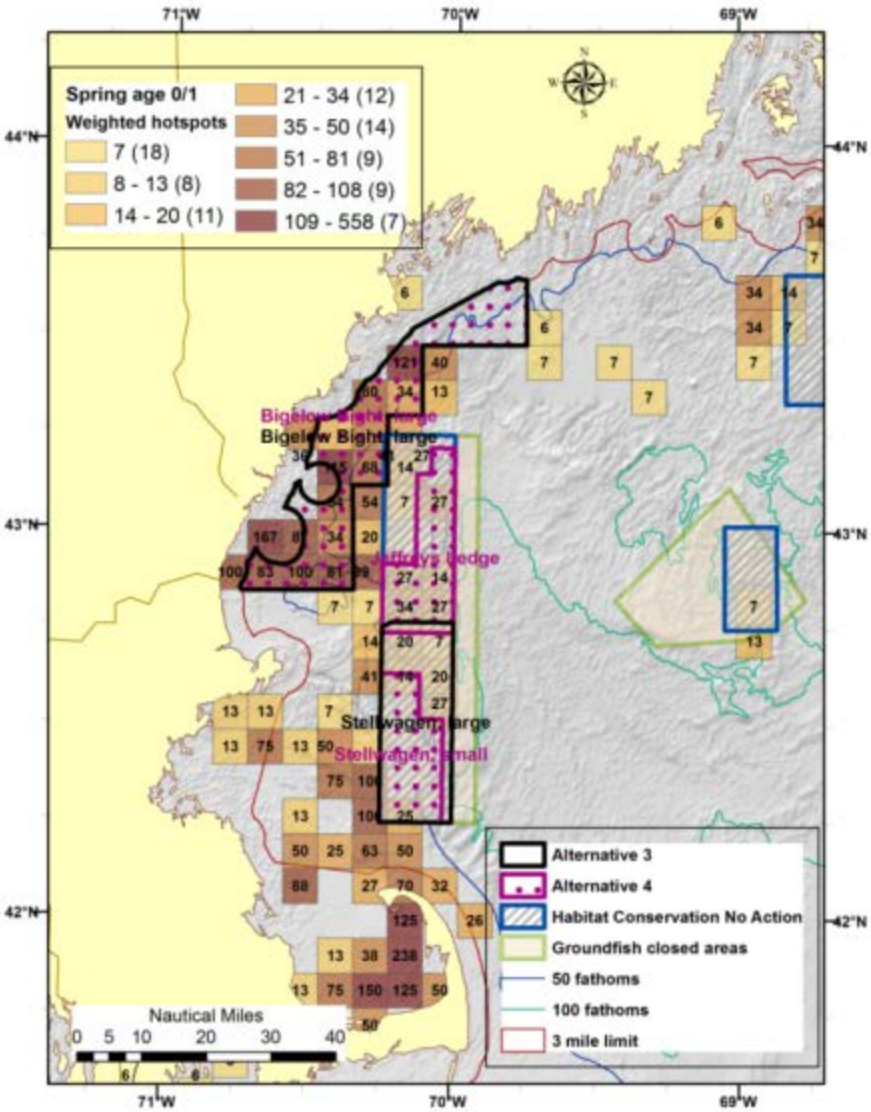
Table 65 – Total unweighted and weighted hotspots in western Gulf of Maine habitat management area alternatives.

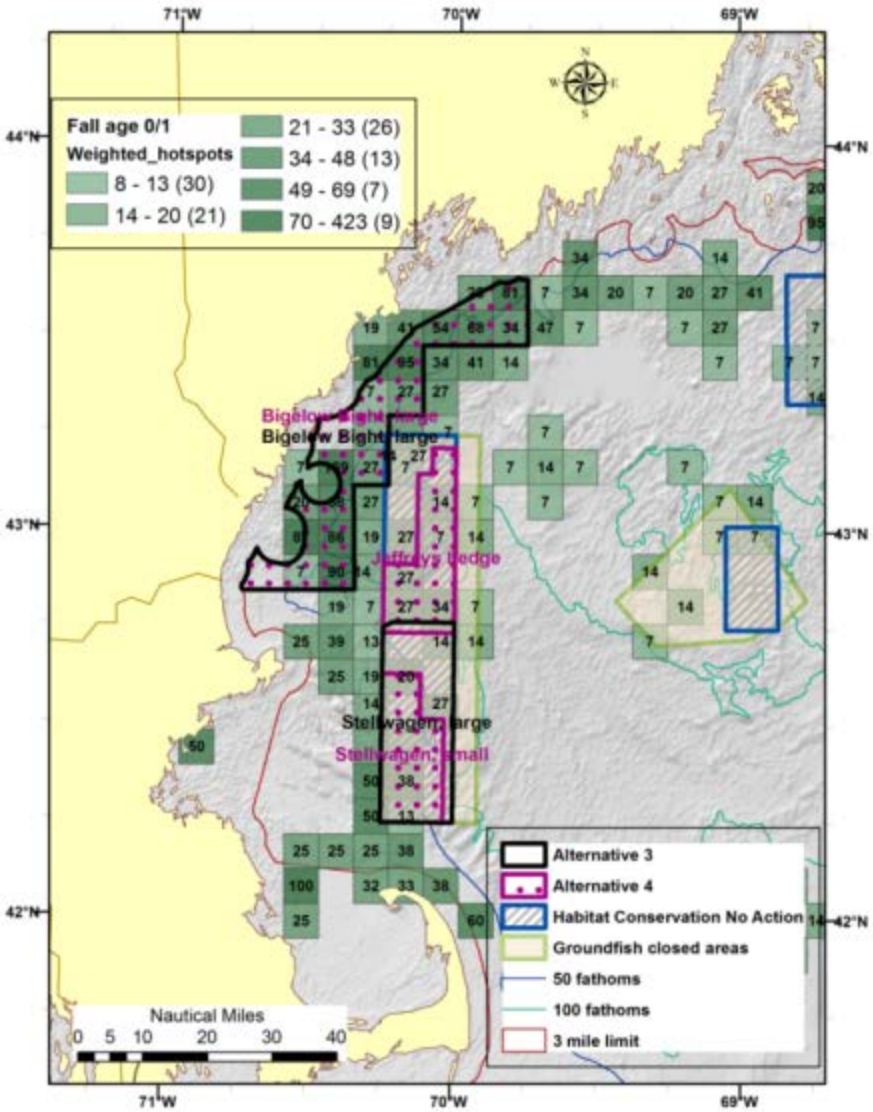
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Western GOM								
No Action	**84**	**261.1**	**49**	**162.2**	**67**	**305.7**	**1**	**6.7**
EFH closure	70	261.1	32	128.4	56	265.2	1	6.7
GF closure	84	261.1	49	162.2	67	305.7	1	6.7
Gear management area	1050	2686.9	213	500.2	1018	1886.8	133	720.9
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	486	939.3	83	162.2	500	968.1	12	6.7
Alternative 4	493	992.7	83	182.5	520	1035.4	11	0.0
Alternative 5	181	518.1	57	142.0	190	460.9	6	0.0
Alternative 6	24	112.9	6	6.8	17	123.5	1	6.7
Alternative 7.1	1050	2686.9	213	500.2	1018	1886.8	133	720.9
Alternative 7.2	549	1518.2	90	189.3	562	1263.9	67	357.6
Alternative 8	20	20.3	21	94.6	11	33.8	0	0.0

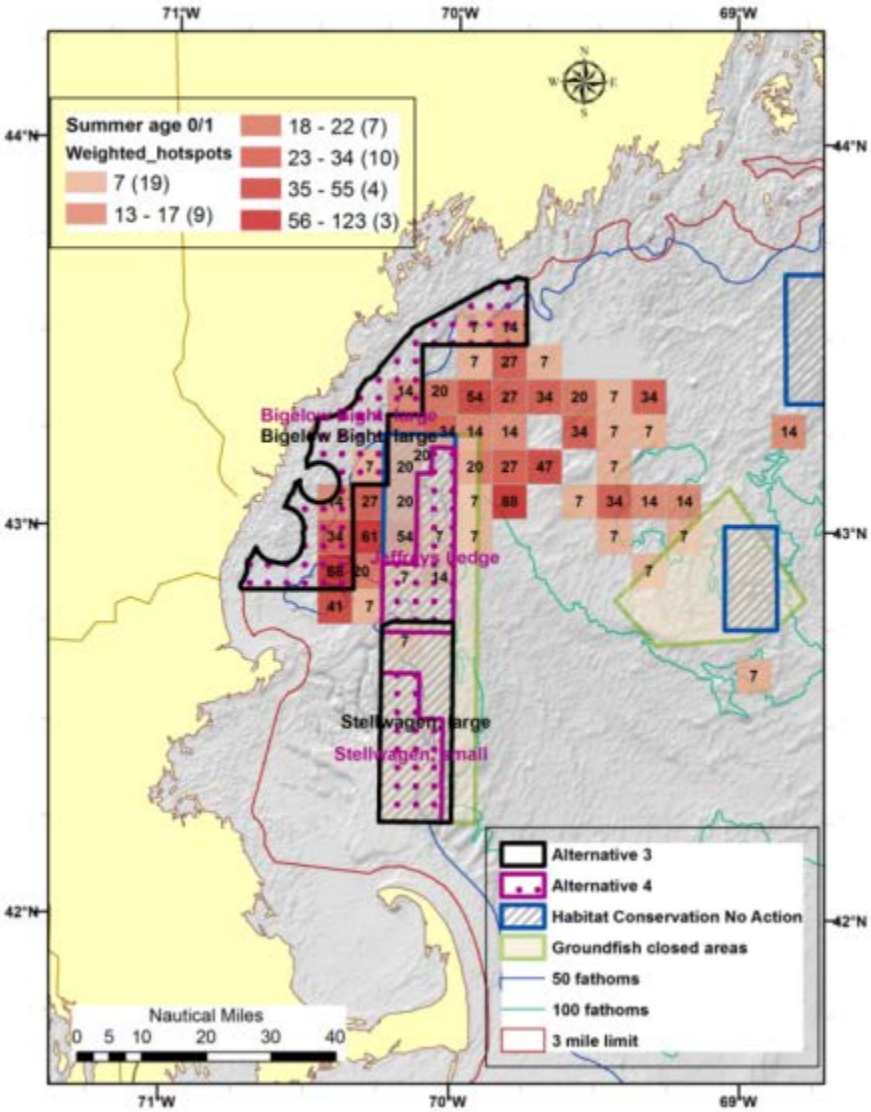
Table 66 – Total hotspots by species for Western Gulf of Maine habitat management area alternatives.

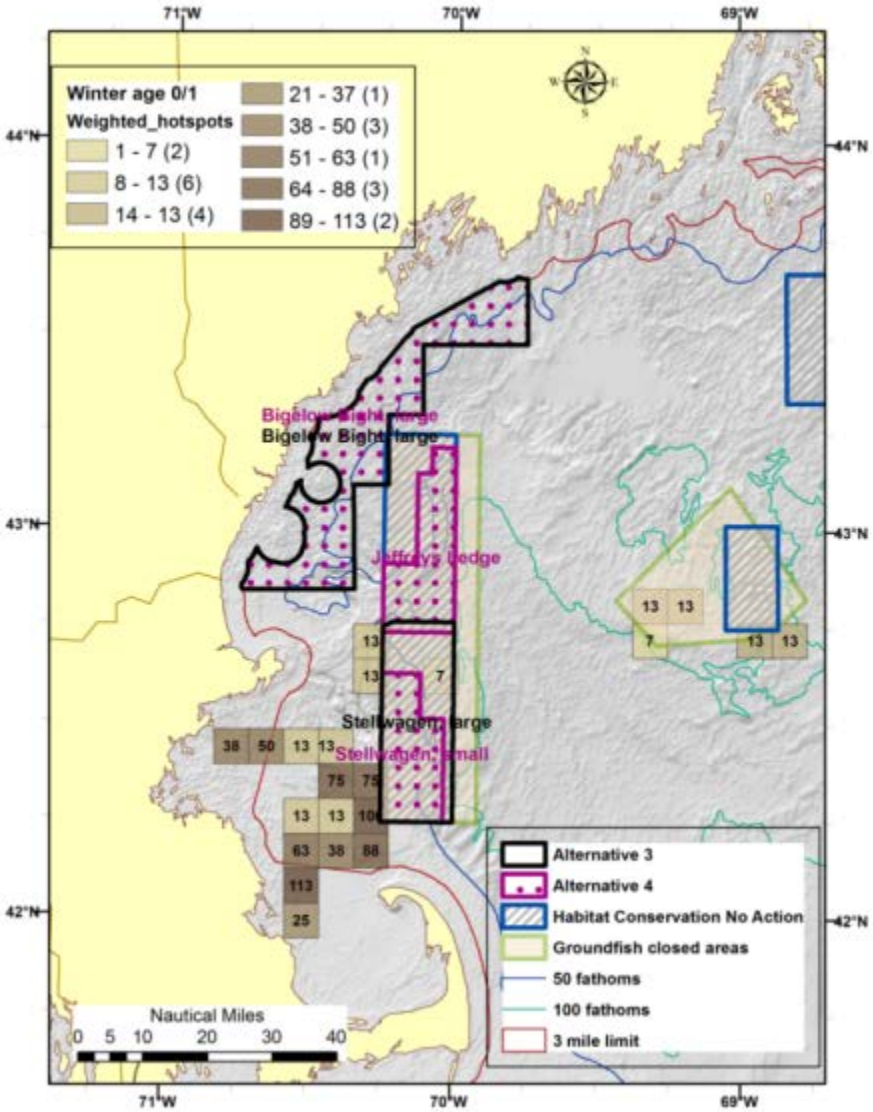
	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Western Gulf of Maine																		
Alternative 1 (No Action)	143	0	68	0	0	16	6	38	0	0	33	50	2	0	2	4	0	362
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	221	45	357	0	0	19	13	20	9	9	112	196	41	0	21	17	1	1081
Alternative 4	224	45	364	0	0	19	13	37	9	9	106	201	41	0	21	17	1	1107
Alternative 5	98	0	148	0	0	19	1	29	0	4	23	72	11	0	21	7	1	434
Alternative 6	23	0	4	0	0	7	0	1	0	0	6	5	1	0	1	0	0	48
Alternative 7.1	354	33	706	0	2	214	9	64	13	13	226	348	39	0	350	24	20	2415
Alternative 7.2	242	45	371	0	0	98	13	38	9	9	113	206	41	0	63	17	3	1268
Alternative 8	22	0	19	0	0	1	1	0	0	0	3	5	0	0	0	2	0	53

Map 59 – WGOM Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.

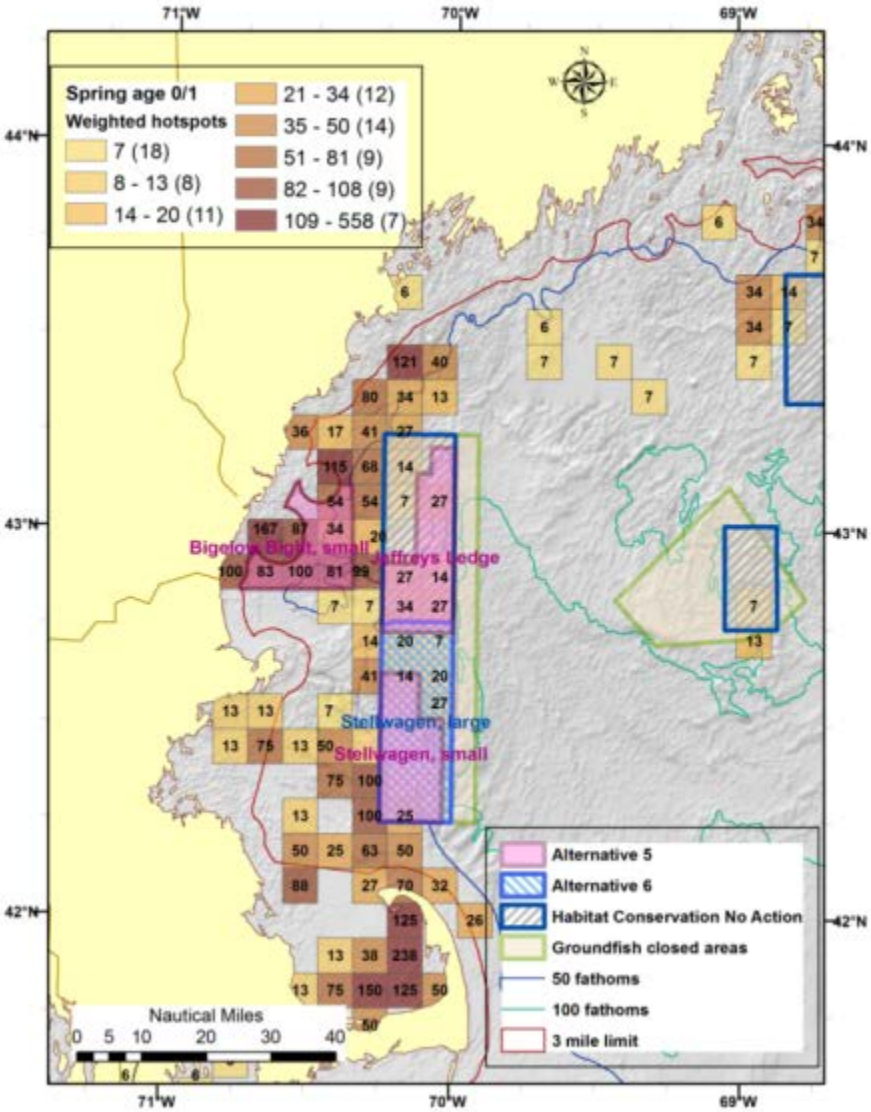


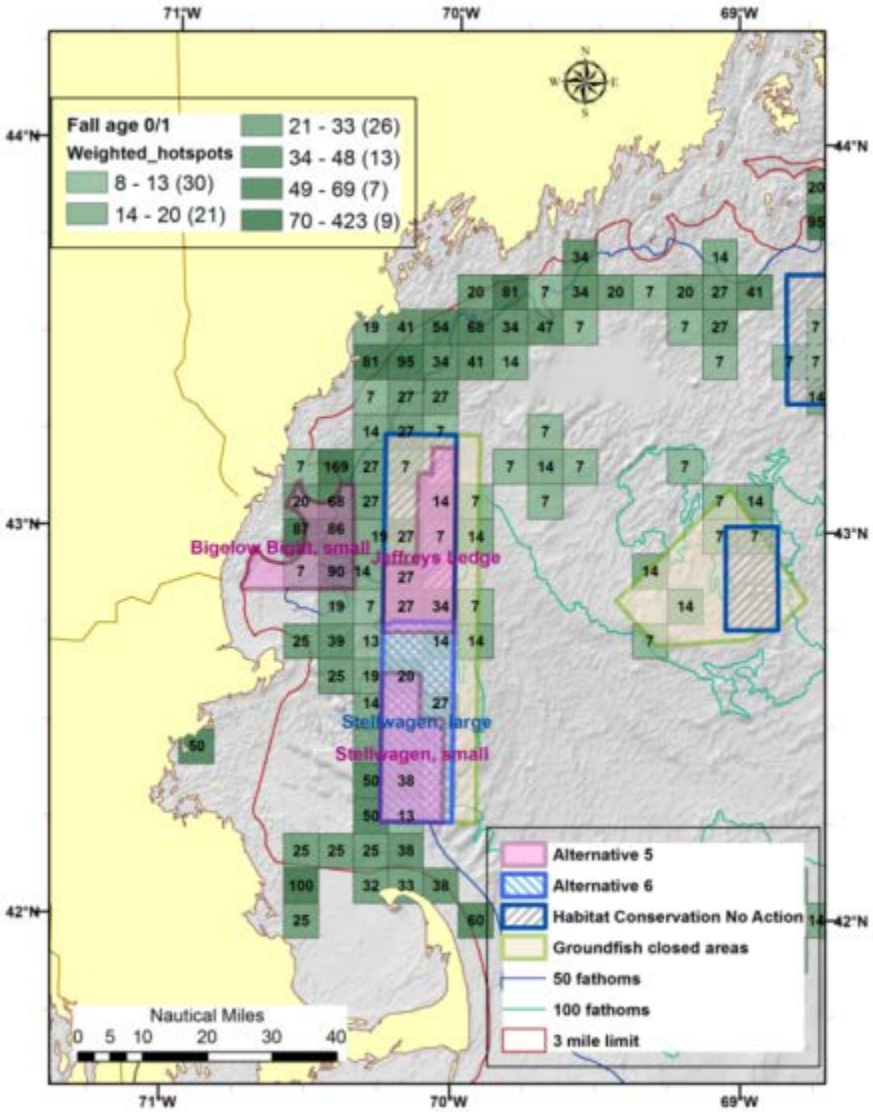


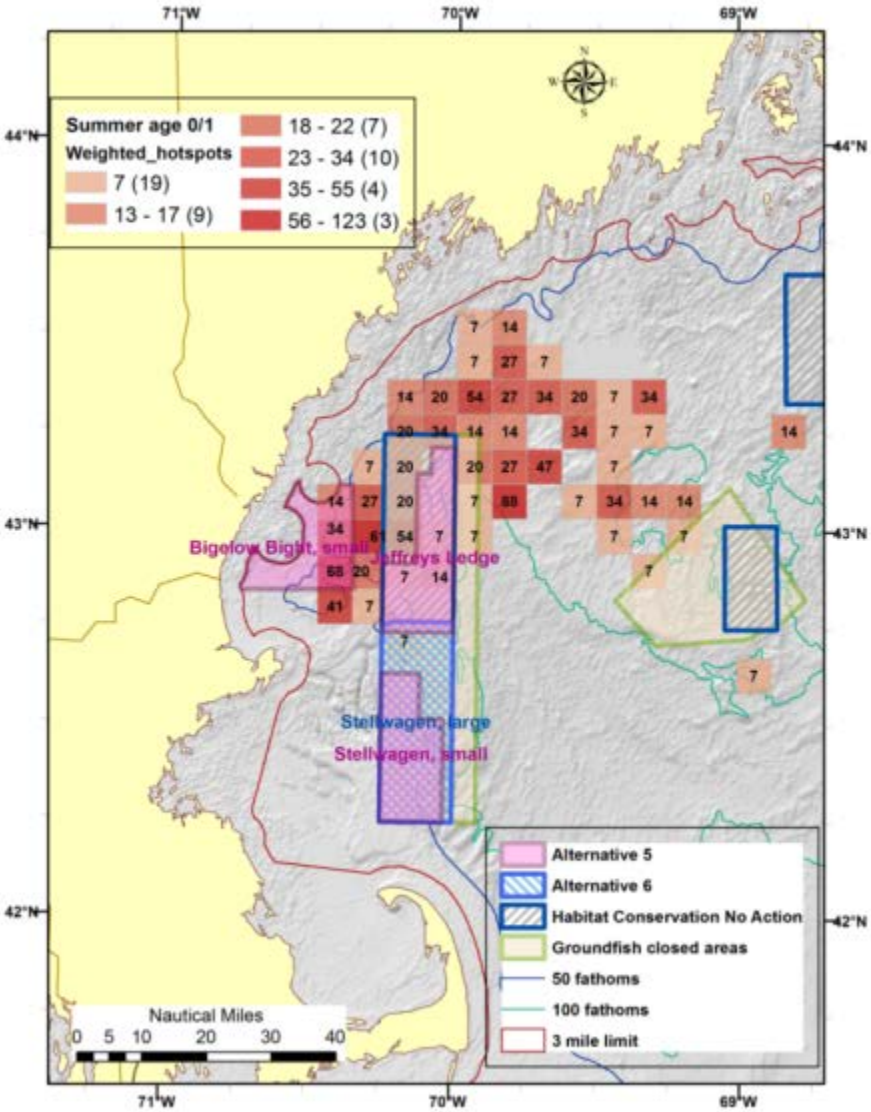

Summer age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Bigelow Bight large
Jeffreys Ledge
Stellwagen large
Stellwagen small
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

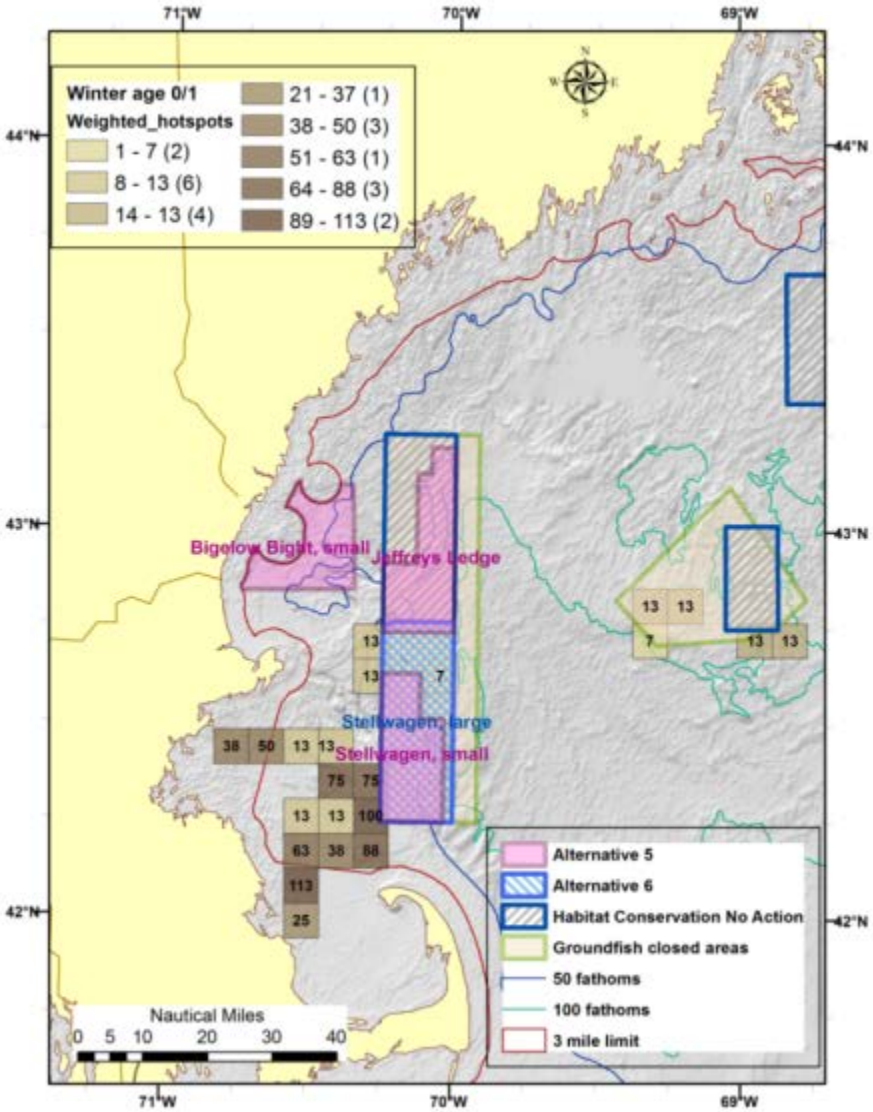

Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Bigelow Bight large
Jeffreys Ledge
Stellwagen large
Stellwagen small
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

Map 60 – WGOM Alternatives 1, 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC, MADMF, ME-NH, and IBS survey data.

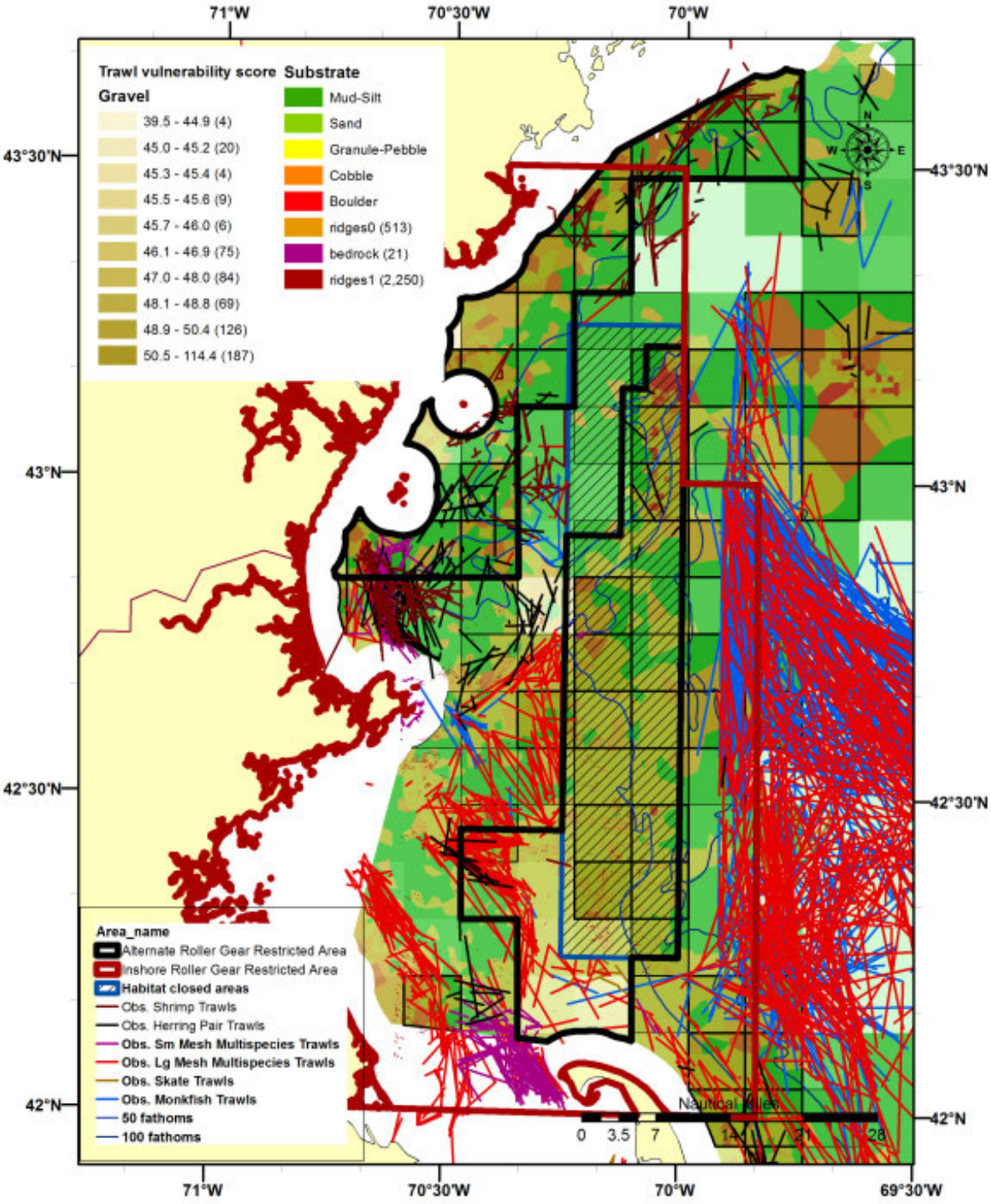




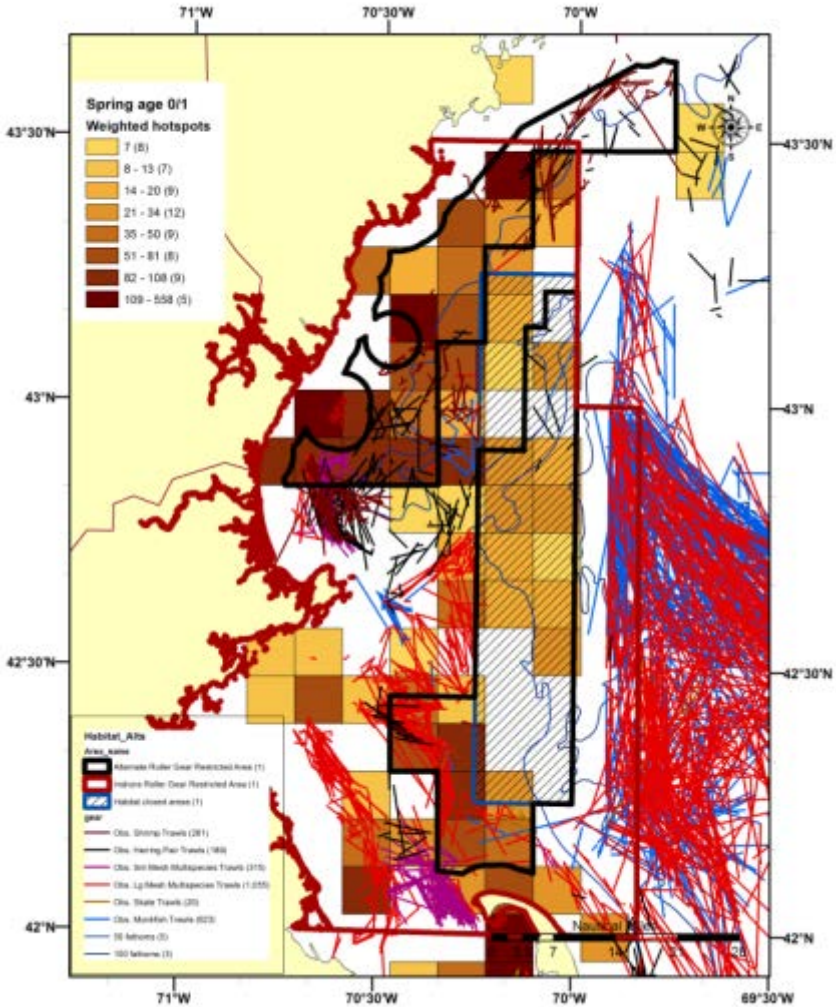

Summer age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Bigelow Bight, small
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 5
Alternative 6
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

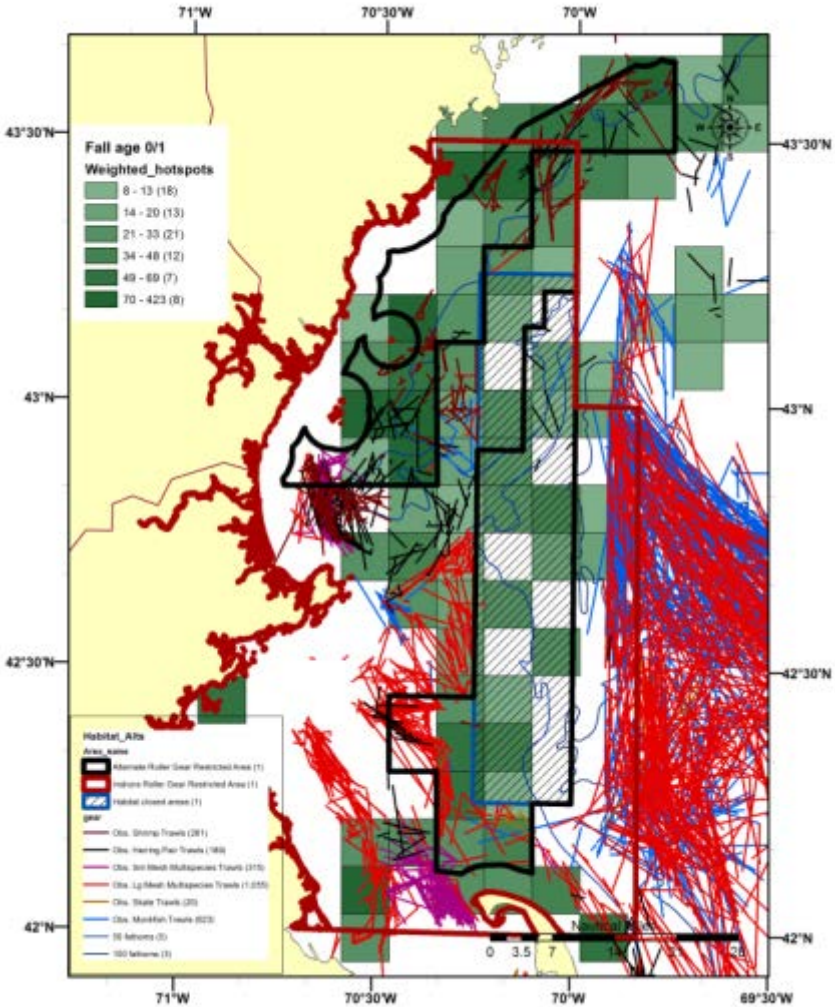

Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Bigelow Bight, small
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 5
Alternative 6
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

Map 61 – Location of observed hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared with outlined 100 km^2 blocks with the 30% of highest trawl vulnerability scores and substrate types in the Western Gulf of Maine sub-region.

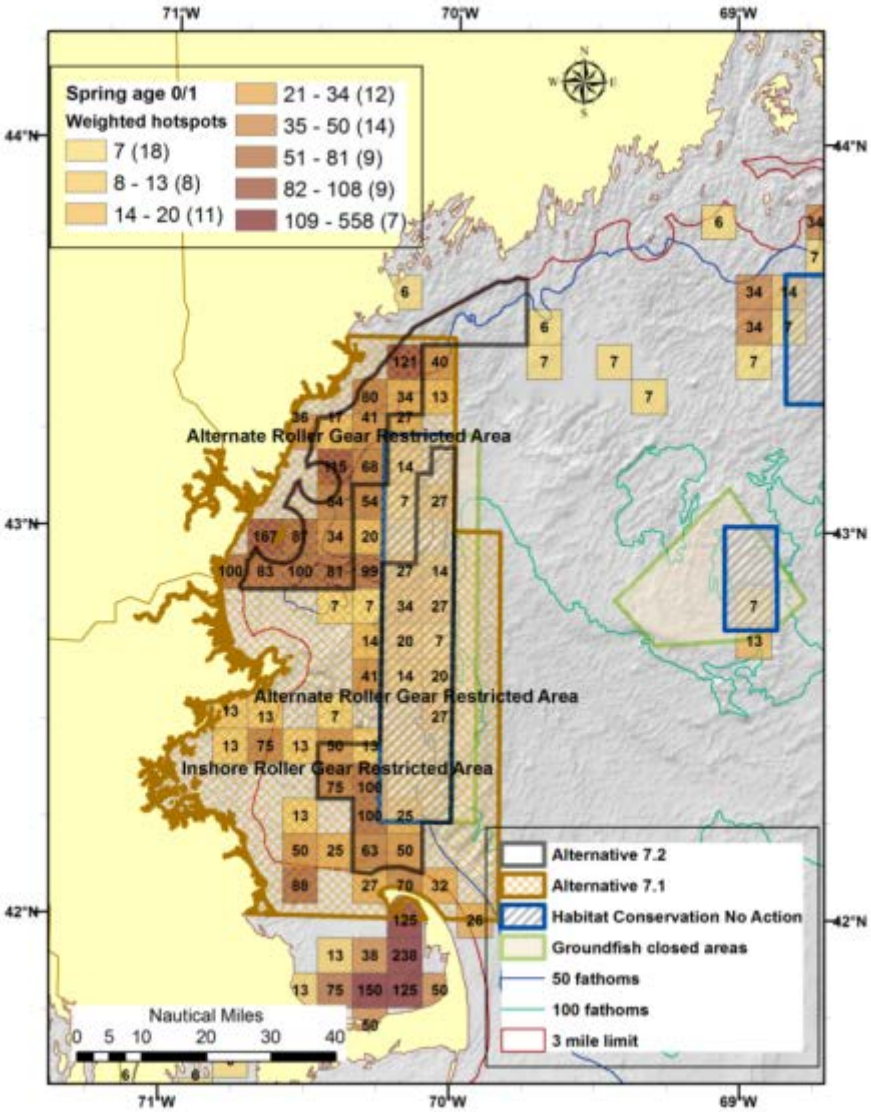


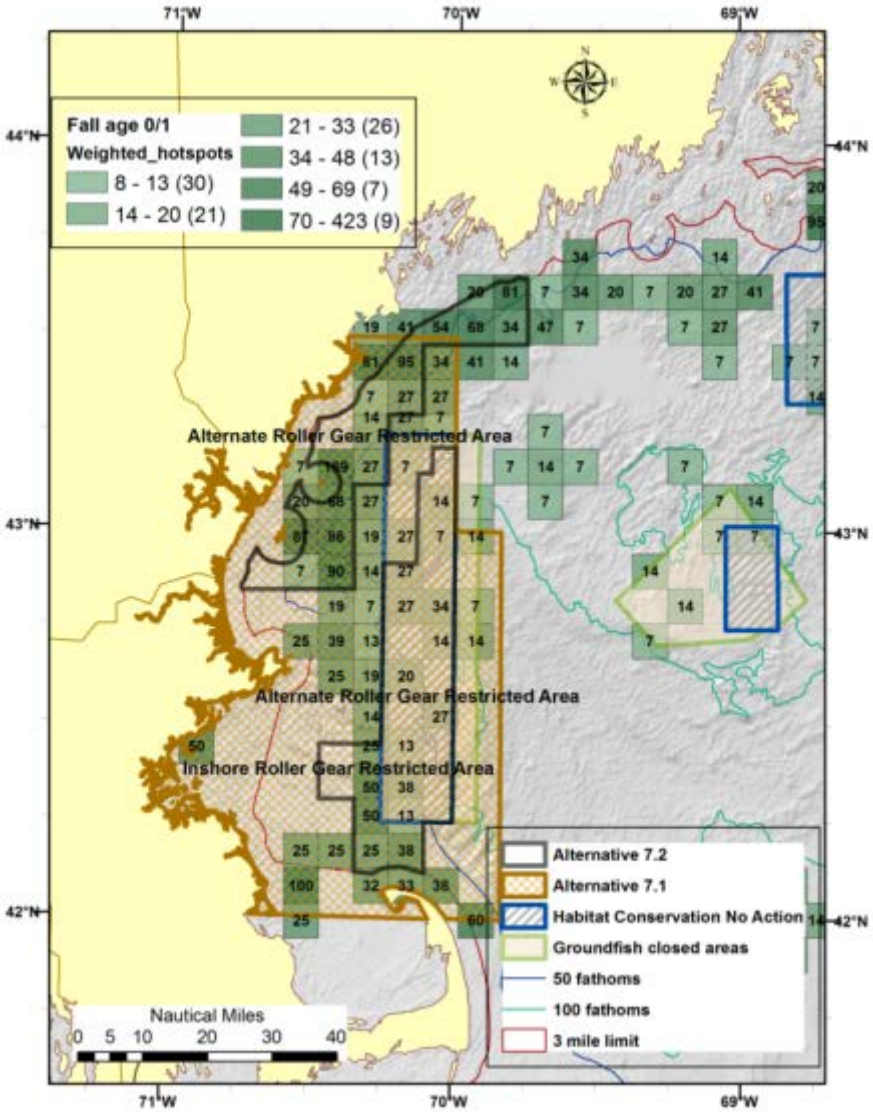
Map 62 – Location of observes hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared spring (left) and fall (right) age 0/1 groundfish hotspots heavily weighted in favor of stocks that are at low biomass and/or associated with coarse and hard substrates.

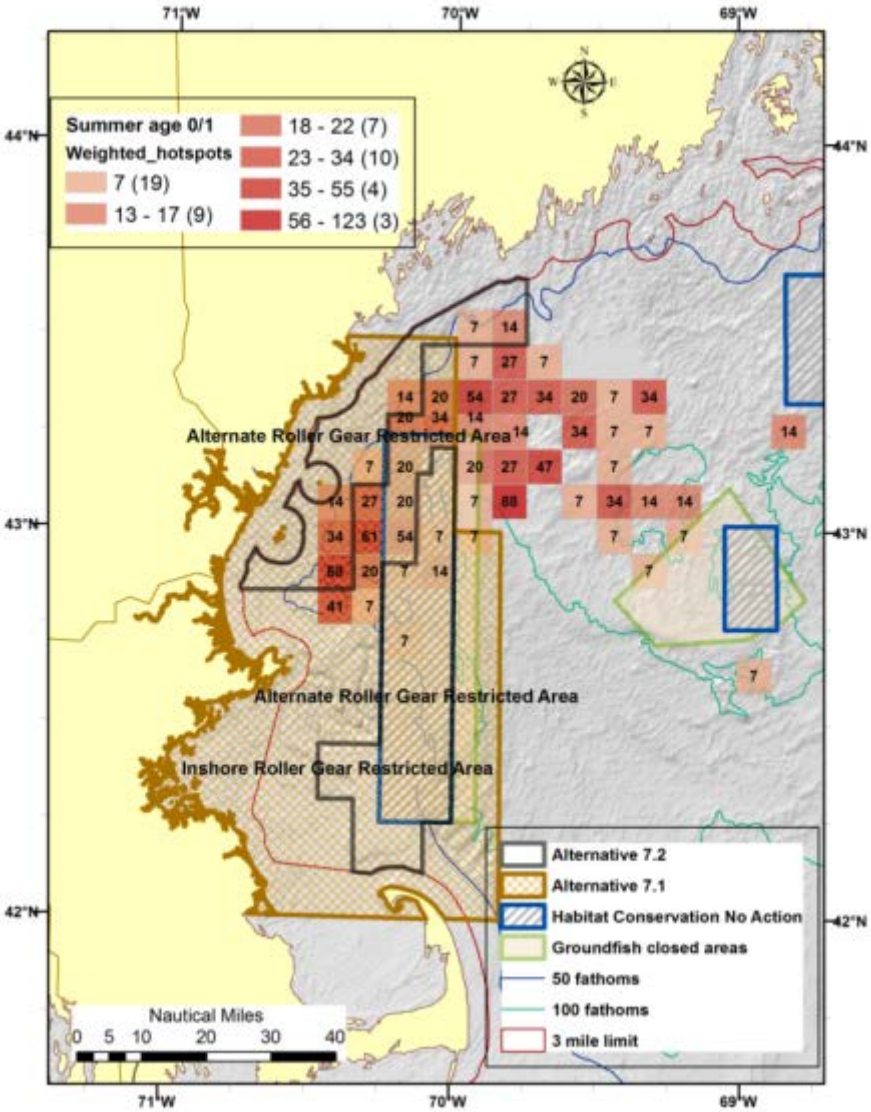


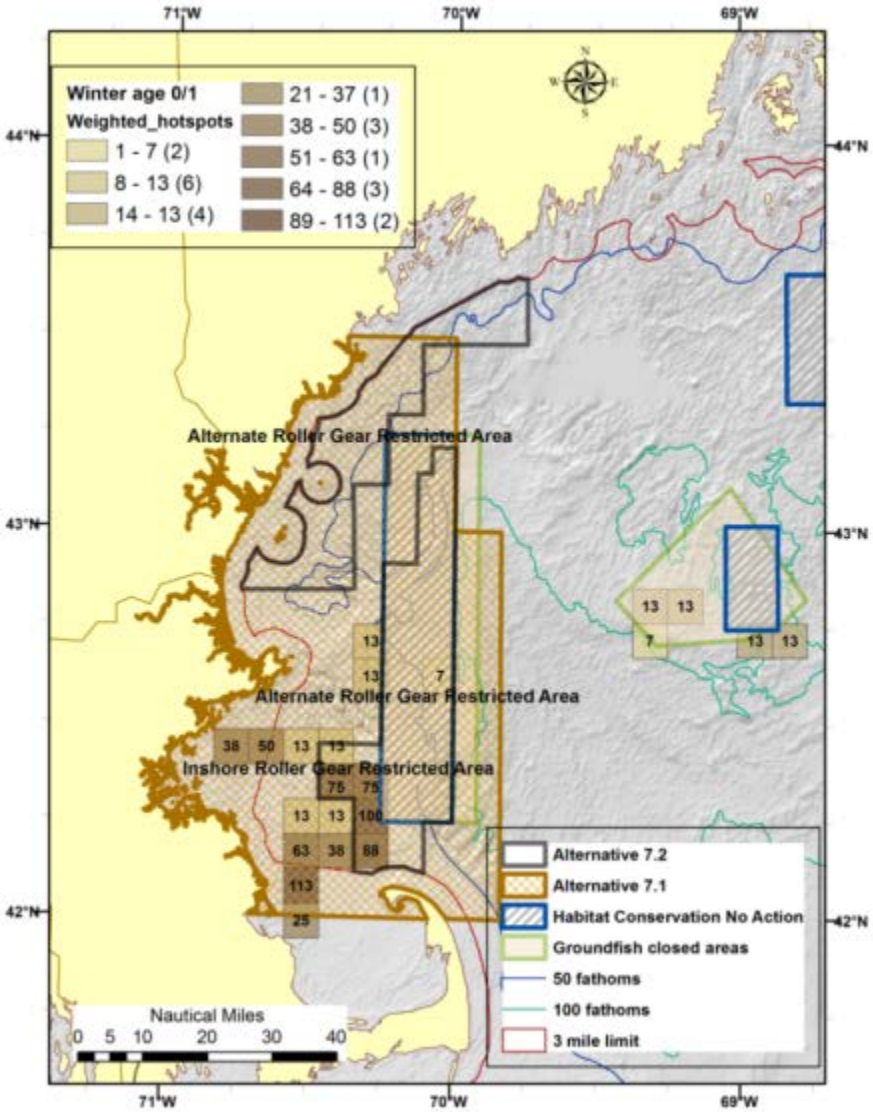


Map 63 – WGOM Alternatives 1, 7A and 7B overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Alternate Roller Gear Restricted Area
Alternate Roller Gear Restricted Area
Inshore Roller Gear Restricted Area
Alternative 7.2
Alternative 7.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Alternate Roller Gear Restricted Area
Alternate Roller Gear Restricted Area
Inshore Roller Gear Restricted Area
Alternative 7.2
Alternative 7.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

4.2.2.6 ***Georges Bank/Southern New England Alternative 1 (No Action)***

Alternative 1/No Action in the Georges Bank/Southern New England Region includes the Closed Area I, II, and Nantucket Lightship Habitat Closure Areas and Groundfish Closed Areas. Table 67 summarizes the seasonal unweighted and weighted age 0/1 groundfish hotspots in these areas, with the distribution of the weighted hotspots shown in Map 64. The main data sources used to identify these hotspots included the spring, fall, and winter NMFS trawl surveys and the summer scallop dredge survey. IBS yellowtail flounder and monkfish surveys were also analyzed, but few to no age 0/1 groundfish hotspots were identified from these data. In general, hotspots from the 2002-2012 survey data were less prevalent on Georges Bank than they were in the Gulf of Maine. This outcome may be caused by generally lower survey CPUE on Georges Bank during this period, more dispersion of age 0/1 fish than occurs in the Gulf of Maine, and/or less variation in catches in this region than in the Gulf of Maine (i.e., the Gulf of Maine had more catches that were significantly above the region-wide mean[15]).

Judging the effects of year-round groundfish closed areas and habitat closures on Georges Bank is more complicated than it is in the Gulf of Maine. While the fishing regulations in the habitat closures are the same as they are elsewhere (no fishing with mobile bottom-tending gear), there are a variety of dredge and trawl special access programs that apply to portions of the groundfish closed areas that do not overlap the habitat closures. These include haddock and yellowtail flounder special access programs and scallop access areas in Closed Area I and Closed Area II. Other than a separator panel that is unlikely to have a positive or negative habitat effect, the SAP and access areas are essentially open to fishing with mobile bottom-tending gear. While there are some seasonal restrictions associated with these programs, seasonal restrictions do not have a substantial positive effect on habitat, although they may influence the amount of discards and spawning fish caught by these fisheries.

The most important groundfish habitat protection is associated with the habitat closures; in particular the Closed Area II Habitat Closure and the northern and southern habitat closures in Closed Area I. Total weighted hotspots in the habitat closures were 11.5 in the fall survey and zero during the other survey seasons (Table 67). The total weighted hotspots in the year-round groundfish closed areas were 63.3 in the spring, 195.5 in the summer, 46.0 in the fall, and 0.0 in the winter surveys. A considerable majority of hotspots in the summer were from age 0/1 haddock hotspots in the southern portion of Closed Area II (Map 64), which has been open to both scallop dredge and groundfish trawl fishing in respective access programs.

Juvenile cod are scattered across eastern Georges Bank, with some concentration on the northern edge, from the Closed Area II Habitat Closure into Canadian waters (Map 66). Although there were few cod hotspots in general, and none outside the habitat closure, the rest of Closed Area II appears to provide some protection to areas where juvenile cod were caught by spring and summer surveys. It is not apparent, however, that Closed Area II (groundfish closure) is

[15] The Council's Closed Area Technical Team conducted some Georges Bank-only hotspot analyses to test the hypothesis that the catches were lower or had a different spatial autocorrelation, but few hotspots were identified by those sensitivity analyses. This led to the conclusion that the sparseness of age 0/1 hotspots was more due to less variation and more dispersion (i.e. less concentration) of age 0/1 catches in the survey tows on Georges Bank.

protecting critical cod habitat, except possibly for the northern edge and the northern portion of the habitat closure. In the fall surveys, it appears that the juvenile cod have left the shallower portions of the bank including most of Closed Area II, except for some age 0/1 and larger sub-legal cod along the northern edge into Canada.

In contrast, age 0/1 and larger sub-legal haddock are distributed across broad regions of eastern Georges Bank during the spring and summer surveys (Map 67, left). Age 0/1 and larger sub-legal haddock appear to be well mixed in the shallower areas of the bank and along the northern edge of the bank, from well west of the Closed Area II Habitat Closure to areas in Canadian waters. During the spring, Closed Area II appears to provide protection for a substantial fraction of the juvenile haddock on eastern Georges Bank given the numbers and distribution of hotspots, which indicate clusters of high catches and potential preferred habitat. Due to the minimal and temporary effects of fishing in sandy areas, this habitat does not appear to be as vulnerable to fishing effects as coarser and harder substrates found elsewhere.

In the fall and winter, juvenile haddock, particularly the older juveniles, appear to move into deeper water around the perimeter of Georges Bank. Age 0/1 haddock appear to remain in shallower water on Georges Bank compared to older sub-legal haddock (Map 67, right). Both cohorts of haddock seem to take up residence in deeper waters of the Closed Area II Habitat Closure, and this is where age 0/1 haddock hotspots occur. Even though there were few age 0/1 hotspots identified on the U.S. portion of Georges Bank, there were a substantial number of unweighted and weighted hotspots on the northern edge, mostly in Canadian waters and partially in U.S. waters (Map 64).

Impacts on groundfish habitat and groundfish populations from Alternative 1/No Action are likely to be beneficial to species inhabiting coarse and hard substrates in the habitat closures, but limited habitat benefits are generated by the other portions of the year-round groundfish closed areas, partly mitigated by access program fishing. For juvenile groundfish such as haddock, winter flounder, and yellowtail flounder that depend on sandy habitats (including prey species such as polychaetes embedded in sand substrates of Georges Bank), direct impacts of fishing (even considering the effect as temporary due to high wave energy and currents) would likely have more influence on these stocks than protecting vulnerable substrate elsewhere would have on them. In other words, these stocks would not benefit as much from protection of vulnerable substrates located elsewhere, and may in fact experience negative impacts due to displacement.

<u>Based on the above analysis and the analyses in Multispecies Framework Adjustment 48 that suggest positive impacts of closed areas on haddock and winter flounder, plus the potential benefit realized by the fishery fishing along the margins of closed areas (particularly on the western edge of Closed Area II), the No Action alternative has a highly positive impact of on the groundfish resource</u>. <u>Because a fairly large fraction of these areas are comprised of mobile sediments and these areas are open to special access program fishing, the impact of the No Action alternative on age 0/1 groundfish habitats is slightly positive.</u>

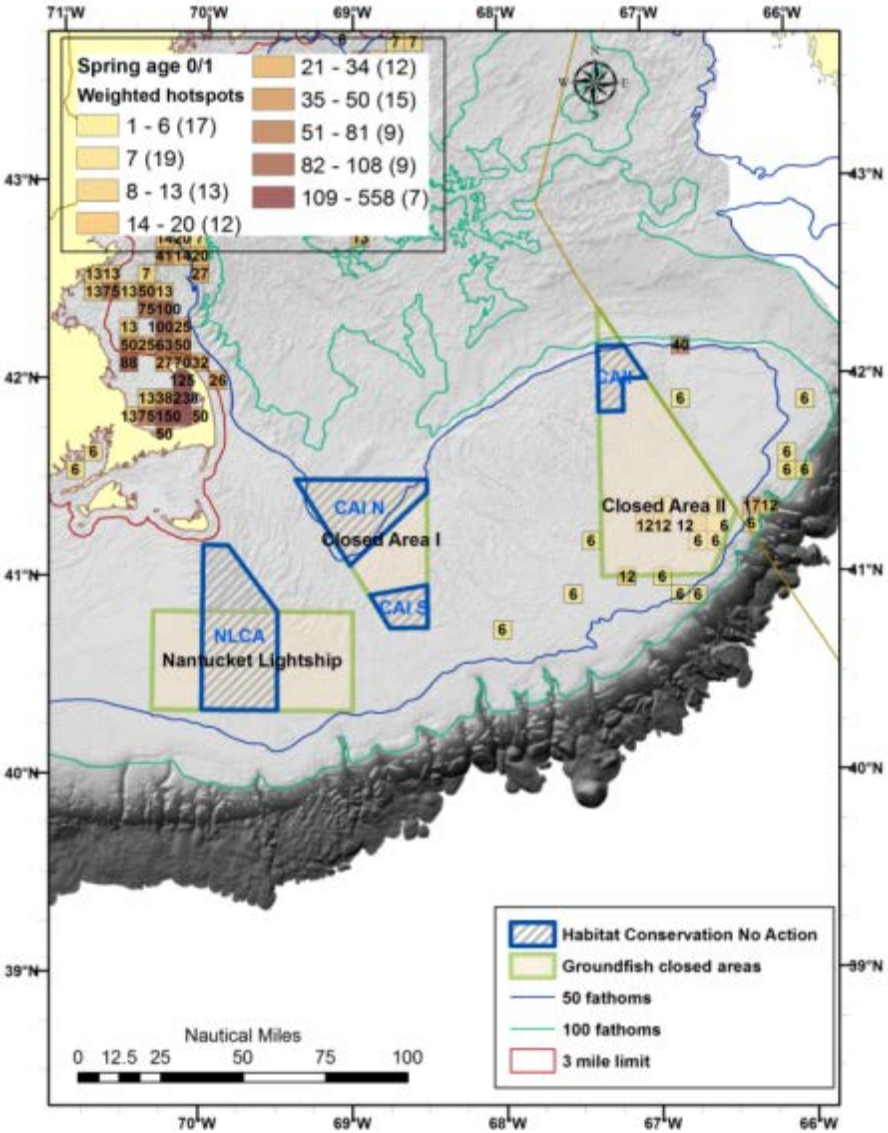
In the Georges Bank/Southern New England region, Alternative 1/No Action is expected to have positive impacts on spawning groundfish via Closed Areas I and II and the Nantucket Lightship Closed Area, which include broad restrictions on gears capable of catching groundfish. Most of

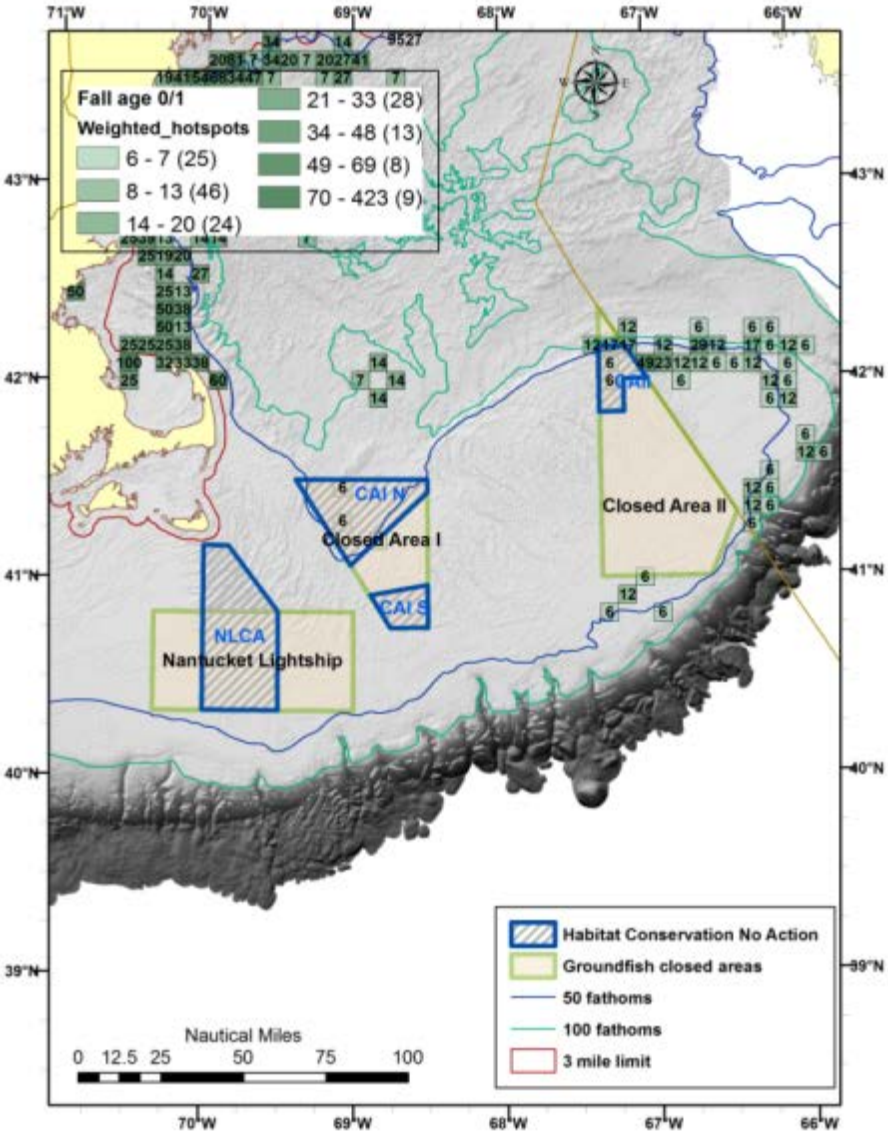
the overlap with large spawner hotspots in this region occurs in Closed Area II, and there are few hotspots in Closed Area I and the Nantucket Lightship Closed Area. Given that the existing habitat closures are mostly within the boundaries of the groundfish closures, the habitat closure elements of the No Action alternatives do not really afford any additional groundfish spawning benefits beyond those provided by the groundfish closures. The spawning benefits associated with these areas are discussed more fully in the analysis of the spawning alternatives on large mesh groundfish.

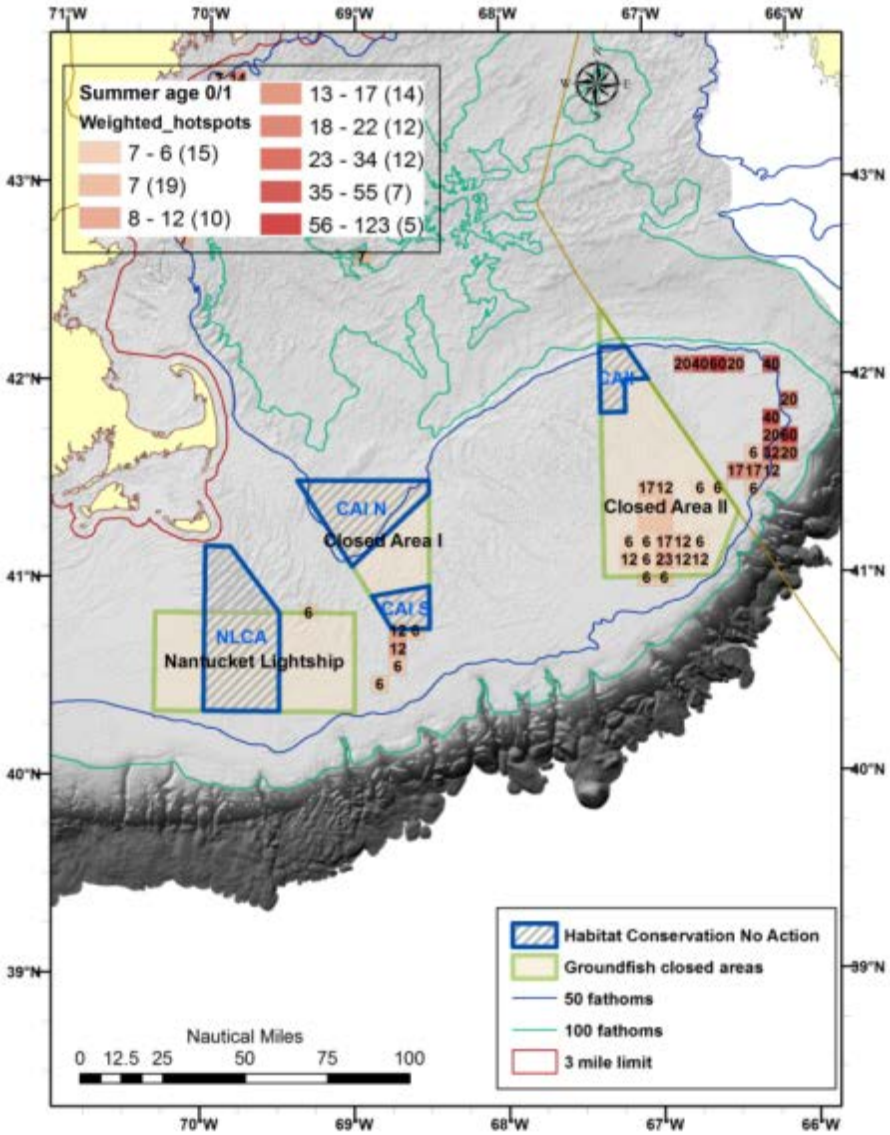
Table 67 – Total unweighted and weighted hotspots in habitat closures and year round groundfish closures in the Georges Bank and Southern New England region.

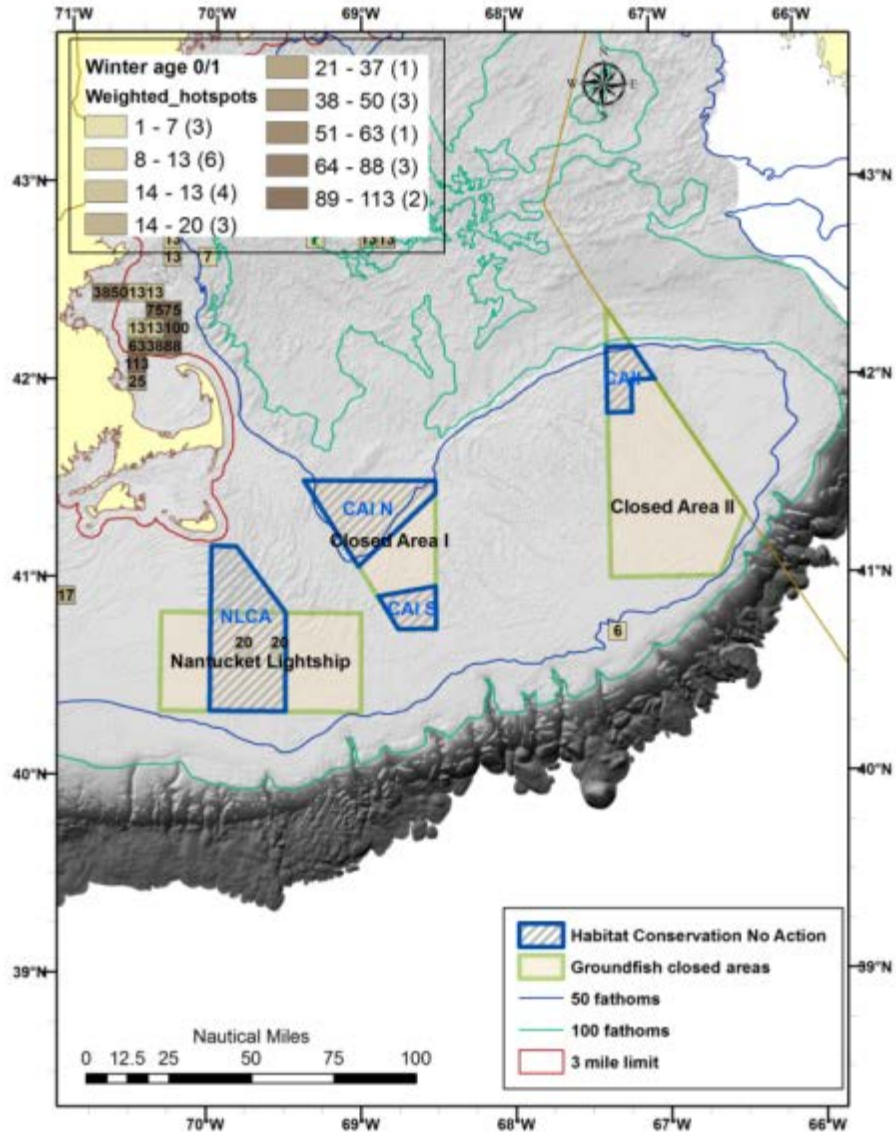
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank/Southern New England								
EFH closure								
Closed Area I N Habitat Closure	0	0.0	0	0.0	10	11.5	0	0.0
Closed Area II Habitat Closure	0	0.0	5	0.0	4	11.5	0	0.0
Nantucket Lightship Habitat Closure	10	0.0	54	0.0	0	0.0	2	40.2
Groundfish closure								
Closed Area II	11	63.3	39	195.5	16	28.8	0	0.0
Closed Area I	0	0.0	0	0.0	35	17.3	0	0.0
Nantucket Lightship Closed Area	16	0.0	79	5.8	1	0.0	4	40.2

Map 64 – Georges Bank Alternative 1 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC trawl and summer dredge survey data.






Summer age 0/1
Weighted_hotspots
7 - 6 (15)
7 (19)
8 - 12 (10)
13 - 17 (14)
18 - 22 (12)
23 - 34 (12)
35 - 55 (7)
56 - 123 (5)
CAI N
Closed Area I
CAI S
Closed Area II
NLCA
Nantucket Lightship
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100


Winter age 0/1
Weighted_hotspots
1 - 7 (3)
8 - 13 (6)
14 - 13 (4)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
CAI N
Closed Area I
CAI S
Closed Area II
NLCA
Nantucket Lightship
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100

4.2.2.7 ***Georges Bank***

No preferred alternatives have been identified for the Georges Bank sub-region.

4.2.2.7.1 Alternative 2 (No Habitat Management Areas)

Alternative 2 proposes no habitat management areas for the Georges Bank sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have negative impacts for groundfish stocks as compared to Alternative 1/No Action, or any of the other alternatives. It is expected to have highly negative impacts on juvenile groundfish habitat compared to Alternative 1/No Action and other alternatives in this section, and could reduce groundfish productivity.

This alternative is expected to have negative impacts on groundfish spawning via removal of the year round groundfish closures (Closed Area I, and particularly Closed Area II). However, the spawning alternatives for this region mitigate these impacts for stocks that spawn during February, March, and early April, when the areas would remain as spawning closures under either of the action spawning alternatives for this region. The No Action alternative for spawning protection in this region would maintain the areas year round. If an action spawning alternative is selected, the primary impacts of removing the Closed Area I and II habitat and groundfish closures would be on stocks that spawn outside the February to April window. Thus, depending on the spawning alternative selected, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning.

4.2.2.7.2 Alternative 3

Alternative 3 includes the Northern Edge HMA, which largely overlaps the existing Closed Area II Habitat Closure but extends into slightly deeper water on the northern edge. The total number of weighted age 0/1 groundfish hotspots was 34.5 in the fall and zero in other survey seasons (Table 68).

Based on these weighted hotspots, this alternative would have moderately negative effects on groundfish habitat relative to that for Alternative 1/No Action. The amount of protection of habitat for age 0/1 and larger sub-legal cod is about the same as No Action (Map 66), but the protection of habitats where age 0/1 haddock are present is considerably less than Alternative 1/No Action, with one important caveat is that the areas where age 0/1 haddock are abundant (Map 67) and where hotspots occur (Table 69) are already fished by both multispecies trawl and scallop dredge access programs. Haddock and red hake hotspots (Table 69) are present in the proposed Northern Edge HMA. The impacts on age 0/1 juvenile groundfish habitat are likely to be positive relative to Alternatives 2, 5, 6A, 6B, and 7, but slightly negative relative to Alternative 8.

Similar to Alternative 2, depending on the spawning alternative selected for the Georges Bank region, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning. Mobile bottom-tending gear restrictions in the Northern Edge HMA would likely afford a slightly positive spawning benefit if Option 1 or 2 is selected. While fixed gears capable of catching groundfish would be allowed in the area,

gillnet use on the northern edge of Georges Bank is fairly limited, and contributes a very small fraction of overall revenues in the currently open portions of the HMA. Longline gear appears to be more frequently used in the currently open portions of the HMA, based on the distribution of revenue by gear type. If longline use expands in the HMA if the Closed Area II groundfish closure is removed, this could reduce any positive benefits of the Northern Edge HMA on spawning groundfish. If management options 3 or 4 are selected, the HMA would not afford any spawning protection benefits.

4.2.2.7.3 Alternative 4

Alternative 4 includes the same Northern Edge HMA as Alternative 3, but also includes a Georges Shoal Gear Modification Area (GMA). While any level of habitat management measures could apply to the Northern Edge area, only limits on ground cables would apply in the Georges Shoal GMA, which is entirely outside and west of Closed Area II and the existing habitat closure area.

The total weighted hotspots for Alternative 4 are the same as Alternative 3 (Table 68), with slightly more red hake hotspots (Table 69). Weighted and species hotspots are also considerably fewer than those for Alternative 1/No Action. The expected impacts on groundfish habitat and groundfish stocks are therefore moderately negative compared to Alternative 1/No Action, and about the same as Alternative 3, based on the number of weighted hotspots and on the expected effect of gear modifications (Section 4.1.3.1.5). The impacts on age 0/1 juvenile groundfish habitat from this alternative are likely to be positive relative to Alternatives 2, 5, 6A, 6B, and 7, but slightly negative compared to Alternative 8.

Alternative 4 is expected to have the same benefits on groundfish spawning as Alternative 3, given that the additional gear modification area included in the alternative would not prohibit the use of any gear types capable of catching groundfish.

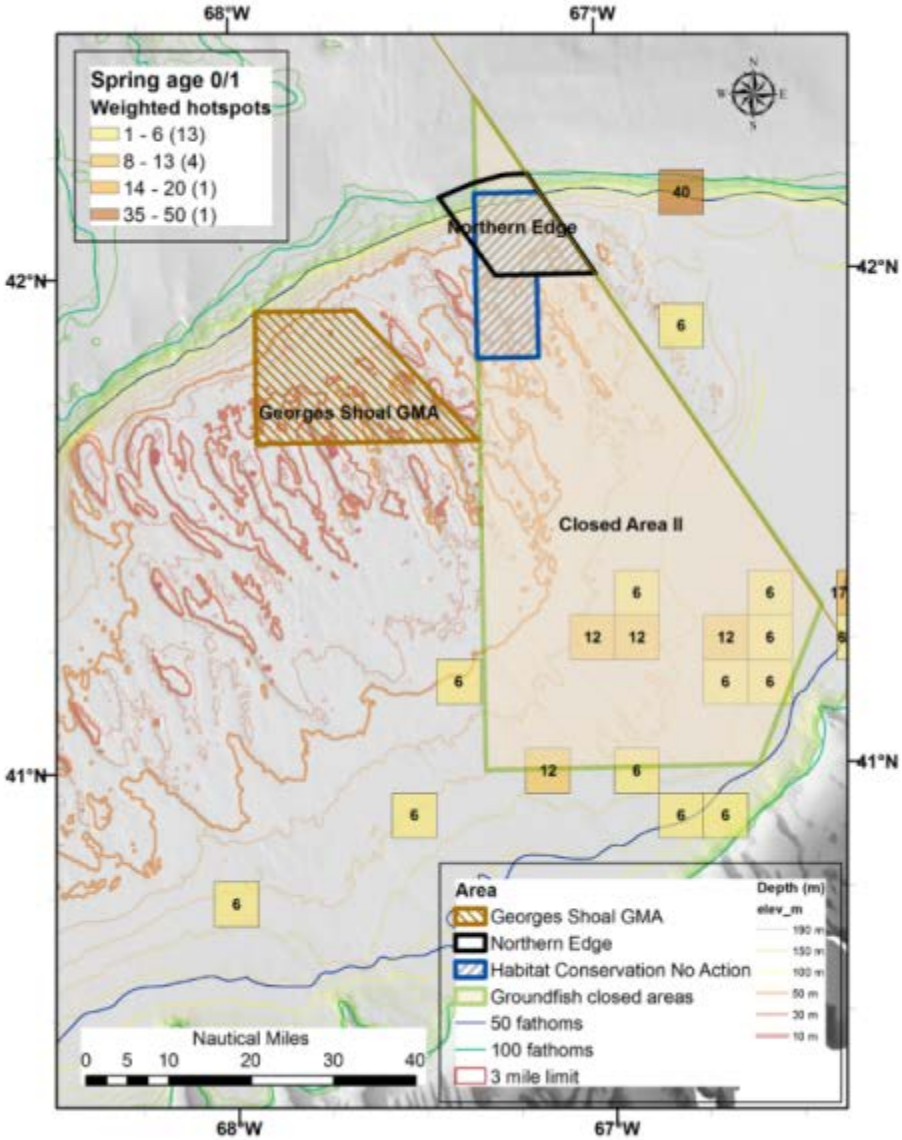
Table 68 – Total unweighted and weighted hotspots in GB habitat management area alternatives compared to No Action.

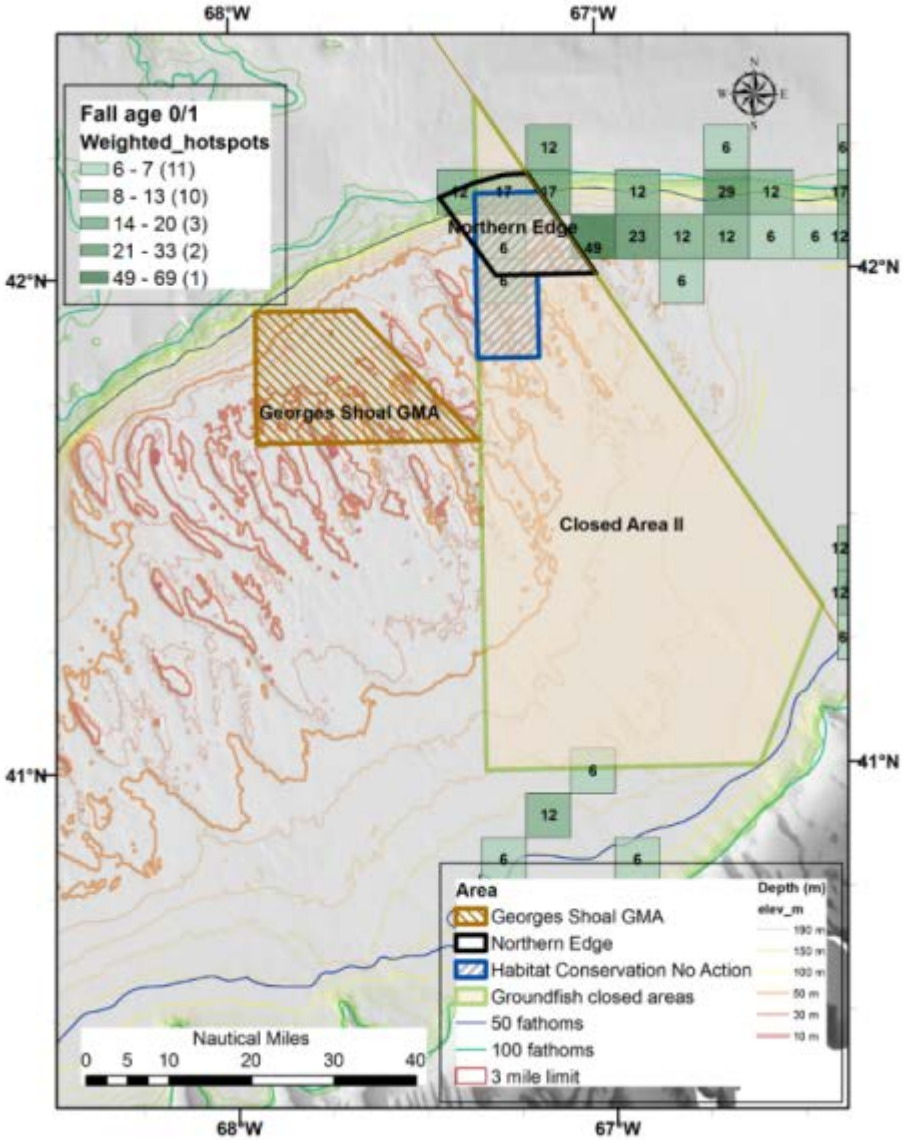
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank								
No Action	**11**	**63.3**	**39**	**195.5**	**51**	**46.0**	**0**	**0.0**
EFH closure	0	0.0	5	0.0	14	23.0	0	0.0
GF closure	11	63.3	39	195.5	51	46.0	0	0.0
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	0	0.0	0	0.0	8	34.5	0	0.0
Alternative 4	0	0.0	1	0.0	12	34.5	0	0.0
Alternative 5	6	0.0	15	0.0	33	11.5	0	0.0
Alternative 6.1	0	0.0	13	0.0	12	11.5	0	0.0
Alternative 6.2	0	0.0	13	0.0	10	5.8	0	0.0
Alternative 7	0	0.0	1	0.0	1	0.0	0	0.0
Alternative 8	6	0.0	15	0.0	35	40.3	0	0.0

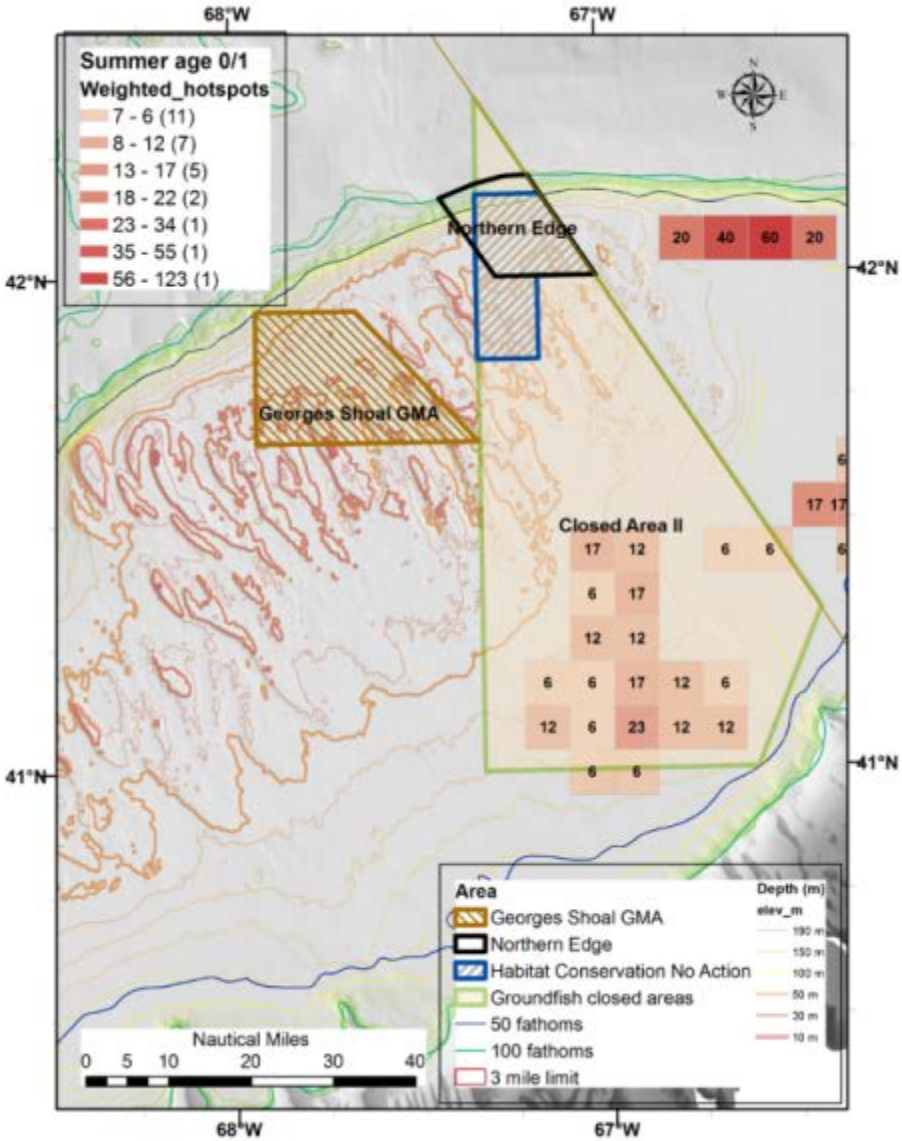
Table 69 – Total hotspots by species for GB habitat management area alternatives, compared to No Action.

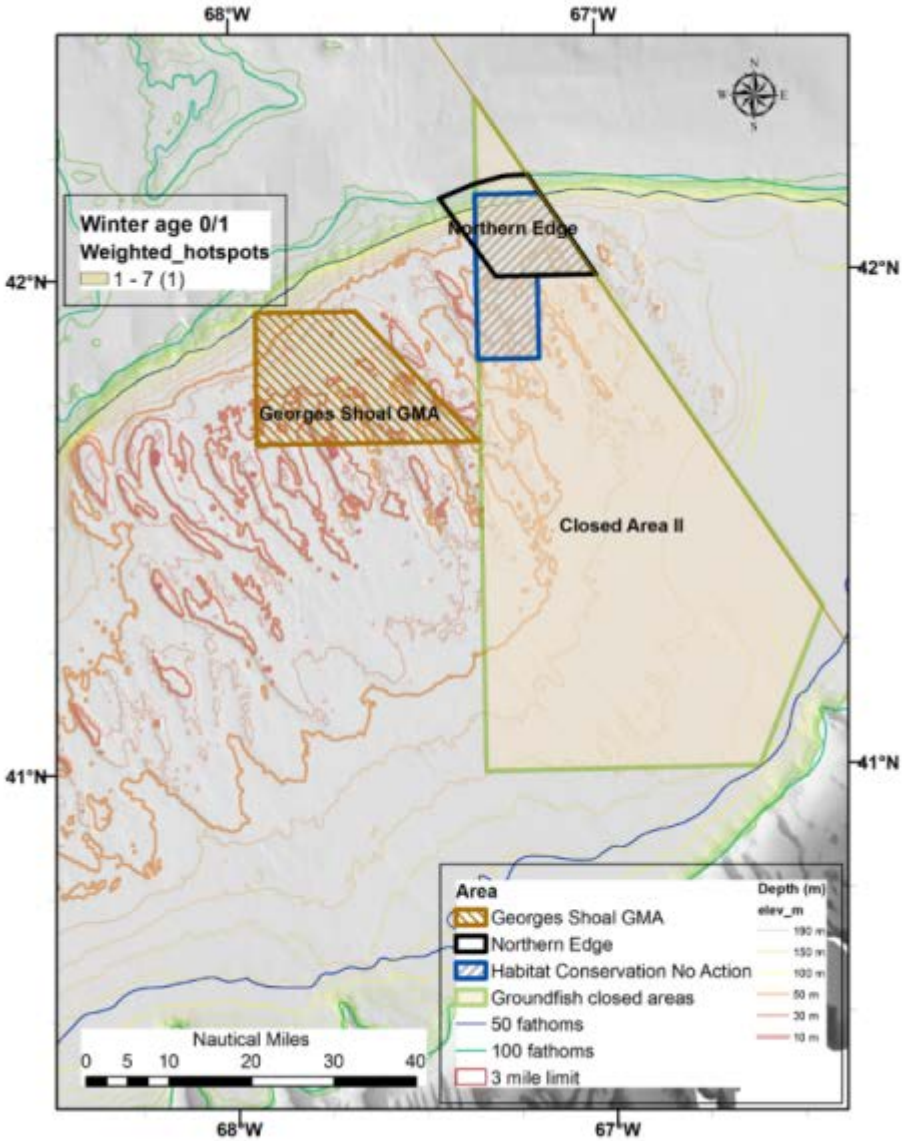
	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Georges Bank																		
Alternative 1 (No Action)	0	0	2	0	0	0	0	57	0	0	42	8	0	1	10	0	0	120
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	0	0	0	0	0	0	0	6	0	0	2	0	0	0	0	0	0	8
Alternative 4	0	0	0	0	0	0	0	6	0	0	6	0	0	0	0	0	1	13
Alternative 5	0	0	0	0	0	0	0	2	0	0	34	1	0	2	14	0	1	54
Alternative 6.1	0	0	0	0	0	0	0	2	0	0	9	0	0	1	13	0	0	25
Alternative 6.2	0	0	0	0	0	0	0	1	0	0	8	0	0	1	13	0	0	23
Alternative 7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
Alternative 8	0	0	0	0	0	0	0	7	0	0	32	0	0	2	14	0	1	56

Map 65 – Georges Bank Alternatives 1, 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NEFSC trawl and summer dredge survey data. Alternative 3 includes the Northern Edge only, while Alternative 4 includes both the Northern Edge and the Georges Shoal GMA.



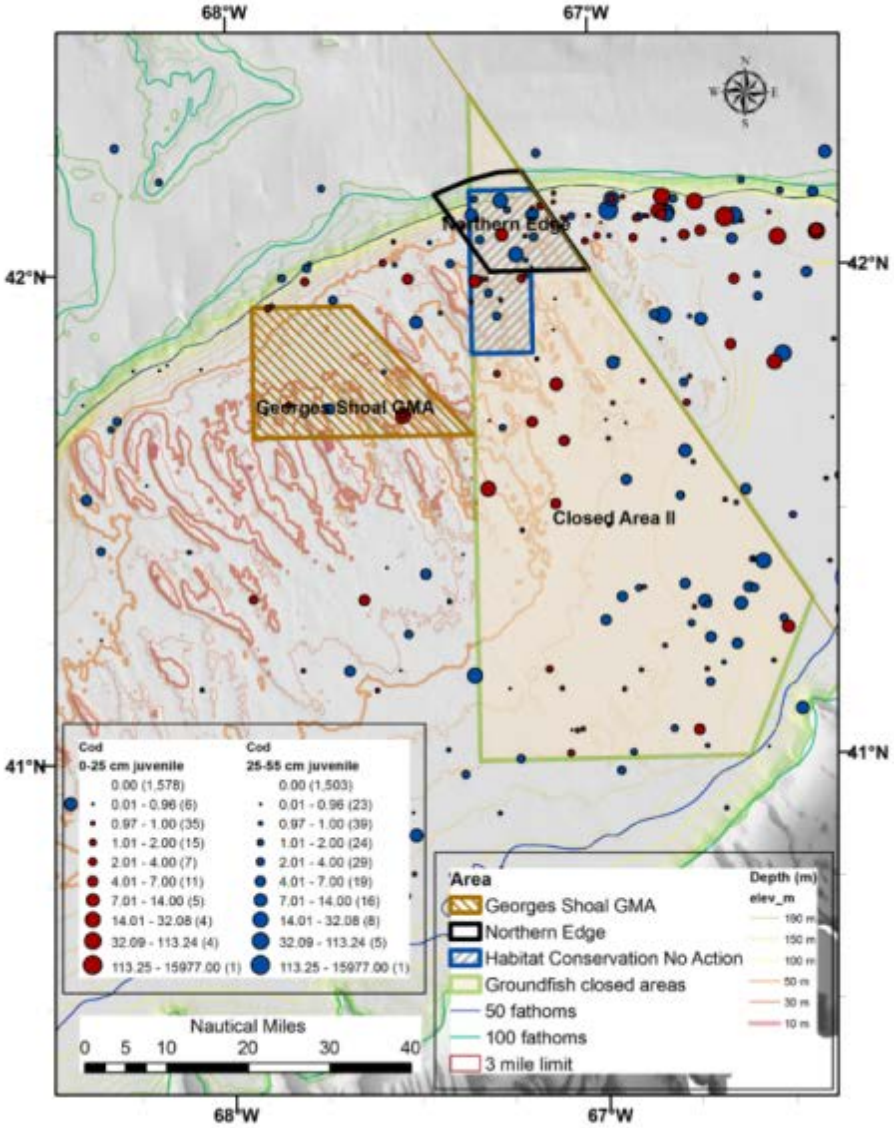



Summer age 0/1
Weighted_hotspots
7 - 6 (11)
8 - 12 (7)
13 - 17 (5)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
68°W
67°W
42°N
41°N
Northern Edge
Georges Shoal GMA
Closed Area II
Area
Georges Shoal GMA
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

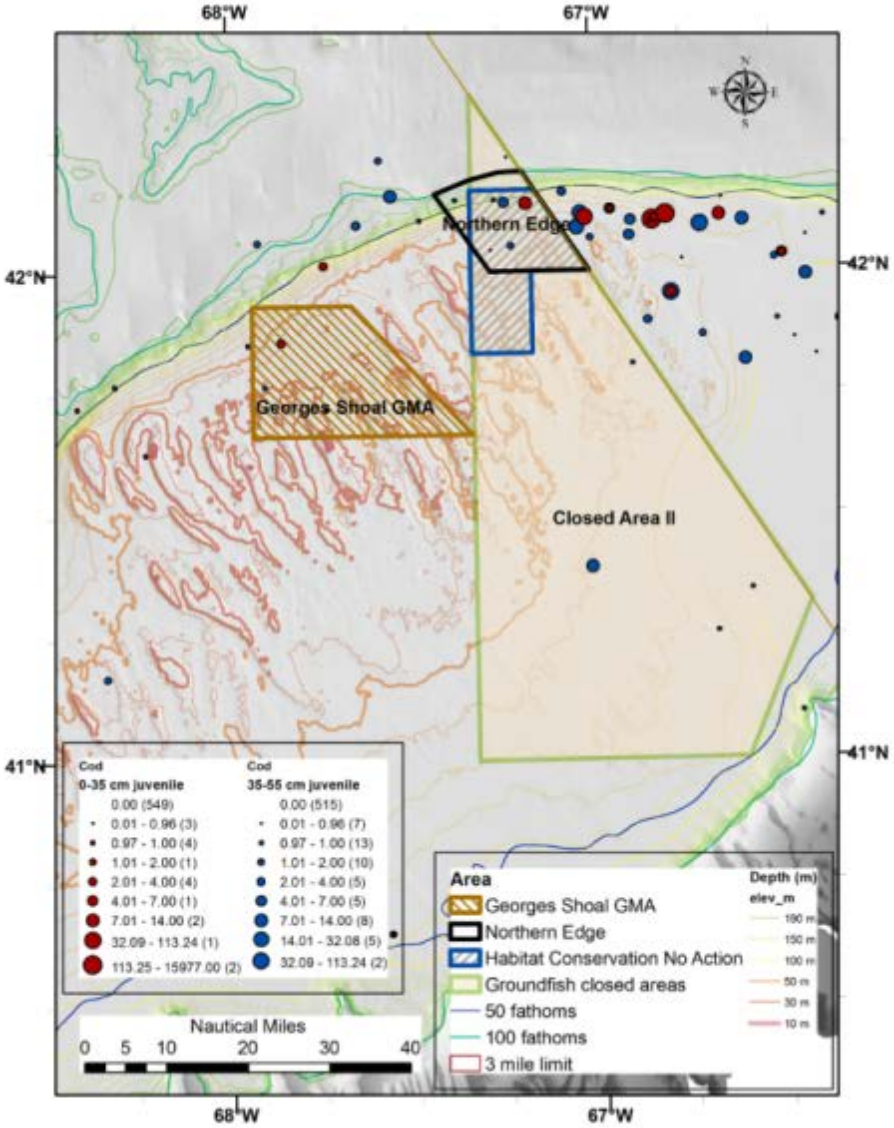

Winter age 0/1
Weighted_hotspots
1 - 7 (1)
68°W
67°W
42°N
41°N
Northern Edge
Georges Shoal GMA
Closed Area II
Area
Georges Shoal GMA
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

Map 66 – Overlap of GB Alternatives 1, 3 and 4 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

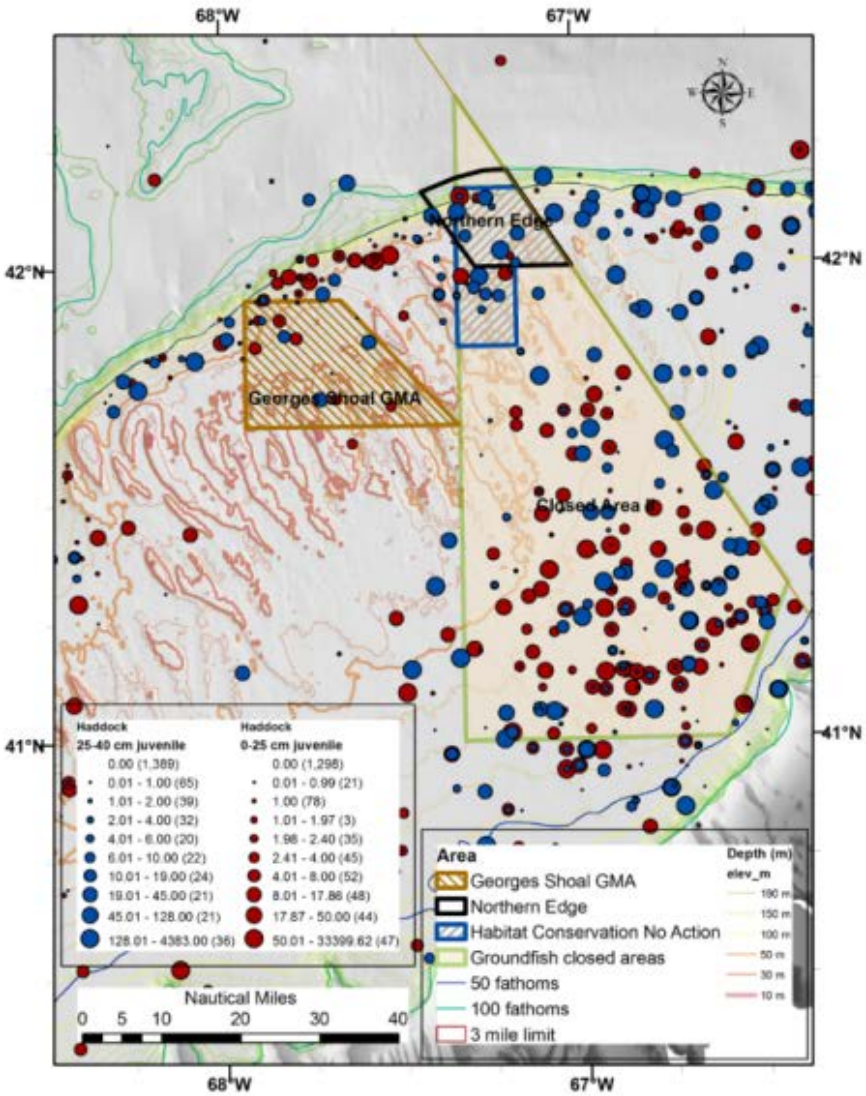


Fall and winter

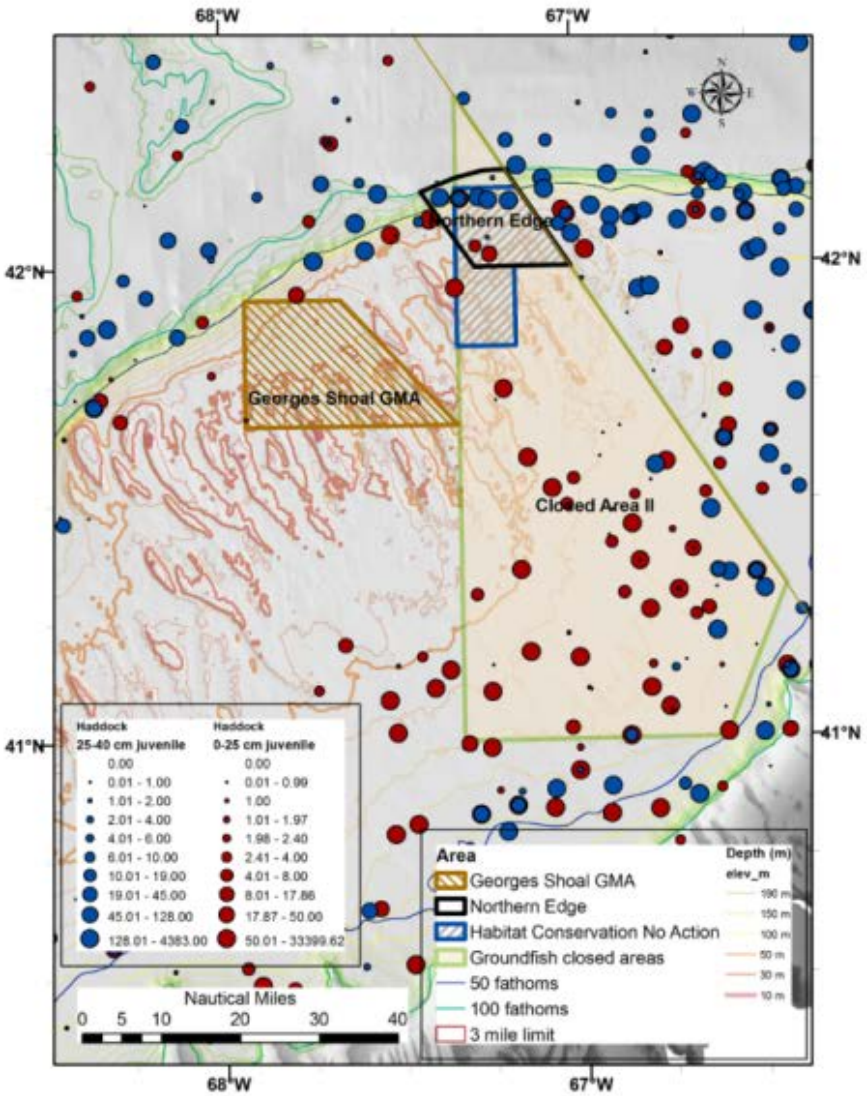


Map 67 – Overlap of GB Alternatives 1, 3 and 4 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer



Fall and winter



4.2.2.7.4 Alternative 5

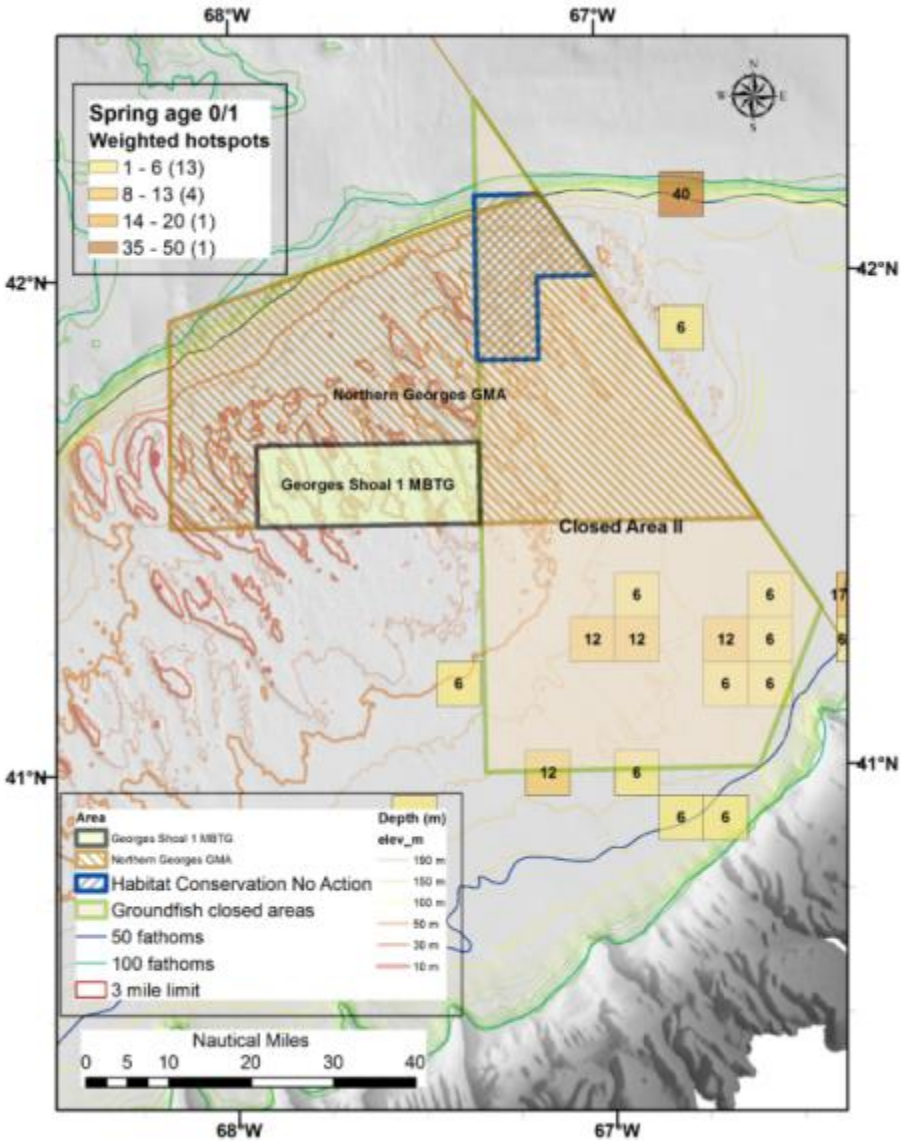
Alternative 5 includes a much larger Northern Georges GMA, which overlap the Closed Area II Habitat Closure, the northern portion of Closed Area II, and the Northern Edge HMA, and the Georges Shoal 1 mobile bottom-tending gear closure area (Map 68). These areas together contain fewer weighted age 0/1 groundfish hotspots than any other alternative except Alternative 2 which includes no habitat management areas.

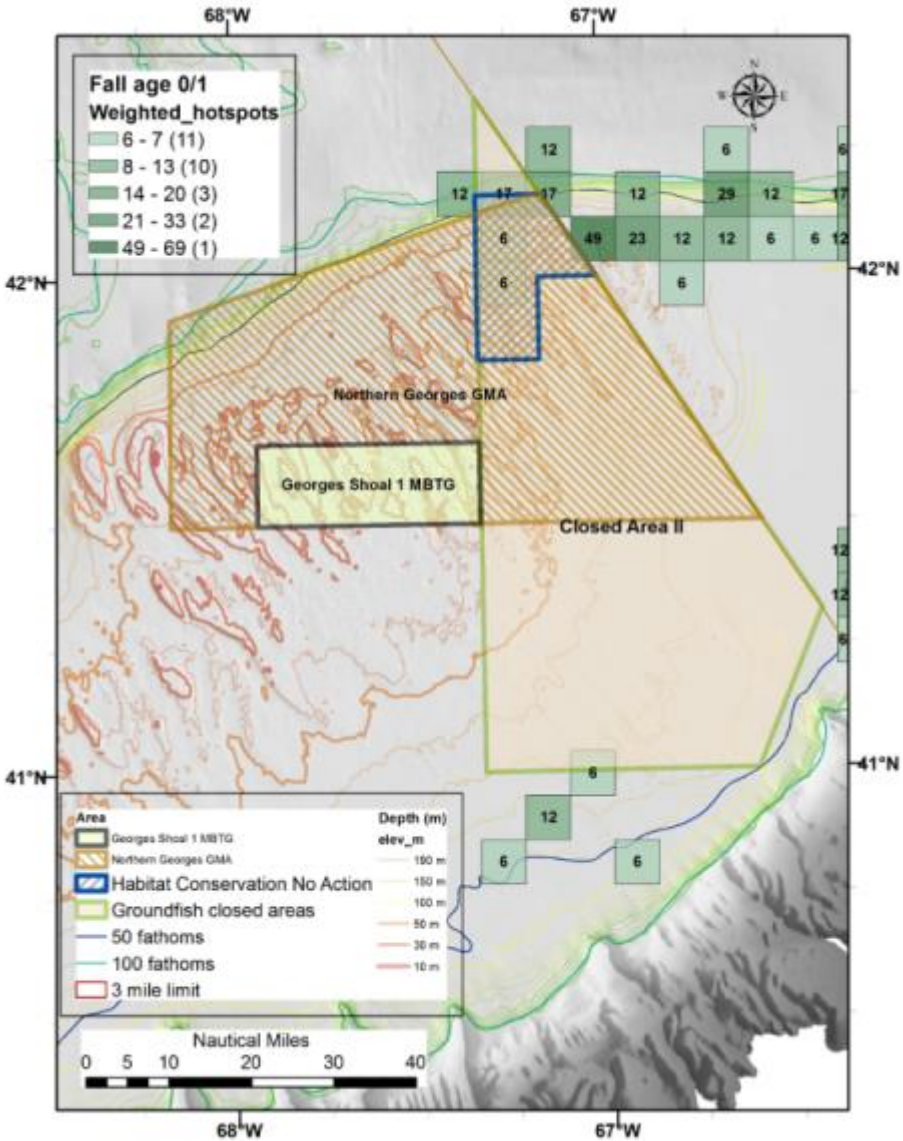
The Alternative 5 HMAs have fewer hotspots for haddock and red hake, but slightly more winter flounder hotspots (Table 69). There do not appear to be more age 0/1 and older sublegal cod in the gear modification area and no cod or haddock juvenile catches in the proposed Georges Shoal 1 mobile bottom-tending gear HMA. Because the Northern Edge GMA extends into deeper water than Georges Shoal GMA in Alternative 4, there does appear to be the potential for added protection for age 0/1 and juvenile haddock on the northern perimeter of Georges Bank (Map 67), depending on the effect of gear modifications (Section 4.1.3.1.5).

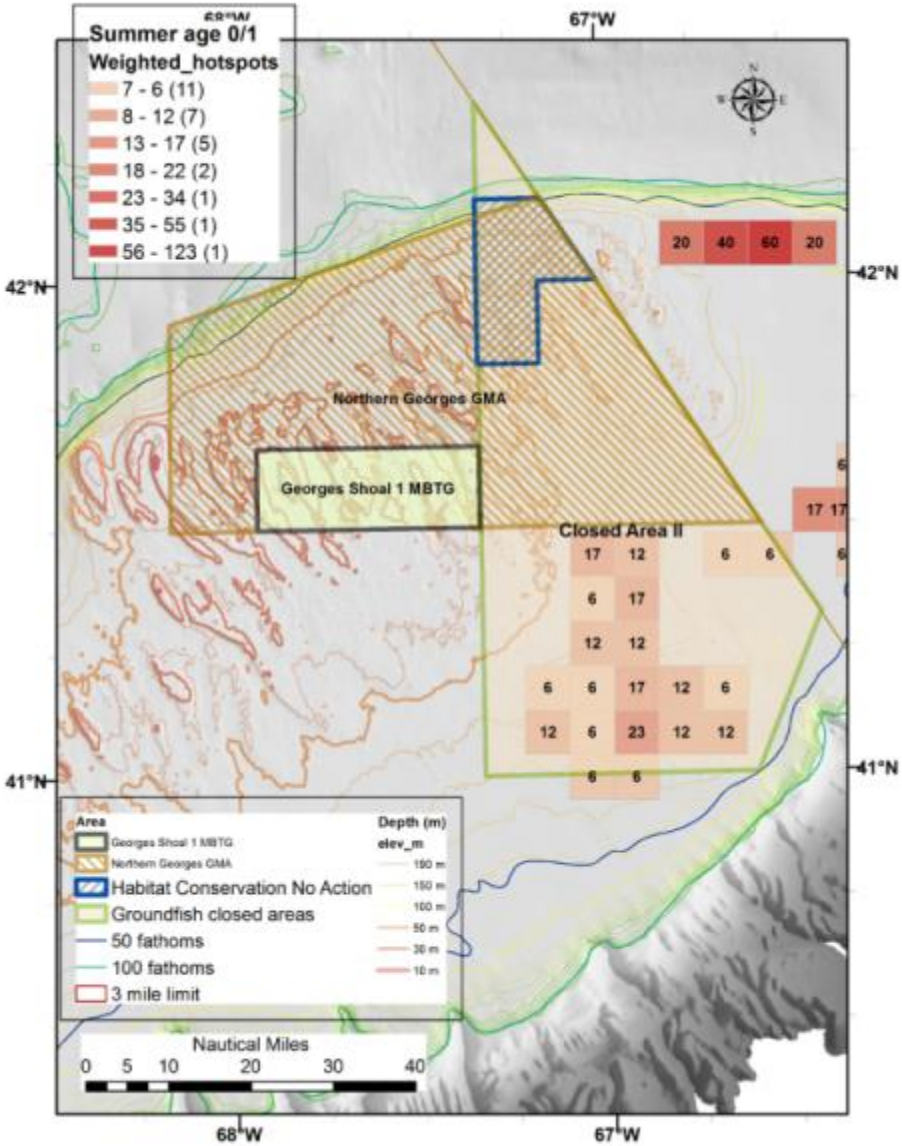
Based on the amount of weighted hotspots and the distribution of age 0/1 and older sublegal cod and haddock, the expected impacts on groundfish habitat and groundfish stocks is expected to be moderately to highly negative compared to Alternative 1/No Action, and possibly worse than Alternatives 3 and 4 depending on whether mobile bottom-tending gear is prohibited in the Northern Edge habitat management area under Alternatives 3 and 4. Alternative 5 has the potential to have more positive impacts than Alternatives 6A and 6B for some age 0/1 juvenile groundfish habitat, particularly for haddock and to a lesser extent, cod, if Option 3 or 4 (gear modification) is chosen for Alternatives 6A and 6B. A mobile bottom-tending gear closure in 6A and 6B would have more positive impacts than a larger gear modification area, however. Based on the distribution of age 0/1 groundfish weighted hotspots and the distribution of age 0/1 and older juvenile cod and haddock, the impacts of Alternative 5 are expected to be neutral with respect to Alternative 7 and negative relative to the large mobile bottom-tending gear closure in Alternative 8, which includes much of the area encompassed by the gear modification area in this alternative.

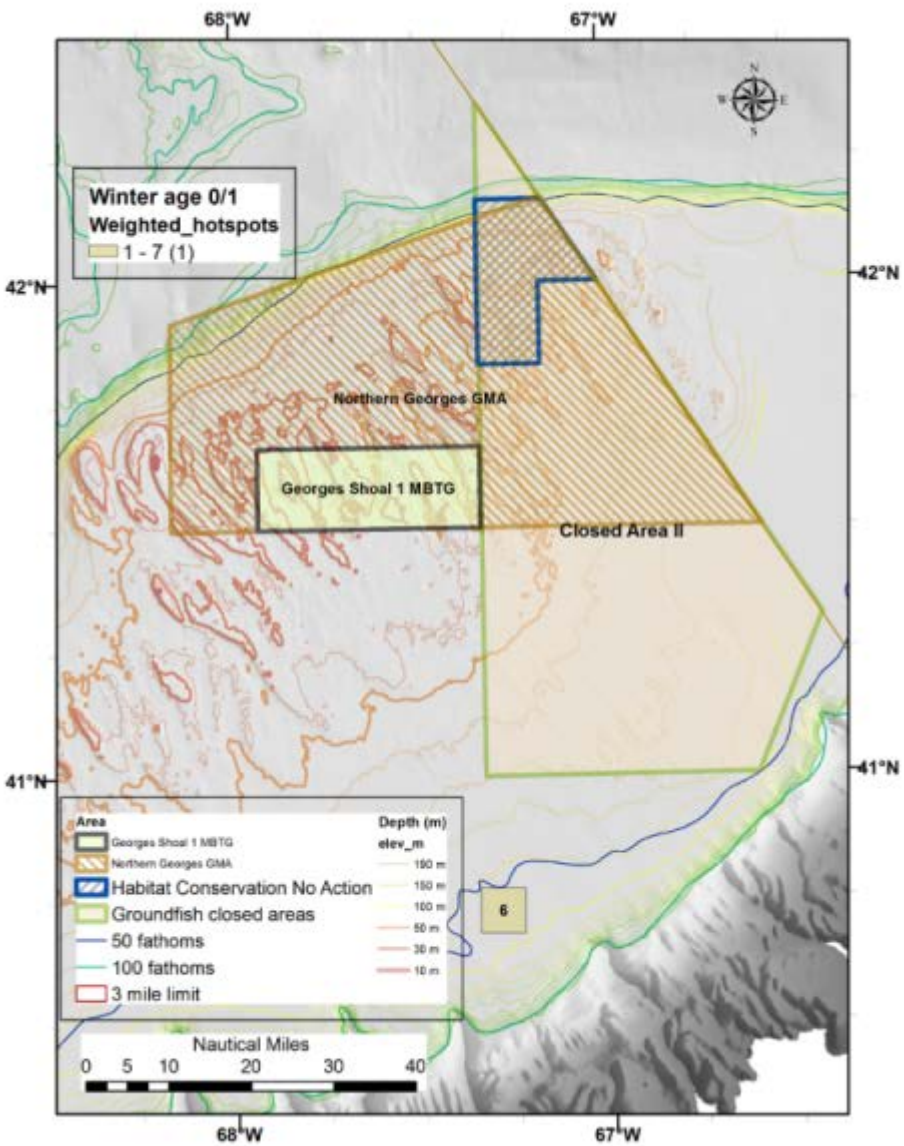
Similar to Alternative 2, depending on the spawning alternative selected for the Georges Bank region, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning. There are very few large spawner hotspots that overlap the Georges Shoal 1 mobile bottom-tending gear closure, and the gear modification area included in the alternative would not prohibit the use of any gear types capable of catching groundfish.

Map 68 – Georges Bank Alternatives 1 and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data.



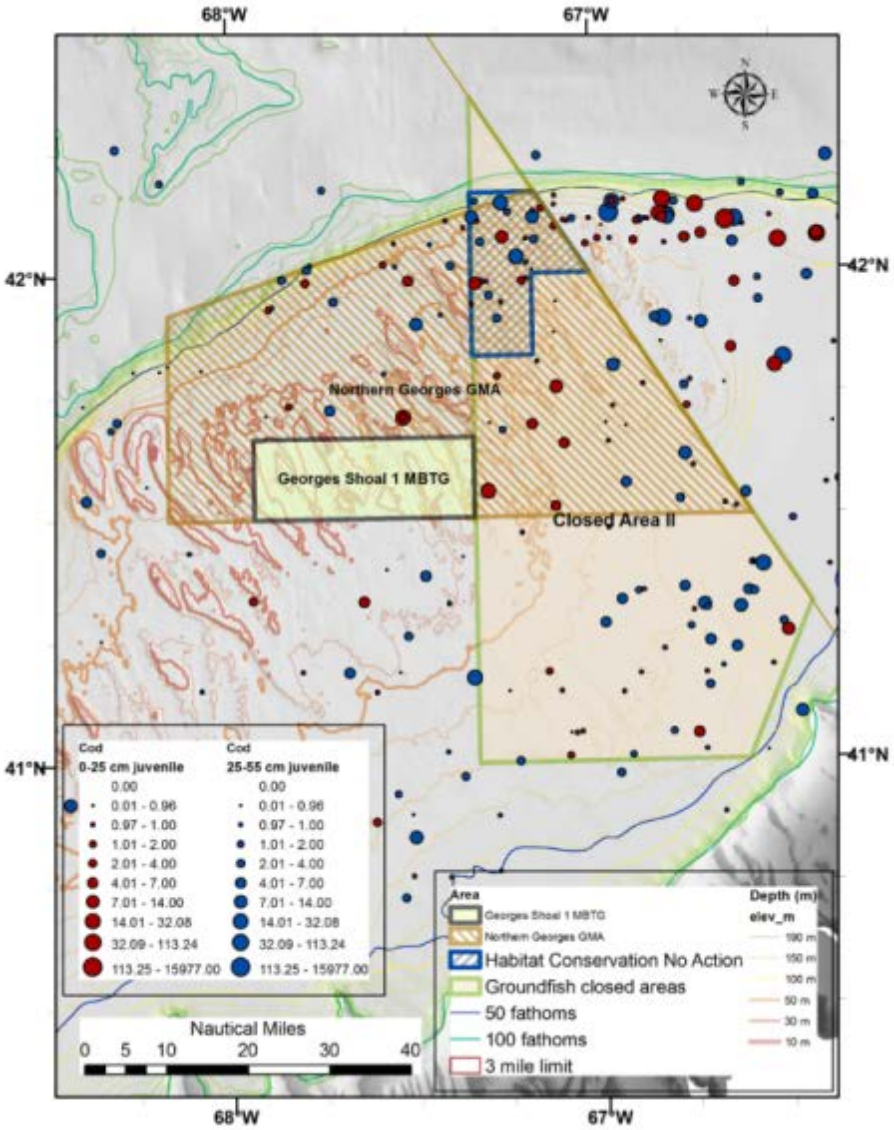



Summer age 0/1
Weighted_hotspots
7 - 6 (11)
8 - 12 (7)
13 - 17 (5)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
67°W
42°N
41°N
68°W
Northern Georges GMA
Georges Shoal 1 MBTG
Closed Area II
Area
Depth (m)
elev_m
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

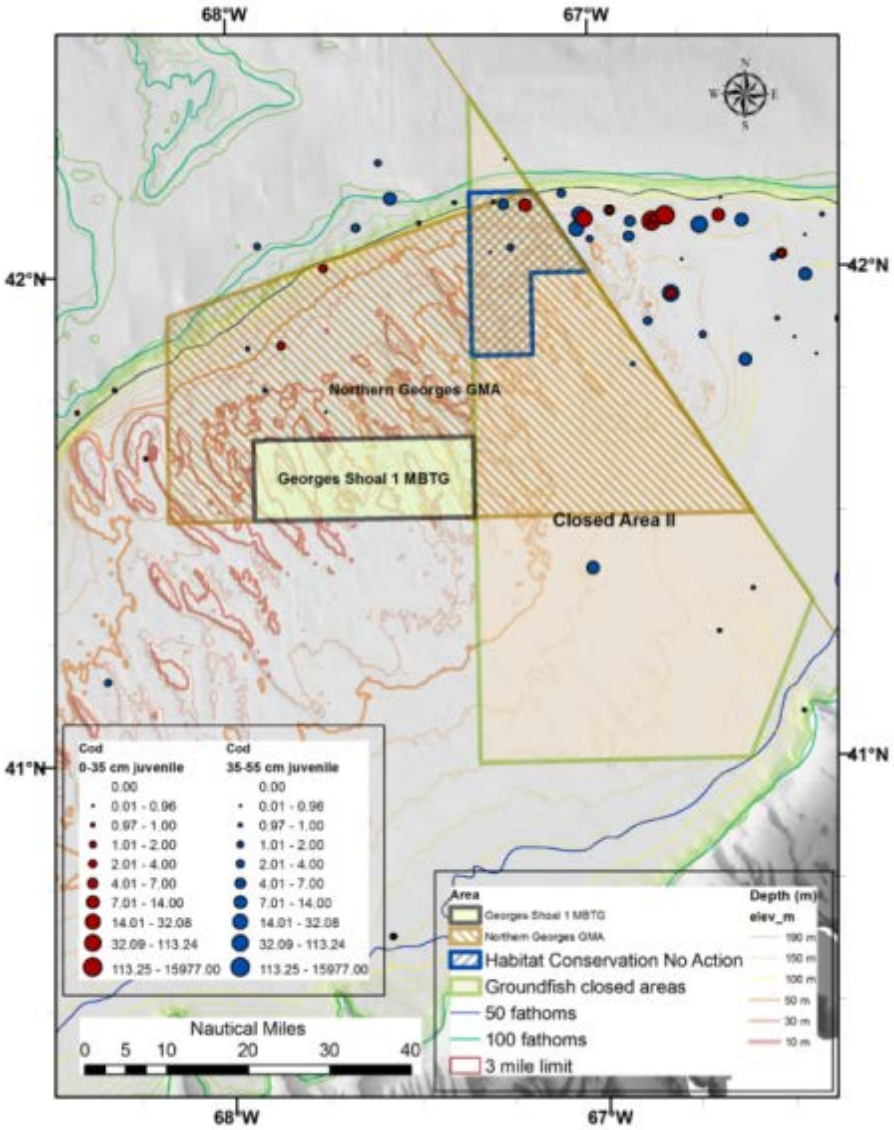

Winter age 0/1
Weighted_hotspots
1 - 7 (1)
68°W
67°W
42°N
41°N
Northern Georges GMA
Georges Shoal 1 MBTG
Closed Area II
Area
Depth (m)
elev_m
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

Map 69 – Georges Bank Alternatives 1 and 5 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

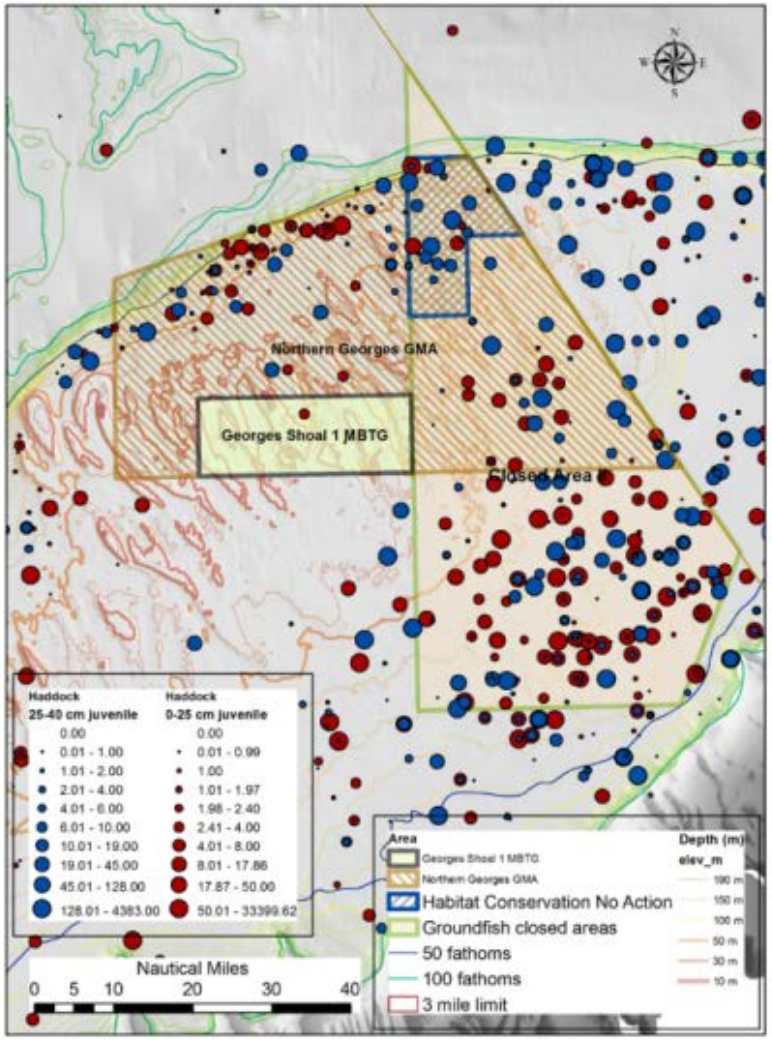


Fall and winter

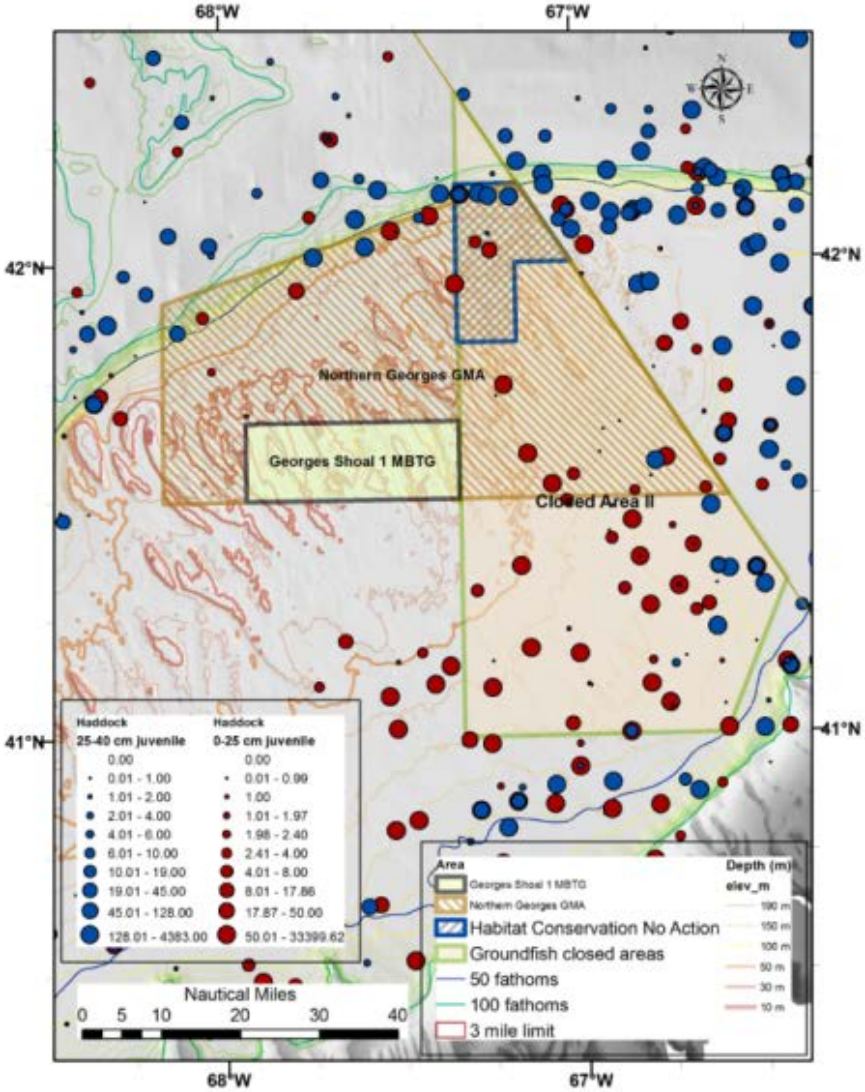


Map 70 – Georges Bank Alternatives 1 and 5 overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer



Fall and winter



4.2.2.7.5 Alternatives 6A and 6B

Alternative 6A (EFH Expanded 1 HMA) expands the Closed Area II Habitat Closure west to 67º30' W longitude, encompassing additional areas of vulnerable substrate and juvenile groundfish habitat. Map 71 shows the total number of weighted age 0/1 groundfish hotspots by season. The amount of age 0/1 groundfish unweighted and weighted hotspots (Table 68) is similar to Alternative 5, and less than Alternatives 3 and 4. The total weighted hotspots are more than Alternative 7 and slightly less than Alternative 8.

Although there are few cod and haddock hotspots identified on the U.S. portion of the northern edge, protection for cod and haddock can be evaluated by examining the distribution of all survey catches of age 0/1 and age 2+ juvenile cod and haddock. One caveat that should be considered when interpreting these results is the effect that fishing has on abundance and presence of juvenile groundfish, i.e. selectivity is higher for age 2+ juveniles.

During the spring and fall (Map 72) most of the age 0/1 cod are in Canadian waters, but there are more catches of age 2+ juvenile cod in U.S. waters, particularly during the spring and summer. Most of the age 2+ cod were observed within the boundary of the existing Closed Area II Habitat Closure. For juvenile cod, expansion of the existing area does not appear to provide additional protection, and there may be less protection relative to the combined habitat and groundfish areas in Alternative 1/No Action. However, the generalized additive model habitat suitability analysis (Appendix F) indicated that both the existing habitat closure and areas to the west are important age 0/1 cod habitat.

Catches of age 0/1 and age 2+ juvenile haddock (Map 73) are more prevalent to the west of the existing habitat closure, an area partially encompassed by the EFH Expanded 1 HMA/Alternative 6A. However, this HMA misses a notable concentration of survey catches extending further to the southwest. Although the EFH Expanded 1 HMA includes some locations having age 0/1 and age 2+ haddock, particularly in the spring and summer surveys, it is doubtful that this additional protection completely compensates for the high abundance of haddock in the southern part of Closed Area II, even though the southern area has less vulnerable substrate.

<u>Based on the amount of weighted hotspots and the distribution of age 0/1 and older juvenile cod and haddock, the expected impacts on groundfish habitat and groundfish stocks are expected to be slightly negative compared to Alternative 1/No Action, and slightly positive compared with Alternatives 3 and 4.</u> The assessment of impacts relative to Alternative 1/No Action is made considering the fact that most of Closed Area II is open to mobile bottom-tending gear fishing through haddock and yellowtail flounder special access programs using modified trawls and to periodic scallop fishing in the southern portion of Closed Area II. <u>This also assumes that the 'EFH Expanded 1' (i.e., 6A) area is closed to fishing with mobile bottom-tending gears. If another option is chosen that only requires modified gear, this alternative has considerably more negative impacts on juvenile groundfish habitat protection, compared to Alternative 1/No Action.</u>

Impacts on age 0/1 juvenile groundfish habitat compared to Alternative 6B are also expected to be positive, since about half of the hotspots are in the eastern portion of the EFH Expanded 1

area which would be removed under Alternative 6B, and the eastern area also has a substantial fraction of age 0/1 and older juvenile presence of haddock and a greater fraction of cod. The impacts are highly positive compared to Alternative 7, which includes areas that contain few age 0/1 groundfish hotspots and few catches of juvenile haddock and cod. Alternative 8 (discussed further below) encompasses the two Alternative 7 HMAs plus additional areas to the west. Although Alternative 8 does not include any additional age 0/1 groundfish hotspots, the western portion of Alternative 8 encompasses considerable survey catches of age 0/1 and older juvenile haddock, particularly in the fall. Impacts on age 0/1 juvenile groundfish habitat relative to Alternative 8 are therefore negative.

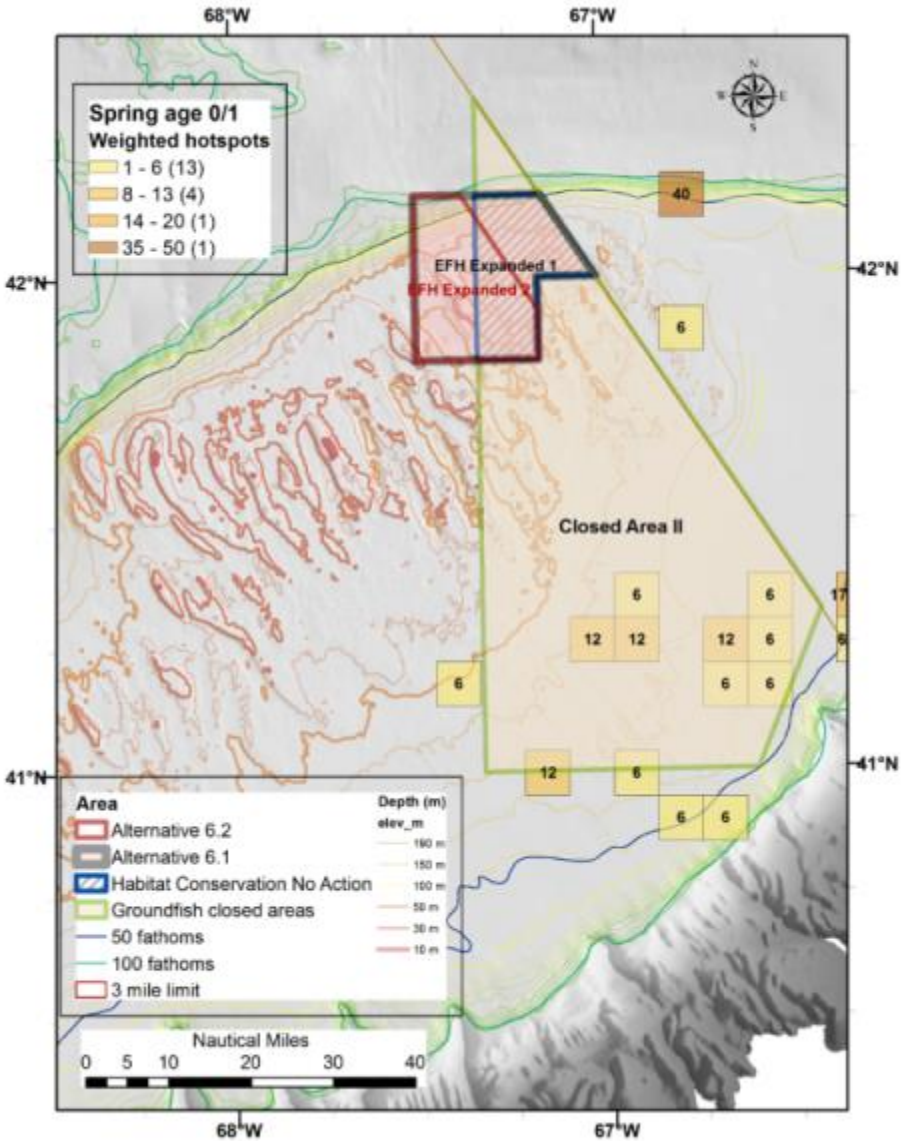
Like Alternative 6A, Alternative 6B would extend the existing Closed Area II Habitat Closure Area west to 67º30' W longitude to create the EFH Expanded 2 HMA. An eight nautical mile 'buffer' between the proposed Habitat Management Area and the Exclusive Economic zone would be open to all fishing gears. This modification re-opens all but about a third of the existing habitat closure to fishing, including the more vulnerable substrates found on the northern edge of Georges Bank.

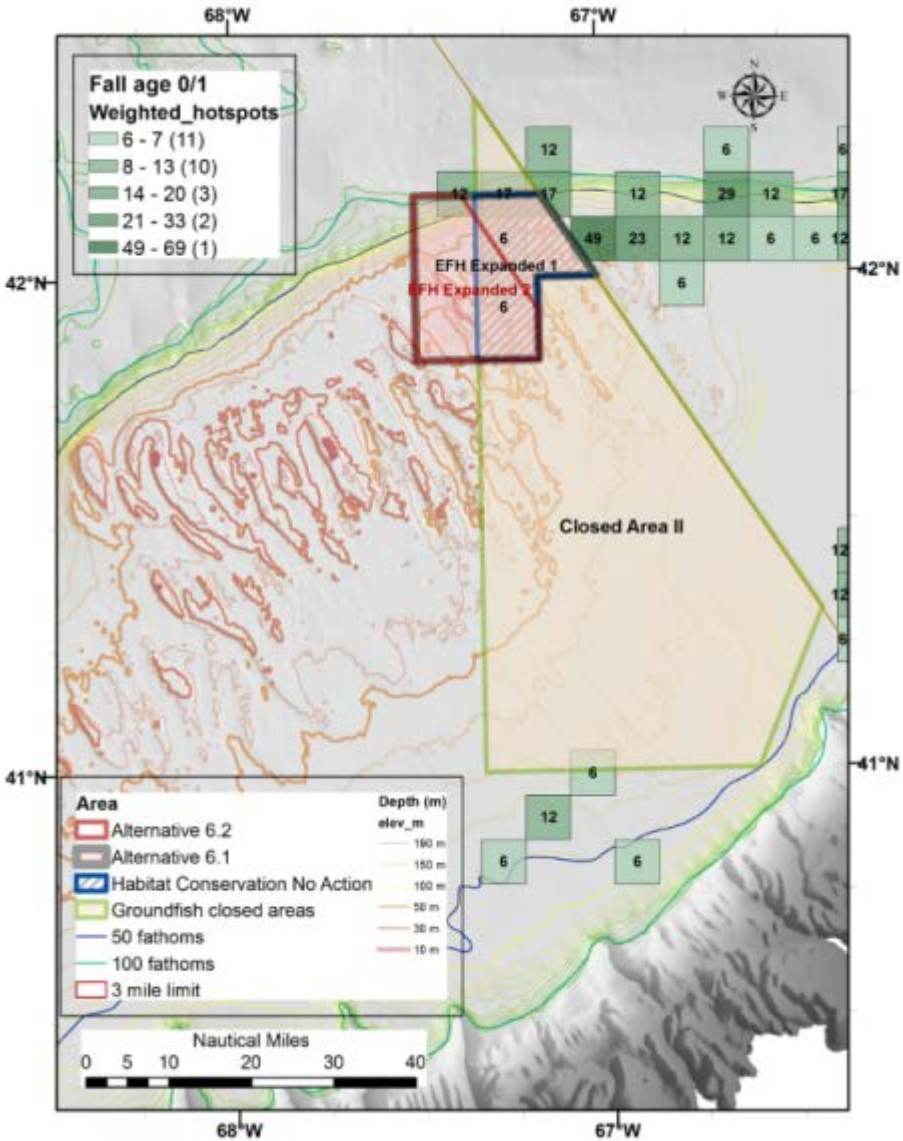
Map 71 shows the total number of weighted age 0/1 groundfish hotspots overlapping this area by season. The numbers of unweighted and weighted age 0/1 groundfish hotspots in Alternative 6B are fewer than any alternative other than Alternative 2 (Table 68), and the area has fewer age 0/1 groundfish hotspots than the existing habitat closure area. Examining the distribution of age 0/1 and age 2+ juvenile cod and haddock catches in survey tows (Map 72 and Map 73), a substantial fraction of high-catch tows are in the 8-mile buffer that would be outside the habitat management area and open to fishing by vessels using mobile bottom-tending gears.

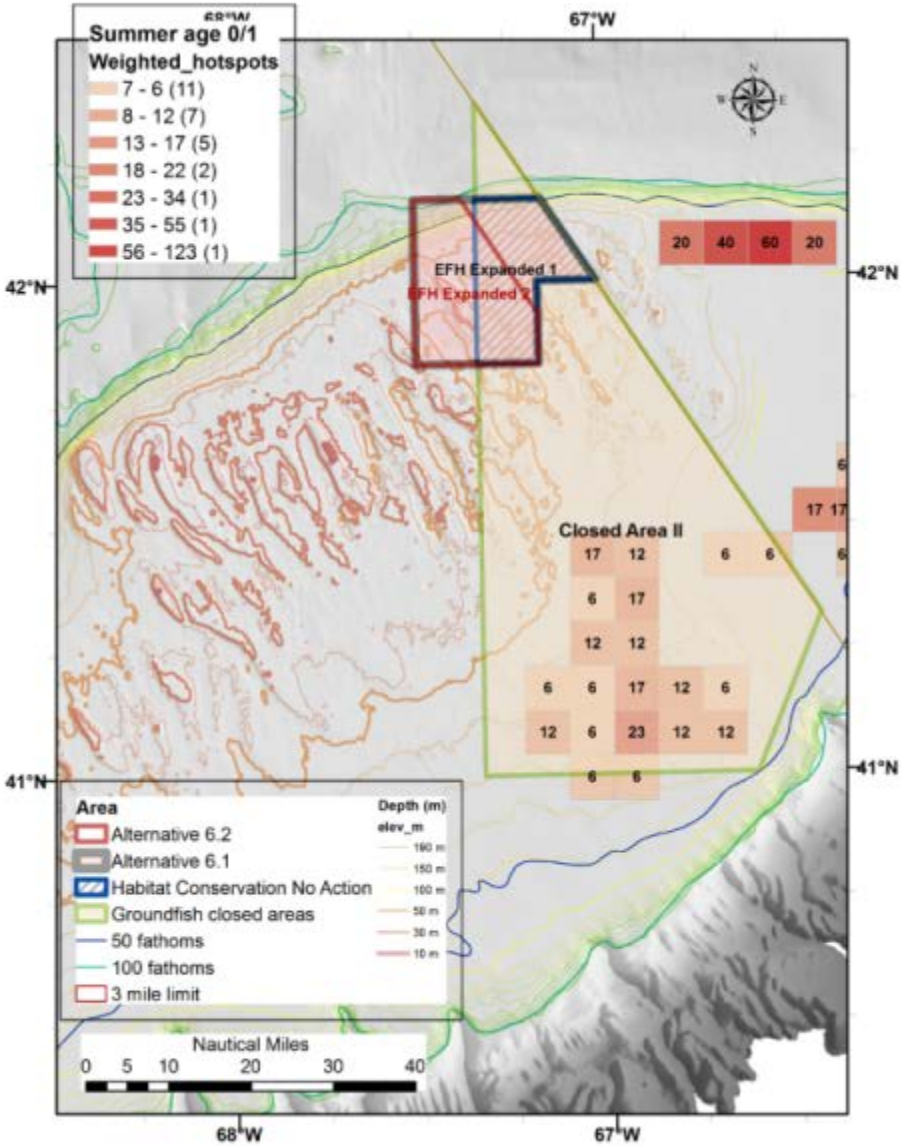
<u>While it may be true that the existing fishing activity immediately west of the current habitat closure removes small cod and haddock and other groundfish that rely on vulnerable substrates (and there has been a detrimental effect of fishing on that habitat), the existing data indicate that this alternative would have a highly negative impact on juvenile groundfish habitat relative to Alternative 1/No Action and also relative to all but Alternatives 2 and 7, regardless of the management option selected.</u> Alternative 6B would have positive impacts on age 0/1 juvenile groundfish habitat relative to Alternatives 2 and 7 since neither contains weighted age 0/1 juvenile groundfish hotspots and appear to provide little protection for age 0/1 and older juvenile haddock and cod.

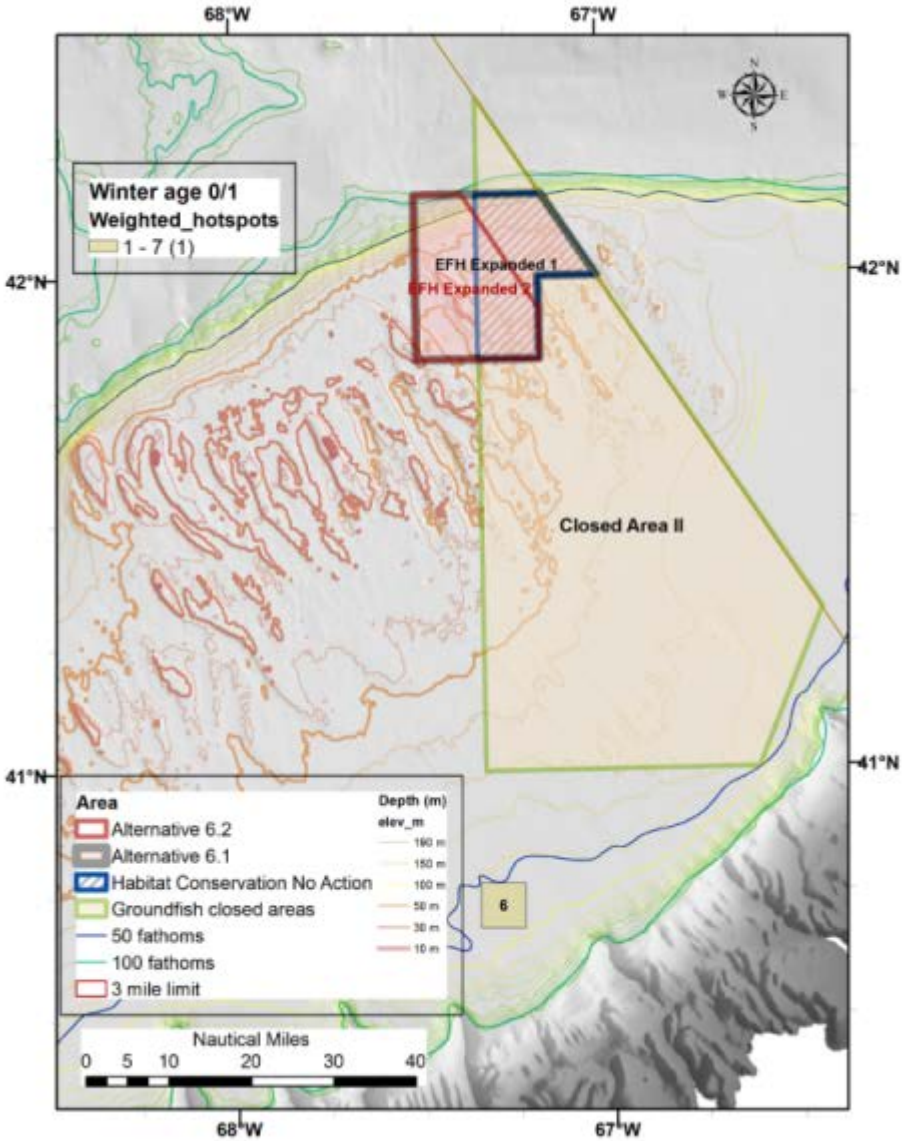
Similar to Alternative 2, depending on the spawning alternative selected for the Georges Bank region, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning. Spawning benefits associated with the EFH Expanded HMAs proposed in these alternatives would be slightly positive, similar to those identified for Alternative 3, and would provide some limited protection for spring and fall spawners, given the overlap with spring and fall large spawner hotspots.

Map 71 – Georges Bank Alternatives 1, 6A and 6B overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data.



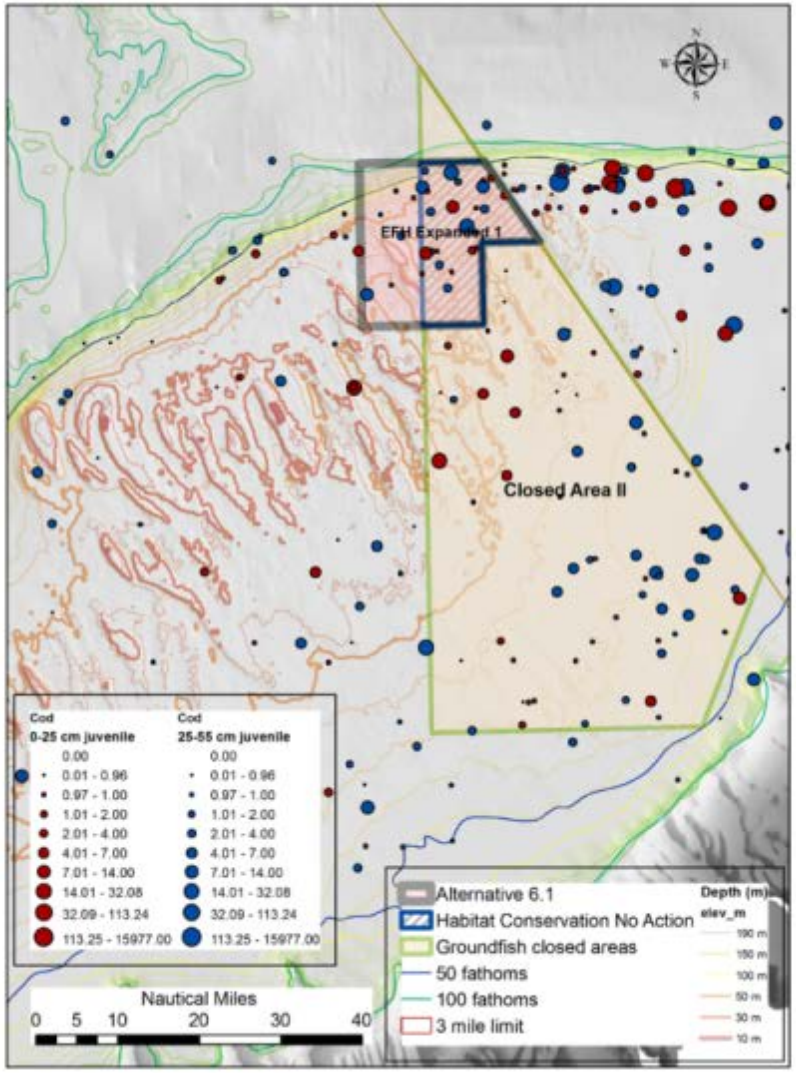



Summer age 0/1
Weighted_hotspots
7 - 6 (11)
8 - 12 (7)
13 - 17 (5)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
68°W
67°W
42°N
41°N
EFH Expanded 1
EFH Expanded 2
Closed Area II
Area
Alternative 6.2
Alternative 6.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

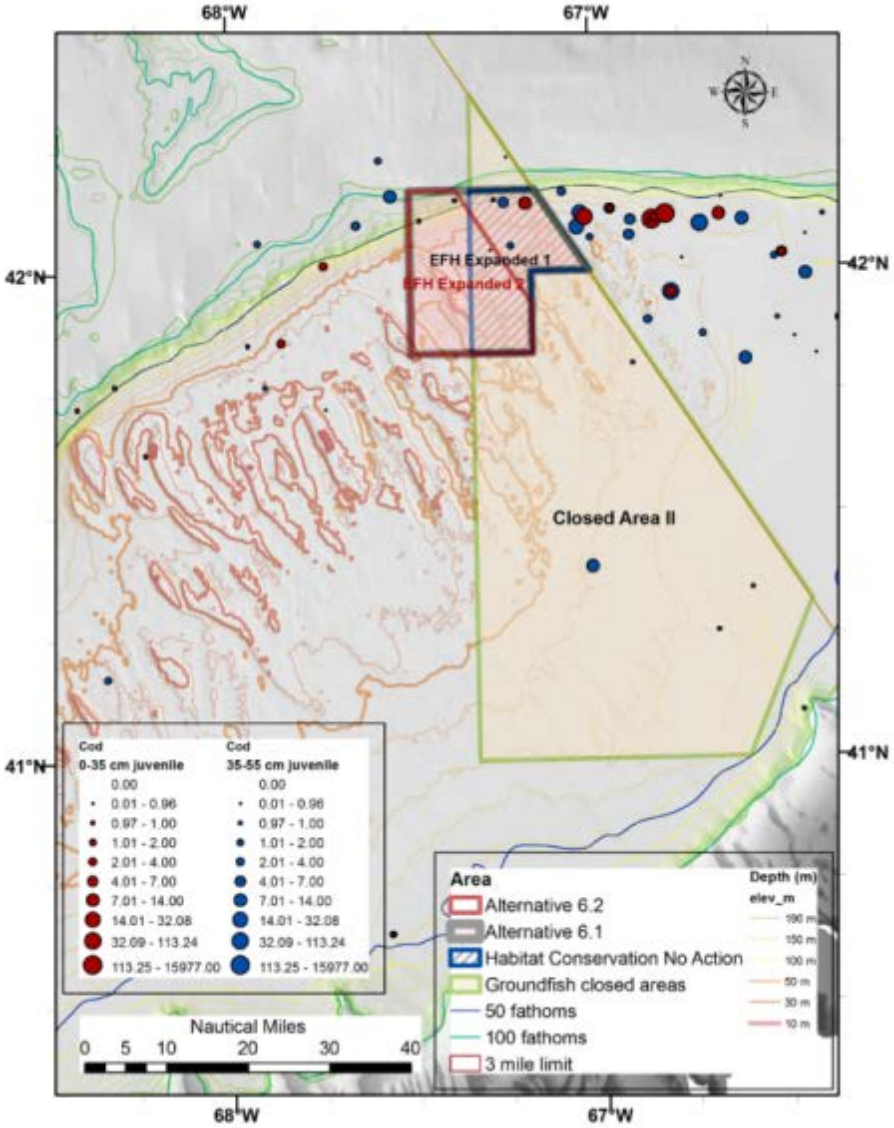

Winter age 0/1
Weighted_hotspots
1 - 7 (1)
68°W
67°W
42°N
41°N
EFH Expanded 1
EFH Expanded 2
Closed Area II
Area
Alternative 6.2
Alternative 6.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

Map 72 – Georges Bank Alternatives 1, 6A, and 6B overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

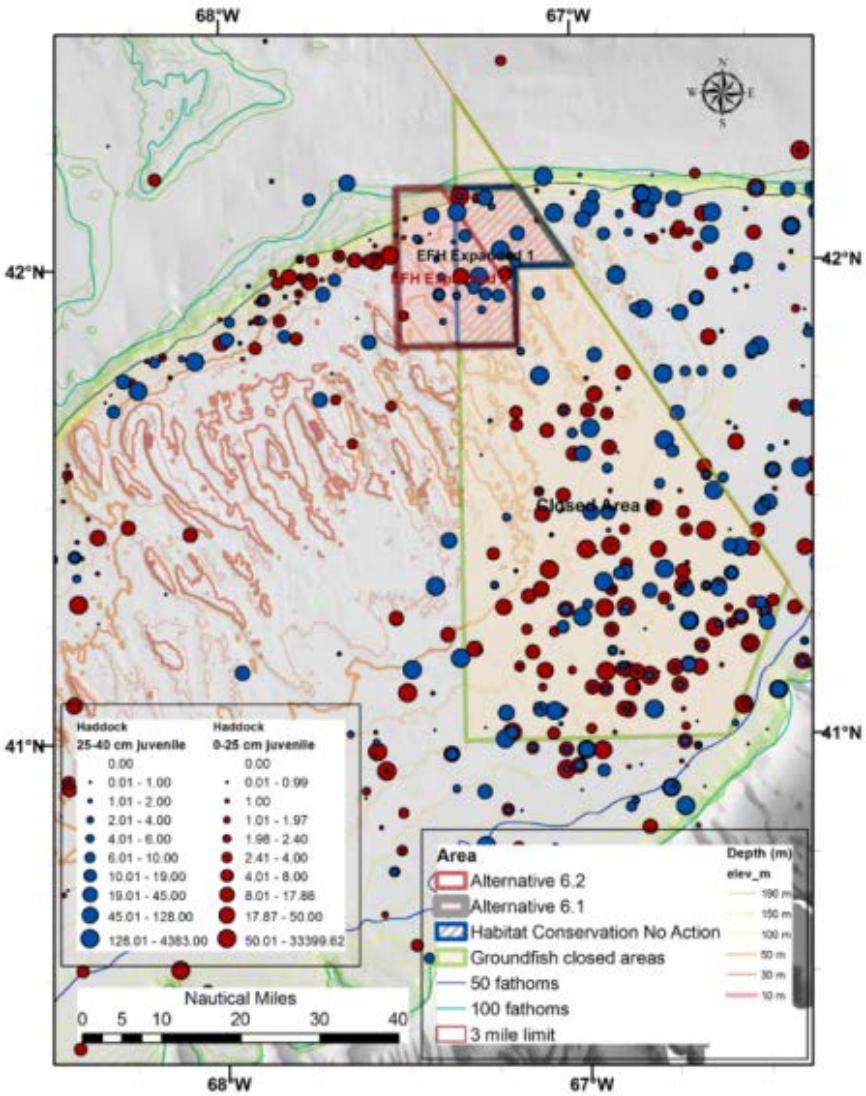


Fall and winter

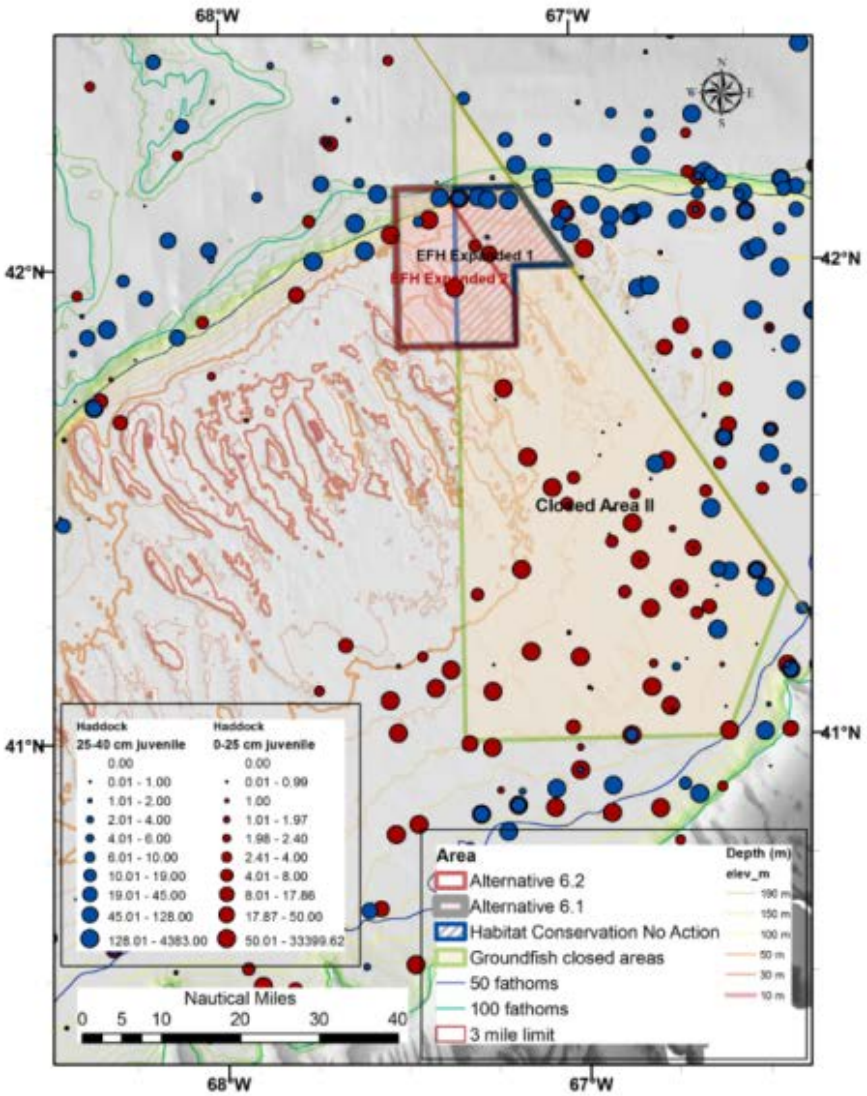


Map 73 – Georges Bank Alternatives 1, 6A, and 6B overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer



Fall and winter



4.2.2.7.6 Alternative 7

Alternative 7 (Map 74) proposes two habitat management areas as mobile bottom-tending gear closures (Options 1 or 2). The EFH South Mobile Bottom Tending Gear HMA overlaps the southern part of the existing habitat closure and about a third of the proposed area is within Closed Area II Groundfish Closure Area, but outside the existing habitat closure. Alternative 7 also includes the Georges Shoal 2 Mobile Bottom Tending Gear HMA to the west of Closed Area II, in the high energy environment on the top of Georges Bank dominated by semi-permanent sand ridges and swales.

No age 0/1 groundfish hotspots occur in either area (Table 68) and this alternative allows more fishing in the habitat closure area than most other Georges Bank sub-region alternatives (with the exception of Alternative 2). This existing area tends to have more age 0/1 groundfish hotspots, as well as more catches of age 0/1 and juvenile cod and haddock (see Map 74).

Even broadening the scope of the analysis to include all juvenile cod and haddock, age 0/1 and age 2+ immature fish, for all tows (not just those representative of hotspots) does not suggest any high degree of association of juvenile cod and haddock with habitat in the Alternative 7 areas. During 2002-2012, catches of age 0/1 cod and older juvenile cod were nearly absent from the Alternative 7 HMAs (Map 75). Relative to neighboring areas, few older juvenile haddock (25-40 cm) were captured in 2002-2011 spring trawl surveys in the northern portion of the EFH South Mobile Bottom Tending Gear, but this area of average catches appears to be associated with a concentration of haddock extending to the north of the proposed area, within the existing habitat closure area (see Map 76, left panel).

There were some comments during scoping that juvenile cod and haddock distributions may have been historically different, when stock size (and environmental conditions) were different than they are today. Comparable trawl survey data are available as early as 1963 in the NMFS fall survey and 1967 in the NMFS spring survey. An early 2013 exploratory hotspot analysis of historic cod distributions by the Closed Area Technical Team did not indicate substantially different historical patterns of hotspot distribution. Visual examination of the trawl survey juvenile cod catch distribution in 1982-1991 (Map 77) and particularly in 1972-1981 (Map 78) suggest that juvenile cod were more widespread across Georges Bank than they are today. There does not, however, appear to be any greater historic concentration of age 0/1 and larger juvenile cod in the proposed Alternative 7 HMAs.

Alternative 7 appears more likely than almost any alternative to redistribute mobile bottom-tending gear fishing effort into areas with more juvenile groundfish hotspots (weighted to favor species that are have low biomass relative to B_{MSY} and are associated with hard substrates), and also into areas that have higher concentrations of age 0/1 cod and haddock. The areas proposed for a mobile bottom-tending gear closure are generally in a high energy environment dominated by sand ridges on top of Georges Bank. Neighboring areas on northern Georges Bank tend to have lower energy and are more dominated by gravel and cobble substrates.

<u>Thus, based on existing data and analysis described above, Alternative 7 is likely to have a highly negative impact on age 0/1 groundfish habitats compared to No Action. Moreover, the impacts on age 0/1 groundfish habitats are likely to be negative compared with all other Georges Bank habitat management alternative, and even Alternative 2 which would not shift fishing effort</u>

away from areas with high energy and sand dominated substrates, where few age 0/1 cod, haddock and juvenile groundfish hotspots were identified.

Similar to Alternative 2, depending on the spawning alternative selected for the Georges Bank region, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning. The EFH South and Georges Shoal 2 mobile bottom-tending gear HMAs proposed in this alternative would have a slight benefit for fall spawners. The Georges Shoal 2 area, which is currently open to fishing, has very limited longline revenues, and no gillnet revenues. Thus, a restriction on mobile bottom-tending gears only would potentially reduce groundfish removals significantly, unless a mobile bottom-tending gear restriction causes an increase in fixed gear usage. It is more difficult to predict potential increases in the EFH South HMA, which is currently closed to most types of fishing as it overlaps the Closed Area II habitat and groundfish closures.

4.2.2.7.7 Alternative 8

Alternative 8 proposes a single large Northern Georges Mobile Bottom Tending Gear HMA (Map 75) covering most of northern Georges Bank, from the Exclusive Economic Zone boundary to Georges Shoal, including some deeper water off the northern edge of the bank. In size, it is about two thirds of the area covered by Closed Area II (1,396 vs. 2,001 nm^2) and includes all of the existing Closed Area II Habitat Closure. It also includes all of the Northern Edge HMA proposed in Alternative 3 and 4 based on the hotspot analysis developed by the Closed Area Technical Team. It does not include the southern portion of Closed Area II where the analysis identified groundfish hotspots. In the spring and summer, it contained 6 and 15 total age 0/1 groundfish hotspots, respectively, but no hotspots weighted in favor of vulnerable species or species associated with hard substrates (Table 68). In the fall, the Northern Georges Mobile Bottom Tending Gear area contained 35 total age 0/1 groundfish hotspots and with a weighted hotspots score of 40.3, compared to 51 and 46.0, respectively, for Alternative 1/No Action.

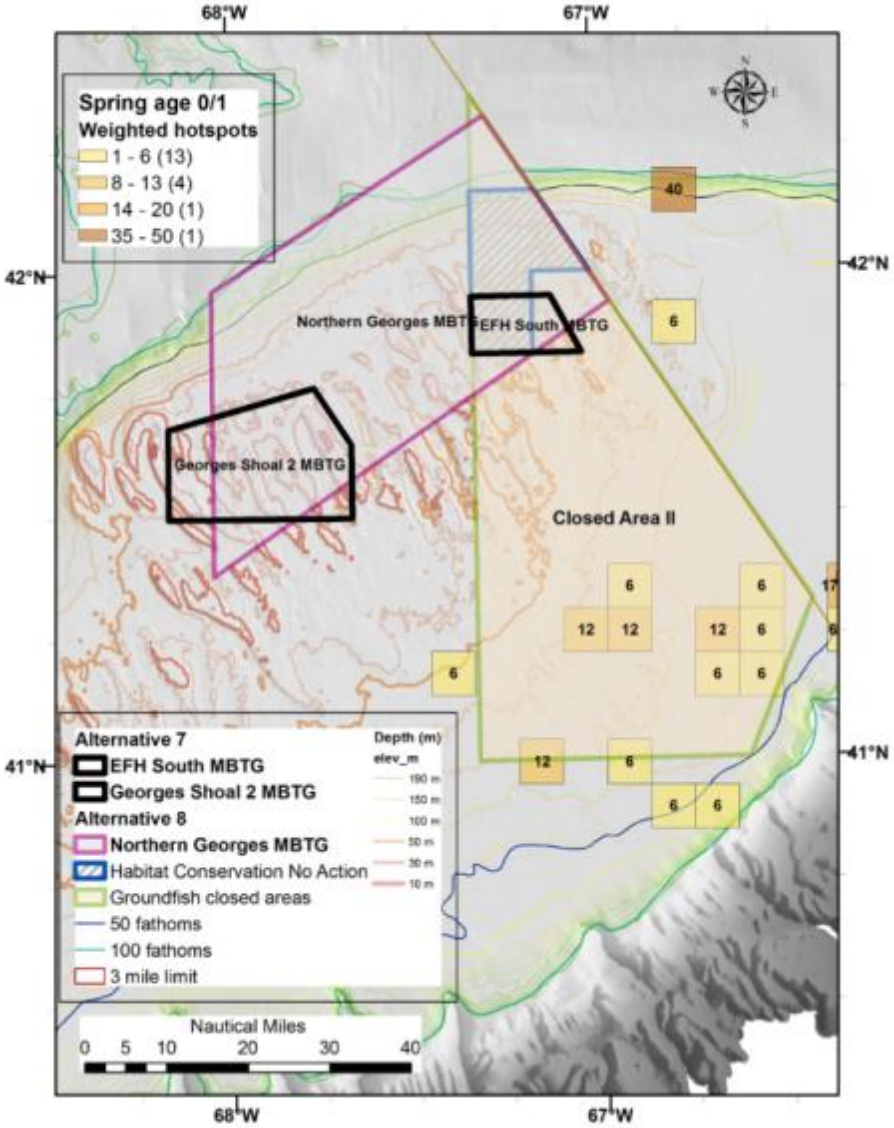
Broadening the scope of the analysis to include larger cod and haddock juveniles, compared to Alternatives 3 to 7, the mobile bottom-tending gear area proposed by this alternative does not encompass many additional above average catches of juvenile cod (Map 75). However, larger juvenile cod are less associated with structured hard substrates than are age 0/1 cod and the southern portion of Closed Area II generally has more mobile, sandy substrates than northern Georges Bank does. On the other hand, during 1982-1991 the area would have encompassed age 0/1 cod in the spring and age 2+ juvenile cod in the spring and fall, west of the existing habitat closure (Map 77). This general pattern of juvenile cod distribution was also apparent in 1972-1981 (Map 78), although the spring distribution of juvenile cod catches were generally indistinguishable from a broad distribution of juvenile cod catch across most of Georges Bank during this period. Whether this difference in cod distribution within the Northern Georges Mobile Bottom Tending Gear HMA is related to changes in temperature or stock size is difficult to say with existing data. During 2002-2012, age 0/1 and 2+ juvenile haddock catches are apparent along the edge of Georges Bank within the Northern Georges Mobile Bottom Tending Gear HMA (Map 76). However, juvenile haddock are rather broadly distributed on eastern Georges Bank.

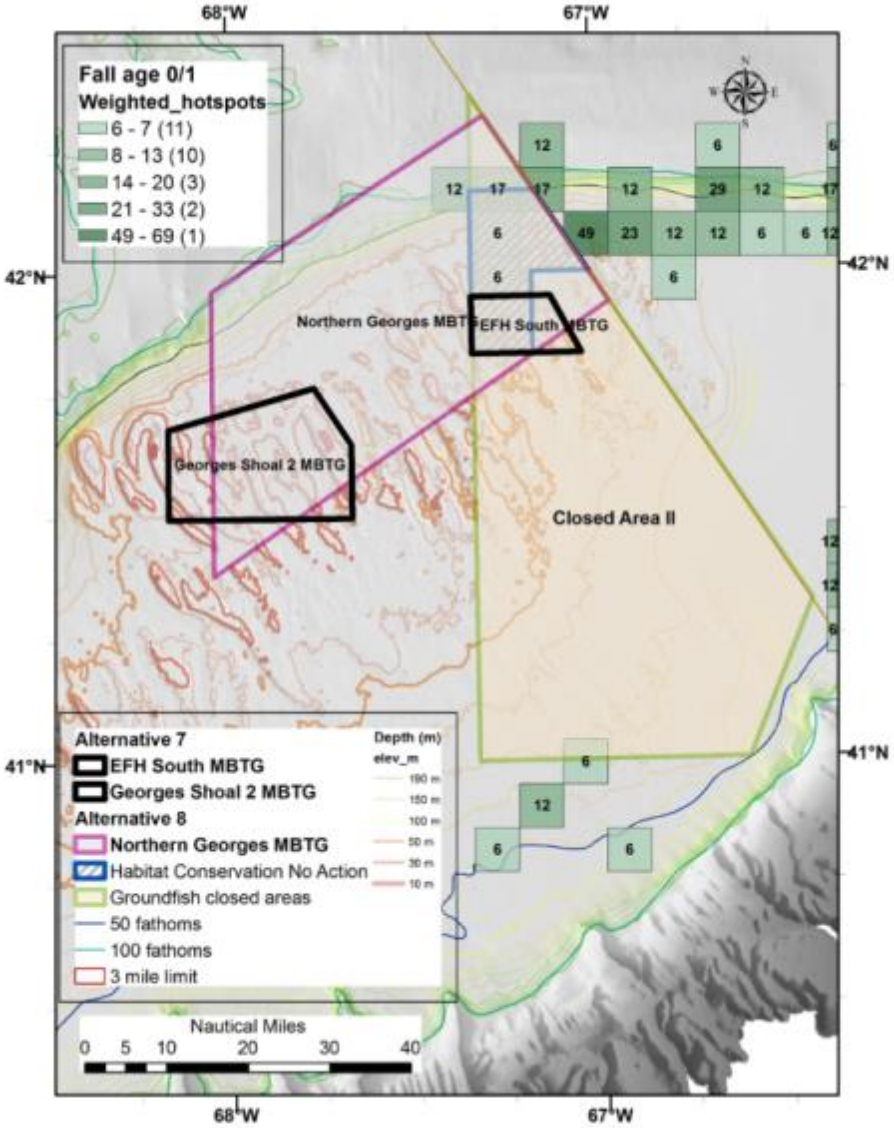
With respect to age 0/1 juvenile groundfish habitat and presence, Alternative 8 is expected to be neutral or slightly negative compared to No Action. Some species such as juvenile cod and

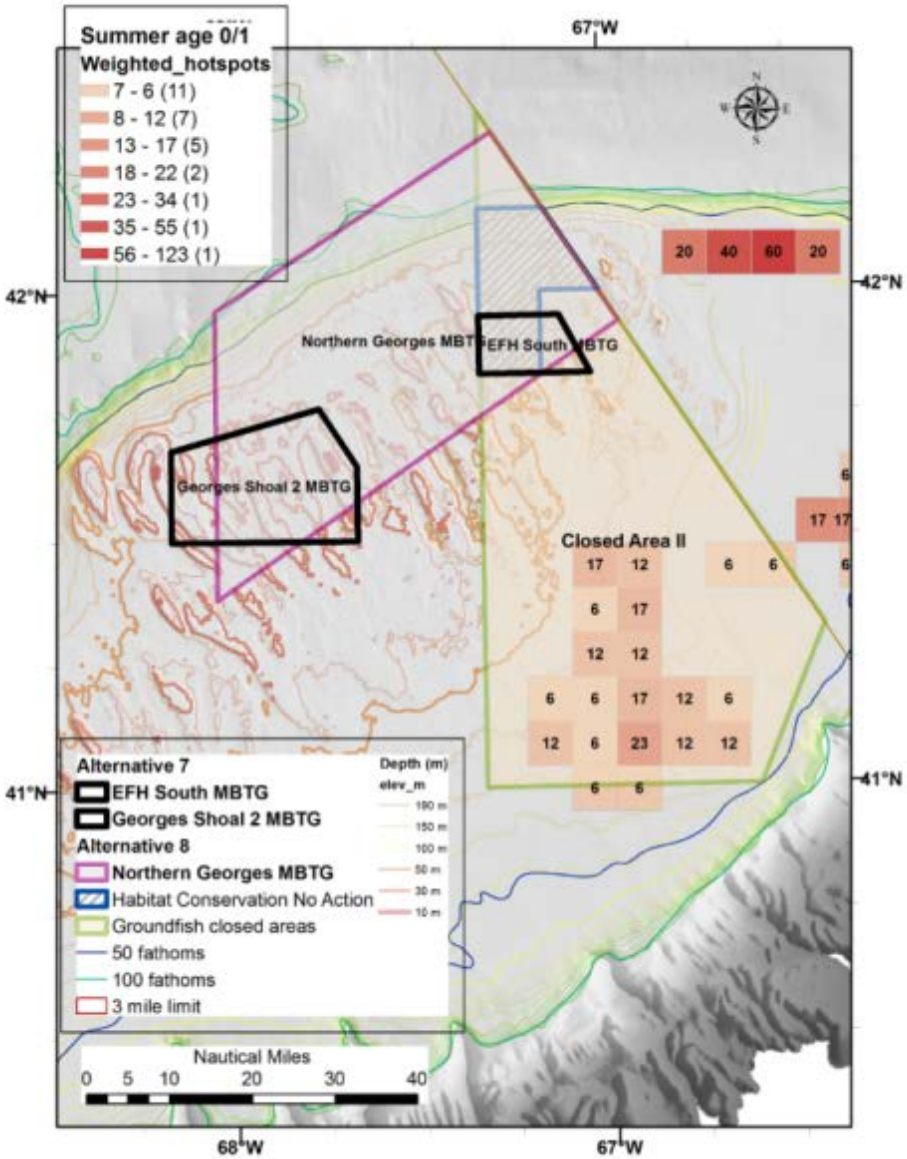
haddock that inhabit the hard substrates on Northern Georges Bank are likely to be positively impacted by this alternative while other species such as yellowtail flounder are likely to have slightly negative impacts from changes in the distribution of fishing effort. However, when making this comparison, it has to be kept in mind that the southern portion of Closed Area II is often open to restricted fishing activity through specific access programs using mobile bottom tending gear, such as trawls and dredges.Alternative 8 is likely to have moderately to highly positive impacts on age 0/1 groundfish habitat compared with other Georges Bank sub-region alternatives, simply because the proposed mobile bottom-tending gear closure would encompass more area with hard substrates where juvenile cod and haddock exist.

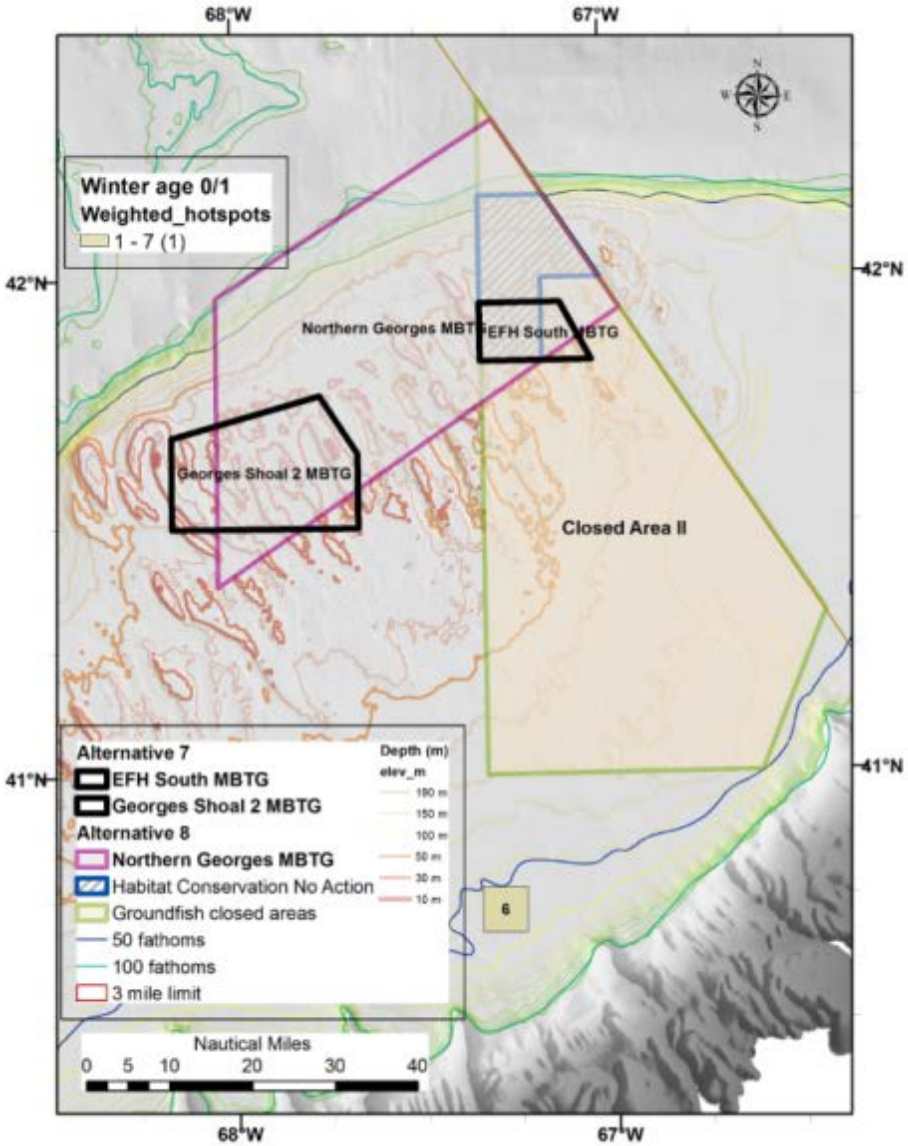
Depending on the spawning alternative selected for the Georges Bank region, this alternative has neutral (Spawning Alternative 1) to slightly negative (Spawning Alternatives 2 or 3) impacts on groundfish spawning. The majority of the revenues from the Northern Georges mobile bottom-tending gear HMA come from bottom trawls and scallop dredges, which would be restricted within the HMA. The relative use of these various gears, combined with large size of the HMA, will likely provide more positive impacts to spawning groundfish than other new HMAs in this sub-region. These benefits would be most likely to accrue to fall spawning groundfish, because the spring spawners will already be protected under the spawning management alternatives, and the fall large spawner hotspots are shifted west into currently open areas within the proposed HMA.

Map 74 – Georges Bank Alternatives 1, 7, and 8 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data.



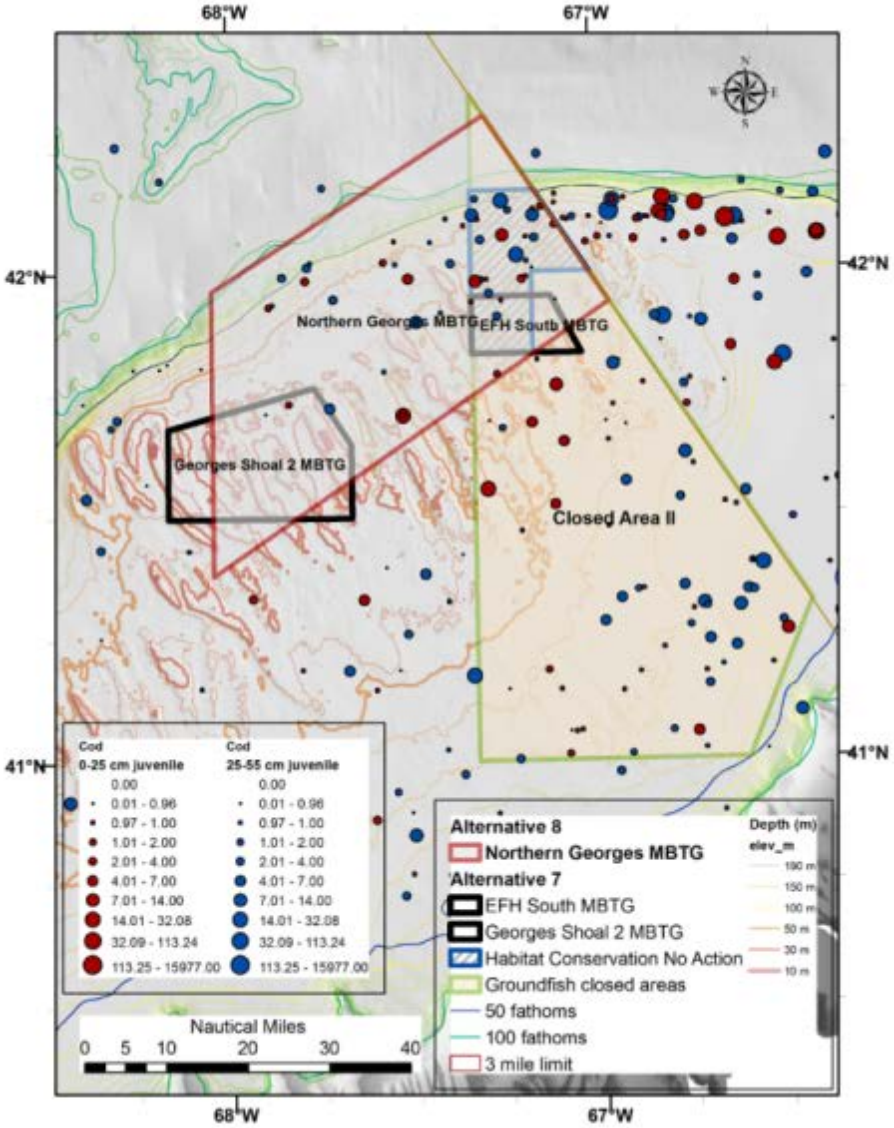



Summer age 0/1
Weighted_hotspots
7 - 6 (11)
8 - 12 (7)
13 - 17 (5)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
67°W
42°N
41°N
68°W
Northern Georges MBTG
EFH South MBTG
Georges Shoal 2 MBTG
Closed Area II
Alternative 7
EFH South MBTG
Georges Shoal 2 MBTG
Alternative 8
Northern Georges MBTG
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

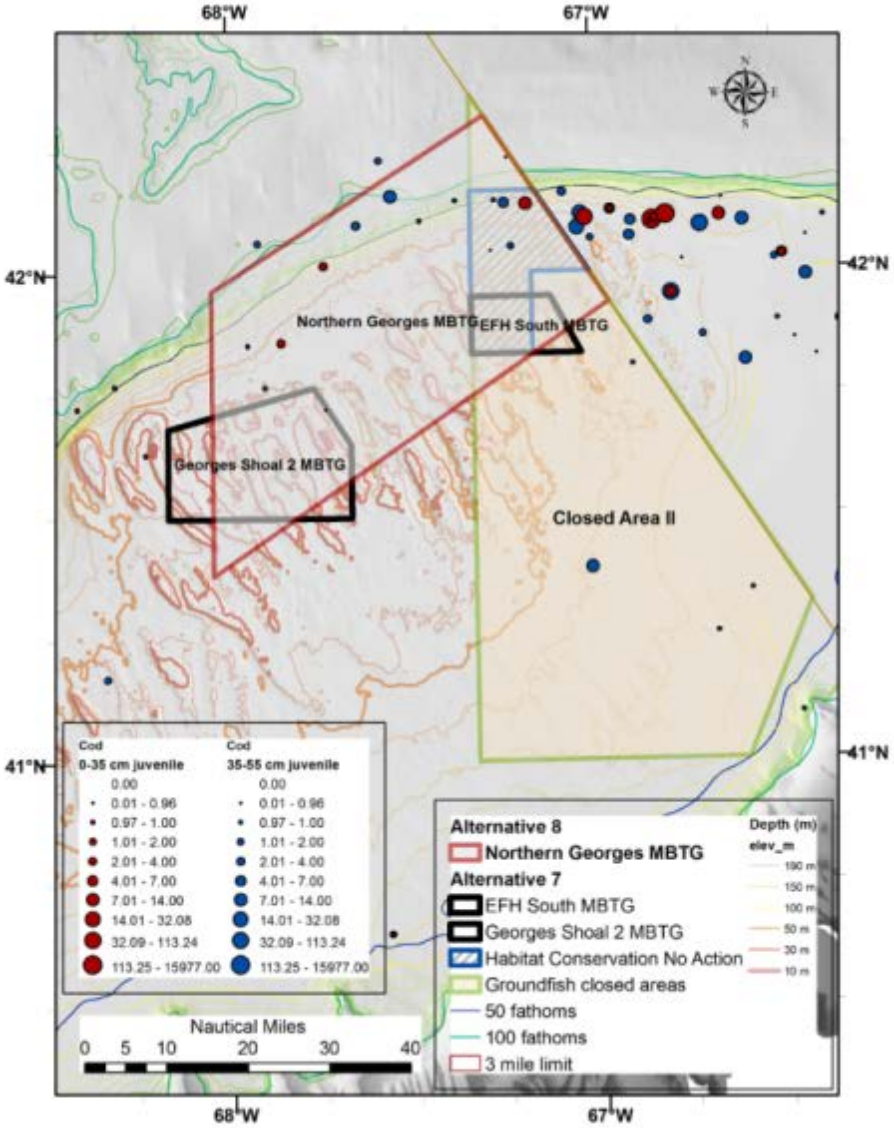

Winter age 0/1
Weighted_hotspots
1 - 7 (1)
68°W
67°W
42°N
41°N
Northern Georges MBTG
EFH South MBTG
Georges Shoal 2 MBTG
Closed Area II
Alternative 7
EFH South MBTG
Georges Shoal 2 MBTG
Alternative 8
Northern Georges MBTG
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Depth (m)
elev_m
Nautical Miles
0 5 10 20 30 40

Map 75 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

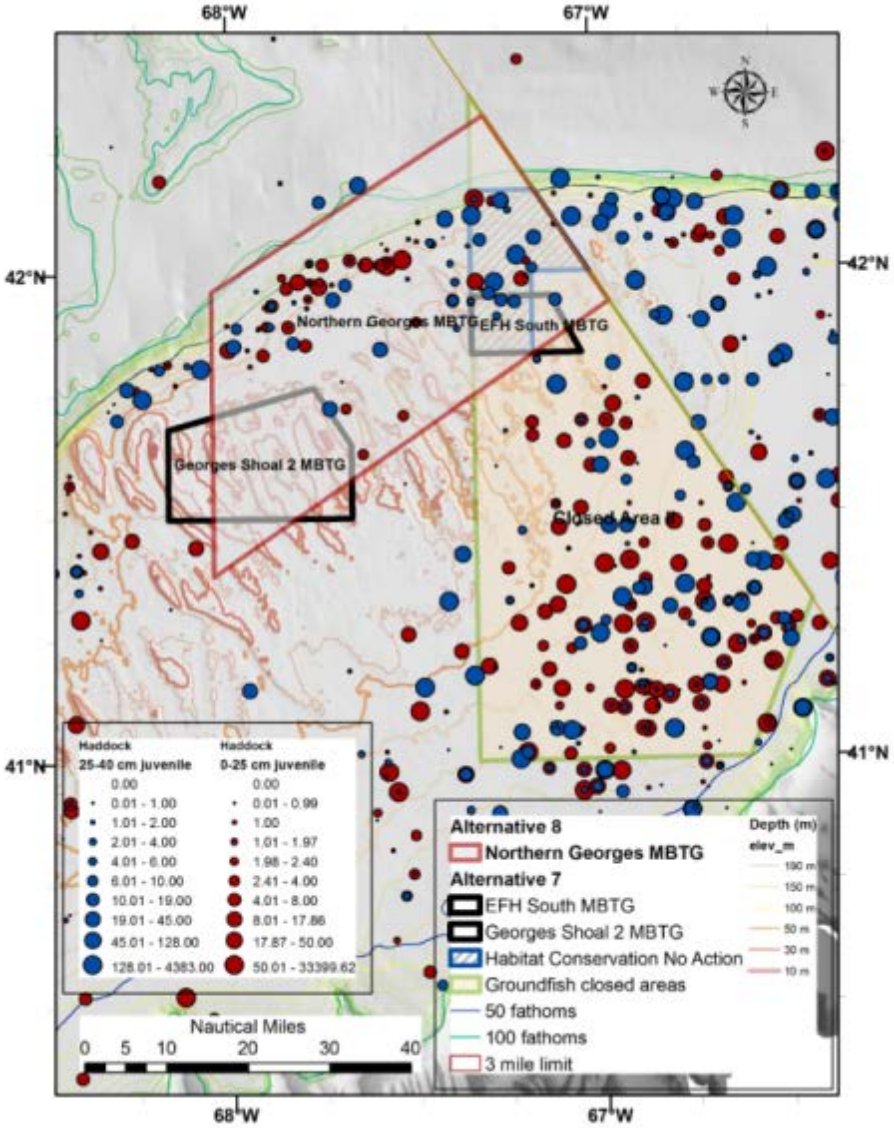


Fall and winter

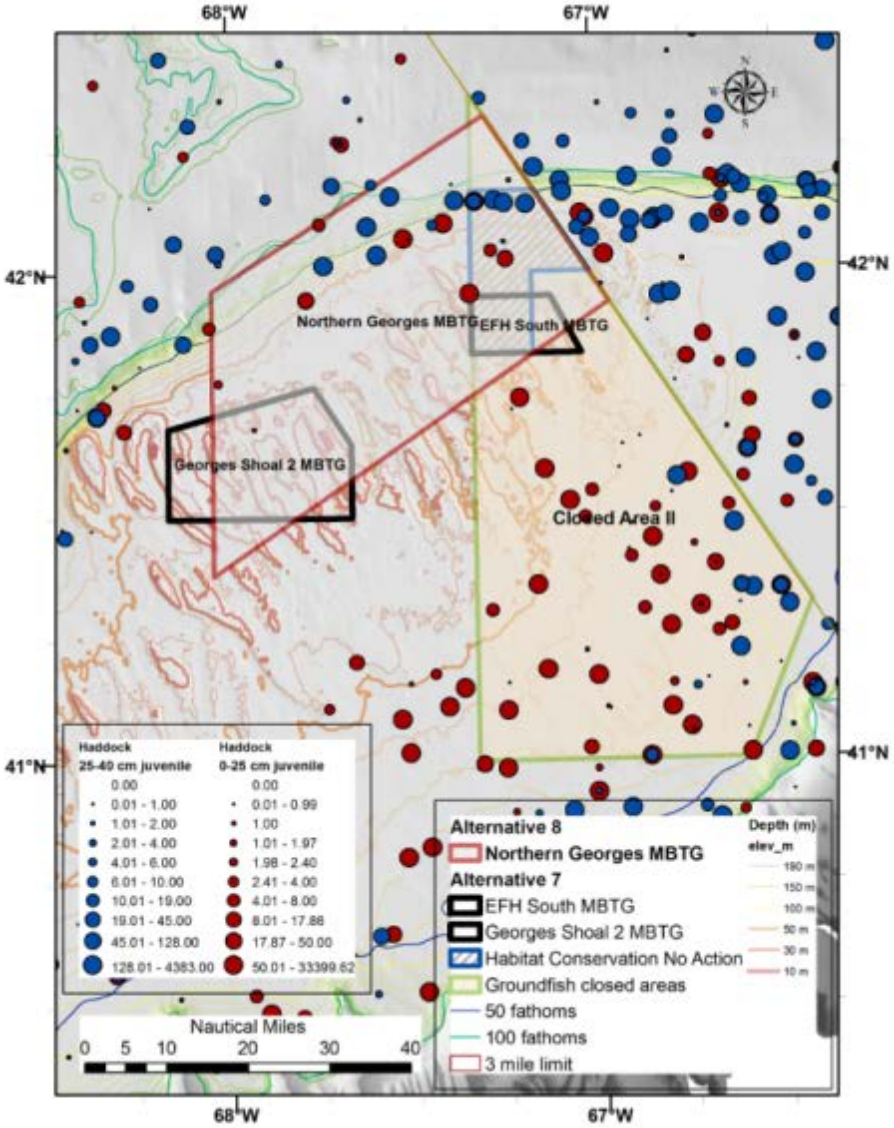


Map 76 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

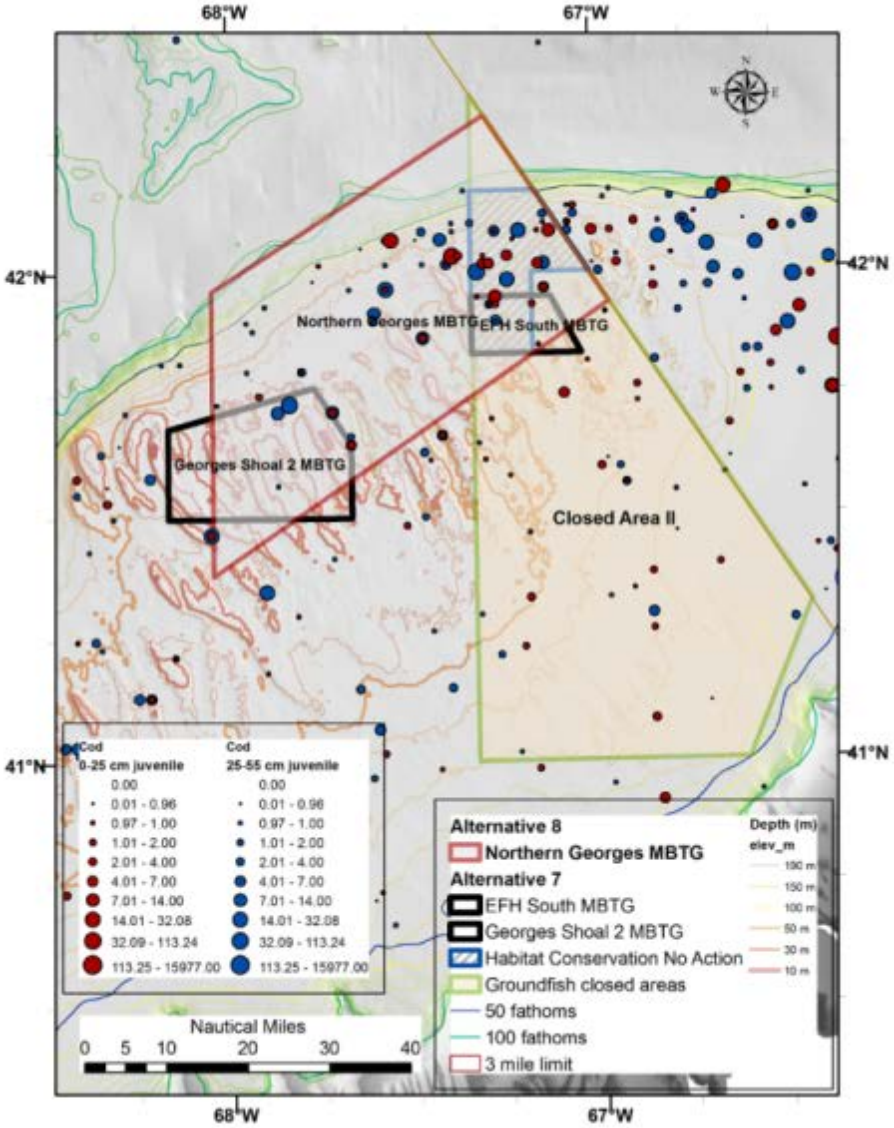


Fall and winter

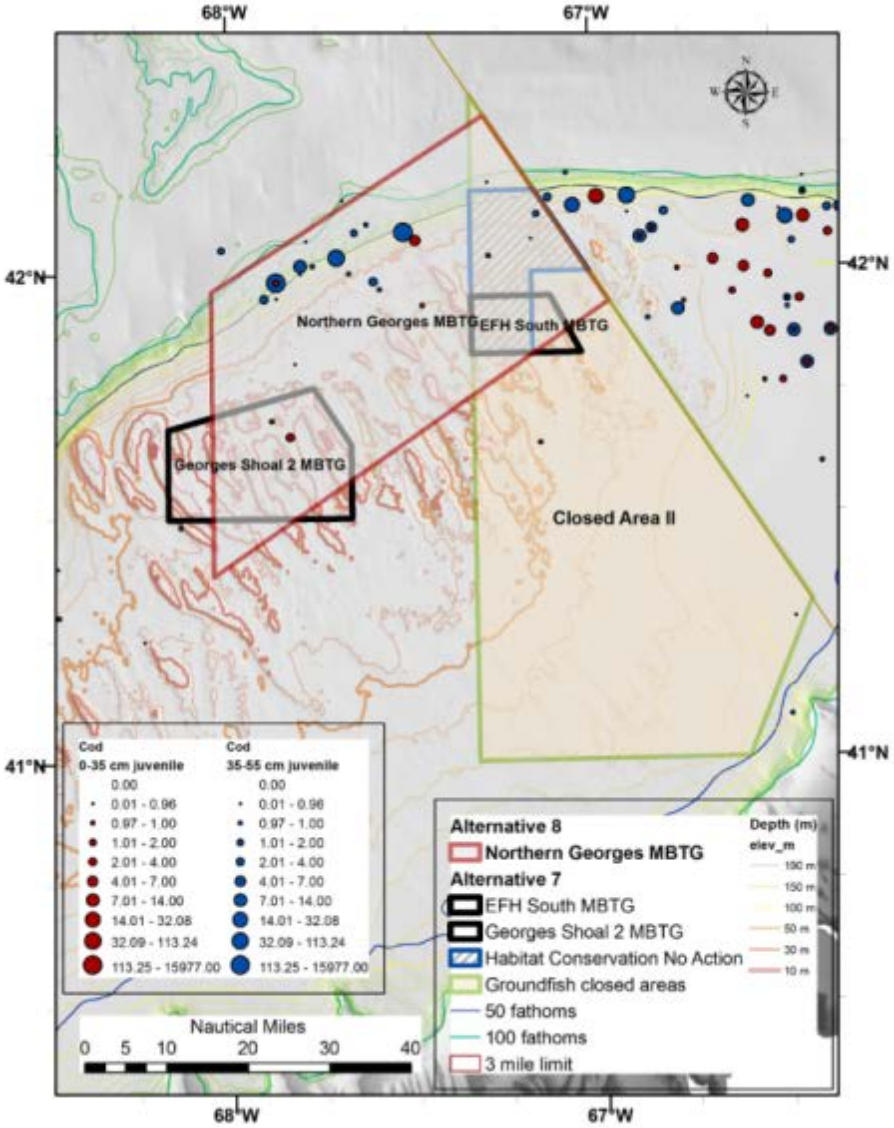


Map 77 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 1982-1991 NMFS surveys.

Spring and summer

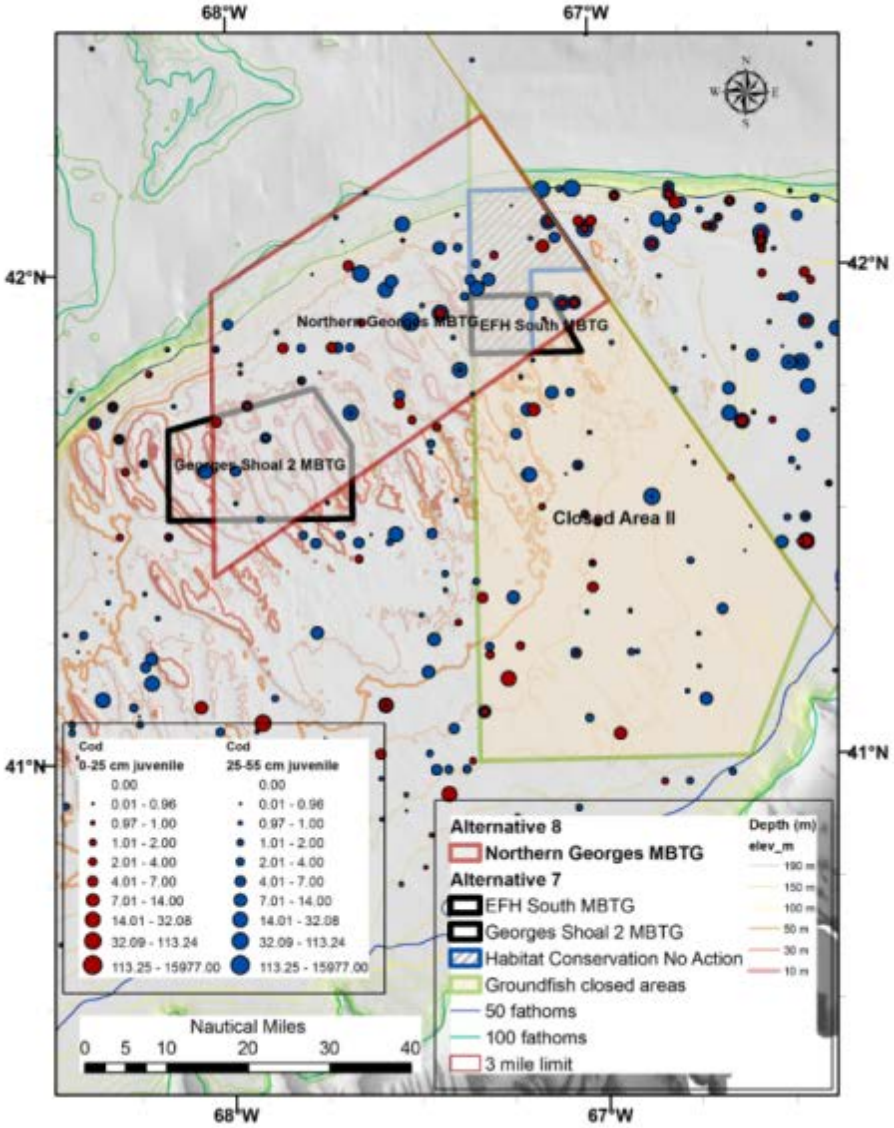


Fall and winter

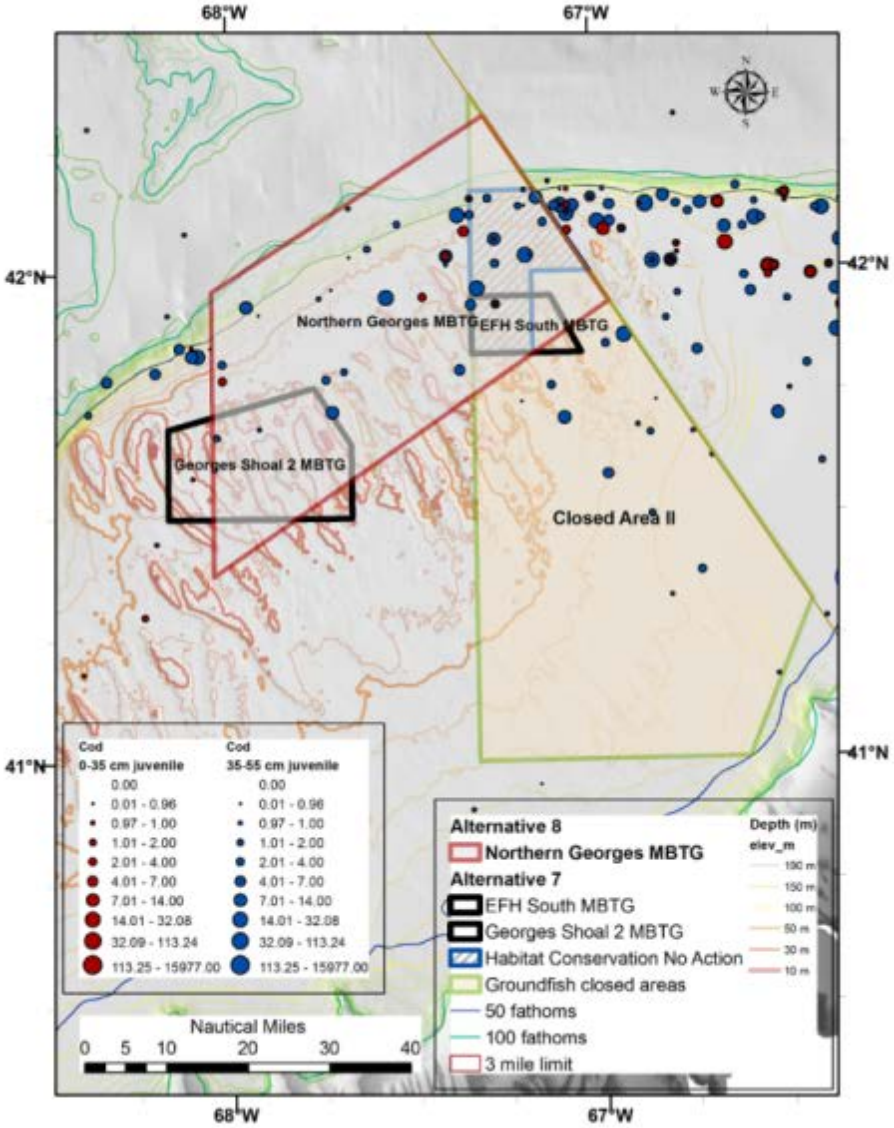


Map 78 – Georges Bank Alternatives 1, 7, and 8 overlap with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 1972-1981 NMFS surveys.

Spring and summer



Fall and winter



4.2.2.8 ***Great South Channel/Southern New England***

The age 0/1 juvenile groundfish hotspots analysis identified very few hotspots in the Great South Channel and Southern New England sub-region. Survey catches here have been generally average or less compared with the entire surveyed area, including the Gulf of Maine and Georges Bank. Habitat Management Areas in this sub-region were chosen partly due to the presence of vulnerable habitat identified in the SASI model and partly due to public input that juvenile cod are prevalent in the proposed areas. Age 0/1 cod are often found on the western side of the Great South Channel, partially covered by some of the Great South Channel alternatives, but these catches were not significantly higher than average survey catches and therefore did not qualify as a statistically valid hotspot. Furthermore, much of the Nantucket Shoals is not routinely surveyed and is not commonly fished on observed trips, so it is difficult to validate the public input regarding the abundance of age 0/1 juvenile groundfish in parts of the proposed areas.

All alternatives except Alternative 2 include two very small Habitat Management Areas in the vicinity of Cox Ledge. Although Cox Ledge serves as important habitat for some juvenile groundfish, the areas were too small to detect age 0/1 groundfish hotspots. Moreover, the small sizes of these proposed Cox Ledge Areas would be less effective than larger areas for groundfish stocks that generally have much larger ranges of movement. Additionally, detection of any potential effect on stock productivity from a closure here would be very difficult.

Given these data limitations and lack of hotspots, in many cases the effects of the alternatives in this sub-region on age 0/1 juvenile groundfish habitat and the groundfish resource are characterized as uncertain. Some alternatives were assessed as having positive impacts on age 0/1 juvenile groundfish habitat because they have a greater overlap with the distribution of age 0/1 cod in survey catches within the Great South Channel. Nonetheless it is impossible to determine whether the catches in the Great South Channel are higher or lower than they might be in unsurveyed areas. Consideration should be given that juvenile cod catches occur inshore in state waters (although not sufficiently high enough to qualify as hotspots in the Massachusetts DMF survey) and also to the east of the Nantucket Shoals. How many cod and other groundfish are in the Nantucket Shoals and how much they rely on vulnerable substrates there is highly uncertain.

4.2.2.8.1 Alternative 2 (No Habitat Management Areas)

Alternative 2 proposes no habitat management areas for the Great South Channel sub-region and therefore no hotspots are encompassed within a habitat management area. <u>This alternative is therefore expected to have negative impacts on groundfish stocks as compared to either Alternative 1/No Action, or any of the other alternatives for this sub-region. Impacts on juvenile groundfish habitat compared to Alternative 1/No Action are uncertain, depending on the amount of effort that shifts into the Nantucket Lightship Closure Area and where it would have occurred if the area remained closed.</u> Effort that shifts from the Great South Channel into the western and central portion of the Nantucket Lightship Closure Area would decrease impacts on juvenile cod habitat, but increases in the eastern portion of the Nantucket Lightship Closure Area may increase impacts on other groundfish species, such as yellowtail flounder. Impacts on age 0/1 juvenile groundfish habitat from Alternative 2 are expected to be negative compared to other

alternatives in this sub-region and could reduce potential improvements in groundfish productivity.

There are very few large spawner hotspots in the Great South Channel/Southern New England sub-region, such that neither the existing nor any alternative management areas are likely to provide a substantial positive impact on spawning groundfish. All of the action alternatives in this sub-region, including Alternative 2, remove the year-round Nantucket Lightship Groundfish Closed Area, and therefore would have a slight negative impact on groundfish spawning protection.

4.2.2.8.2 Alternative 3

Alternative 3 includes the Cox Ledge HMA and the Great South Channel East HMA, which includes deeper portions of the Channel as compared to Alternative 4. There were no weighted groundfish hotspots found in the proposed HMAs (Table 70; Map 79). It is difficult to assess groundfish habitat in the Great South Channel East HMA because a large portion that overlaps the Nantucket Shoals is not surveyed. Although there are no weighted hotspots in the two proposed habitat management areas, nine age 0/1 winter flounder hotspots were detected from the fall survey (Table 71). Winter flounder hotspots were given zero weight in the analysis because juveniles are found almost exclusively in less vulnerable mud or sand substrates.

Map 80 shows the relationship between the proposed habitat management alternatives and survey catches of age 0/1 and larger sub-legal cod. There appear to be few juvenile cod in the existing habitat closure in any of the seasonal surveys, but there is some overlap with the Great South Channel East HMA.

Map 81 shows the relationship between Alternative 3 and survey catches of age 0/1 and larger sub-legal haddock. Except for the central portion of Closed Area I and the northeastern part of the Nantucket Lightship Closure Area (which are also scallop dredge access areas), there is little overlap of age 0/1 haddock with any habitat closure, year-round groundfish closure, or proposed habitat management area. There is some indication that the northern area of Closed Area I hosts older juvenile haddock, although the substrates in this area are not estimated to be as vulnerable to the impacts of fishing, especially compared to the substrates that older haddock rely on along the Northern Edge of Georges Bank.

<u>Relative to Alternative 1/No Action and the other alternatives in this sub-region, the impact of this alternative on groundfish habitat and on groundfish stocks is very uncertain.</u> Much of this uncertainty arises because a large portion of the Nantucket Shoals is unsurveyed and few observed commercial fishing trips occur there. <u>Given the eastern extension into the Great South Channel, Alternative 3 is expected to have positive impacts relative to Alternatives 4 and which does not includes portions of the channel where age 0/1 cod have been observed in survey catches.</u> Impacts on age 0/1 juvenile groundfish habitat compared to Alternative 6 are uncertain, because it is not known what effect that gear modifications in the Great South Channel GMA will have on fishing effort and its impact on vulnerable habitats where cod occur. It should be noted that applying gear options 3 and 4 (i.e. gear modifications) would have similar effects as in Alternative 6, but the relative impacts on age 0/1 juvenile groundfish habitat would therefore be negative compared to Alternative 6.

There are very few large spawner hotspots in the Great South Channel/Southern New England sub-region, such that neither the existing nor any alternative management areas are likely to provide a substantial positive impact on spawning groundfish. All of the action alternatives in this sub-region, including Alternative 3, remove the year-round Nantucket Lightship Groundfish Closed Area, and therefore would have a slight negative impact on groundfish spawning protection.

4.2.2.8.3 Alternative 4

Alternative 4 is a subset of Alternative 3, but the Great South Channel HMA does not extend as far to the east into the deeper waters of the Great South Channel where age 0/1 cod are more numerous in survey catches. Like any other action alternative for the Great South Channel sub-region, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 70; Map 80). Like Alternative 3, only (6) winter flounder hotspots were detected by the analysis of age 0/1 fish survey catches. They were present in the fall survey, but given zero weight in the final analysis because juvenile winter flounder are found almost exclusively on less vulnerable mud or sand substrates. Furthermore, it is difficult to assess groundfish habitat in the proposed habitat management areas because a large portion that overlaps the Nantucket Shoals is not surveyed.

<u>The effect of this alternative on groundfish habitat and on groundfish stocks is therefore uncertain. Due to less overlap with cod distribution in the Great South Channel, it is likely to have fewer positive impacts than Alternative 3, but have positive impacts compared to Alternative 5. Like Alternative 3, the impacts on age 0/1 juvenile groundfish habitat compared to Alternative 6 are also uncertain due to the unknown effects of a gear management area in the Great South Channel.</u>

There are very few large spawner hotspots in the Great South Channel/Southern New England sub-region, such that neither the existing nor any alternative management areas are likely to provide a substantial positive impact on spawning groundfish. All of the action alternatives in this sub-region, including Alternative 4, remove the year-round Nantucket Lightship Groundfish Closed Area, and therefore would have a slight negative impact on groundfish spawning protection.

4.2.2.8.4 Alternative 5

Alternative 5 also includes the Cox Ledge HMA, but proposes the Nantucket Shoals HMA that includes the northern portion of the Nantucket Lightship Habitat Closure Area and overlaps Nantucket Shoals, where there are few to no survey observations. Like any other action alternative for the Great South Channel sub-region, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 70; Map 82). As discussed above, it is difficult to assess groundfish habitat in the proposed habitat management areas, because a large portion that overlaps the Nantucket Shoals is not surveyed. Only one winter flounder hotspot was identified in the Nantucket Shoals HMA, from the fall survey data.

Therefore, the effects of this alternative on groundfish habitat and on groundfish stocks are uncertain. Due to less overlap with cod distribution in the Great South Channel, it is likely to have less habitat benefit than Alternative 3.

There are very few large spawner hotspots in the Great South Channel/Southern New England sub-region, such that neither the existing nor any alternative management areas are likely to provide a substantial positive impact on spawning groundfish. All of the action alternatives in this sub-region, including Alternative 5, remove the year-round Nantucket Lightship Groundfish Closed Area, and therefore would have a slight negative impact on groundfish spawning protection.

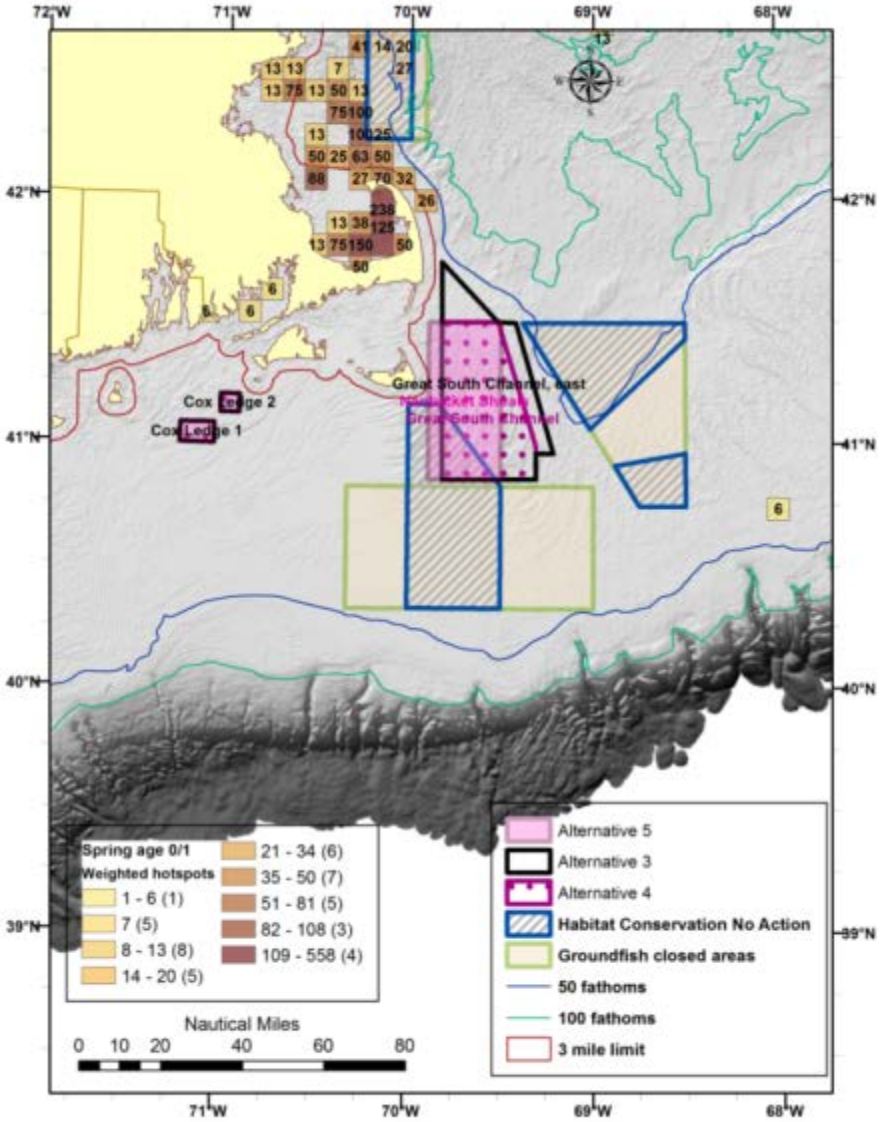
Table 70 – Total unweighted and weighted hotspots in GSC habitat management area alternatives compared to No Action.

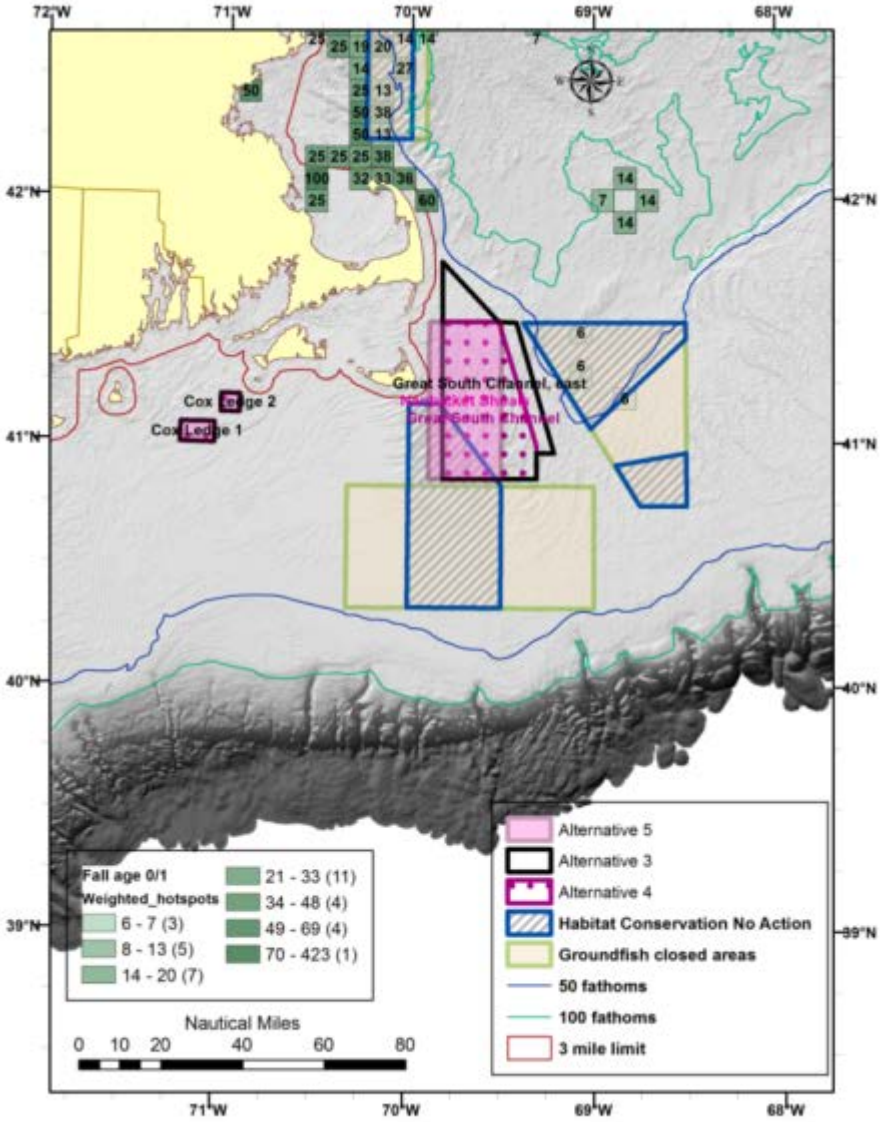
	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Great South Channel								
No Action	**26**	**0.0**	**133**	**5.8**	**1**	**0.0**	**6**	**80.4**
EFH closure	10	0.0	54	0.0	0	0.0	2	40.2
GF closure	16	0.0	79	5.8	1	0.0	4	40.2
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	0	0.0	0	0.0	9	0.0	0	0.0
Alternative 4	0	0.0	0	0.0	6	0.0	0	0.0
Alternative 5	0	0.0	0	0.0	1	0.0	0	0.0
Alternative 6	0	0.0	0	0.0	13	0.0	0	0.0

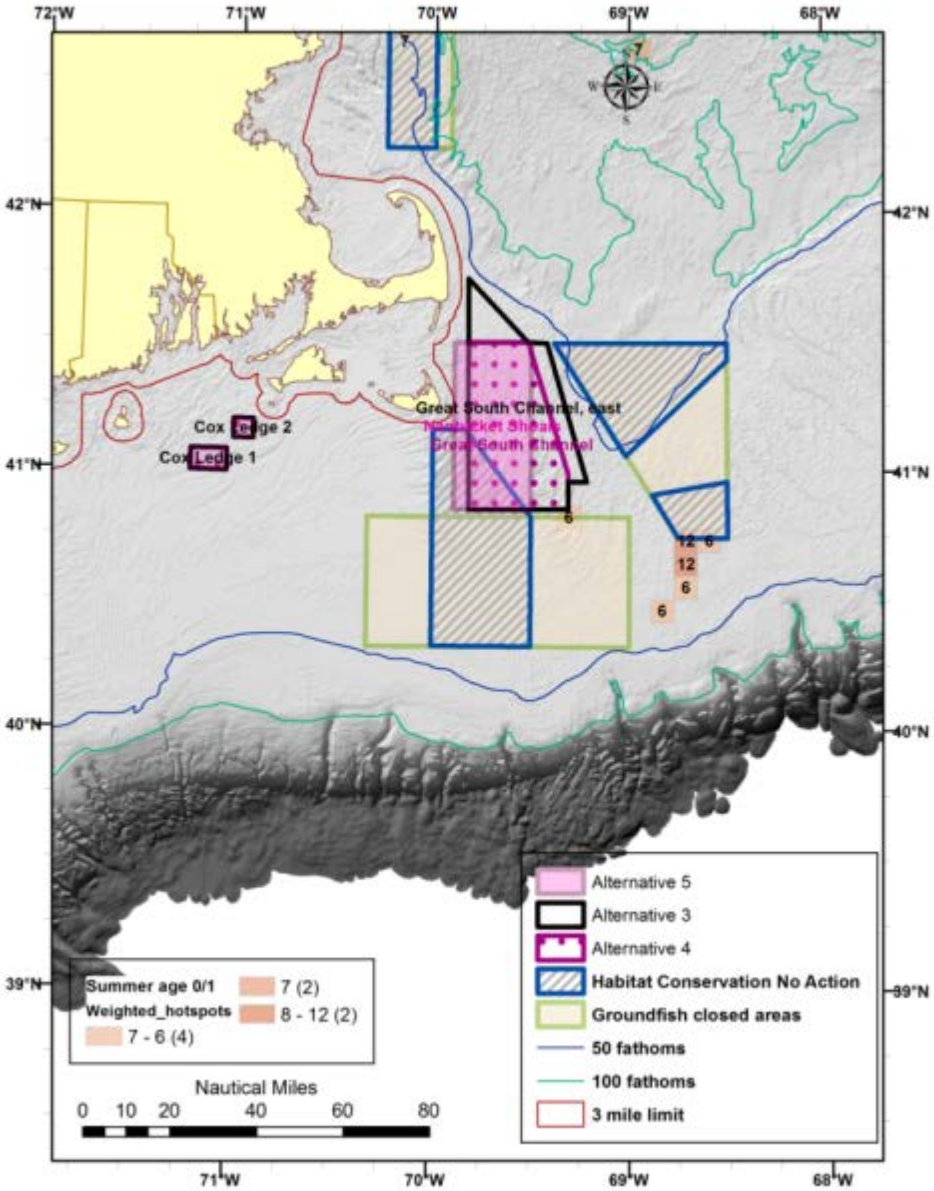
Table 71 – Total hotspots by species for Great South Channel/Southern New England habitat management area alternatives, compared to No Action.

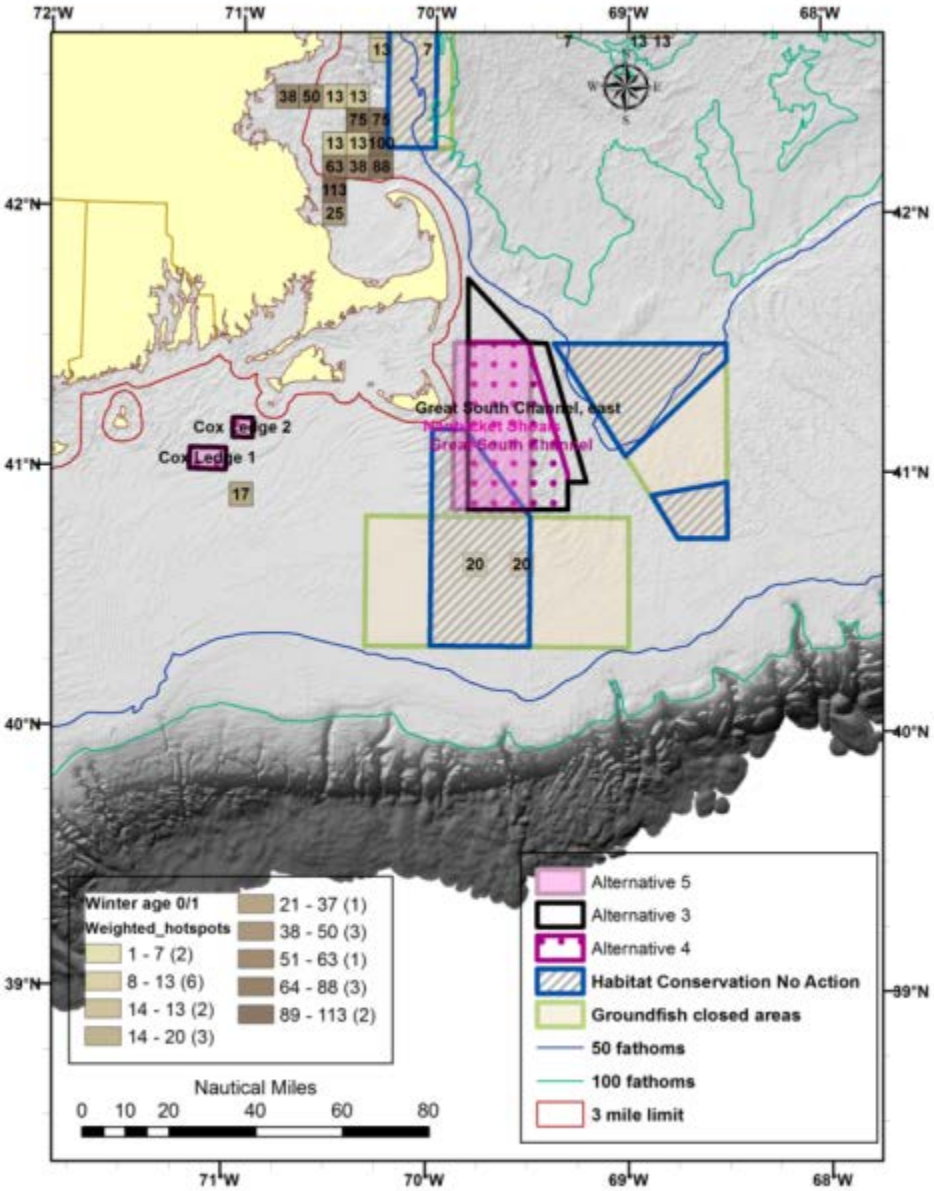
	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Great South Channel / Southern New England																		
Alternative 1 (No Action)	0	0	0	0	0	4	35	1	0	0	24	4	0	1	0	0	0	69
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	9
Alternative 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6
Alternative 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Alternative 6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	11	0	0	13

Map 79 – GSC Alternatives 3, 4, and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



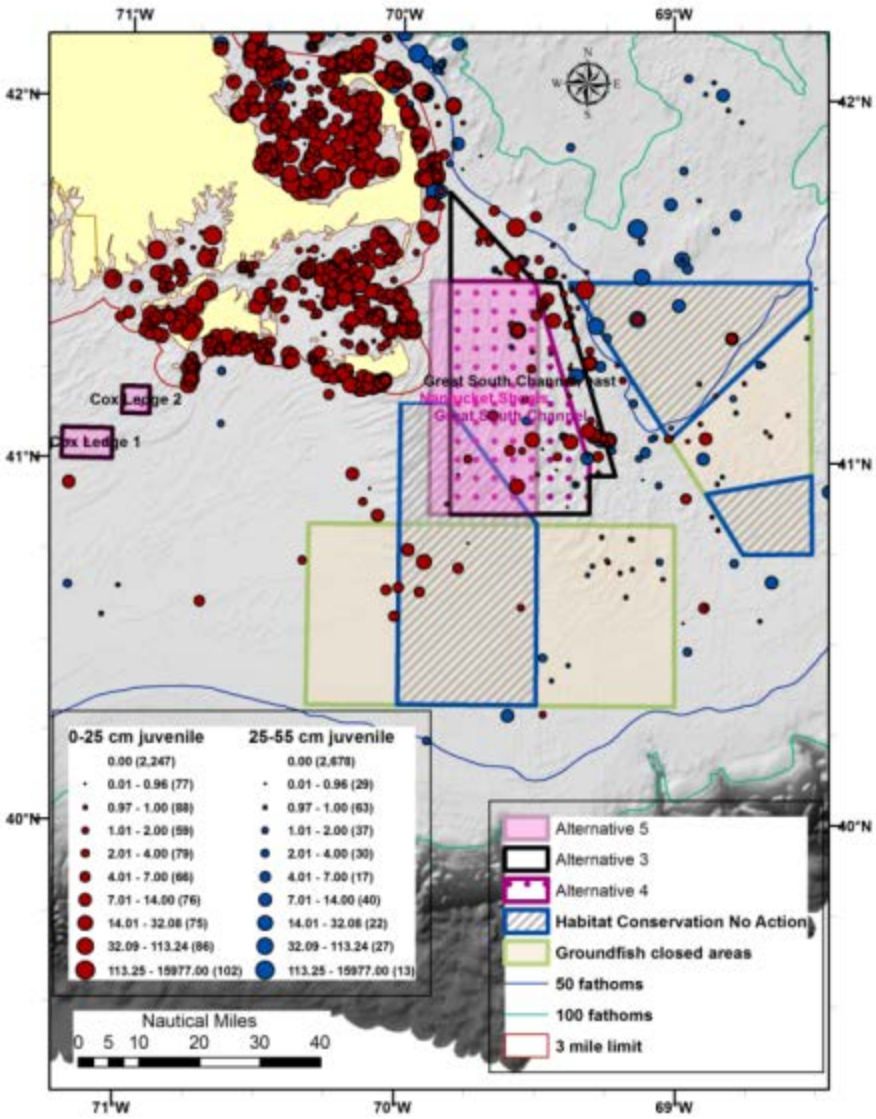



72°W
71°W
70°W
69°W
68°W
42°N
41°N
40°N
39°N
Cox Ledge 2
Cox Ledge 1
Great South Channel, east
Nantucket Shoals
Great South Channel
Summer age 0/1
Weighted_hotspots
7 - 6 (4)
7 (2)
8 - 12 (2)
Alternative 5
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80

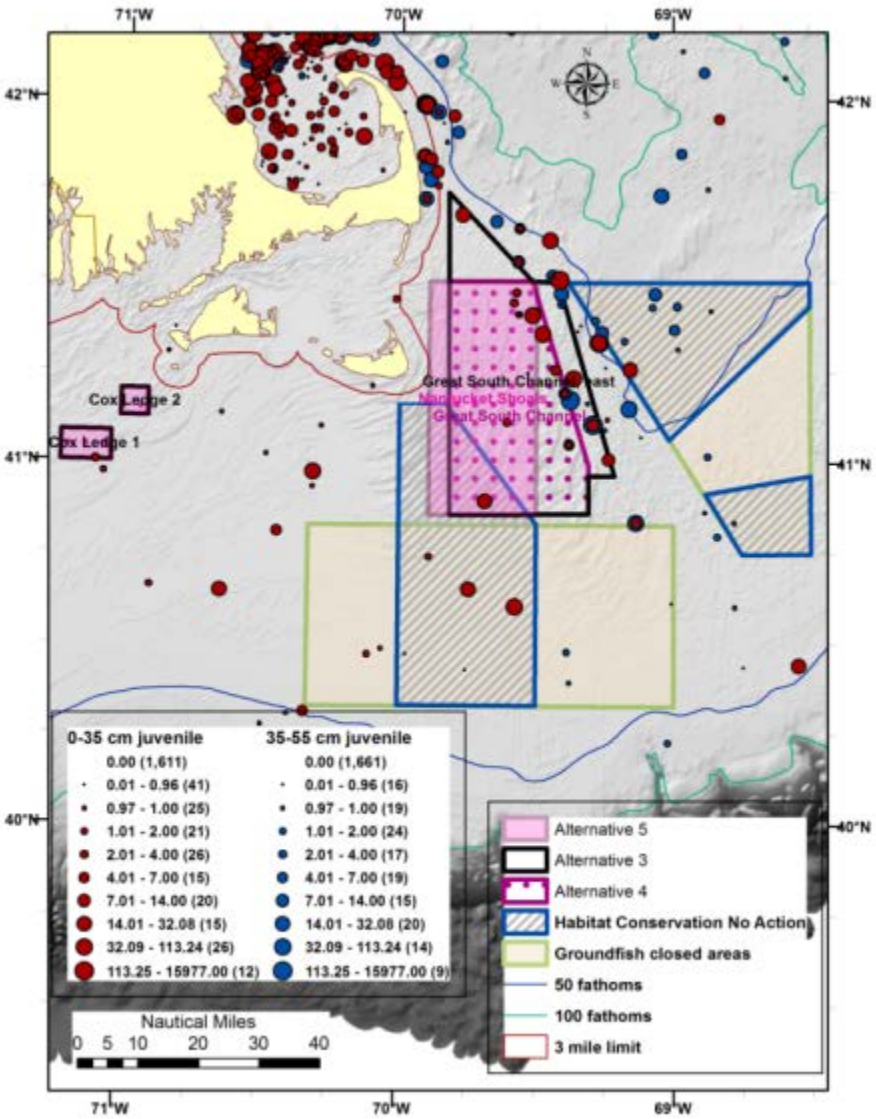

72°W
71°W
70°W
69°W
68°W
42°N
41°N
40°N
39°N
Cox Ledge 2
Cox Ledge 1
Great South Channel, east
Nantucket Shoals
Great South Channel
Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (2)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Alternative 5
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80

Map 80 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys.

Spring and summer

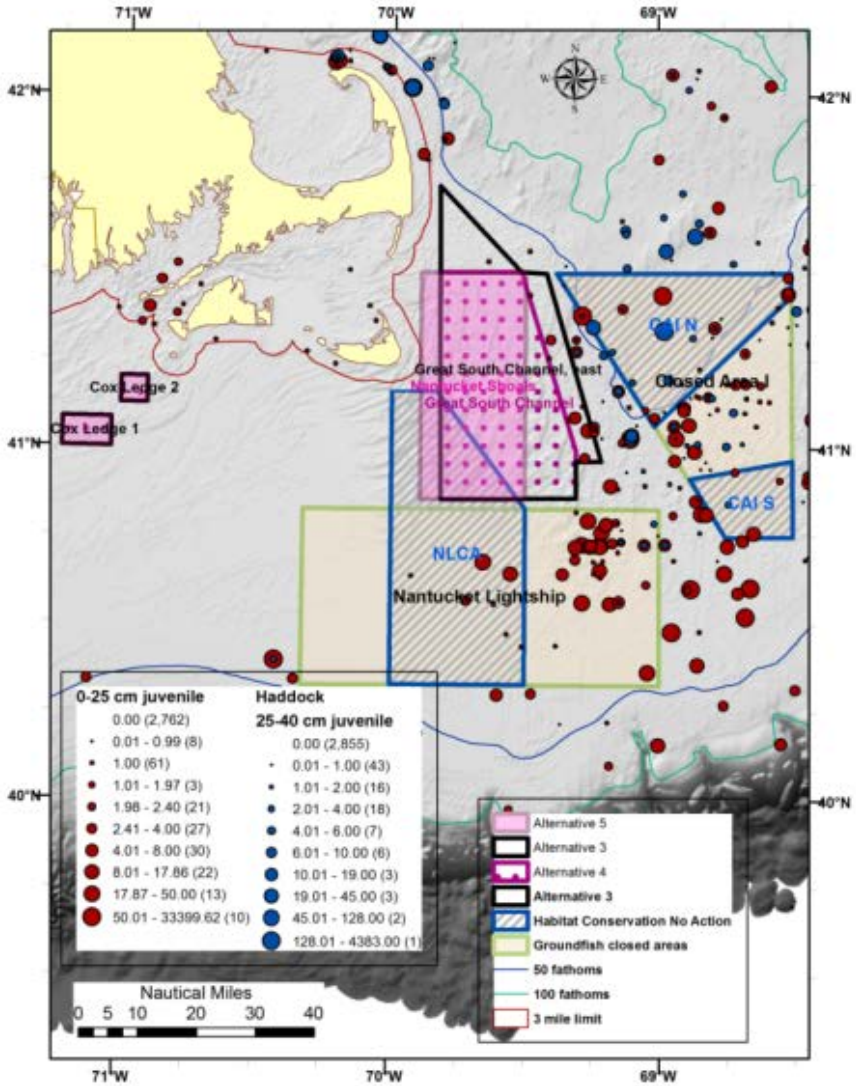


Fall and winter

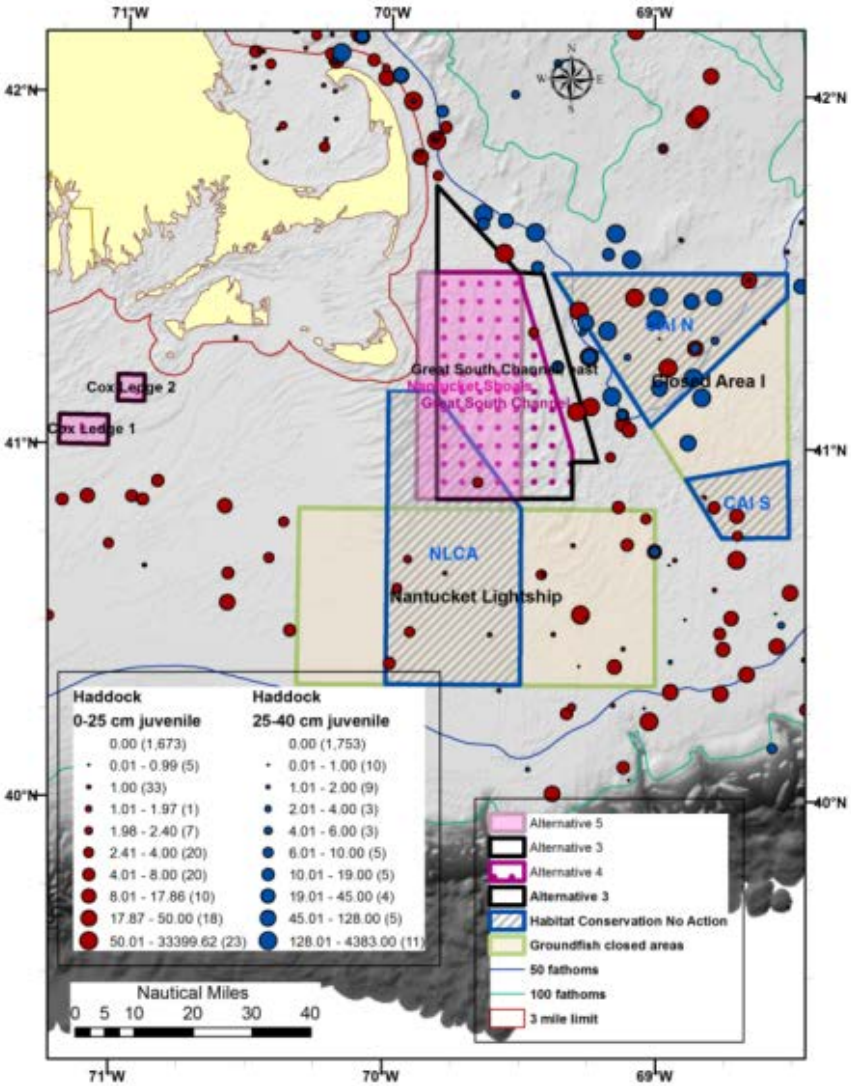


Map 81 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys.

Spring and summer



Fall and winter



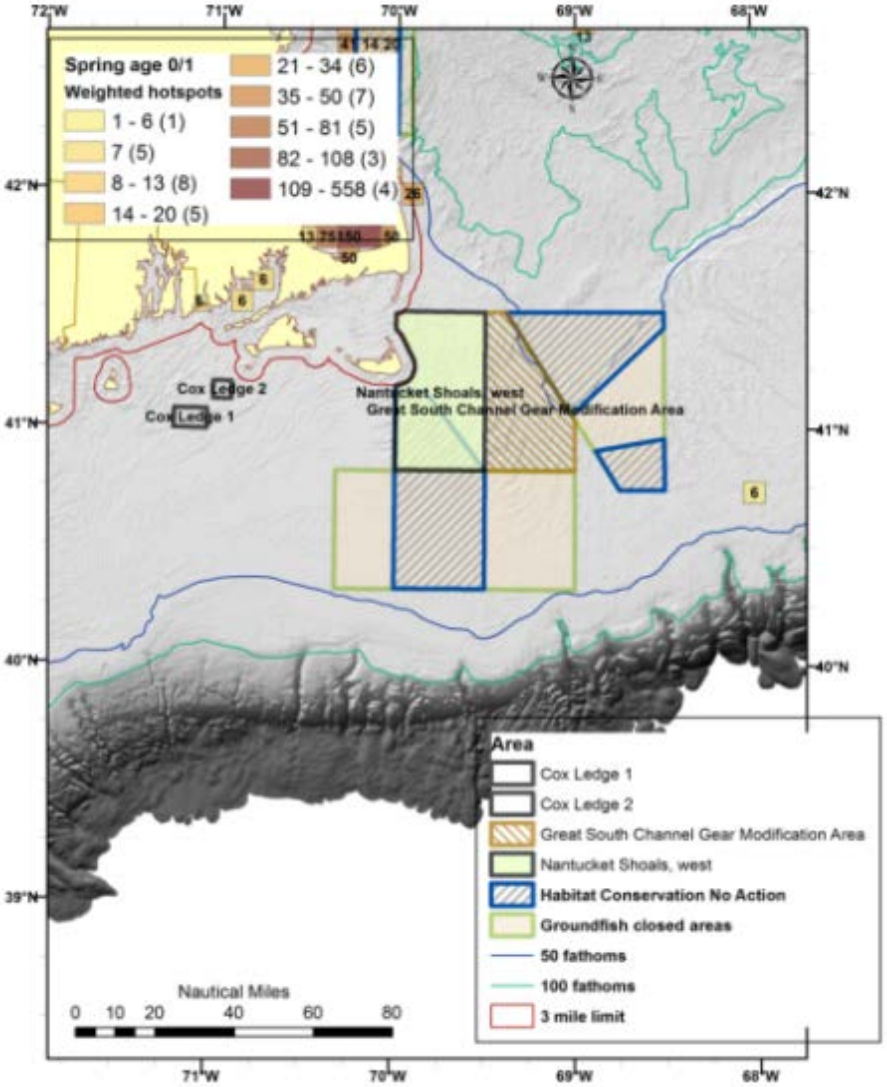
4.2.2.8.5 Alternative 6

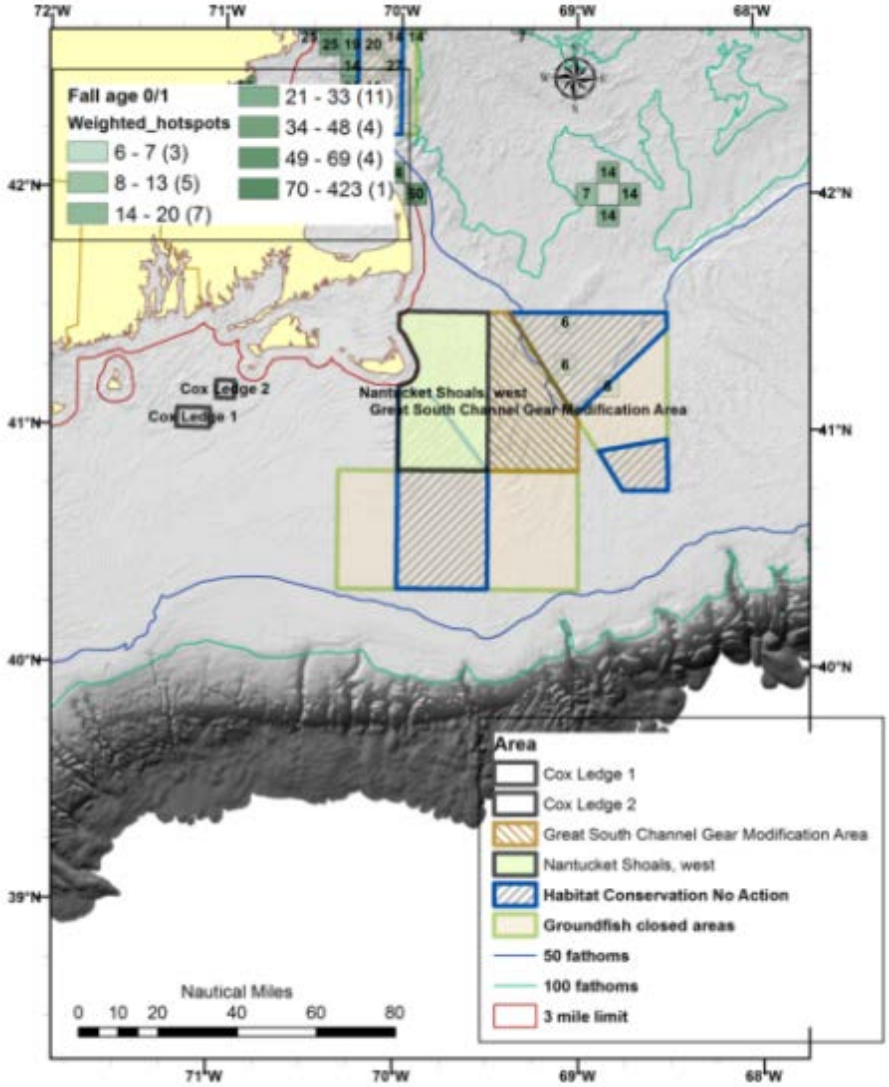
Alternative 6 includes the Cox Ledge HMA, the Nantucket Shoals West HMA, which is a slight variation of the Alternative 5 area, and adds a gear modification area which includes all of the Great South Channel east to the boundary of Closed Area I (Map 82). Assessing the effect on groundfish habitat is difficult because the proposed areas have considerable overlap with unsurveyed areas of Nantucket Shoals. Nonetheless the gear modification area has substantial overlap with known catches of age 0/1 cod that inhabit the Channel. Although there were no weighted age 0/1 groundfish hotspots associated with areas proposed by this alternative, they contained more unweighted hotspots than any other alternative except for Alternative 1 (No Action). Two red hake and 11 winter flounder hotspots were detected in these areas by the analysis of age 0/1 survey catches (Table 71). Red hake were given zero weight because they are not large mesh groundfish species and winter flounder were given zero weight because the juveniles are found almost exclusively on mud or sand substrates (which were classified as less vulnerable).

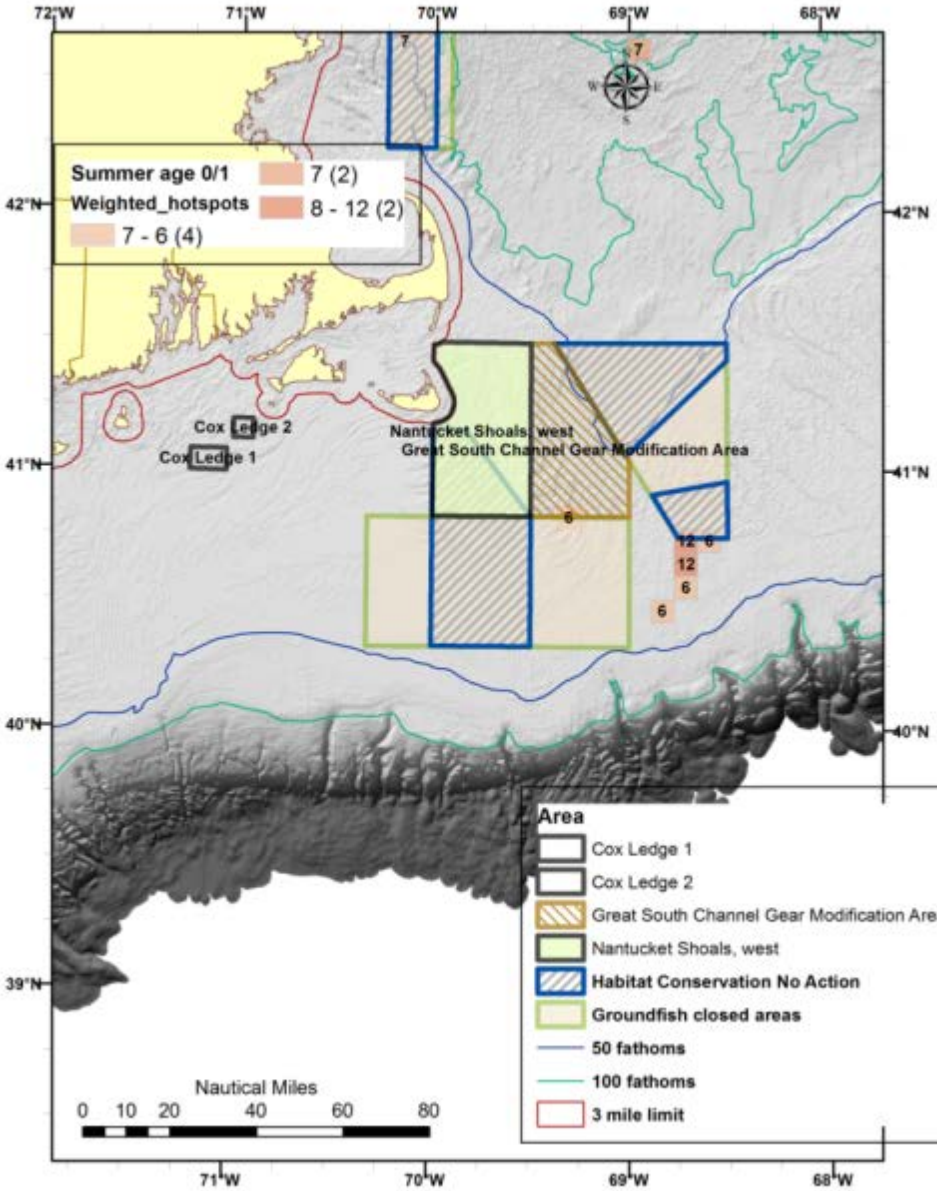
<u>The effect of this alternative on groundfish habitat and on groundfish stocks is highly uncertain, due to uncertainties about the effectiveness of proposed trawl gear modifications (discussed in Section 4.1.3.1.5) coupled with exemptions for fishing with scallop and clam dredges.</u>

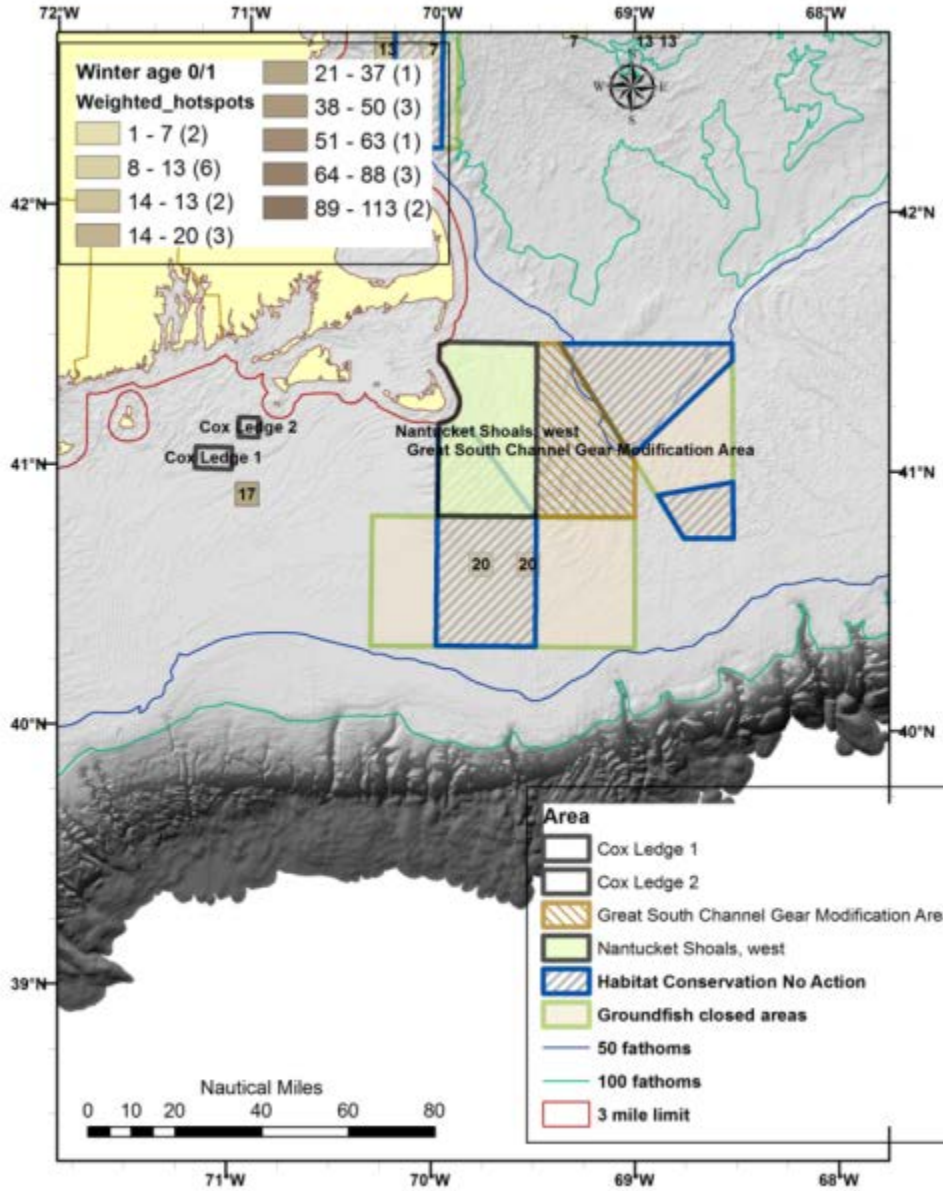
There are very few large spawner hotspots in the Great South Channel/Southern New England sub-region, such that neither the existing nor any alternative management areas are likely to provide a substantial positive impact on spawning groundfish. All of the action alternatives in this sub-region, including Alternative 6, remove the year-round Nantucket Lightship Groundfish Closed Area, and therefore would have a slight negative impact on groundfish spawning protection.

Map 82 – GSC Alternatives 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data. Alternative 5 includes only the Nantucket Shoals west area (shaded light green with a black border). Alternative 6 includes the Nantucket Shoals west area and a Great South Chanel Gear Modification Area (brown hatching surrounded by a brown border).






Summer age 0/1
Weighted_hotspots
7 - 6 (4)
7 (2)
8 - 12 (2)
Cox Ledge 2
Cox Ledge 1
Nantucket Shoals, west
Great South Channel Gear Modification Area
Area
Cox Ledge 1
Cox Ledge 2
Great South Channel Gear Modification Are
Nantucket Shoals, west
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80

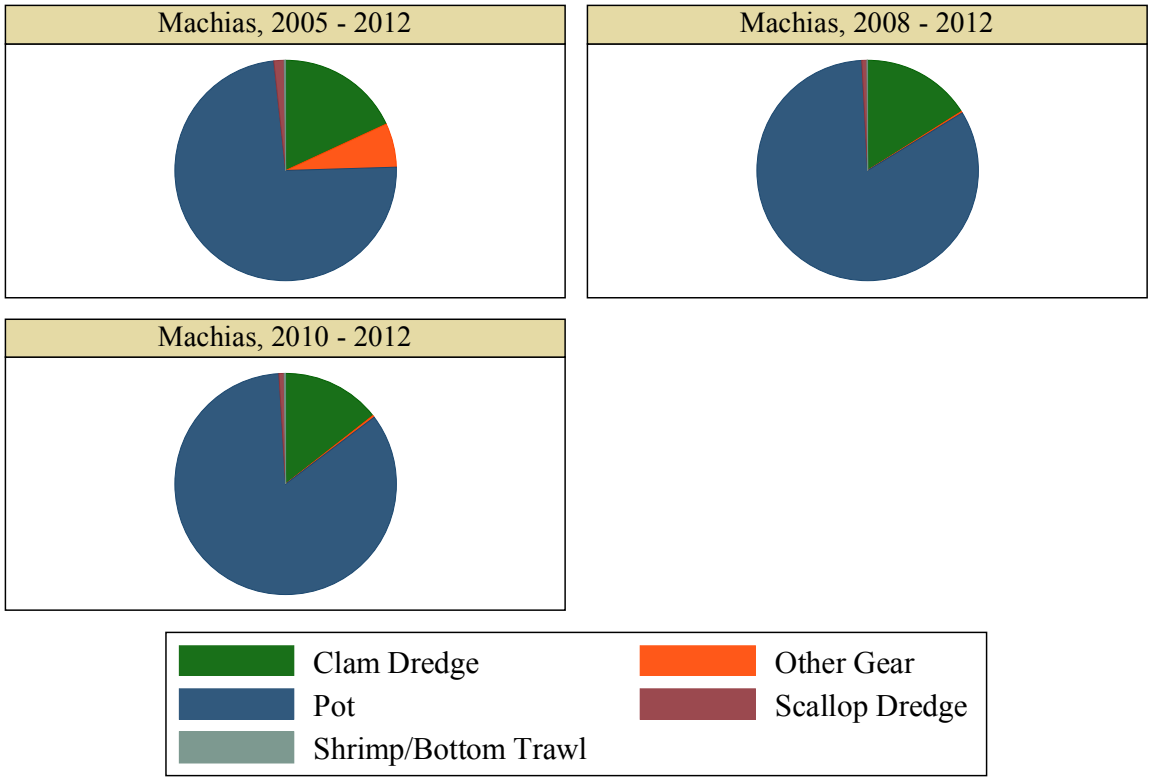

Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (2)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Cox Ledge 2
Cox Ledge 1
Nantucket Shoals, west
Great South Channel Gear Modification Area
Area
Cox Ledge 1
Cox Ledge 2
Great South Channel Gear Modification Are
Nantucket Shoals, west
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80

4.2.3 Human communities and the fishery

4.2.3.1 ***Eastern Gulf of Maine***

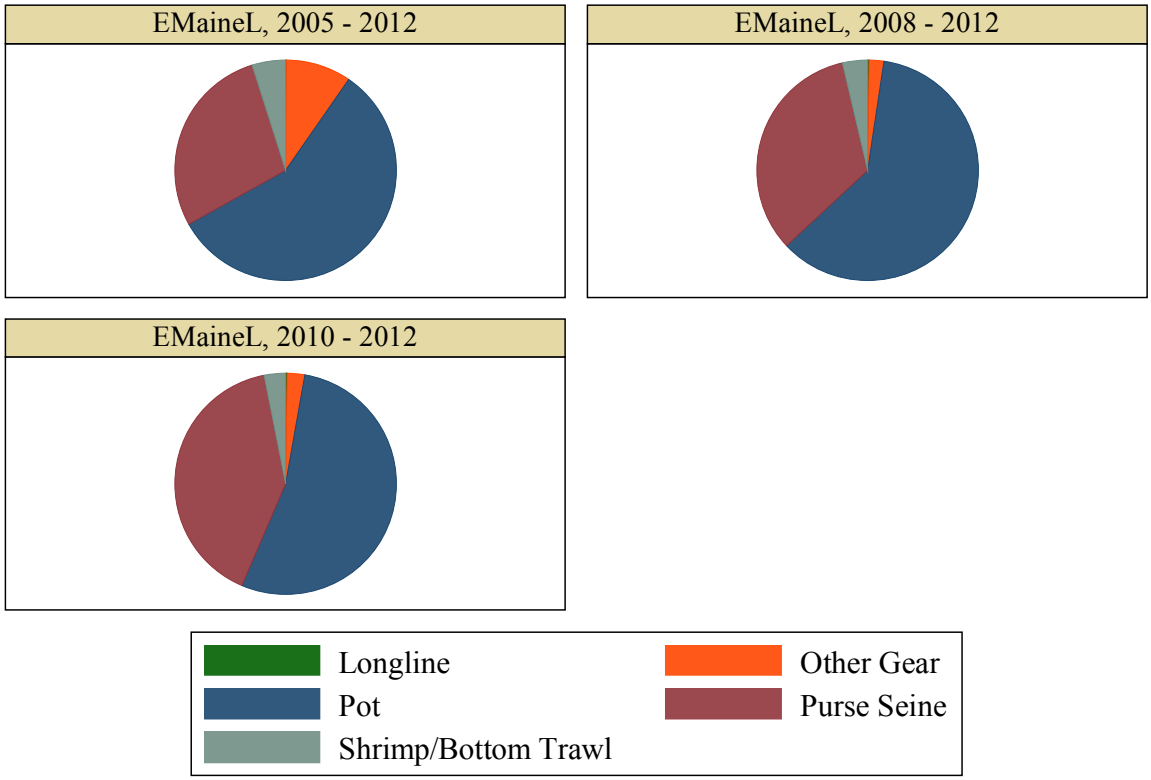
Tables and figures related to analysis of the economic and social impacts of the Eastern Gulf of Maine habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 17 – Machias HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 476,109; 2008 - 2012 = $ 416,544; 2010 - 2012 = $ 439,210



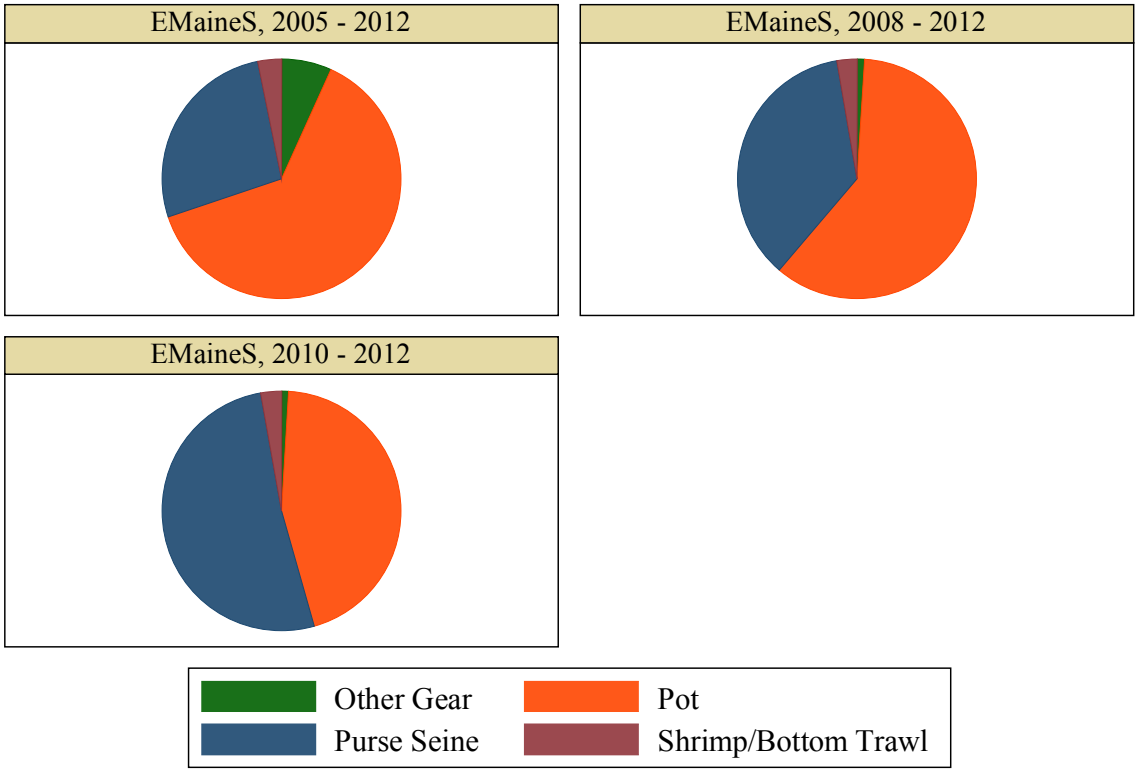
Graphs by Area and years

Figure 18 – Large Eastern Maine HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,076,300; 2008 - 2012 =$ 2,059,535; 2010 - 2012 = $ 2,719,470



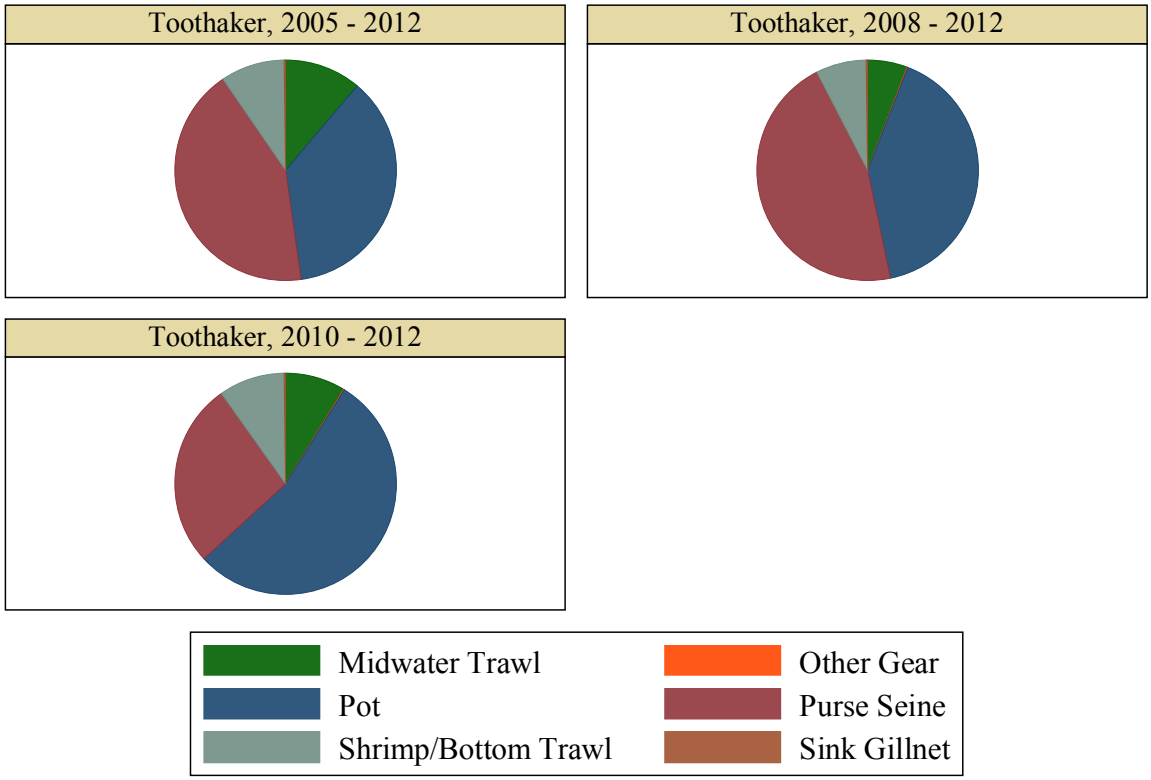
Graphs by Area and years

Figure 19 – Small Eastern Maine HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 612,696; 2008 - 2012 =$ 574,660; 2010 - 2012 = $ 661,771



Graphs by Area and years

Figure 20 – Toothaker Ridge HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 774,603; 2008 - 2012 = $ 825,982; 2010 - 2012 = $ 776,860



Graphs by Area and years

Table 72 – Mobile bottom-tending gear revenues potentially impacted by the areas included in the Eastern Gulf of Maine Habitat Alternatives. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U= unknown vessel characteristics.

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Machias (Alts 2 and 3)	Clam Dredge	ALL	85,964	70,422	45,947	168,542	42,572	18	877	2005 - 2012
	Clam Dredge	ALL	66,409	69,268	22,444	99,680	42,572	15	701	2008 - 2012
	Clam Dredge	ALL	63,264	69,268	12,452	71,577	48,948	12	624	2010 - 2012
	Scallop Dredge	ALL	7,345	4,232	8,099	26,158	565	8	88	2005 - 2012
	Scallop Dredge	ALL	3,085	3,388	1,565	4,828	565	6	56	2008 - 2012
	Scallop Dredge	ALL	3,344	3,388	317	3,637	3,007	6	67	2010 - 2012
	Shrimp/Bottom Trawl	ALL	851	618	761	1,898	16	7	18	2005 - 2012
	Shrimp/Bottom Trawl	ALL	581	227	763	1,898	16	5	19	2008 - 2012
	Shrimp/Bottom Trawl	ALL	887	574	896	1,898	190	5	19	2010 - 2012
Large Eastern Maine (Alt 2)	Shrimp/Bottom Trawl	L	20,136	23,112	11,945	41,552	6,027	11	45	2005 - 2012
	Shrimp/Bottom Trawl	L	17,546	8,548	15,037	41,552	6,027	11	44	2008 - 2012
	Shrimp/Bottom Trawl	L	24,385	23,164	16,590	41,552	8,439	14	57	2010 - 2012
	Shrimp/Bottom Trawl	M	49,066	40,277	21,732	81,638	23,883	17	107	2005 - 2012
	Shrimp/Bottom Trawl	M	34,236	36,280	7,183	42,249	23,883	11	71	2008 - 2012
	Shrimp/Bottom Trawl	M	30,884	30,463	7,221	38,306	23,883	10	68	2010 - 2012
	Shrimp/Bottom Trawl	S/U	31,899	26,100	20,205	74,381	12,686	15	135	2005 - 2012
	Shrimp/Bottom Trawl	S/U	23,183	18,738	12,598	44,442	12,686	14	126	2008 - 2012
	Shrimp/Bottom Trawl	S/U	28,164	24,087	14,671	44,442	15,962	14	142	2010 - 2012
	Longline	ALL	2,854	1,456	3,106	8,662	0	5	25	2005 - 2012
	Longline	ALL	4,253	3,690	3,190	8,662	977	6	37	2008 - 2012
	Longline	ALL	6,187	6,209	2,486	8,662	3,690	7	40	2010 - 2012
	Purse Seine	ALL	584,606	511,195	500,888	1,303,009	3,269	7	100	2005 - 2012
	Purse Seine	ALL	684,882	700,101	618,803	1,303,009	3,269	8	98	2008 - 2012
	Purse Seine	ALL	1,098,920	1,293,650	345,419	1,303,009	700,101	8	119	2010 - 2012
Small Eastern Maine (Alt 3)	Shrimp/Bottom Trawl	L	3,886	4,644	2,755	8,630	247	8	32	2005 - 2012
	Shrimp/Bottom Trawl	L	3,243	1,505	3,439	8,630	247	7	28	2008 - 2012
	Shrimp/Bottom Trawl	L	4,512	4,658	4,194	8,630	247	9	34	2010 - 2012
	Shrimp/Bottom Trawl	M	9,596	9,886	3,820	14,542	5,489	14	72	2005 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	Shrimp/Bottom Trawl	M	7,829	5,826	3,874	14,542	5,489	8	43	2008 - 2012
	Shrimp/Bottom Trawl	M	8,619	5,826	5,132	14,542	5,489	7	39	2010 - 2012
	Shrimp/Bottom Trawl	S/U	6,264	3,846	5,414	17,530	2,093	13	86	2005 - 2012
	Shrimp/Bottom Trawl	S/U	4,508	3,238	3,806	11,224	2,093	11	77	2008 - 2012
	Shrimp/Bottom Trawl	S/U	5,648	3,626	4,890	11,224	2,093	10	81	2010 - 2012
	Purse Seine	ALL	164,912	91,314	210,051	625,825	590	6	66	2005 - 2012
	Purse Seine	ALL	207,032	86,136	264,877	625,825	590	7	65	2008 - 2012
	Purse Seine	ALL	340,437	309,351	271,184	625,825	86,136	7	92	2010 - 2012
Toothaker Ridge (Alt 3)	Shrimp/Bottom Trawl	L	9,502	6,963	8,255	28,187	2,350	17	83	2005 - 2012
	Shrimp/Bottom Trawl	L	11,012	8,314	10,265	28,187	2,350	17	95	2008 - 2012
	Shrimp/Bottom Trawl	L	16,098	11,794	10,613	28,187	8,314	22	138	2010 - 2012
	Shrimp/Bottom Trawl	M	24,404	22,825	9,161	40,847	12,321	23	214	2005 - 2012
	Shrimp/Bottom Trawl	M	18,946	19,247	4,703	25,311	12,321	18	159	2008 - 2012
	Shrimp/Bottom Trawl	M	21,054	20,338	3,949	25,311	17,512	19	161	2010 - 2012
	Shrimp/Bottom Trawl	S/U	38,814	37,652	14,026	57,724	18,052	28	394	2005 - 2012
	Shrimp/Bottom Trawl	S/U	31,306	31,213	9,945	44,400	18,052	25	327	2008 - 2012
	Shrimp/Bottom Trawl	S/U	37,322	36,353	6,647	44,400	31,213	25	347	2010 - 2012
	Purse Seine	ALL	330,808	224,057	389,761	1,232,128	18,348	8	94	2005 - 2012
	Purse Seine	ALL	378,119	245,346	499,630	1,232,128	18,348	10	91	2008 - 2012
	Purse Seine	ALL	209,864	245,346	176,471	365,899	18,348	10	85	2010 - 2012
	Sink Gillnet	ALL	1,611	1,621	960	2,699	221	10	25	2005 - 2012
	Sink Gillnet	ALL	1,389	871	1,109	2,691	221	9	22	2008 - 2012
	Sink Gillnet	ALL	2,004	2,451	989	2,691	871	11	29	2010 - 2012
	Midwater Trawl	ALL	86,087	20,585	133,124	369,327	24	5	19	2005 - 2012
	Midwater Trawl	ALL	48,183	5,121	85,601	198,978	24	3	6	2008 - 2012
	Midwater Trawl	ALL	68,281	5,121	113,208	198,978	744	5	9	2010 - 2012

Table 73 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the areas included in the eastern Gulf of Maine alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Large Eastern Maine (Alt 2)	Bottom Trawl	2005 - 2012	19.30	11.88	1.63	0.12	5.12
	Bottom Trawl	2008 - 2012	12.21	9.20	1.33	0.20	2.80
	Bottom Trawl	2010 - 2012	3.42	6.67	0.51	0.04	1.01
	LA Scallop	2005 - 2012	0.04	0.75	0.05	0.01	0.08
Machias (Alts 2 and 3)	GC Scallop	2005 - 2012	5.37	1.13	4.77	2.17	7.70
Small Eastern Maine (Alt 3)	Bottom Trawl	2005 - 2012	0.29	2.63	0.11	0.01	0.27
	Bottom Trawl	2008 - 2012	0.22	1.60	0.14	0.00	0.33
Toothaker Ridge (Alt 3)	Bottom Trawl	2005 - 2012	187.77	17.88	10.50	0.23	24.48
	Bottom Trawl	2008 - 2012	213.33	15.20	14.03	2.04	24.98
	Bottom Trawl	2010 - 2012	200.55	12.67	15.83	3.10	27.52
	Shrimp Trawl	2005 - 2012	18.79	2.75	6.83	2.69	9.16
	Shrimp Trawl	2008 - 2012	25.87	3.60	7.19	2.43	9.95
	Shrimp Trawl	2010 - 2012	29.86	4.00	7.46	2.43	9.63

Table 74 – Party/charter recreational fishing revenue associated with the areas included in the eastern Gulf of Maine alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents to average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD_Revenue
Large Eastern Maine (Alt 2)	2006 - 2012	1249.764	0.571429	7.857143	2187.088	1970.975	2206.69
	2008 - 2012	1719.84	0.6	10.8	2866.4	3430.45	2129.654
	2010 - 2012	1722.917	0.666667	10.33333	2584.375	2584.375	2931.488

Table 75 – Total number of vessels conducting mobile bottom-tending gear trips in 2012 in currently open portions of the eastern Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Eastern Gulf of Maine		Alternative 2		Alternative 2 (option 5)		Alternative 3	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**25**	**9**	**28**	**13**	**35**	**15**
	Boston	11		11		14	
	Gloucester	14		15	3	21	
	New Bedford	3	3	5	4	6	3
ME		**34**	**47**	**103**	**113**	**59**	**70**
	Addison				3		
	Beals		6	9	13		6
	Bremen						3
	Boothbay Harbor					3	
	Bucks Harbor			3			
	Friendship					4	4
	Harpswell				3		
	Jonesport	12	3	27	13	12	3
	Machiasport			3	3		
	New Harbor					3	
	Northeast Harbor			3	3		
	Port Clyde	6	3	8	3	8	3
	Portland	8	7	13	7	18	10
	Rockland			6			
	South Bristol		3		4	8	5
	Stonington			7	4		
	Tenants Harbor			5	5		
	Vinalhaven			8	8		
	Westbrook		3		3		3
	Winter Harbor		4	4	6		4
	Newington			6			

Table 76 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the eastern Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only.

Eastern Gulf of Maine				
	Alternative	**2**	**2**	**3**
	Option	**1,2,3,4**	**5**	**1,2,3,4**
State	**Port**	**Total Revenue**	**Total Revenue**	**Total Revenue**
MA	**Total**	**73,418.59**	**73,418.59**	**54,324.21**
	BOSTON	8,132.20	8,132.20	11,094.55
	GLOUCESTER	58,342.19	58,342.19	38,161.21
	NEW BEDFORD	6,944.19	6,944.19	5,068.45
ME	**Total**	**104,748.24**	**1,377,373.79**	**120,561.39**
	FRIENDSHIP			2,510.71
	JONESPORT	87,119.85		74,230.26
	PORT CLYDE	11,193.57	25,566.04	28,829.75
	PORTLAND	1,970.05	11,283.61	9,030.02
	ROCKLAND		826772.98	
	SOUTH BRISTOL			683.50
	VINALHAVEN		9570.68	
	WINTER HARBOR		88278.23	

4.2.3.1.1 Alternative 1 (No Action/No Habitat Management Areas)

There are currently no year-round closed areas in this sub-region.

The groundfish resource impacts discussion (Section 4.2.2.1) indicates that there is some expectation that recent restoration projects in Eastern Maine will help rejuvenate groundfish populations in this sub-region. However, there is high uncertainty regarding the overall cause of the groundfish population collapse, and thus whether the restoration projects will ultimately prove successful. Therefore, the current no action alternative is expected to have a neutral economic impact, with a possibility of moderately negative impacts if synergies between restoration and conservation actions are not capitalized upon. Alternative 1 would result in mainly neutral non-economic social impacts as it would maintain the status quo.

All other alternatives are compared to No Action in the sections that follow.

4.2.3.1.2 Alternative 2

Alternative 2 would designate two new habitat management areas, the Large Eastern Maine HMA and the Machias HMA.

Figure 17 and Figure 18 identify the major gears currently fishing in the vicinity of the Machias and Large Eastern Maine management alternatives. Pots are the primary gear type in Machias, highlighting the importance of lobster in this area of the Gulf of Maine. This result is despite the fact that lobster landings are underrepresented in the federal VTR database. Note that the "other gear" category in Machias includes other dredges (i.e. not clam or scallop dredge) which would potentially be affected by the area management alternatives. However, for privacy purposes these gears could not be broken out separately. Although pots still account for over 50% of the average revenue in the Large Eastern Maine area, purse seine in particular represents another significant fishery in the area. In the Large Eastern Maine area, the "other gear" category includes other dredges, clam dredges, and scallop dredges, which would potentially be affected by the area management alternatives but cannot be detailed for privacy purposes.

Table 72 provides a more detailed view of mobile bottom-tending gear use. In Machias, the fishery with the most potential revenue displacement is the clam fishery. The annual revenue metric is high, despite the average revenue displaced per trip being $101 (5.9% of an average trip's revenue). This can be explained by the fact that the Machias alternative abuts productive clam beds to the south (see for instance the 44th SAW Assessment Report Appendix A8, Stock Assessment for Ocean Quahog in Maine Waters), and although there is evidence of clam fishery activity, the majority of the clam activity in the area, as represented by the logbook data, appears to occur outside of the Machias management area. This interpretation is bolstered by the existence of the Maine PSP closure, for which the exemption encompasses only a small portion of the Machias and Large Eastern Maine areas. Scallop dredge revenue seems to follow a similar pattern, with an average revenue displacement per trip of $50 (6.4% of an average trip's revenue) between 2010 and 2012. The shrimp/bottom trawl revenues potentially displaced are minimal in Machias. In the Large Eastern Maine area, the shrimp and bottom trawl gears represent the most revenue potentially displaced by Alternative 2, with vessels of all categories plying these waters although there does seem to be a downward trend through time. The average revenue impacted

per trip for shrimp/bottom trawl vessels larger than 70 ft is estimated to be $428 (1.8% of an average trip's revenue), for vessels between 40 and 70 ft it is $450 (3% of an average trip's revenue), and for vessels smaller than 40 ft it is $198 (4.7% of an average trip's revenue). Although not insignificant amounts, when compared to other areas under consideration in this amendment the trawl revenue in Large Eastern Maine seems to represent fishing on the edges of more productive fishing grounds as opposed to the area being a center of fishing. The total combined bottom & shrimp trawl revenue expected to be displaced by Alternative 2 is an average of $84,320 over the 2010 – 2012 period. This represents 0.07% of the average annual revenue reported in VTR for these two gear types for generated from the Gulf of Maine, Georges Bank, and Southern New England over the same period (see section 4.5 of Volume 1 for relevant statistical areas and magnitude of total revenue). Total impacted clam revenue represents 0.4% of the average total revenue reported in clam log books in 2010 – 2012 within the Gulf of Maine, Georges Bank, and Southern New England areas.

Table 73 presents the VMS analysis of fishing effort in Machias and Large Eastern Maine, which seem to bear out the VTR analysis of Table 72. Historically, some small amount of general category scalloping has occurred within the boundaries of Machias, while Large Eastern Maine shows insubstantial amounts of bottom trawl and scallop fishing.

Table 74 summarizes the recreational fishing reported within Alternative 2. The 10 angler trips reported within the Large Eastern Maine area is minimal, while no recreational trips were reported within the boundaries of Machias during the time period analyzed.

Option 1 has a relatively small impact on the total revenues being generated from the waters of the Machias and Large Eastern Maine HMA, with a complete exclusion of mobile bottom-tending gears affecting less than 6% - 8% (between $185,694 and $253,682 annually) of the total revenue generated in these areas between 2010 and 2012. Option 2 as written exempts only hydraulic clam dredges from the management areas. Although the clam logbook data does not include a gear categorization, Stevenson et al. (2004) indicates that the clam fishery in Machias, which would benefit most from this exemption, is actually prosecuted with the dry clam dredge and thus would not qualify for the exemption.

<u>The short term impacts of Alternative 2 are thus expected to be slightly negative, with neither Machias nor Large Eastern Maine reported to be centers of mobile bottom-tending gear activity. In the long run, low positive impacts are expected through expected increases in groundfish productivity (see section 4.2.2.3.1), though as noted these impacts are less certain and smaller than those expected from management areas in other sub-regions.</u> The magnitude of these impacts is expected to be smaller than Alternative 3, given the relative habitat protection afforded (see section 4.2.2.3.2). Although discounting plays a role in whether the net benefits are ultimately positive or negative, the low short-term negative impacts, and low long-term positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

Options 3 and 4 would primarily exempt fishermen dredging in Machias, and thus 94% of the revenue potentially displaced by area management (see Table 72). However, as discussed in section 4.1.2.3, both the costs borne by trawl fishermen and the benefits of gear restrictions

defined in these options in terms of habitat conservation are highly uncertain. What information exists indicates that Option 3 would be expected to decrease catch rates for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected uncertain impact on seabed habitats identified in section 4.2.1.1.2, indicates that Options 3 and 4 would be expected to induce a slightly negative impact as compared to Alternative 1/No Action.

Option 5 adds the restriction of gear capable of catching groundfish to the mobile bottom-tending gear restrictions of Option 1. The analysis of Option 1 is equally valid in describing the expected impact of Option 5 on mobile bottom-tending gear. Table 72 presents the additional impact expected for non-mobile gear capable of catching groundfish. Purse seine is the largest category of gear exempted from Option 1 that would be impacted by Option 5, and accounts for 99% of the additional revenue expected to be displaced in the last 3 year period. Between 2010 and 2012 the average revenue per trip for purse seine vessels within the Large Eastern Maine area is calculated at $9,261, with the impact concentrated on 8 permit holders averaging just under 15 trips a year. The Large Eastern Maine area thus seems to be a relatively important center of seine net fishing for a small number of fishermen. It should be noted that this concentration of seine net effort looks to have been fairly recent and is generated by the herring fishery, with revenue estimates much lower in the longer time horizons investigated. Although some longline fishing occurs in the area, it is at a much smaller scale as indicated in Table 72, with an average trip-level revenue displacement estimated to be $155 between 2010 and 2012. This suggests that the Large Eastern Maine area is not a center of fishing effort with this gear. Option 5 is not expected to impact any additional fishing effort within Machias, beyond what has already been detailed in Option 1. However, the 'other gear' category in both Machias (Table 72) and Large Eastern Maine (Table 72) include both mobile bottom-tending gear and gear capable of catching groundfish, which cannot be detailed due to confidentiality issues. In aggregate, Option 5 would be expected to displace between $1,256,035 and $1,313,253 annually, or 40-42% of all the revenue generated between 2010 and 2012 from the waters proposed to be regulated under Option 5.

The social impacts of the eastern Gulf of Maine habitat alternatives would most heavily impact port communities in Maine based on the location of registration of affected vessels (Table 75). With the exception of Portland, most of these communities are smaller coastal communities that have high levels of engagement and reliance on commercial fishing and have limited economic opportunities outside of fishing and relatively high social vulnerability indices (see tables in Volume 1 Fishing Communities section). Many of these communities are heavily dependent on lobstering. While lobster gear would not be affected by these closures, other gear types that allow fishermen in these areas to diversify their harvest would be impacted, thus reducing their level of resilience to future impacts by reducing their diversification. Although Portland is a larger community with a more diverse economy and less reliance on commercial fishing, diversity of fishing opportunities has declined in recent years. The social impacts related to port of landing are concentrated in Boston, Massachusetts. None of the identified communities would benefit from the clam dredge exemption (Option 2) as it does not apply to dry dredges which are typically used in this area (Stevenson et al 2004). Communities in downeast Maine using scallop dredges would benefit from the gear modification options (Option 3, 4) however due to

confidentiality concerns these communities are not detailed in the analysis. Option 5 would have larger negative impacts particularly on communities in Maine with high levels of vulnerability and particularly high indicators of commercial fishing dependence (see tables in Volume 1 Fishing Communities section).

The short-term social impacts of Alternative 2, Options 1-4 in comparison to Alternative 1/No Action are expected to be slightly negative, although slightly less negative than the impacts associated with Alternative 3. The social impacts of Alternative 2, Option 5 are expected to have more negative impacts than Options 1-4. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.2.3.1.3 Alternative 3

Alternative 3 would designate three new habitat management areas, the Small Eastern Maine HMA, the Machias HMA, and the Toothaker Ridge HMA.

Figure 17, Figure 19, and Figure 20 present the major gear types fishing in the vicinity of the Alternative 3 management areas. Although the overall pattern of gear usage is similar, the Small Eastern Maine area encompasses roughly 25-30% of the revenue associated with the Large Eastern Maine area in Alternative 2. Again, purse seine and lobster pots are the dominant gear types in the Small Eastern Maine area. This result is despite the fact that lobster landings are underrepresented in the Federal VTR database. The "other gear" category in the Small Eastern Maine alternative includes dredges which would be subject to options being considered within Alternative 3 but cannot be detailed due to confidentiality concerns. The entirety of the Small Eastern Maine area falls within the Maine Mahogany Clam PSP closure, meaning that no clam fishing is currently allowed within its bounds. Machias is discussed under Alternative 2. Toothaker Ridge is dominated by purse seine and lobster pot gear, with the latter seeming to increase its share of the revenue in the most recent three years analyzed (2010 – 2012). "Other gear" includes clam dredges, scallop dredges, and other dredges, which would be subject to management options being considered within Alternative 3 but cannot be detailed due to privacy concerns.

Table 72 provides a more detailed view of the mobile bottom-tending gears used in these three areas. Machias is discussed under Alternative 2. In the Small Eastern Maine area, the shrimp and bottom trawl gears represent the most revenue potentially displaced by Alternative 3 Option 1, with vessels of all categories plying these waters although there does seem to be a downward trend through time. The average impacted revenue per trip for shrimp/bottom trawl vessels > 70 ft is estimated to be $110 (0.44% of an average trip's revenue), for vessels between 40 and 70 ft it is $176 (0.97% of an average trip's revenue), and for vessels smaller than 40 ft it is $52 (1.4% of an average trip's revenue). Although not insignificant amounts, this trawl revenue in Small Eastern Maine seems to represent fishing on the edges of more productive fishing grounds as opposed to centers of fishing themselves. This result is mirrored within the boundaries of Toothaker Ridge, where average revenue displaced per trip for shrimp/bottom trawl vessels > 70 ft is estimated to be $116 (0.5% of an average trip's revenue), for vessels between 40 and 70 ft it is $130 (1.4% of an average trip's revenue), and for vessels smaller than 40 ft it is $108 (2.8% of an average trip's revenue). However, the total of 646 bottom trawl trips estimated to overlap the

boundaries of Toothaker Ridge suggests that this area abuts much more productive fishing grounds than other areas in this sub-region, though it is not a major center of fishing itself. The shrimp and bottom trawl revenue expected to be displaced by alternative 3 option 1 represents 0.07% of the average annual revenue reported for these two gear types in the VTR between 2010 – 2012 (see section 4.5 of Volume 1 for relevant statistical areas and total revenue magnitude).

Table 73 presents the VMS analysis of fishing effort in Machias, Small Eastern Maine, and Toothaker Ridge, which seem to bear out the VTR analysis of Table 72. Small Eastern Maine has had minimal bottom trawl effort within its boundaries. Bottom trawl effort within Toothaker Ridge is somewhat more pronounced than either Machias or Small Eastern Maine, a result consistent with the VTR analysis of these areas. The median is much smaller than the mean effort, suggesting that a few individuals utilize this area more intensively than the majority of individuals fishing in the area. Shrimp trawl effort is also estimated to fall within Toothaker Ridge, though at relatively low levels.

Although there have historically been some recreational trips whose VTR location place them within the Small Eastern Maine and Toothaker Ridge areas, this information cannot be presented due to privacy concerns.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect roughly $170,000, or 9% of the total revenue generated from the waters surrounding the areas in the most recent three year period (2010 – 2012). This mainly affects bottom trawl fishermen in the vicinity of Toothaker Ridge, and clam dredge fishermen around Machias. As noted above, clam dredging in this area is prosecuted with the dry clam dredge and thus would not qualify for the Option 2 exemption.

<u>The short-term impacts of Alternative 3are thus expected to be slightly negative, with none of the areas reported to be centers of mobile bottom-tending gear activity. In the long-term, slightly positive impacts are expected through expected increases in groundfish productivity (see section 4.2.2.3.2) though as noted these impacts are less certain and smaller than those expected from management areas in other sub-regions, and smaller than the positive impacts associated with Alternative 2.</u> Although discounting plays a role in whether the net benefits are ultimately positive or negative, the short-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

Options 3 and 4 would primarily exempt fishermen dredging in Machias, and thus a substantial portion of the revenue potentially displaced by area management. However, as discussed under Alternative 2, both the costs and the benefits of gear restrictions are highly uncertain. Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish, and fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. <u>This, coupled with the expected uncertain impact on seabed habitats identified in section 4.2.1.1.3, indicates that both Options 3 and 4 would be expected to induce a slightly negative impact as compared to Alternative 1/No Action.</u>

The short-term social impacts of Alternative 3 in comparison to the Alternative 1/No Action are expected to be slightly negative, and slightly more negative in comparison to Alternative 2. See the Alternative 2 discussion for further details. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish stocks and there are spillover benefits in open areas.

4.2.3.2 ***Central Gulf of Maine***

Tables and figures related to analysis of the economic and social impacts of the central Gulf of Maine habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

The Habitat Plan Development Team received indication that Platts Bank was being fished for scallops in calendar year 2013, in a departure from previous time periods. In order to investigate this issue, the VTR analysis was re-run, focused solely on scallop dredge fishing in the Platts Bank area. Figure 21 and Figure 22 present the results of this analysis. Individuals are ranked from largest to smallest impact, in terms of revenue estimated to have been generated from Platts Bank, and are summarized in groups of five, to ensure confidentiality. As can be seen, 90% of the total scallop revenue estimated to have been generated within Platts Bank was generated by the top 5 individuals. Figure 22 illustrates the average trip level revenue estimated to have fallen within the Platts Bank area. The average trip level revenue does not differ between groups to the extent that the total revenue per group does. This indicates that the difference in the revenue generated by groups is driven primarily by the number of trips taken to Platts Bank. In fact, the top 5 individuals encompass 65% of the total trips to Platts Bank. It is clear that, although a total of 61 individuals have some portion of their revenue estimated to have been derived from Platts Bank, the majority of the impact from Alternative 3 rests with a very few individuals. The analyses in the following sections do not factor in this new phenomenon, given uncertainty regarding the future sustainability of the scallop fishery on Platts Bank. Nevertheless, this additional source of fishing should be considered as potentially displaced if Alternative 3 is selected.

Figure 21 – Scallop fishing revenue within the vicinity of Platts Bank in 2013. Individuals are ranked from largest to smallest impact, in terms of revenue estimated to have been generated from Platts Bank, and are summarized in groups of five, to ensure confidentiality. A total of $42,373 is estimated to have been generated by scallop dredges in Platts Bank within the calendar year 2013.

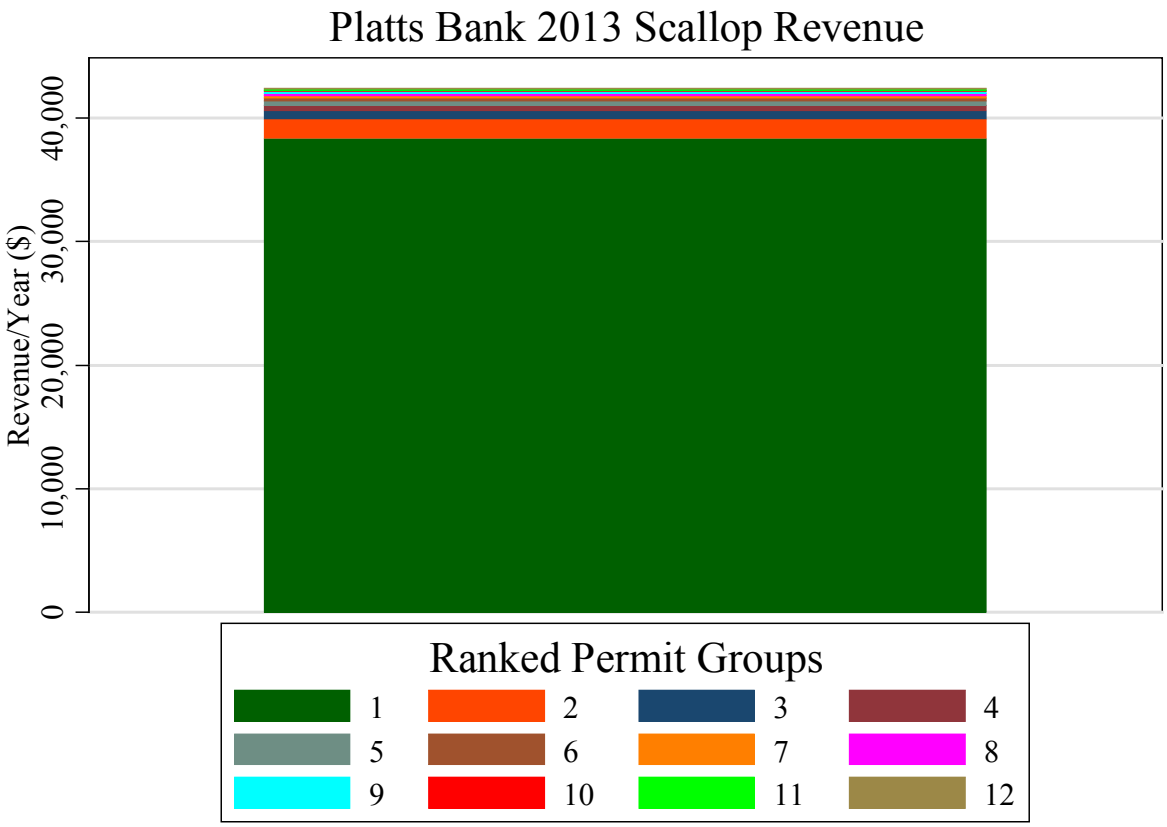


Figure 22 – Average trip-level scallop fishing revenue within the vicinity of Platts Bank, by ranked permit group. Individuals are ranked from largest to smallest impact, in terms of revenue estimated to have been generated from Platts Bank, and are summarized in groups of five, to ensure confidentiality.

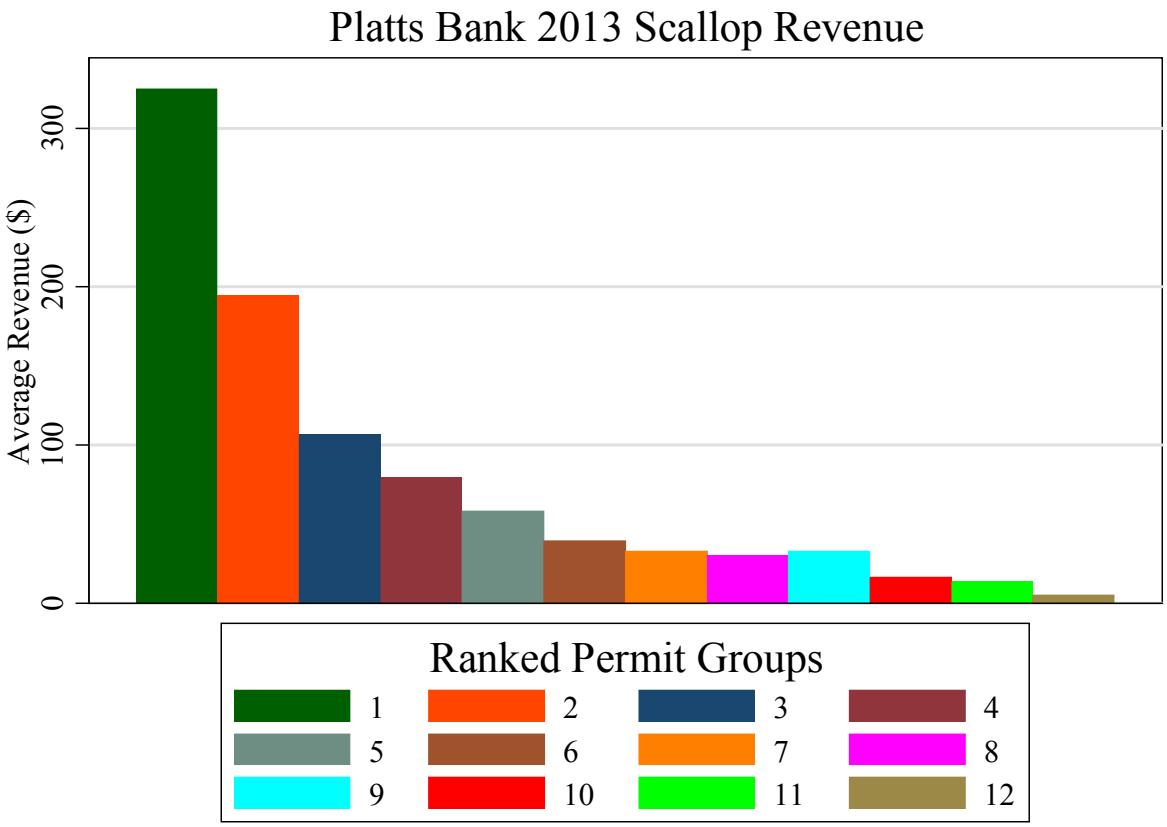
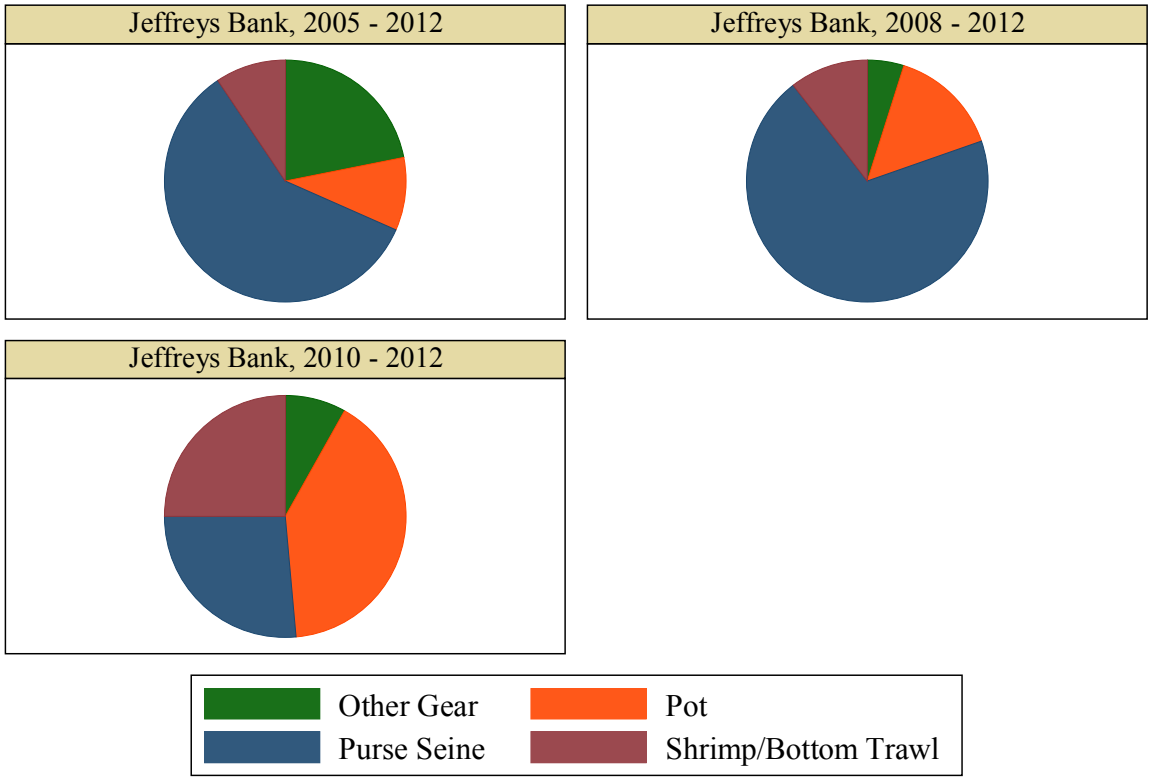
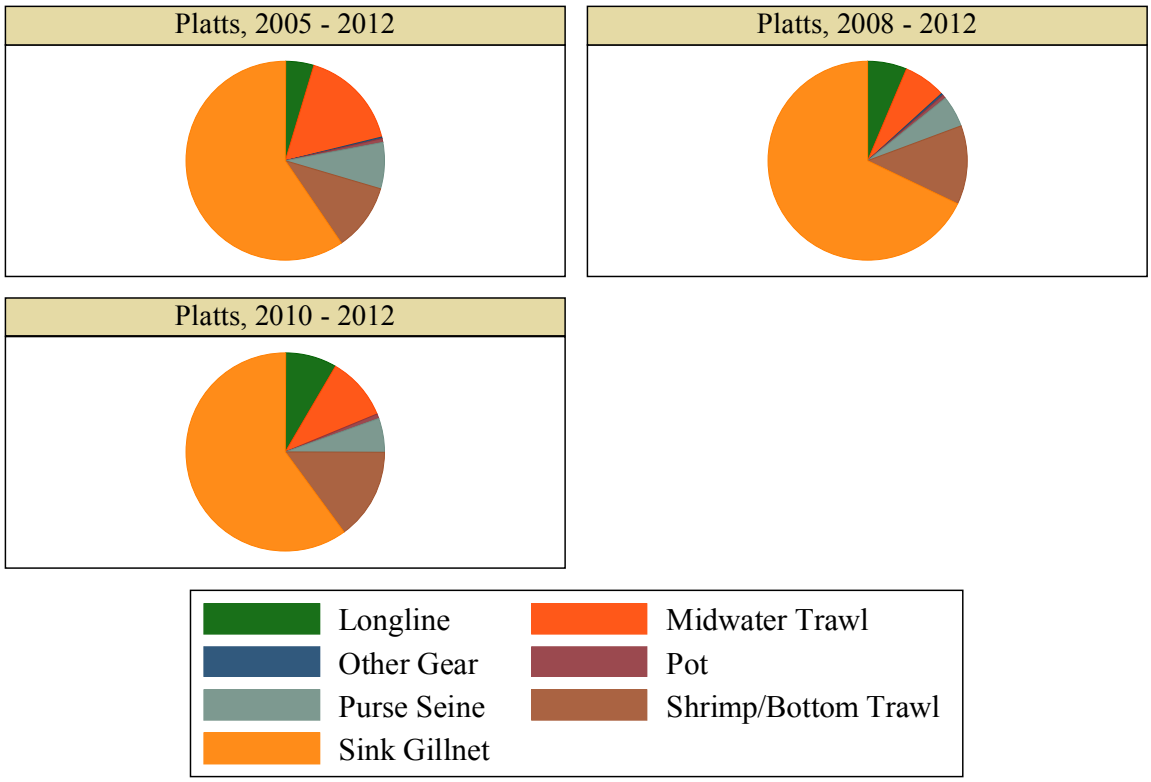


Figure 23 – Jeffreys Bank HMA revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 490,005; 2008 - 2012 = $ 424,539; 2010 - 2012 = $ 212,244



Graphs by Area and years

Figure 24 – Platts Bank HMA revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 206,164; 2008 - 2012 = $ 185,991; 2010 - 2012 = $ 209,074



Graphs by Area and years

Table 77 – Mobile bottom-tending gear revenues potentially impacted by the areas included in the central Gulf of Maine Habitat Alternatives that are currently open to fishing. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Shrimp/Bottom Trawl	Jeffreys Bank	L	10,591	6,052	12,949	42,170	2,505	21	116	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	L	13,698	7,985	16,153	42,170	2,505	20	130	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	L	20,029	9,933	19,199	42,170	7,985	25	186	2010 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	15,054	14,375	6,888	24,697	5,669	20	144	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	10,804	9,895	4,245	17,389	5,669	16	94	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	12,882	11,361	3,972	17,389	9,895	16	88	2010 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	20,558	18,423	6,131	32,356	14,743	13	113	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	19,917	18,644	4,554	27,024	14,743	11	85	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	20,137	18,644	6,275	27,024	14,743	10	89	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	7,763	6,437	6,002	20,099	638	29	218	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	9,351	7,415	7,324	20,099	638	30	264	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	13,309	12,413	6,389	20,099	7,415	38	376	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	11,237	11,323	3,886	18,138	4,290	30	212	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	11,164	11,352	5,033	18,138	4,290	25	192	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	14,049	12,659	3,600	18,138	11,352	25	234	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,484	3,366	1,133	5,610	1,961	26	148	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,405	2,800	1,460	5,610	1,961	19	119	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,891	4,102	1,834	5,610	1,961	17	117	2010 - 2012

Table 78 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the central Gulf of Maine Alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the yearly means, while the statistics are calculated at the individual level. Note that shrimp trawl effort is unreported due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Jeffreys Bank	Bottom Trawl	2005 - 2012	99.44	18.38	5.41	0.12	13.75
Jeffreys Bank	Bottom Trawl	2008 - 2012	117.99	16.40	7.19	0.41	15.95
Jeffreys Bank	Bottom Trawl	2010 - 2012	88.97	14.67	6.07	0.33	14.09
Platts Bank	Bottom Trawl	2005 - 2012	3.81	14.13	0.27	0.01	0.59
Platts Bank	Bottom Trawl	2008 - 2012	3.02	11.40	0.26	0.01	0.61
Platts Bank	Bottom Trawl	2010 - 2012	2.04	12.33	0.17	0.01	0.41

Table 79 – Party/charter recreational fishing revenue associated with Platts Bank and Cashes Ledge. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. The Cashes Ledge area refers to both the current groundfish and habitat closures.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Platts Bank	2006 - 2012	29355.19	3.1	197.4	1360.836	1193.2	583.5898
Platts Bank	2008 - 2012	25704.98	3.0	173.2	1460.51	1416.925	663.2817
Platts Bank	2010 - 2012	22507.52	3.0	152.3	1534.603	1491.5	731.2774
Cashes Ledge	2006 - 2012	70130.55	5.1	405.9	4631.26	4537.7	2776.84
Cashes Ledge	2008 - 2012	66321.63	4.0	374.0	4670.54	5029.83	2589.67
Cashes Ledge	2010 - 2012	62794.66	4.7	360.0	3844.57	4098.38	2321.80

Table 80 – Current Cashes Ledge groundfish and habitat closures: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	299	273	509	152	74	66	130	156	145	302	157	221
	Cod	$51	$55	$64	$92	$26	$12	$20	$9	$19	$46	$34	$42
		3%	3%	4%	5%	2%	1%	2%	1%	2%	4%	3%	2%
	Redfish	$45	$107	$59	$59	$112	$56	$220	$139	$166	$93	$148	$226
		3%	6%	4%	3%	10%	4%	17%	13%	16%	8%	14%	12%
	Pollock	$321	$362	$578	$694	$225	$443	$293	$293	$181	$388	$173	$155
		21%	19%	34%	40%	20%	34%	23%	27%	18%	35%	16%	8%
	Plaice	$227	$172	$139	$141	$98	$93	$118	$149	$171	$160	$211	$131
		15%	9%	8%	8%	9%	7%	9%	13%	17%	14%	20%	7%
	Witch Flounder	$160	$300	$241	$232	$132	$48	$63	$52	$48	$76	$63	$352
		10%	16%	14%	13%	12%	4%	5%	5%	5%	7%	6%	19%
	White Hake	$150	$145	$92	$118	$196	$240	$179	$150	$181	$141	$120	$144
		10%	8%	5%	7%	18%	18%	14%	14%	18%	13%	11%	8%
	Monkfish	$485	$608	$370	$313	$234	$253	$258	$249	$236	$176	$241	$679
		32%	33%	22%	18%	21%	19%	20%	23%	23%	16%	23%	37%
	Lobster	$53	$79	$65	$67	$54	$146	$100	$43	$9	$8	$13	$68
		3%	4%	3%	4%	5%	12%	8%	4%	1%	1%	1%	3%
Fixed Gillnet	Total Hauls	96	27	86	53	73	52	149	110	103	64	65	
	Cod	80	43	37	91	98	63	106	130	98	96	128	
		9%	5%	5%	13%	18%	8%	14%	18%	14%	17%	17%	
	Haddock	16	6	9	22	5	4	4	2	2	6	8	
		2%	1%	1%	3%	1%	1%	1%	0%	0%	1%	1%	
	Redfish	12	14	13	6	9	35	16	7	11	14	21	
		1%	2%	2%	1%	2%	5%	2%	1%	2%	3%	3%	
	Pollock	591	653	558	478	57	129	215	305	335	209	420	
		70%	80%	71%	69%	10%	17%	29%	42%	48%	38%	55%	
	White Hake	37	55	73	21	283	423	193	143	103	83	76	
		4%	7%	9%	3%	51%	57%	26%	20%	15%	15%	10%	
	Lobster	$32	$37	$17	$4	$44	$37	$69	$10	$22	$7	$7	
		4%	5%	2%	1%	8%	5%	9%	1%	3%	1%	1%	
Separator Trawl	Total Hauls						32				19		
	Cod						$41				$38		

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							3%				4%		
	Haddock						$32				$69		
							2%				7%		
	Redfish						$1,200				$83		
							77%				8%		
	Pollock						$78				$669		
							5%				64%		
	White Hake						$70				$124		
							4%				12%		

Table 81 – Jeffreys Bank Habitat Closure Area: Average value per bottom trawl haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

	Month									
	Jan-Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Hauls		***9***	***29***	***84***	***100***	***37***	***22***	***35***	***51***	***98***
Atlantic cod		$103	$151	$64	$82	$70	$31	$24	$20	$19
		9%	19%	6%	7%	6%	3%	2%	1%	1%
Atlantic halibut		$118	$5	$6	$6	$6	$19	$0	$8	$9
		11%	1%	1%	1%	1%	2%	0%	0%	0%
Acadian redfish		$4	$9	$24	$15	$64	$46	$36	$51	$65
		0%	1%	2%	1%	5%	5%	3%	3%	4%
Pollock		$124	$33	$23	$35	$40	$112	$2	$5	$10
		11%	4%	2%	3%	3%	11%	0%	0%	1%
American plaice		$41	$89	$62	$61	$143	$89	$75	$174	$80
		4%	11%	5%	5%	12%	9%	6%	9%	5%
Witch flounder		$222	$327	$678	$573	$190	$228	$276	$165	$282
		20%	41%	60%	51%	16%	23%	22%	9%	16%
White hake		$43	$20	$35	$73	$259	$76	$88	$66	$93
		4%	3%	3%	6%	22%	8%	7%	4%	5%
Monkfish		$228	$153	$231	$255	$409	$387	$725	$1,315	$1,103
		21%	19%	20%	23%	34%	39%	59%	71%	62%
American lobster		$209	$5	$5	$3	$0	$2	$0	$39	$105
		19%	1%	0%	0%	0%	0%	0%	2%	6%

Table 82 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the central Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Central Gulf of Maine		Alternative 3		Alternative 4	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**61**	**38**	**39**	**19**
	Boston	17		15	
	Gloucester	28	11	22	7
	New Bedford	21	22	8	7
ME		**37**	**44**	**23**	**22**
	Harpswell		4		
	Port Clyde	6	3	6	3
	Portland	28	11	19	10
	South Bristol		4		4
	Westbrook		3		3

Table 83 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the central Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only.

Central Gulf of Maine			
	Alternative	**3**	**4**
	Option	**1,2,3,4**	**1,2,3,4**
State	**Port**	**Total Revenue**	**Total Revenue**
MA	**Total**	**82,625.75**	**55,596.50**
	BOSTON	20,126.69	5,468.58
	GLOUCESTER	40,172.87	29,436.69
	NEW BEDFORD	22,305.47	20,691.23
ME	**Total**	**39,423.29**	**22,606.23**
	PORT CLYDE	17,629.72	16,983.74
	PORTLAND	20,609.52	5,534.27

Table 84 – Sum of 2012 party/charter recreational fishing revenue associated with the central Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only.

State	Number of vessels	Total trip value
MA	4	62,779.73

4.2.3.2.1 Alternative 1 (No Action)

Alternative 1/No Action in the central Gulf of Maine region includes the Jeffreys Bank and Cashes Ledge Habitat Closure Areas and the Cashes Ledge Groundfish Closure Area. Given the length of time over which the Cashes Ledge and Jeffreys Bank areas have been closed, the expectation is that benefits afforded by these areas are already flowing, but additional benefits of these conservation measures are expected to accrue in the future. Despite current, direct costs to the fleet in terms of fishing displacement, Alternative 1/No Action is expected to induce slight positive economic impacts due to the protection of habitats supporting juvenile groundfish that are susceptible to fishing disturbance.

Alternative 1/No Action would result in mainly neutral social impacts as it would maintain the status quo. However, if current benefits to groundfish are being realized (as mentioned above) there may be moderate positive impacts associated with Alternative 1/No Action.

All other alternatives are compared to No Action in the sections that follow.

4.2.3.2.2 Alternative 2 (No Habitat Management Areas)

This alternative would remove the current Cashes Ledge and Jeffreys Bank Habitat Closure Areas, and the Cashes Ledge Groundfish Closure Area, and would not designate any additional habitat management areas in the region.

The economic benefits arising from removing management areas in the central Gulf of Maine are expected to arise from two main sources: 1) increasing fishing revenue or 2) decreasing the costs of fishing. Generally the underlying reasoning for removing management areas is providing fishermen more flexibility and options in when and how to fish. The economic costs of removing management areas are likely to arise from impacts on fish productivity, impact on non-targeted species, and gear interactions and effort displacement from other fisheries. The analysis in this section qualitatively explores the likelihood of both these costs and benefits, and generates an overall expected impact of the no management area alternative both in the short and long term.

Table 80 and Table 81 identify all species that contribute at least 5% of haul-level revenues in any given month from areas within 10 nautical miles of the current Cashes Ledge and Jeffreys Bank combined groundfish and habitat closures. Pollock in particular seems to be an important species across all gear types for Cashes Ledge, while witch flounder consistently generates a large portion of revenues associated with hauls surrounding Jeffreys Bank. In the vicinity of Cashes Ledge, white hake and redfish generate a substantial amount of revenue for the fixed gillnet and separator trawl gears respectively in the late spring and early summer months. Observed bottom trawl trips in the vicinity of both Cashes Ledge and Jeffreys Bank also generate substantial revenue from monkfish. Given that witch flounder are overfished and overfishing is occurring, no positive benefit is likely to be generated by fishing for this species in a reopened Jeffreys Bank. Pollock, monkfish, redfish, and white hake are not overfished, and are not subject to overfishing. Some small increase in revenue is likely to be generated by allowing additional targeting of these species within currently closed areas. However, the analysis conducted for the sector exemptions within Framework 48 of the Northeast Multispecies FMP indicate that Cashes Ledge hosts neither larger individuals nor higher densities of monkfish, white hake, redfish, or

pollock, as compared to currently open waters. Higher densities of these species inside versus outside the closed area could have lead to higher catch per unit effort, and thus lower costs of fishing through increased efficiency. Higher densities could also indicate a substantial segment of the biomass might currently be unavailable to the fishery, i.e. locked away in the closed area, which could help explain the fact that the catch limits for some of these species are not being fully harvested. Further, although managed under an annual catch limit, larger monkfish, white hake, redfish, or pollock inside the closure could allow fishermen capture price premiums associated with larger fish. Given that neither higher densities nor larger individuals seem to be concentrated within the currently closed portions of the Central Gulf of Maine, the benefits of removing management areas are likely to be relatively small. The Managed Species (4.2) and Fishing Communities (4.6) sections of Affected Environment seems to reaffirm this result for monkfish, white hake, redfish, and pollock in the existing Jeffreys Bank and Cashes Ledge management areas.

Although both Jeffreys Bank and Cashes Ledge are relatively near shore, particularly compared to areas on Georges Bank, their size and productivity suggests that, if opened, only local effort is likely to flow into their waters. Given the information presented in this document, access to Cashes Ledge and Jeffreys Bank is expected to displace current effort, as opposed to generating additional effort in the groundfish fishery.

Table 79 presents the recreational fishing revenue estimates for Cashes Ledge. Recreational fishing on Jeffreys Bank is not detailed due to confidentiality concerns. VTR data suggest that a small number of individuals are using Cashes Ledge relatively intensively, with an average gross annual revenue of $13,456 being generated per recreational vessel operating in the area. Increased fishing gear interactions and potential displacement of existing recreational fishing effort within the Cashes Ledge closure are other potential costs of reopening the area with this alternative. The increased costs accruing to the recreational fishery, due to congestion from an influx of commercial gear, depend on the flow of effort into the area, and the gear conflict avoidance measures taken by both recreational fishermen and groundfish/mobile bottom-tending gear fishermen. This effect is likely to be slightly negative, given the recreational fishing currently reported within the Cashes Ledge closure.

<u>In the short-term, Alternative 2 is expected to generate slightly positive economic impacts when compared to Alternative 1/No Action, as groundfish and mobile bottom-tending gear fishermen gain additional flexibility in when and how they are allowed to fish. However, in the long-term, slightly negative impacts are expected when compared to Alternative 1/No Action, due to the lack of protection for habitat supporting juvenile groundfish and susceptible to fishing disturbance.</u> <u>Given the length of time over which Cashes Ledge and Jeffreys Bank areas have been closed, and thus the expectation that any benefits afforded by these areas are already flowing, the overall impact of Alternative 2 is expected to be slightly negative.</u> Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

<u>The short-term social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be slightly positive as fishermen would gain access to new fishing areas. There are</u>

potential long-term moderately negative social impacts if benefits to fish populations from the Cashes Ledge closure area are lost. There may be some indirect, slightly negative social impacts to stakeholders concerned with ocean conservation who are particularly supportive of maintaining the Cashes Ledge closure.

4.2.3.2.3 Alternative 3

Alternative 3 would modify the boundaries of the current Jeffreys Bank and Cashes Ledge Habitat Closures, and designate three new habitat management areas: Ammen Rock, Fippennies Ledge, and Platts Bank.

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank and Platts Bank HMAs are presented in Figure 23 and Figure 24. The currently open area of the Modified Jeffreys Bank has supported a substantial amount of revenue derived from gears that would not be displaced by this alternative, although the proportion derived from bottom/shrimp trawls has increased in the most recent 3 year period. However, during 2010-2012 the open portions of Jeffreys Bank generated only about half of the longer run average revenue (Figure 23). Platts Bank revenue has similarly been dominated by gear that would not be displaced by this alternative. Table 77 presents more detailed information for the bottom/shrimp trawl fishery, with these two gears being combined due to privacy concerns. The only vessels in these gear types potentially presenting an upward trend in revenue (trips) is the over 70 ft vessels, with a 46% (42%) difference between the three year and five year average on Jeffreys Bank, and a 42% (42%) difference between the three and five year average on Platts Bank. The bottom trawl per-trip revenue in currently open waters surrounding Jeffreys Bank expected to be affected by this alternative is $108 (0.5% of an average trip's revenue) for vessels over 70 ft, $146 (0.9% of an average trip's revenue) for vessels between 50 and 70 ft, and $226 (1.8% of an average trip's revenue) for vessels < 50 ft. In Platts Bank, these values are $35 (0.2% of an average trip's revenue) for vessels >= 70 ft, $60 (0.4% of an average trip's revenue) for vessels between 50 and 70 ft, and $33 (0.3% of an average trip's revenue) for vessels < 50 ft. These low numbers in Platts Bank are explained at least in part by the size of the proposed areas. Nevertheless, the analysis suggests that the impacts of area closure considered here are likely relatively small, with 0.07% of the 2010 – 2012 average annual shrimp and bottom trawl revenue generated from currently open waters expected to be impacted by the Central Gulf of Maine Alternative 3 (see section 4.5 of Volume I for total revenue numbers and statistical areas).

Table 78 presents VMS effort estimates for the currently open areas of Modified Jeffreys Bank and for Platts Bank. Of the two areas, Modified Jeffreys Bank is associated with the majority of the estimated effort, consistent with the VTR analysis in Table 77. The larger mean as compared to the median of the distribution suggests that a few fishermen use this area more intensively than the majority of individuals.

Table 79 details the recreational fishing revenue reported to fall within the boundaries of the Modified Jeffreys Bank and Platts Bank areas. The revenue generated from recreational fishing in Platts Bank is on the same order of magnitude as the Bottom Trawl revenue.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect between $84,000-$101,000 in gross revenue (20-24% of the total) generated from the open waters

surrounding the Modified Jeffreys Bank and Platts Bank areas in the most recent three year period (2010-2012), not taking into account the new scallop effort being witnessed on Platts Bank in 2013 (see introduction of Central Gulf of Maine economic analysis). This works out to be $77-$88 per affected trip, again suggesting that although the areas are fished, the center of bottom/shrimp trawl activity in the central Gulf of Maine is outside of the management areas being considered within Alternative 3. The total area currently closed to a combination of gear capable of catching groundfish, and mobile bottom-tending gear is substantially larger than the total area under consideration in Alternative 3 (see Volume 1, Table 21). Thus, Alternative 3 opens more water to fishing than Alternative 1/No Action, particularly to gillnet and longline fishermen. Relative to Alternative 1/No Action, groundfish stocks are likely to face a negative impact (see section 4.2.2.4.2). Thus, the short-term economic impact of Alternative 3, Option 1 is likely to be slightly positive when compared to no action, but the long-term benefit is expected to be slightly negative when compared to the same. Conversely, the short-term economic benefit of Alternative 3, Option 1 is likely to be smaller than Alternative 2, but the positive long term economic impact is likely to be larger than Alternative 2. Both the short and long-term impacts of Alternative 3, Option 1 are expected to be negligibly different than Alternative 4, Option 1. Given the lack of clam dredge effort in this portion of the Gulf of Maine, Alternative 3, Option 2 is expected to have the same impacts as Alternative 3, Option 1. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the short-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

As discussed previously, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in these options in terms of habitat conservation are highly uncertain. Available data indicate that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative impact on seabed habitats identified in section 4.2.1.2.3, indicates that both Option 3 and 4 would be expected to induce a slightly negative impact, as compared to Alternative 1/No Action.

The social impacts of the Alternatives 3 and 4 would most heavily impact landing ports in Maine as well as Boston, Gloucester, and New Bedford, Massachusetts. New Bedford and Boston have high social vulnerability index scores and New Bedford and Gloucester have high levels of dependence on commercial fishing (see table in Volume 1, Human/Communities section). Impacts to communities where permit owners reside are concentrated in mid-coast and southern Maine (Table 82). With the exception of Portland and Westbrook, these communities all have the highest level of dependence on commercial fishing. None of the identified communities included vessels using hydraulic clam dredges or scallop dredges and therefore they would not benefit from the clam dredge exemption (Option 2) or the gear modification options (Option 3, 4).

While Alternative 3 may open up more total area to fishing than Alternative 1/No Action, it will have a negligible impact on the size and demographic characteristics of the fishery given that it is likely to only impact local fishing effort. The impacts associated with modifying current closed areas and adding additional closures will likely have a negative impact on the size and demographic characteristics of the fishery as well as potential negative impacts on the attitudes,

beliefs and values of fishermen, therefore the short-term non-economic social impacts of Alternative 3 in comparison to the no action alternative are expected to be slightly negative and slightly more negative than Alternative 4. In particular, the modification of Jeffreys Bank and the addition of the Platts Bank closed areas will have a large impact on fishing vessels from the midcoast Maine area. These vessels are highly dependent on groundfish in these areas. Moderately positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits into open areas.

4.2.3.2.4 Alternative 4

Alternative 4 would modify the boundaries of the current Jeffreys Bank and Cashes Ledge Habitat Closures, and designate a new habitat management area on Ammen Rock.

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank management area is presented in Figure 23, Table 77 (VTR), Table 78 (VMS), and Table 79 (recreational fishing), and a discussion of expected impacts can be found in section 4.2.3.2.3, Central Gulf of Maine Alternative 3 economic impacts.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect between $53,048 - $70,219 in gross revenue (25-33% of the total) generated from the open waters surrounding the Modified Jeffreys Bank area in the most recent three year period (2010 – 2012). As with Alternative 3, the total area currently closed to a combination of gear capable of catching groundfish, and mobile bottom-tending gear is substantially larger than that under consideration in Alternative 4. Thus, Alternative 4 opens more water to fishing than Alternative 1/No Action, particularly to gillnet and longline fishermen. As compared to Alternative 1/No Action, groundfish themselves are likely to face a negative impact (see section 4.2.2.4.3). Thus, the short-term economic impact of Alternative 4, Option 1 is likely to be slightly positive when compared to Alternative 1, but the long-term impact is expected to be slightly negative when compared to the same. Conversely, the short-term economic impact of Alternative 4, Option 1 is likely to be smaller than Alternative 2, but the long term economic impact is likely to be larger than Alternative 2. Both the short and long-term impacts of Alternative 4, Option 1 are expected to be negligibly different than Alternative 3, Option 1. Given the lack of clam dredge effort in this portion of the Gulf of Maine, Alternative 4, Option 2 is expected to have the same impacts as Alternative 4, Option 1. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the short-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

As discussed previously, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in these options in terms of habitat conservation are highly uncertain. However, given what information is known, Alternative 4, Options 3 and 4 would be expected to induce a slightly negative impact as compared to Alternative 1/No Action.

As with Alternative 3, while Alternative 4 may open up more total area to fishing than Alternative 1/No Action, it will have a negligible social impact on the size and demographic characteristics of the fishery given that it is likely to only impact local fishing effort. The impacts associated with modifying current closed areas and adding additional closures will likely have a

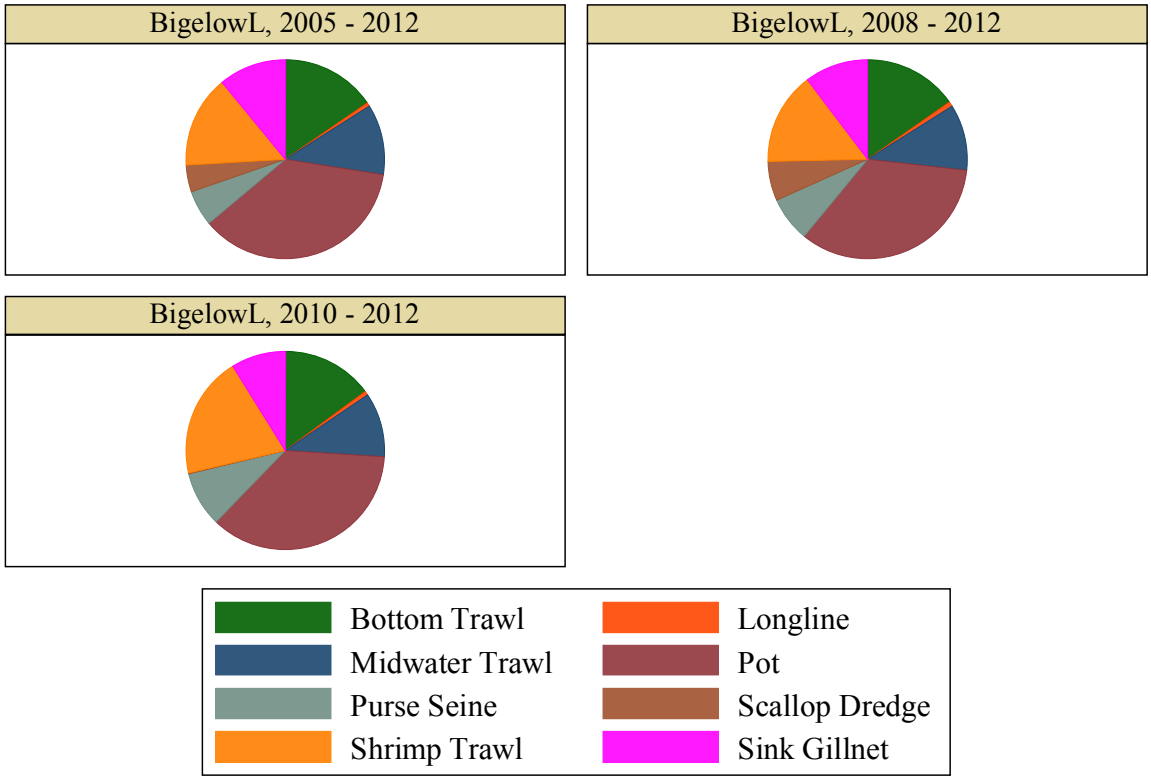
negative impact on the size and demographic characteristics of the fishery as well as potential negative impacts on the attitudes, beliefs and values of fishermen, therefore the short-term non-economic social impacts of Alternative 4 in comparison to the no action alternative are expected to be slightly negative and slightly less negative than Alternative 3. In particular, the modification of Jeffreys Bank will have a large impact on fishing vessels from the midcoast Maine area. These vessels are highly dependent on groundfish in this area. Moderate positive social impacts are possible in the long-term, if adjustments to closed areas effectively increase fish populations and there are spillover benefits in open areas. There may be some indirect, slightly negative social impacts to stakeholders concerned with ocean conservation who are particularly supportive of maintaining the current Cashes Ledge closure.

4.2.3.3 ***Western Gulf of Maine***

Tables and figures related to analysis of the economic impacts of the western Gulf of Maine habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

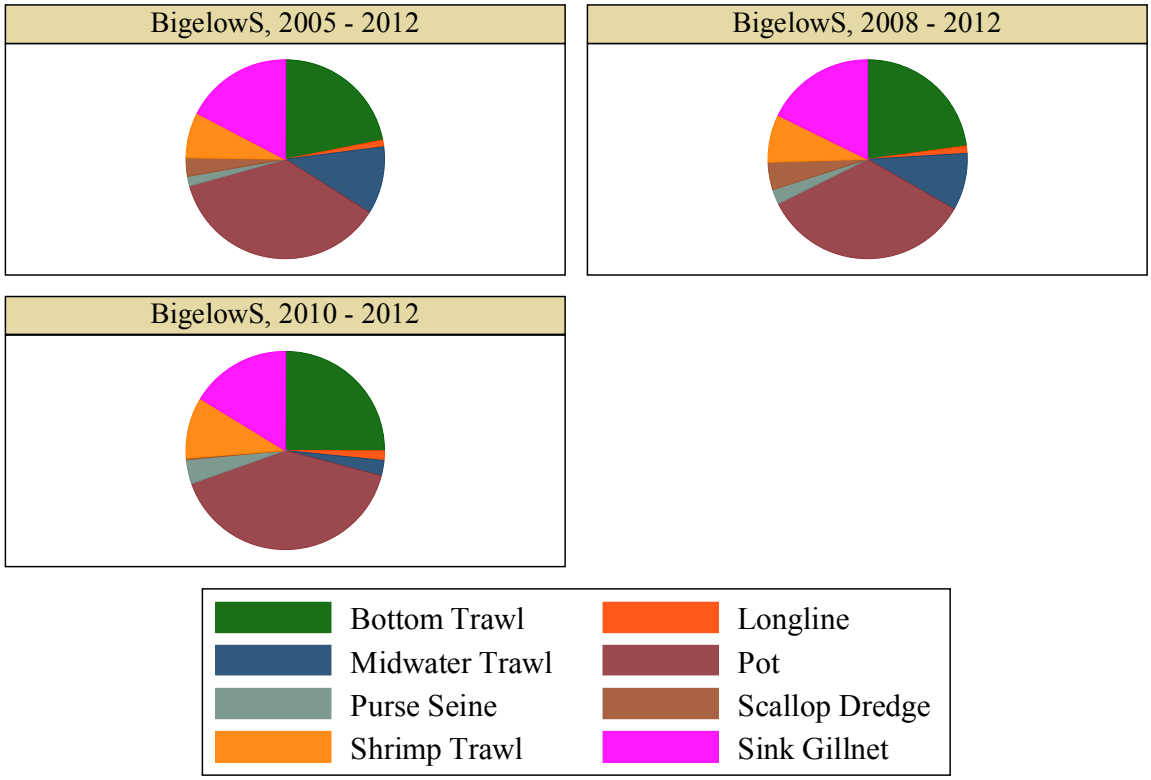
Note that the expected economic impact to the shrimp trawl fishery is based on historical data, when in actuality the impact to this fishery in the next year, and potentially further into the future, is expected to be neutral in all alternatives given that the fishery is currently under a moratorium (see http://www.asmfc.org/species/northern-shrimp).

Figure 25 – Large Bigelow Bight HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005-2012 = $ 6,507,068; 2008-2012 = $ 7,206,629; 2010-2012 = $ 7,860,367



Graphs by Area and years

Figure 26 – Small Bigelow Bight HMA commercial fishing revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005-2012 = $ 3,007,689; 2008-2012 = $ 3,117,597; 2010-2012 = $ 3,110,068



Graphs by Area and years

Table 85 – Mobile bottom-tending gear revenues potentially impacted by the areas included in western Gulf of Maine Habitat Alternatives 3, 4, and 5. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dashes indicate information dropped due to privacy concerns.

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bigelow Bight Large (Alts 3 and 4)	Bottom Trawl	L/U	153,354	96,588	120,103	344,961	41,565	33	322	2005 - 2012
	Bottom Trawl	L/U	206,737	223,359	124,248	344,961	58,527	33	382	2008 - 2012
	Bottom Trawl	L/U	210,066	223,359	101,601	304,367	102,473	42	515	2010 - 2012
	Bottom Trawl	M	326,353	316,090	104,408	538,907	201,200	42	642	2005 - 2012
	Bottom Trawl	M	348,782	350,086	127,419	538,907	201,200	37	593	2008 - 2012
	Bottom Trawl	M	423,620	381,866	101,098	538,907	350,086	35	661	2010 - 2012
	Bottom Trawl	S	518,540	503,988	88,202	677,644	404,238	61	1,284	2005 - 2012
	Bottom Trawl	S	547,222	557,443	94,880	677,644	434,450	53	1,083	2008 - 2012
	Bottom Trawl	S	526,326	557,443	80,936	587,086	434,450	50	948	2010 - 2012
	Scallop Dredge	ALL	287,143	6,510	795,625	2,256,200	1,347	19	135	2005 - 2012
	Scallop Dredge	ALL	456,750	8,793	1,005,930	2,256,200	1,347	18	106	2008 - 2012
	Scallop Dredge	ALL	8,734	8,793	2,322	11,025	6,383	13	99	2010 - 2012
	Shrimp Trawl	L/U	80,690	-	-	-	-	3	54	2005 - 2012
	Shrimp Trawl	L/U	112,590	-	-	-	-	3	61	2008 - 2012
	Shrimp Trawl	L/U	176,087	155,447	37,396	-	-	4	87	2010 - 2012
	Shrimp Trawl	M	328,587	262,307	202,267	759,329	119,248	17	386	2005 -

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
										2012
	Shrimp Trawl	M	375,327	355,154	253,117	759,329	119,248	15	384	2008 - 2012
	Shrimp Trawl	M	524,001	457,520	210,129	759,329	355,154	19	470	2010 - 2012
	Shrimp Trawl	S	564,532	514,067	309,493	1,066,776	192,454	54	983	2005 - 2012
	Shrimp Trawl	S	595,770	507,414	405,031	1,066,776	192,454	50	902	2008 - 2012
	Shrimp Trawl	S	847,795	969,194	298,789	1,066,776	507,414	59	1,128	2010 - 2012
Bigelow Bight Small (Alt 5)	Bottom Trawl	L/U	77,758	37,722	69,017	181,720	23,435	30	261	2005 - 2012
	Bottom Trawl	L/U	101,505	100,433	86,228	181,720	23,435	29	299	2008 - 2012
	Bottom Trawl	L/U	96,888	96,888	103,878	170,341	23,435	38	432	2010 - 2012
	Bottom Trawl	M	191,965	165,251	108,663	417,614	80,639	39	514	2005 - 2012
	Bottom Trawl	M	196,102	143,077	151,664	417,614	80,639	33	464	2008 - 2012
	Bottom Trawl	M	269,259	269,259	209,806	417,614	120,904	34	562	2010 - 2012
	Bottom Trawl	S	338,321	348,587	98,697	448,986	170,712	50	1,028	2005 - 2012
	Bottom Trawl	S	340,890	371,931	126,792	448,986	170,712	42	836	2008 - 2012
	Bottom Trawl	S	297,911	297,911	179,887	425,110	170,712	40	701	2010 - 2012
	Scallop Dredge	ALL	99,890	2,746	255,119	678,423	1,167	17	124	2005 - 2012
	Scallop Dredge	ALL	171,821	3,847	337,743	678,423	1,167	14	84	2008 - 2012
	Scallop Dredge	ALL	3,758	3,758	3,664	6,348	1,167	11	90	2010 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	Shrimp Trawl	OTHER	97,887	88,552	53,220	200,482	37,459	8	169	2005 - 2012
	Shrimp Trawl	OTHER	117,328	98,744	57,526	200,482	71,342	9	213	2008 - 2012
	Shrimp Trawl	OTHER	144,517	144,517	79,146	200,482	88,552	11	278	2010 - 2012
	Shrimp Trawl	S	126,748	122,356	82,391	288,207	38,708	25	346	2005 - 2012
	Shrimp Trawl	S	125,029	86,601	114,875	288,207	38,708	22	326	2008 - 2012
	Shrimp Trawl	S	205,282	205,282	117,275	288,207	122,356	30	518	2010 - 2012

Table 86 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the western Gulf of Maine Alternatives 3, 4, and 5, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the yearly means, while the other statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Bigelow Bight Large (Alts 3 and 4)	Bottom Trawl	2005 - 2012	2,192.86	81.876	26.78	6.80	48.13
	Bottom Trawl	2008 - 2012	2,065.51	81	25.50	7.15	42.04
	Bottom Trawl	2010 - 2012	1,680.96	82	20.50	6.99	30.84
	GC Scallop	2005 - 2012	8.69	6	1.45	0.41	2.59
	GC Scallop	2008 - 2012	7.74	4.6	1.68	0.46	2.81
	GC Scallop	2010 - 2012	9.58	5.33	1.80	0.59	2.97
	LA Scallop	2005 - 2012	2.84	5.38	0.53	0.03	1.48
	LA Scallop	2008 - 2012	1.53	3.2	0.48	0.05	1.07
	LA Scallop	2010 - 2012	1.43	2.33	0.61	0.03	1.52
	Shrimp Trawl	2005 - 2012	3,101.23	41.13	75.41	47.60	79.52
	Shrimp Trawl	2008 - 2012	3,987.73	46.8	85.21	58.98	85.73
	Shrimp Trawl	2010 - 2012	5,102.96	52	97.51	66.70	93.46
Bigelow Bight Small (Alt 5)	Bottom Trawl	2005 - 2012	1,680.90	55.38	30.35	9.00	52.53
	Bottom Trawl	2008 - 2012	1,574.23	56.00	28.11	9.76	43.80
	Bottom Trawl	2010 - 2012	1,389.55	61.67	22.53	9.70	32.84
	GC Scallop	2005 - 2012	8.46	5.38	1.57	0.57	2.70
	GC Scallop	2008 - 2012	7.41	4.40	1.69	0.39	2.87
	GC Scallop	2010 - 2012	9.04	5.00	1.81	0.57	3.07
	LA Scallop	2005 - 2012	1.97	3.38	0.58	0.03	1.59
	LA Scallop	2008 - 2012	1.50	2.80	0.54	0.05	1.13
	LA Scallop	2010 - 2012	1.42	2.33	0.61	0.03	1.51
	Shrimp Trawl	2005 - 2012	979.19	18.88	51.88	27.79	63.18
	Shrimp Trawl	2008 - 2012	1,251.65	22.60	55.38	27.79	68.69
	Shrimp Trawl	2010 - 2012	1,656.72	27.33	60.61	27.09	76.30

Table 87 – Party/charter recreational fishing revenue associated with the areas included in the western Gulf of Maine habitat alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
WGOM (Alt 1)	2006 - 2012	4,401,368.01	104.29	33,601.14	2,284.56	1,117.74	2,122.40
	2008 - 2012	3,836,231.91	99.20	29,995.40	2,159.80	1,117.74	1,905.85
	2010 - 2012	3,581,579.90	97.33	28,521.67	2,081.10	1,117.74	1,855.08
Bigelow Bight Large (Alts 3 and 4)	2006 - 2012	1,118,180.22	41.14	10,085.86	2,196.20	1,790.25	1,736.98
	2008 - 2012	1,011,674.03	40.20	9,287.00	2,215.67	1,875.50	1,698.56
	2010 - 2012	915,081.68	36.67	8,174.00	2,314.71	2,046.00	1,723.44
Bigelow Bight Small (Alt 5)	2006 - 2012	796,808.50	35.14	7,903.57	2,022.36	1,534.50	1,715.14
	2008 - 2012	780,816.36	35.20	7,712.40	2,118.33	1,705.00	1,734.67
	2010 - 2012	687,350.03	32.67	6,629.00	2,226.84	1,875.50	1,763.07
Stellwagen Large (Alts 3 and 6)	2006 - 2012	1,937,635.30	70.14	11,176.00	2,446.51	1,117.74	2,685.22
	2008 - 2012	1,556,208.63	66.80	9,099.40	2,196.17	1,117.74	2,360.07
	2010 - 2012	1,386,290.43	65.33	7,964.67	2,104.69	1,117.74	2,318.12
Stellwagen Small (Alts 4 and 5)	2006 - 2012	1,646,086.23	58.00	8,965.71	2,440.71	1,117.74	2,778.78
	2008 - 2012	1,303,553.52	54.20	7,111.80	2,146.83	1,117.74	2,424.74
	2010 - 2012	1,162,954.24	52.00	6,319.33	2,041.46	1,117.74	2,362.64
Jeffreys Ledge (Alts 4 and 5)	2006 - 2012	2,349,754.80	50.57	21,758.14	2,236.95	1,960.75	1,630.08
	2008 - 2012	2,169,797.99	48.40	20,269.40	2,205.98	2,046.00	1,547.31
	2010 - 2012	2,130,533.06	48.33	20,245.00	2,121.34	1,875.50	1,509.67

Table 88 – Western Gulf of Maine [Groundfish] Closure Area: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	1,256	1,357	1,432	686	540	354	528	608	648	734	824	951
	Cod	$245	$349	$368	$302	$616	$365	$313	$499	$648	$739	$523	$489
		17%	20%	23%	21%	33%	27%	30%	44%	58%	54%	45%	34%
	Haddock	$17	$97	$126	$7	$76	$48	$16	$24	$39	$39	$25	$26
		1%	5%	8%	0%	4%	4%	2%	2%	3%	3%	2%	2%
	Redfish	$41	$81	$69	$86	$82	$60	$28	$20	$22	$22	$23	$29
		3%	5%	4%	6%	4%	4%	3%	2%	2%	2%	2%	2%
	Pollock	$240	$327	$268	$357	$565	$359	$204	$256	$140	$140	$115	$204
		17%	18%	17%	25%	30%	27%	20%	23%	12%	10%	10%	14%
	Monkfish	$278	$280	$205	$135	$116	$101	$98	$77	$70	$90	$127	$160
		19%	16%	13%	9%	6%	8%	9%	7%	6%	7%	11%	11%
	Witch Flounder	$182	$161	$115	$116	$65	$38	$56	$44	$64	$116	$84	$126
		13%	9%	7%	8%	3%	3%	5%	4%	6%	8%	7%	9%
	Plaice	$133	$131	$110	$93	$57	$102	$129	$79	$52	$102	$118	$118
		9%	7%	7%	6%	3%	8%	12%	7%	5%	7%	10%	8%
	White Hake	$157	$210	$187	$257	$226	$167	$106	$71	$52	$79	88	90
		11%	12%	12%	18%	12%	13%	10%	6%	5%	6%	8%	6%
	Lobster	$76	$87	$53	$52	$58	$63	$46	$17	$5	$5	29	56
		5%	5%	3%	4%	3%	5%	4%	2%	0%	0%	3%	4%
Longline	Total Hauls	67	120	323		62							24
	Cod	$550	$377	$122		$241							$447
		91%	92%	40%		41%							90%
	Haddock	$50	$31	$176		$307							$34
		8%	7%	58%		53%							7%
Fixed Gillnet	Total Hauls	799	610	649	95	402	709	848	979	966	926	828	761
	Cod	$483	$306	$178	$289	$489	$450	$559	$661	$642	$765	$826	$649
		45%	48%	43%	66%	74%	26%	51%	58%	61%	60%	52%	36%
	Haddock	$6	$24	$60	$4	$3	$6	$3	$3	$3	$34	$5	$5
		1%	4%	15%	1%	0%	0%	0%	0%	0%	3%	0%	0%
	Pollock	$458	$121	$6	$106	$22	$861	$217	$173	$230	$329	$659	$1,014
		43%	19%	1%	24%	3%	50%	20%	15%	22%	26%	41%	57%
	Yellowtail	$35	$117	$127	$11	$5	$2	$1	$0	$0	$0	$0	$1

		Month											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
		3%	18%	31%	2%	1%	0%	0%	0%	0%	0%	0%	0%
	Spiny Dogfish	$-	$-	$-	$-	$15	$48	$143	$76	$2	$0	$0	$-
						2%	3%	13%	7%	0%	0%	0%	
	Monkfish	$13	$1	$0	$1	$24	$49	$66	$59	$45	$45	$54	$45
		1%	0%	0%	0%	4%	3%	6%	5%	4%	4%	3%	2%
Separator Trawl	Total Hauls				25		19		11	4			
	Cod				$367		$875		$1,344	$907			
					23%		47%		66%	63%			
	Haddock				$7		$130		$9	$7			
					0%		7%		0%	1%			
	Redfish				$312		$241		$89	$279			
					20%		13%		4%	19%			
	Pollock				$626		$474		$466	$182			
					39%		26%		23%	13%			
	Lobster				$127		$18		$6	$13			
					8%		1%		0%	1%			
Handline	Total Hauls	175	57	22									9
	Cod	$125	$93	$111									$84
		100%	100%	100%									99%

Table 89 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the western Gulf of Maine potentially impacted by the management alternatives.

Western Gulf of Maine		Alternative 3 and 4 (Bigelow Large)		Alternative 5 (Bigelow Small)	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**108**	**78**	**103**	**71**
	Boston	18		17	
	Gloucester	65	33	61	31
	New Bedford	26	25	25	23
	Newburyport	4		3	
	Rockport	3	3		3
ME		**67**	**74**	**32**	**44**
	Boothbay Harbor	4			
	Cundys Harbor	3			
	Harpswell	7	11		
	New Harbor	3			
	Port Clyde	6	3		
	Portland	40	13	25	11
	South Bristol	7	5		4
	Westbrook		3		3
NH		**21**	**20**	**18**	**18**
	Hampton		4		4
	Portsmouth	7		6	
	Rye	5		4	
	Seabrook	10	5	9	5

Table 90 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the western Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only.

Western Gulf of Maine			
	Alternative	**3, 4**	**5**
	Option	**1,2,3,4**	**1,2,3,4**
State	**Port**	**Total Revenue**	**Total Revenue**
MA	**Total**	**653,435.28**	**535,726.45**
	BOSTON	143,868.81	89,810.25
	GLOUCESTER	399,297.95	343,299.98
	NEW BEDFORD	22,010.60	15,382.77
	NEWBURYPORT	71,167.46	70,902.88
	ROCKPORT	15,055.53	
ME	**Total**	**1,005,469.21**	**99,662.30**
	BOOTHBAY HARBOR	6,513.74	
	CUNDYS HARBOR	96,926.02	
	HARPSWELL	105,828.25	
	NEW HARBOR	3,800.90	
	PORT CLYDE	5,531.18	
	PORTLAND	557,148.00	41,009.42
	SOUTH BRISTOL	6,078.00	
NH	**Total**	**637,716.61**	**604,648.48**
	PORTSMOUTH	126,095.49	102,841.13
	RYE	196,199.01	186,481.79
	SEABROOK	313,662.48	313,565.92

Table 91 – Total number of vessels conducting party/charter recreational fishing trips in 2012. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Western Gulf of Maine		Alternative 2 (current WGOM)		Alternative 3		Alternative 4 and 7		Alternative 5		Alternative 6	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**62**	**62**	**59**	**57**	**61**	**60**	**61**	**60**	**55**	**54**
	Boston			3		3		3			
	Gloucester	13	6	13	6	13	6	13	6	13	6
	Marshfield	23	10	23	10	23	10	23	10	23	10
	Newburyport	5	4	5	4	7	5	7	5		3
	Plymouth	3	3	4	3	3	3	3	3	4	3
	Salisbury	4				4		4			
	Scituate	6		4		4		4		4	
ME		**17**	**15**	**8**	**8**	**17**	**16**	**15**	**14**		
	Ogunquit		3				3		3		
	Portland	3				4					
	Saco	4				3		3			
	Wells	5				5		5			
NH		**24**	**24**	**23**	**24**	**27**	**28**	**27**	**28**	**9**	**9**
	Hampton	7	5	7	5	7	5	7	5		
	Hampton Falls		3		3		3		3		3
	Portsmouth					3		3			
	Rye	8	5	7	4	10	6	10	6		
	Seabrook	7		7		7		7		5	

Table 92 – Sum of 2012 party/charter recreational fishing revenue associated with the western Gulf of Maine Alternatives. Ports with less than 3 vessels each were included in the state totals only.

Western Gulf of Maine						
Alternative		**1**	**3**	**4**	**5**	**6**
State	**Port**	**Value**	**Value**	**Value**	**Value**	**Value**
MA	**Total**	**2,089,428.64**	**1,816,700.08**	**1,957,535.32**	**1,956,417.58**	**1,683,875.31**
	BOSTON		4843.54	4843.54	4,843.54	
	GLOUCESTER	950,451.58	929400.81	863826.73	863,826.73	929,400.81
	MARSHFIELD	489,756.41	481000.78	369971.94	369,971.94	481,000.78
	NEWBURYPORT	57,377.32	43964.44	87556.30	86,438.56	
	PLYMOUTH	150,336.03	151453.77	150336.03	150,336.03	151,453.77
	SALISBURY	357,490.51		418407.34	418,407.34	
	SCITUATE	17,883.84	12667.72	8010.47	8,010.47	12,667.72
ME	**Total**	**743,661.90**	**216714.95**	**871334.3**	**693,547.50**	**19,687.80**
	PORTLAND	21,030.15		29979.15		
	SACO	11,782.85		15959.05	3,877.90	
	WELLS	107,089.70		120811.5	89,788.30	
NH	**Total**	**1,523,076.50**	**461,032.00**	**1,908,577.00**	**1,908,236.00**	**63,340.75**
	HAMPTON	349,951.25	239,637.75	579,870.50	579,870.50	
	PORTSMOUTH			26,598.00	26,598.00	
	RYE	137,423.00	70,160.75	204,429.50	204,088.50	
	SEABROOK	1,007,996.00	149,443.25	1,097,679.00	1,097,679.00	56,520.75

4.2.3.3.1 Alternative 1 (No Action)

Alternative 1/No Action 1 is expected to induce moderately positive economic impacts, mainly accrued to the groundfish fishery, through the protection of both groundfish habitat and spawning grounds. Alternative 1/No Action would result in mainly neutral social impacts as it would maintain the status quo. A detailed discussion of no action vs. no habitat management areas (Alternative 2) is provided below. All other alternatives are compared to No Action in the sections that follow.

4.2.3.3.2 Alternative 2 (No Habitat Management Areas)

This alternative would remove the current Western Gulf of Maine Habitat Closure Area and the Western Gulf of Maine Groundfish Closure Area, and would not designate any additional habitat management areas in the region.

Table 88 presents the haul-level revenue generated by species caught on observed trips in the area within a 10 nautical mile buffer of the combined Western Gulf of Maine Groundfish and Habitat Closure Areas. A substantial amount of effort occurs within this 10 nautical mile buffer, for a varied mix of gear types. Cod and pollock account for a substantial portion of the revenue across all gear types. The Gulf of Maine cod stock is overfished, and overfishing is occurring, and thus in the short term, no significant increases in revenue are expected to result from targeting this species under Alternative 2. Pollock is not overfished, and overfishing is not occurring. In addition, the analyses conducted for both Framework 48 to the Northeast Multispecies FMP and this action suggest the Western Gulf of Maine closures contain substantial pollock biomass. Access to this biomass would likely provide some increased revenue, but the analysis in Framework 50 for the Northeast Multispecies FMP highlights that only 33% of the total annual catch entitlement was caught in 2010, and 50% in 2011, suggesting that access to biomass because of area closure has not historically been the limiting factor for pollock landings in the Gulf of Maine. Haddock also plays an important role for longline fishermen in the vicinity of the Western Gulf of Maine closures. However, this is likely due to a selectivity issue as opposed to biomass availability, given that this pattern is not repeated across other gear types capable of catching haddock. No large increase in revenue would be expected from haddock due to the adoption of Alternative 2, especially given that the status of the Gulf of Maine haddock stock is currently poor.

At a combined 883 square nautical miles, the Western Gulf of Maine closures amount to a large portion of the inshore western Gulf of Maine. Opening this area up to fishing is likely to decrease the costs of fishing for some commercial groundfish and mobile bottom-tending gear fishermen, who will not need to travel as far in order to access open fishing grounds. Maps in the groundfish fishery overview of Volume 1 indicate that a substantial amount of effort currently occurs very near to the area boundaries. Statistical area 514 in particular generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears, though separator trawls are more active in other statistical areas. Some of this effort would redistribute into the current closure if Alternative 2 is chosen. Furthermore, the sheer size and position of the management areas suggest that their reopening could induce currently inactive fishermen back into the fishery, for the purpose of exploratory fishing if not more sustained undertakings.

Table 87 presents the revenue from recreational charter and party vessels whose VTR points fall within the boundaries of the existing closures. A large number of permit holders, and a substantially larger number of anglers on party/charter trips, currently ply these waters. Table 91 lists communities associated with recreational trips in these areas in 2012, which are likely to experience impacts from Alternative 2. These recreational charter and party permits are mainly associated with communities in Massachusetts although there are some from southern Maine and New Hampshire (Table 91).

Increased fishing gear interactions and potential displacement of existing recreational fishing effort within the existing closures are other potential costs of this alternative. The increased costs accruing to the recreational fishery, due to congestion from an influx of commercial gear, depend on the flow of effort into the area, and the gear conflict avoidance measures taken by both recreational fishermen and groundfish/mobile bottom tending gear fishermen. This effect is likely to be negative, given the substantial recreational fishing currently reported within the Western Gulf of Maine closure areas.

When compared to Alternative 1/No Action, Alternative 2 is expected to induce moderate positive economic impacts in the short-term, and moderate negative impacts in the long-term, the latter due to its negative impact on groundfish species (see section 4.2.2.5.1). The magnitude of the short-term positive benefits are expected to be substantially larger than Alternatives 1, 3, 4, 5, 6, or 8. Conversely, the long-term negative impacts would be substantially larger in magnitude than Alternatives 1, 3, 4, 5, 6, or 8. The discount rate and time horizon before costs begin to accrue will play an important role on the overall magnitude and sign of the net benefits due to Alternative 2. The lower the discount rate, and shorter the time horizon before the costs of area management begin to accrue, the more likely the overall impact will be negative. However, given that the No Action Alternative 1 is expected to be producing short-term benefits with the same general magnitude as those derived from Alternative 2, but with positive long-term benefits, the net benefits of alternative 2 are expected to be lower than Alternative 1.

The short-term social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be highly positive as fishermen would gain access to new relatively large and accessible fishing area. There are potential long-term highly negative social impacts if benefits to fish populations from the Western Gulf of Maine Habitat and Groundfish Closure Areas are lost.

4.2.3.3.3 Alternative 3

Alternative 3 would modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Large Stellwagen HMA, and designate the Large Bigelow Bight HMA. The Western Gulf of Maine Groundfish Closure Area would be removed.

Figure 25 illustrates the diverse, and relatively stable, assemblage of fishing gears used to fish the waters of the Large Bigelow Bight area. The most obvious change between 2005 and 2012 is the substantial decrease in scallop dredge revenue in the most recent three year period. Table 85 indicates that the difference in scallop landings across time is explained by a single year (2008) with $2,256,200 in revenue, skewing the distribution. Bottom trawl and shrimp trawl revenues are much more stable across time. The VTR analysis estimates that within the bottom trawl fleets, area management in Large Bigelow Bight would affect a mean revenue of $408 (2.6% of

an average trip's revenue) per trip for vessels > 70 ft, $641 (7.3% of an average trip's revenue) per trip for vessels between 50 ft and 70 ft, and $555 (23% of an average trip's revenue) per trip for vessels < 50 ft. In total, Large Bigelow Bight is expected to impact 0.9% of average annual bottom trawl revenue recorded in VTR between 2010 and 2012. The shrimp trawl fishery would be affected to an even greater extent, with a mean trip revenue of $2,024 (56% of an average trip's revenue) for vessels >70 ft, $1,115 (48% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $752 (43% of an average trip's revenue) for vessels < 50 ft. The displaced revenue accounts for 34% of all shrimp trawl revenue reported within the VTR for 2010 – 2012 (see section 4.5 of Volume I for magnitude and statistical areas used). Given that the Large Bigelow Bight area abut New Hampshire state waters, in which there is a complete ban on mobile gear fishing, including all otter trawls (http://www.gencourt.state.nh.us/rules/state_agencies/fis600.html), the impact on New Hampshire fishermen in particular is likely to be acute.

Table 86 presents the VMS analysis for effort estimated to fall within the Large Bigelow Bight management area. Neither the general category nor the limited access scallop estimates of effort reflect the revenue spike estimated for 2008 through the VTR analysis. Bottom trawl effort seems to be on a downward trend in the area, with the 2010-2012 average 23% lower than the 2005-2012 average. Again, this steep a downward trajectory is not apparent in the VTR analysis, with the average number of trips only down 6% over the same time periods across all vessel sizes. Additonal analysis would be necessary in order to ascertain whether the difference between VMS and VTR results are significant. Conversely, the shrimp trawl shows a marked increase in effort estimated to fall within the Large Bigelow Bight area, with an increase of 65% in the mean annual effort when comparing 2010-2012 to the full 2005-2012 series average. This is consistent with the VTR analysis, which indicates a 59% increase over the same time periods. Although some discrepancies exist between the VTR and VMS analysis, they paint a similar broad picture, with both indicating the importance of Large Bigelow Bight to bottom and shrimp trawl fishermen in particular.

Table 87 details the recreational fishing revenue generated from the Large Bigelow Bight and Large Stellwagen areas. There is significant charter and party boat fishing in both areas, with a substantial number of angler trips and permitted vessels reported in the areas. To the extent that mobile bottom-tending gear crowds out recreational effort, an exclusion of these gear types would benefit the recreational fishery in the Large Bigelow Bight area. However, longline and gillnet effort is expected to flow into the Western Gulf of Maine Groundfish Closure Area. To the extent that recreational and commercial gear interactions would increase due to this effort displacement, the recreational fishery is expected to experience negative impacts. Given the relative amount of recreational fishing reported within the Western Gulf of Maine closure (Table 87), <u>the net impact to the recreational fishery is likely to be moderately negative for all options, when compared to Alternative 1/No Action. The negative impact to the recreational fishery is expected to be smaller than Alternative 2 and 6, but larger than Alternatives 4 and 5.</u> These impacts are associated with trips that land in or have permits registered in towns in Massachusetts, southern Maine, and New Hampshire (Table 91).

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect $2,716,628 in gross revenue (35% of the total) generated from Large Bigelow Bight in the most recent three

year period (2010-2012). The Alternative 2 discussion above indicates that the economic benefits arisising from the removal of the Western Gulf of Maine closures was likely to derive from the decreased cost of commercial fishing, as opposed to increases in gross revenue. Statistical area 514, overlapping the Stellwagen Large portion of the Western Gulf of Maine closure, generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears, though separator trawls are more active in other statistical areas. This, in turn, suggests that more effort is concentrated around the Stellwagen Large, versus the more northerly portion of the western Gulf of Maine closures. The Large Bigelow Bight HMA is closer inshore, and larger than, the area around Jeffreys Ledge that would opened under Alternative 3. Coupled with the importance of the Large Bigelow Bight area to bottom trawl and shrimp trawl fishermen, this indicates that Alternative 3, Option 1 is, in the short-term, likely to generate moderate negative economic impacts to bottom trawl and shrimp trawl fishermen, when compared to Alternative 1/No Action. Conversely, Alternative 3, Option 1 is likely to generate positive economic benefits for gillnet and longline fishermen, who will gain more flexibility in where and when they can fish, likely translating into a decreased cost of fishing. The net impact across all commercial gear and recreational fleet, is expected to be moderately negative in the short-term given the relative size of each of the fleets. Moderate positive economic benefits are expected in the long-term for all large mesh groundfish fishermen, when compared to Alternative 1/No Action, due to the expected highly positive impact of Alternative 3 on large mesh groundfish stocks (see section 4.2.2.5.2). The magnitude of the negative short-term impacts are expected to be larger than Alternatives 1 2, and 8 (which are expected to have positive impacts), and commesurate options in Alternative 6, and smaller than Alternatives 4 and 5. Conversely, the positive long-term benefits are expected to be larger than Alternatives 1 , 2, 5, 6, and 8 and negligibly different from Alternative 4. The discount rate and time horizon before benefits begin to accrue will play an important role on the overall magnitude and sign of the net benefits due to Alternative 3. The lower the discount rate, and shorter the time horizon before the benefits of area management begin to accrue, the more likely the overall impact will be positive. However, given that the No Action Alternative 1 is expected to be producing positive short-term benefits with positive long-term benefits with the same general magnitude as alternative 3, the net benefits of Alternative 3 are expected to be lower than Alternative 1.

Option 2 is expected to have the same economic outcomes as Option 1, given the fact that the southern portion of the Large Bigelow Bight area falls within the current PSP closure, and no calm revenue is estimated to have been generated from the northern portion between 2005 and 2012. There is a proposed rule to lift this PSP closure for clams currently under review. However, this is not likely to influence the amount of clamming currently conducted in the area, given the historical survey and fishery data available (see section 4.3.8 of Volume I for an overview of the distribution and fishery, and 79 FR 38274 in the Federal Register for expected impacts due to the PSP removal).

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. Given what is known, Options 3 and 4 would be expected to induce a moderate negative impact as compared to Alternative 1/No Action.

The social impacts of implementing the Large Bigelow Bight HMA would affect ports of landing and city of registration from Maine to Massachusetts (Table 90). None of the identified communities included vessels using clam dredges so would not benefit from the clam dredge exemption (Option 2), and limited or no hydraulic clam dredging is likely to occur in the western Gulf of Maine. Many of the communities identified have vessels using scallop dredges and would benefit from the gear modification options (Options 3 and 4). Analysis of the impacts of the modification of the current Western Gulf of Maine Habitat Closure Area into the Large Stellwagen HMA is difficult due to the fact that this area is currently closed.

The short-term social impacts of Alternative 3 in comparison to Alternative 1/No Action are expected to be moderately negative, slightly less negative than Alternative 4, but more negative than Alternative 5. The addition of the Large Bigelow Bight HMA would most likely have negative social impacts on smaller vessels that are more likely to fish inshore and cannot easily adapt to fishing in other areas or easily access the areas of the Western Gulf of Maine closure that would be opened. The access to the northern part of the Western Gulf of Maine closure may have positive social impacts on larger vessels. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas. However, due to the geographic range of the Large Bigelow Bight area it may be difficult for smaller vessels to adapt in the near-term. Additionally, fishermen commented during informational interviews conducted by the Council that this area would disproportionately impact the shrimp fishery as well as voicing concerns about the current impact of fixed gears in this area and how this may increase if mobile gears are restricted thus limiting the benefits to habitat in the area.

4.2.3.3.4 Alternative 4

Alternative 4 would modify the boundaries of the current Western Gulf of Maine Habitat Closure Area to create the Small Stellwagen and Jeffreys Ledge HMAs, and designate the Large Bigelow Bight HMA.

Fishing activity in the Large Bigelow Bight area is discussed under Alternative 3 above (Figure 25, Table 85 – VTR, Table 86 – VMS, Table 87 – recreational).

Given the relative amount of recreational fishing reported within the Western Gulf of Maine Groundfish Closure Area (Table 87), the impact to the recreational fishery is likely to be negative for all options, when compared to Alternative 1/No Action. The negative impact to the recreational fishery is expected to be smaller than Alternatives 2, 3, and 6, but larger than Alternatives 5 and 8. Table 91 lists communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts. In particular towns in Massachusetts, southern Maine, and New Hampshire are associated with trips that land in or have permits registered in these communities.

As discussed under Alternative 3, a complete exclusion of mobile bottom tending gear, as per Option 1, would affect $2,716,628 in gross revenue (35% of the total) generated from Large Bigelow Bight in the most recent three year period (2010-2012). The combination of Large Bigelow Bight, Small Stellwagen, and Jeffreys Ledge are thus expected to induce negative economic impacts in the short run for shrimp and bottom trawl under Option 1, when compared

to Alternative1/No Aciton, Alternative 2, and Alternative 8. The magnitude is expected to be larger than Alternatives 3, 5, and 6. Conversely, Alternative 4 is expected to induce positive economic benefits to gillnet and longline fishermen, by opening currently closed areas to fishing and decreasing interactions between static and mobile gears, which is expected to decrease the costs of fishing compared to Alternatives 1, 2, and 8 and commesurate options in Alternatives 3, 5, and 6. As compared to Alternative 1/No Action, moderate negative impacts are expected in the short-term, due to the relative size of each of the fishing fleets affected, with moderate postive long-term benefits expected. . The discount rate and time horizon before benefits begin to accrue will play an important role on the overall magnitude and sign of the net benefits due to Alternative 4. The lower the discount rate, and shorter the time horizon before the benefits of area management begin to accrue, the more likely the overall impact will be positive. However, given that the No Action Alternative 1 is expected to be producing positive short-term benefits with positive long-term benefits with the same general magnitude as Alternative 4, the net benefits of Alternative 4 are expected to be lower than Alternative 1.

Option 2 is expected to have the same economic outcomes as Option 1, given the fact that the southern portion of the Large Bigelow Bight area falls within the current PSP closure, and no calm revenue is estimated to have been generated from the northern portion between 2005 and 2012. There is a proposed rule to lift this PSP closure for clams currently under review. However, this is not likely to influence the amount of clamming currently conducted in the area, given the historical survey and fishery data available (see section 4.3.8 of Volume 1 for an overview of the distribution and fishery, and 79 FR 38274 in the Federal Register for expected impacts due to the PSP removal).

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. Given what is known, Options 3 and Option 4 would be expected to induce negative impacts as compared to no action.

The addition of the Large Bigelow Bight HMA would most likely have negative social impacts on smaller vessels that are more likely to fish inshore and cannot easily adapt to fishing in other areas or easily access the areas of the Western Gulf of Maine closure that would be opened. The access to the northern part of the Western Gulf of Maine closure may have positive social impacts on larger vessels. Analysis of the impacts of the modification of the current Western Gulf of Maine habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas is difficult due to the fact that these areas are currently closed. However, positive social impacts related to the modification of the WGOM closure are less likely to benefit the small vessels which will be highly impacted by the Large Bigelow Bight HMA. The social impacts of Alternative 4 in comparison to the no action alternative are expected to be moderately negative. Moderate positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.2.3.3.5 Alternative 5

Alternative 5 would also modify the boundaries of the Western Gulf of Maine Habitat Closure Area to create the Small Stellwagen and Jeffreys Ledge HMAs, and designate the Small Bigelow Bight HMA.

Figure 26 identifies the fishing gear active in Small Bigelow Bight, and their relative share of total revenue. In total, the Small Bigelow Bight encompasses 40% of the revenue generated from Large Bigelow Bight, with a relatively larger share of the revenue generated using bottom trawl and sink gillnet in the smaller area. Table 85 details the revenue generated by gears potentially impacted by this alternative. This revenue represents 37% of what is generated within Large Bigelow Bight with the same gear, although a larger portion is contributed by bottom trawl (57%) as opposed to shrimp trawl (23%). The Small Bigelow Bight area is an important bottom trawl fishing ground. Average revenue for vessels >70 ft is $268/trip (1.7% of an average trip's revenue), for vessels between 50 and 70 ft it is $441/trip (4.9% of an average trip's revenue), and vessels < 50 ft it is $467/trip (20.6% of an average trip's revenue), substantially lower than the Large Bigelow Bight area. Nevertheless, the VTR analysis estimates that 80% of bottom trawl trips potentially impacted by the Large Bigelow Bight area would still be impacted by the Small Bigelow Bight management area to some extent. Overall, the affected bottom trawl revenue represents 0.5% of the total bottom trawl revenue reported through VTR in the Gulf of Maine, Georges Bank and Southern New England (see section 4.5 of Volume I for statistical areas used and magnitude of total). This is compared to only 47% of the shrimp trawl trips from Large Bigelow Bight estimated to be also impacted by the Small Bigelow Bight alternative, representing 7.7% of the 2010 – 2012 average annual shrimp trawl revenue reported within the VTR for relevant statistical areas (see section 4.5 of Volume I). The average trip revenue displaced on affeted shrimp trawl trips is $396 (25.4% of an average trip's revenue) for vessels < 50 ft, and $520 (26.4% of an average trip's revenue) for all other vessels. These results are again backed up by the VMS analysis presented in Table 86, which estimates that the Bottom and Shrimp Trawl effort in Small Bigelow Bight are respectively 83% and 32% of what falls within the boundary of Large Bigelow Bight. Combined, this suggests that the Small Bigelow Bight excludes the most intensively fished grounds for shrimp trawl, but still encapsulates a large portion of the bottom trawl fishing grounds associated with Large Bigelow Bight HMA. A general discussion of the Western Gulf of Maine closure can be found in Alternative 2, and provides a sense of the benefits and costs associated with the Small Stellwagen and Jeffreys Ledge HMAs.

Table 87 represents the recreational fishing effort reported within Small Bigelow Bight, which encompasses 75% of the revenue, and 81% of the angler trips associated with Large Bigelow Bight. This suggests that Small Bigelow Bight is an important center for recreational fishing. Nevertheless, to the extent that recreational and commercial gear interactions would increase due to the displacement of gillnet and longline effort into areas of the Western Gulf of Maine closure currently closed to these gear types, the recreational fishery is expected to experience negative impacts. Table 87 also shows the recreational effort reported within the boundaries of the Small Stellwagen and Jeffreys Ledge areas. Longline and gillnet effort is expected to flow into the Western Gulf of Maine Groundfish Closure Area. To the extent that recreational and commercial gear interactions would increase, the recreational fishery is expected to experience negative impacts in this area. Although the Stellwagen and Jeffreys Ledge areas will continue to be exclusion zones for mobile bottom-tending gear, given the relative amount of recreational fishing reported within the Western Gulf of Maine Closure Area (Table 87), the net impact to the recreational fishery is likely to be negative for all options, when compared to Alternative 1. The magnitude of this negative impact is expected to be larger than that of Alternatives 4 and 8, but

smaller than Alternatives 2, 3, or 6. Table 79 lists the communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts.

A complete exclusion of mobile bottom tending gear, as per Option 1, would affect $1,093,667 in gross revenue (35% of the total) generated from Small Bigelow Bight in the most recent three year period (2010-2012). Alternative 5 Option 1 is likely to induce negative impacts to the shrimp trawl fishery as compared to Alternative 1. These impacts are expected to be lower than Alternative 3 and Alternative 4, in particular given that the Small Bigelow Bight area seems to exclude the most productive shrimp grounds, but substantially larger in magnitude than Alternatives 1, 2, and 6. A substantial portion of the current Western Gulf of Maine Closure Area falling within statistical area 514 would continue to remain closed to bottom trawl fishing, meaning that Alternative 5 is expected to induce a neutral to slightly negative short-term impact for fishermen using bottom trawls when compared to Alternative 1. This short-term negative impact is expected to be substantially larger than Alternatives 2 (which has expected positive impacts) and 6, and smaller than Alternatives 3 and 4. Alternative 5 is expected to induce moderate positive economic benefits to the gillnet and longline fishermen, by opening currently closed areas to fishing and decreasing interactions between static and commercial mobile gear, which is expected to decrease the costs of fishing slightly compared to Alternatives 1-4, 6, and 8. However, the cumulative economic impacts in the short-term are expected to be moderately negative, when compared to no action, due to the relative size of the fishing fleets under management. In the long-term, a moderately positive benefit is expected from Alternative 5, Option 1 when compared to Alternative 1/No Action, due to increased protection for groundfish habitat (see section4.2.2.5.4). The discount rate and time horizon before benefits begin to accrue will play an important role on the overall magnitude and sign of the net benefits due to Alternative 5. The lower the discount rate, and shorter the time horizon before the benefits of area management begin to accrue, the more likely the overall impact will be positive. However, given that the No Action Alternative 1 is expected to be producing positive short-term benefits with positive long-term benefits with the same general magnitude as Alternative 5, the net benefits of Alternative 5 are expected to be lower than Alternative 1. Option 2 is expected to have the same economic outcome as Option 1, for reasons noted in the discussion of Alternative 3 & 4.

As discussed previously both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. Options 3 and 4 would be expected to induce a moderately negative impact as compared to Alternative 1/No Action.

Analysis of the social impacts of Alternative 5 is difficult due to the fact that the Small Stellwagen and Jeffreys Ledge HMAs are currently closed, however positive social impacts related to the modification of the Western Gulf of Maine Habitat Closure Area are less likely to benefit the small vessels which will be highly impacted by the Small Bigelow Bight HMA. The implementation of the Small Bigelow Bight HMA will likely have moderately negative social impacts, particularly affecting smaller vessels that are not able to adapt and fish further offshore; however these impacts will be less significant in comparison to the impacts associated with the Larger Bigelow Bight HMA included in Alternatives 3 and 4, particularly because many of the communities in Maine that would be impacted by the large Bigelow Bight HMA will not be

impacted by this smaller area. Moderate positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas. Overall, the social impacts of Alternative 5 in comparison to Alternative 1/No Action are expected to be moderately negative.

4.2.3.3.6 Alternative 6

Alternative 6 would modify the boundaries of the Western Gulf of Maine Habitat Closure Area to create the Large Stellwagen HMA.

The Large Stellwagen area lays within statistical area 514, which generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears of any statistical area. A large portion of the current Western Gulf of Maine Habitat Closure Area within statistical area 514 would remain closed to bottom trawl fishing under Alternative 6 Option 1. Nevertheless, Alternative 6 Option 1 is expected to generate moderate positive economic benefits for fishermen using bottom trawls, when compared to Alternative 1, due to the fact that Alternative 6 is a subset of the area currently closed under Alternative 1. The short-run positive impact is expected to be substantially smaller than Alternative 2, and substantially larger than Alternatives 3 (of which this is a subset), 4, 5, and 8 given the relative size of the closures in each. The other fisheries/gears currently active within the Gulf of Maine have centers of effort outside of this statistical area. Shrimp trawl would likely see a slightly positive impact from Alternative 6 when compared to Alternative 1/No Action, in the event that the fishery is reopened. This impact is expected to be substantially smaller than Alternative 2 and substantially larger than Alternatives 3, 4, 5, and 8 which all include areas seemingly more productive for shrimp fishermen. Gillnet and longline fishermen are expected to experience moderately positive economic impacts when compared to Alternatives 1 and 8 due to the increase in area open to these gear types. The magnitude of this impact is negligibly smaller than what would be expected from Alternatives 3, 4, and 5, given that slightly higher fishing costs might arise from more interactions between gear types under Alternative 6. Thus, the magnitude of the positive economic impacts to longline and gillnet fishermen is expected to be negligibly larger than Alternative 2.

Table 87 details the recreational fishing reported to occur within the Stellwagen Large area. Although this effort will continue to be shielded from gear interactions with bottom trawls, the influx of gillnet and longline effort in this area, in addition to the removal of exclusions against mobile bottom-tending gear and gear capable of catching groundfish in the northern portion of the current Western Gulf of Maine closures is expected to induce moderately negative impacts to the recreational fishery when compared to Alternative 1/No Action. The magnitude of this impact is expected to be larger than Alternatives 3-5 and 8, but smaller than Alternative 2. Table 91 lists communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts.

Across all fisheries, the short-term impacts are expected to be slightly positive when compared to Alternative 1/No Action, given the relative size of the fleets under management. In the long term, slightly negative impacts are expected when compared to Alternative 1, given the decreased protection for groundfish habitat (see section 4.2.2.5.5). Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly positive impacts, and long-term slightly negative impacts make clear that the net benefits are likely to be

relatively marginal/negligible regardless of their ultimate sign. Option 2 is expected to have the same economic outcome as Option 1, for reasons outlined in the discussions of the economic impacts for Alternative 3 and 4.

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. Both Options 3 and 4 would be expected to induce a moderate negative impact as compared to no action.

The short-term non-economic social impacts of Alternative 6 are expected to be moderately positive. Minimal social impacts are associated with fishing vessels adapting to the new boundaries of the Large Stellwagen HMA due to its proximity in overall size and location of the current habitat closure. There are potential long-term negative social impacts if benefits to fish populations from the Western Gulf of Maine Habitat and Groundfish Closure Areas are lost.

4.2.3.3.7 Alternatives 7A and 7B

Alternative 7 would implement roller gear size restrictions for all trawl vessels as a habitat management measure in the western Gulf of Maine in the existing Inshore Roller Gear Restricted Area (Alternative 7A) or a modified roller gear area (Alternative 7B). This alternative can be implemented in addition to any of the other six alternatives.

Taken as a standalone measure, when compared to Alternative 1/No Action, Alternative 7A is expected to induce moderately positive economic benefits in the short-term, and moderately negative economic impacts in the long-term, the latter due to its negative impact on groundfish species (see section 4.2.2.5.6). The magnitude of the short run positive benefits are expected to be substantially larger than Alternatives 1, 3-6, equal to Alternative 2, assuming the roller gear restrictions as currently implemented would continue in the latter, and smaller than 7B. Conversely, the long run negative impacts would be substantially larger in magnitude than Alternatives 1, 3-6, and 8 equal to Alternative 2, if the roller gear restrictions would continue in the latter, and smaller than 7B.

When **coupled with the preferred alternative** (No Action Alternative 1), Alternative 7A is expected to have neutral impacts in both the short-term and long-term, as it continues current area management regulations. When coupled with Alternatives 2-6 or 8, Alternative 7A is not expected to change the net impact conclusions, as Alternative 7A would hold constant across all alternatives and is very similar to the existing roller gear restriction except that it would apply to all trawl vessels, not only Northeast multispecies vessels.

Given the smaller area encompassed by the roller gear restriction in Alternative 7B, which is for the most part a sub-set of Alternative 7A, the induced inefficiency by changing from what is ostensibly an optimal gear configuration is no larger, and likely smaller, than the inefficiency induced by the restrictions in the Alternative 7A area. Therefore the cost of Alternative 7B to bottom trawl fishermen is expected to be smaller than 7A. Conversely, what habitat conservation the gear restriction induces is also likely to be smaller than 7A, given that it protects a smaller amount of area susceptible to fishery impacts. Coupling Alternative 7B with any other alternative in the western Gulf of Maine would follow the general comparison of benefits between those alternatives and the status quo. This is a result of a relatively small impact expected from

Alternative 7B when compared to the much larger impacts associated with Alternatives 1 – 6 and 8.

The social impacts of Alternative 7 will depend upon the other spatial alternatives selected. Generally, if implemented in conjunction with one of the other spatial management alternatives, Alternative 7 is expected to have neutral social impacts. Taking Alternative 7 as a standalone option, generally, due to the positive short term impacts associated with opening the Western Gulf of Maine Closure Area, the short term impacts of Alternative 7 are expected to be positive in comparison to Alternative 1/No Action.

4.2.3.3.8 Alternative 8

Alternative 8 is identical to the Alternative 1/No Action in terms of impacts for all gears save shrimp trawl, which would be exempted within the northwest section of the Western Gulf of Maine Habitat Closure. The discussion of Alternative 1 and 2 present the expected benefits and costs of Alternative 1. The shrimp fishery section of Volume 1 includes a map of the historical effort distribution for shrimp trawls, as self-reported within the dealer and VTR databases. Statistical Area 513, in which the exemption area discussed within Alternative 8 falls, has the highest concentration of northern shrimp landings reported within the dealer reports. The VTR points also suggest a substantial amount of effort self-reported around the exemption area of Alternative 8, particularly in the January to March timeframe. Together, this suggests that an exemption for shrimp trawls within the area would provide some benefit for shrimp trawls seasonally, through the ability to follow the shrimp biomass off-shore. However, the fishery description in Volume 1 suggests that the majority of the fishery (92% of trips) is prosecuted in-shore in waters shallower than 55 fathoms.

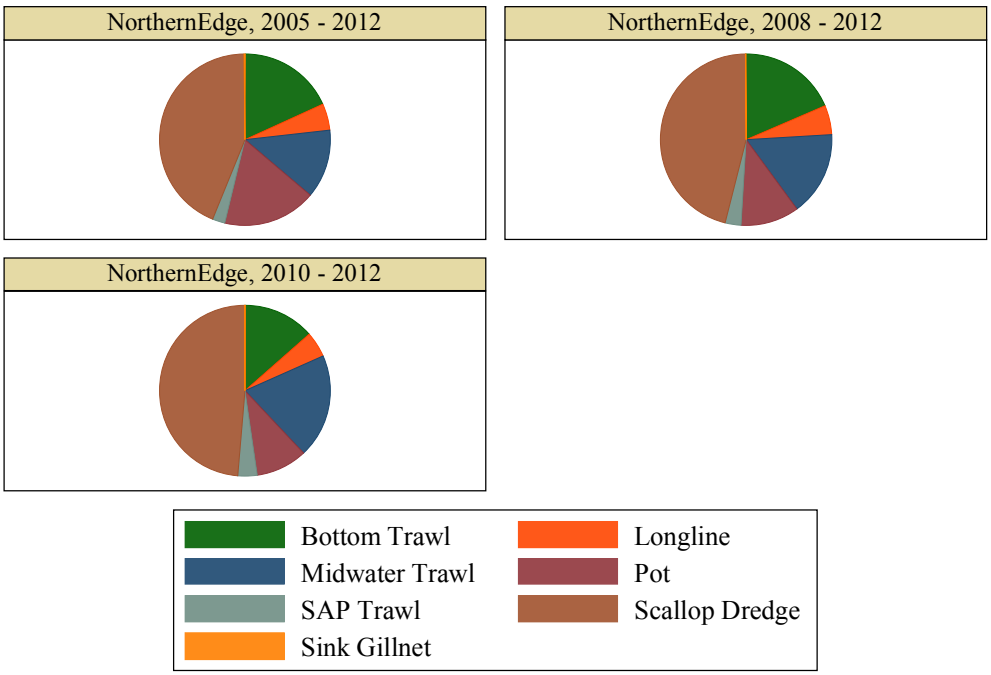
The current northern shrimp fishery moratorium means that the short-run impacts of Alternative 8 are expected to be neutral, with respect to Alternative 1/No Action. Given the high uncertainty in the future prospects for the northern shrimp fishery due to the stock collapse, the long-termimpacts are highly uncertain.

The social impacts of Alternative 8 would likely be positive compared to the No Action Alternative; however, there may be some slight negative impacts to *Social Structures and Organizations* due to differing levels of restrictions on different fisheries.

4.2.3.4 ***Georges Bank***

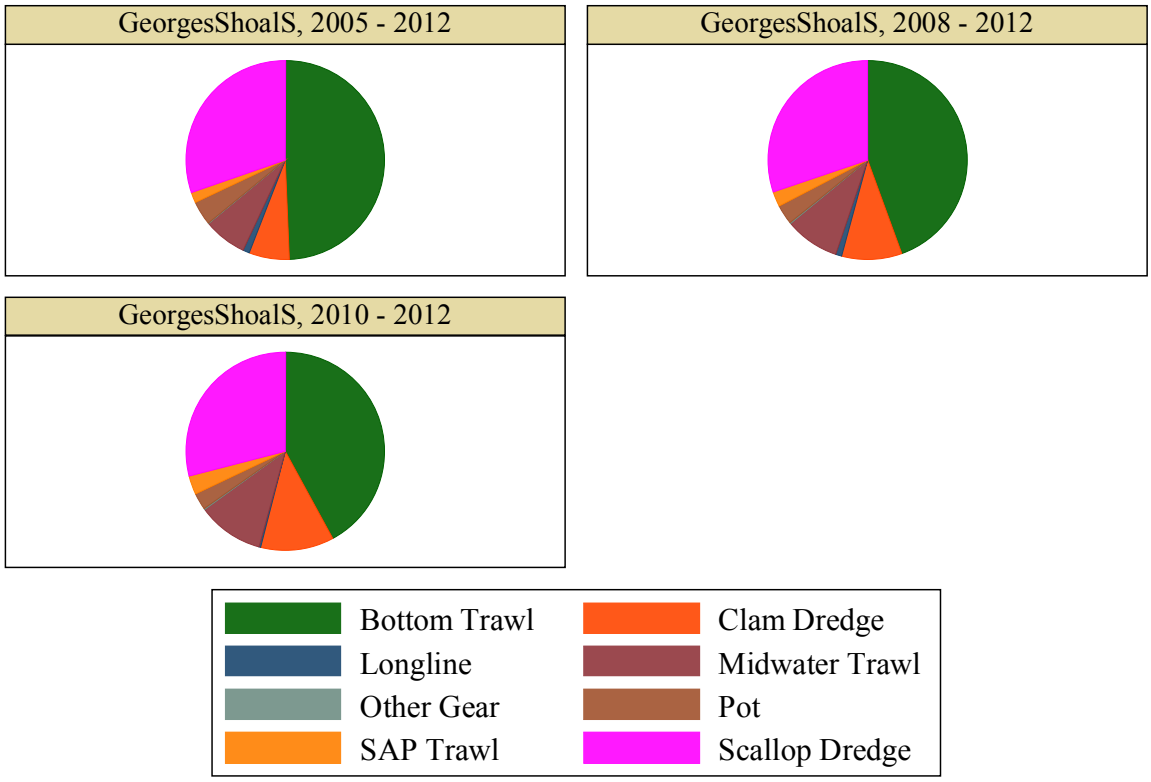
Tables and figures related to analysis of the social and economic impacts of the Georges Bank habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 27 – Northern Edge HMA (Alternatives 3 and 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 852,785; 2008 - 2012 = $ 1,087,408; 2010 - 2012 = $ 1,454,659



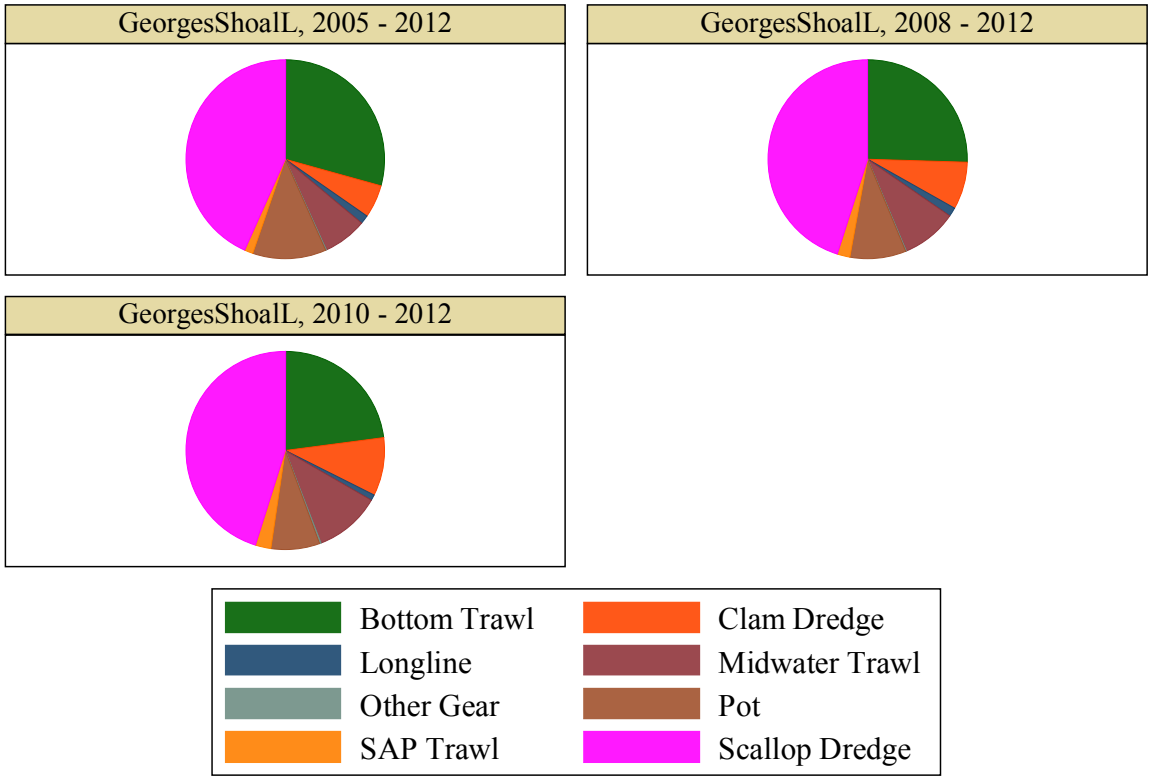
Graphs by Area and years

Figure 28 –Georges Shoal Gear Modification Area (Alternative 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 3,448,932; 2008 - 2012 = $ 3,702,336; 2010 - 2012 = $ 5,053,355



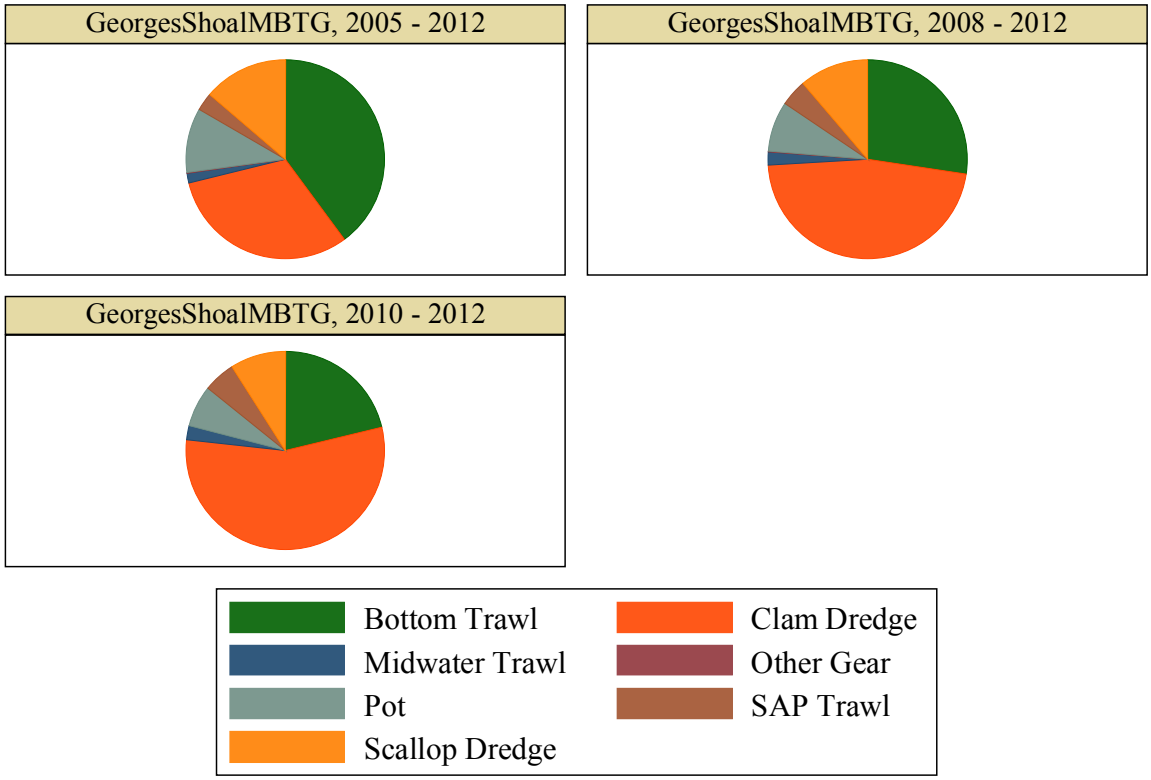
Graphs by Area and years

Figure 29 – Northern Georges Gear Modification Area (Alternative 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 19,384,365; 2008 – 2012 = $ 21,334,179; 2010 – 2012 = $ 29,024,703



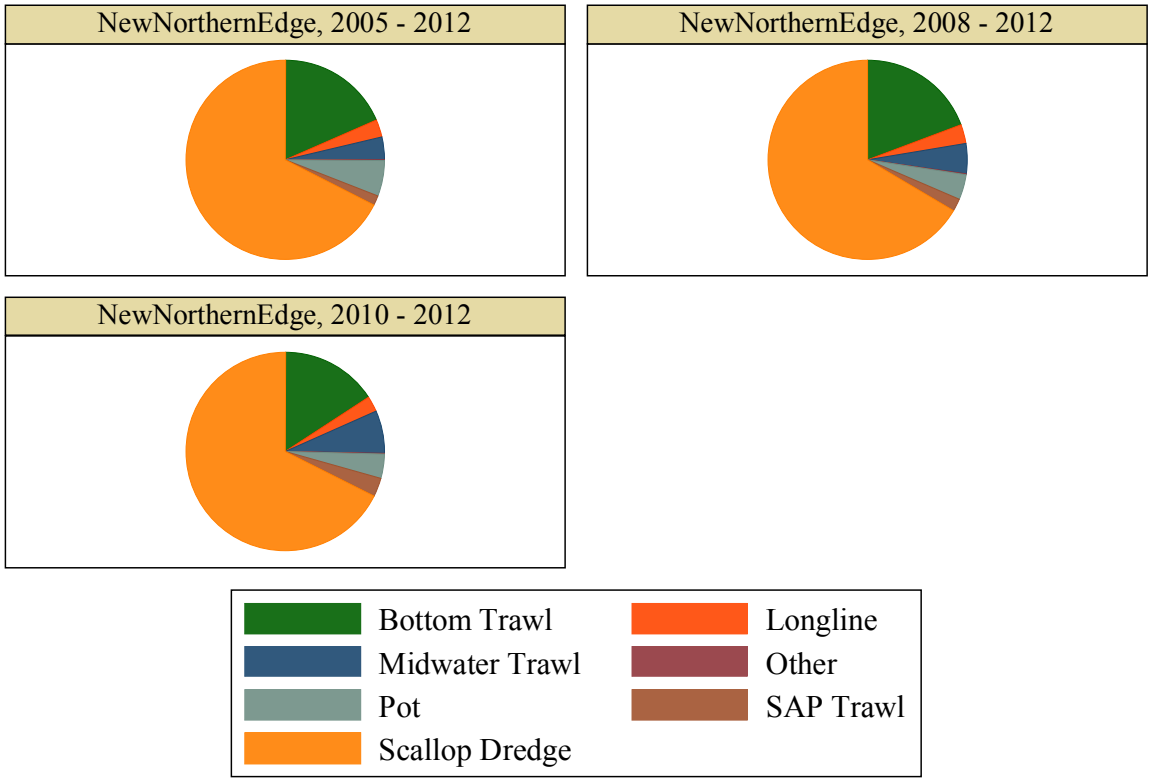
Graphs by Area and years

Figure 30 – Georges Shoal 1 MBTG closure HMA (Alternative 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that three gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 1,966,622; 2008 – 2012 = $ 2,106,342; 2010 – 2012 = $ 2,944,249



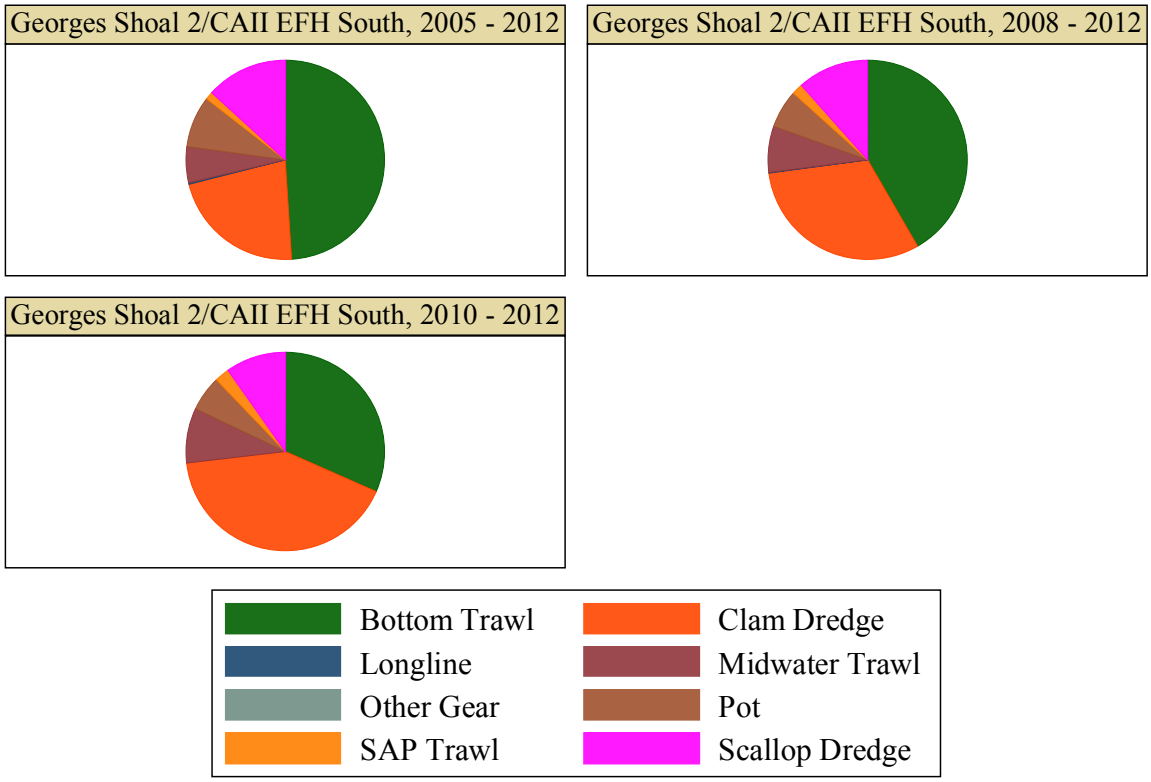
Graphs by Area and years

Figure 31 – EFH Expanded 1 HMA (Alternative 6A) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 5,821,773; 2008 – 2012 = $ 6,731,022; 2010 – 2012 = $ 7,803,157



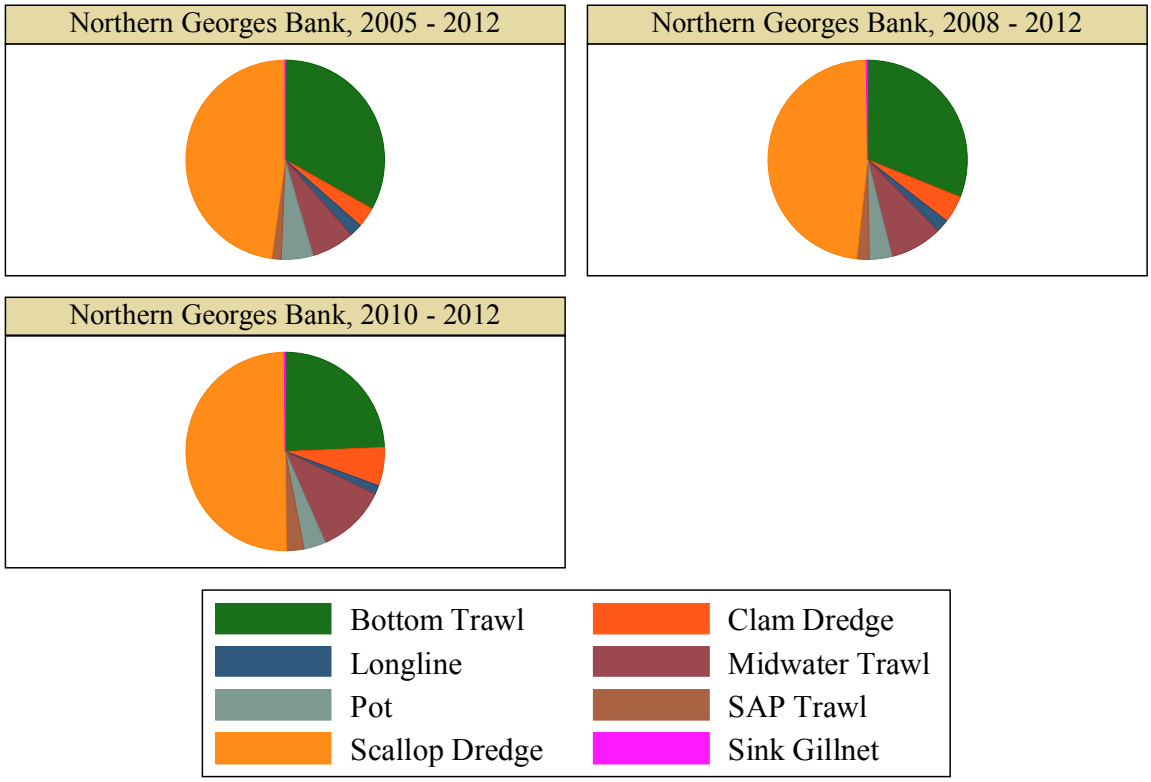
Graphs by Area and years

Figure 32 – Georges Shoal 2 MBTG/EFH South MBTG (Alternative 7) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,617,306; 2008 – 2012 = $ 2,963,928; 2010 – 2012 = $ 3,698,026



Graphs by Area and years

Figure 33 – Northern Georges MBTG HMA (Alternative 8) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 19,464,700; 2008 – 2012 = $ 22,610,573; 2010 – 2012 = $ 26,819,277



Graphs by Area and years

Table 93 – Mobile bottom-tending gear in currently open portions of the areas included in the Georges Bank habitat alternatives. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Northern Edge (Alts 3 and 4)	Bottom Trawl	L	130,708	147,035	64,237	199,617	41,662	86	536	2005 - 2012
	Bottom Trawl	L	173,620	176,300	30,298	199,617	124,951	76	602	2008 - 2012
	Bottom Trawl	L	181,177	176,300	15,098	198,111	169,120	67	612	2010 - 2012
	Bottom Trawl	OTHER	24,221	18,060	17,542	63,660	10,492	19	70	2005 - 2012
	Bottom Trawl	OTHER	27,492	18,485	21,990	63,660	10,492	16	68	2008 - 2012
	Bottom Trawl	OTHER	13,760	12,302	4,191	18,485	10,492	13	67	2010 - 2012
	SAP Trawl	ALL	19,844	0	29,802	77,560	0	21	38	2005 - 2012
	SAP Trawl	ALL	31,751	35,324	32,890	77,560	0	21	61	2008 - 2012
	SAP Trawl	ALL	52,919	45,872	21,982	77,560	35,324	21	102	2010 - 2012
	Scallop Dredge	L	350,183	172,968	521,716	1,631,649	93,089	39	57	2005 - 2012
	Scallop Dredge	L	470,187	250,421	653,543	1,631,649	93,089	40	59	2008 - 2012
	Scallop Dredge	L	658,387	250,421	846,533	1,631,649	93,089	40	55	2010 - 2012
	Scallop Dredge	OTHER	21,967	9,163	40,169	120,613	611	4	5	2005 - 2012
	Scallop Dredge	OTHER	29,315	7,951	51,228	120,613	611	3	4	2008 - 2012
	Scallop Dredge	OTHER	47,081	12,680	63,724	120,613	7,951	3	5	2010 - 2012
Georges Shoal Gear Mod Area (Alt 4)	Bottom Trawl	L	1,552,085	1,668,829	574,181	2,263,786	398,000	92	966	2005 - 2012
	Bottom Trawl	L	1,508,644	1,690,509	722,179	2,263,786	398,000	75	947	2008 - 2012
	Bottom Trawl	L	1,963,998	1,937,697	287,542	2,263,786	1,690,509	77	1,112	2010 - 2012
	Bottom Trawl	OTHER	150,431	151,352	44,351	218,177	79,899	25	143	2005 - 2012
	Bottom Trawl	OTHER	136,513	126,833	44,864	195,496	79,899	19	126	2008 - 2012
	Bottom Trawl	OTHER	162,487	165,133	34,408	195,496	126,833	18	130	2010 - 2012
	SAP Trawl	L	55,208	0	91,418	256,113	0	24	64	2005 - 2012
	SAP Trawl	L	88,333	86,604	104,727	256,113	0	24	102	2008 - 2012
	SAP Trawl	L	147,222	98,949	94,504	256,113	86,604	24	170	2010 - 2012
	SAP Trawl	M	1,562	-	-	-	-	3	4	2005 - 2012
	SAP Trawl	M	2,499	-	-	-	-	3	7	2008 - 2012
	SAP Trawl	M	4,165	-	-	-	-	3	11	2010 - 2012
Northern Georges Gear Mod	Bottom Trawl	L	5,114,013	4,982,598	1,932,954	7,945,043	1,606,149	96	1,142	2005 - 2012
	Bottom Trawl	L	4,941,968	4,723,674	2,433,392	7,945,043	1,606,149	78	1,096	2008 - 2012
	Bottom Trawl	L	6,126,673	6,509,766	2,037,115	7,945,043	3,925,209	81	1,303	2010 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Area (Alt 5)	Bottom Trawl	OTHER	579,782	566,568	182,716	936,752	355,355	27	177	2005 - 2012
	Bottom Trawl	OTHER	487,115	534,179	117,092	630,842	355,355	21	150	2008 - 2012
	Bottom Trawl	OTHER	508,001	537,805	140,141	630,842	355,355	20	158	2010 - 2012
	SAP Trawl	L	265,317	0	466,970	1,330,220	0	26	71	2005 - 2012
	SAP Trawl	L	424,508	340,471	545,100	1,330,220	0	26	114	2008 - 2012
	SAP Trawl	L	707,513	451,847	542,148	1,330,220	340,471	26	189	2010 - 2012
	SAP Trawl	M	9,290	-	-	-	-	3	4	2005 - 2012
	SAP Trawl	M	14,864	-	-	-	-	3	7	2008 - 2012
	SAP Trawl	M	24,774	-	-	-	-	3	12	2010 - 2012
Georges Shoal 1 Mobile Bottom Tending Gear Closure (Alt 5)	Bottom Trawl	L	706,762	723,825	389,042	1,450,060	152,958	94	1,024	2005 - 2012
	Bottom Trawl	L	522,154	602,145	275,430	790,314	152,958	77	988	2008 - 2012
	Bottom Trawl	L	562,145	743,164	355,150	790,314	152,958	80	1,163	2010 - 2012
	Bottom Trawl	OTHER	78,357	70,661	48,758	172,837	20,306	24	149	2005 - 2012
	Bottom Trawl	OTHER	55,672	48,824	35,067	113,120	20,306	19	129	2008 - 2012
	Bottom Trawl	OTHER	60,750	48,824	47,543	113,120	20,306	18	132	2010 - 2012
	Clam Dredge	ALL	613,797	-	-	-	-	3	22	2005 - 2012
	Clam Dredge	ALL	982,076	-	-	-	-	3	35	2008 - 2012
	Clam Dredge	ALL	1,636,793	-	-	-	-	3	59	2010 - 2012
	SAP Trawl	L	54,170	0	111,631	323,520	0	26	68	2005 - 2012
	SAP Trawl	L	86,672	52,958	135,227	323,520	0	26	108	2008 - 2012
	SAP Trawl	L	144,453	56,880	155,089	323,520	52,958	26	181	2010 - 2012
	SAP Trawl	M	2,803	-	-	-	-	3	4	2005 - 2012
	SAP Trawl	M	4,484	-	-	-	-	3	7	2008 - 2012
	SAP Trawl	M	7,474	-	-	-	-	3	12	2010 - 2012
	Scallop Dredge	ALL	270,002	306,711	181,440	509,051	0	51	74	2005 - 2012
	Scallop Dredge	ALL	237,565	283,873	187,230	471,933	0	42	57	2008 - 2012
	Scallop Dredge	ALL	267,160	329,548	242,073	471,933	0	44	58	2010 - 2012
EFH Expanded 1/EFH Expanded 2 (Alts 6A and 6B)*	Bottom Trawl	L	962,407	1,046,931	357,415	1,361,136	366,423	92	712	2005 - 2012
	Bottom Trawl	L	1,193,324	1,202,655	162,011	1,361,136	945,672	81	769	2008 - 2012
	Bottom Trawl	L	1,151,666	1,148,189	207,753	1,361,136	945,672	71	775	2010 - 2012
	Bottom Trawl	Other	110,507	101,694	49,934	200,779	51,880	23	95	2005 - 2012
	Bottom Trawl	Other	104,399	101,006	58,184	200,779	51,880	19	88	2008 - 2012
	Bottom Trawl	Other	72,945	65,949	25,299	101,006	51,880	16	86	2010 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	SAP Trawl	ALL	88,246	0	154,287	439,931	0	24	52	2005 - 2012
	SAP Trawl	ALL	141,193	131,674	179,759	439,931	0	24	82	2008 - 2012
	SAP Trawl	ALL	235,322	134,362	177,202	439,931	131,674	24	137	2010 - 2012
	Scallop Dredge	ALL	3,928,140	3,271,818	2,427,233	8,903,240	946,927	46	67	2005 - 2012
	Scallop Dredge	ALL	4,473,699	3,489,690	2,615,381	8,903,240	2,298,015	45	66	2008 - 2012
	Scallop Dredge	ALL	5,274,952	4,623,601	3,350,439	8,903,240	2,298,015	44	61	2010 - 2012
Georges Shoal 2 MBTG (Alt 7)	Bottom Trawl	L	1,157,861	1,146,337	202,976	1,546,930	879,714	103	1,201	2005 - 2012
	Bottom Trawl	L	1,120,526	1,041,362	256,277	1,546,930	879,714	91	1,227	2008 - 2012
	Bottom Trawl	L	1,058,663	1,041,362	75,560	1,141,373	993,253	81	1,245	2010 - 2012
	Bottom Trawl	OTHER	125,458	131,244	31,705	160,383	65,669	26	168	2005 - 2012
	Bottom Trawl	OTHER	115,729	122,286	35,502	154,505	65,669	21	152	2008 - 2012
	Bottom Trawl	OTHER	109,386	122,286	38,905	140,202	65,669	19	143	2010 - 2012
	Clam Dredge	ALL	577,552	907	1,499,084	4,278,212	0	2	28	2005 - 2012
	Clam Dredge	ALL	924,083	31,861	1,879,472	4,278,212	0	2	45	2008 - 2012
	Clam Dredge	ALL	1,539,533	308,525	2,375,797	4,278,212	31,861	2	75	2010 - 2012
	SAP Trawl	L	32,096	0	55,989	158,214	0	25	66	2005 - 2012
	SAP Trawl	L	51,353	37,106	65,189	158,214	0	25	106	2008 - 2012
	SAP Trawl	L	85,589	61,448	64,062	158,214	37,106	25	177	2010 - 2012
	SAP Trawl	M	1,246	0	2,307	5,026	0	3	4	2005 - 2012
	SAP Trawl	M	1,994	2	2,729	5,026	0	3	6	2008 - 2012
	SAP Trawl	M	3,323	4,941	2,876	5,026	2	3	9	2010 - 2012
	Scallop Dredge	L	338,409	355,299	98,732	457,781	212,177	53	79	2005 - 2012
	Scallop Dredge	L	333,699	342,985	98,293	457,781	212,177	48	67	2008 - 2012
	Scallop Dredge	L	354,674	342,985	97,788	457,781	263,256	44	59	2010 - 2012
	Scallop Dredge	OTHER	9,864	10,172	6,006	20,972	2,333	6	8	2005 - 2012
	Scallop Dredge	OTHER	7,924	9,413	3,850	11,317	2,333	3	4	2008 - 2012
	Scallop Dredge	OTHER	7,688	9,413	4,733	11,317	2,333	3	3	2010 - 2012
Northern Georges MBTG (Alt 8)	Bottom Trawl	L	5,815,913	5,598,868	1,494,206	8,973,559	3,947,560	103	1,179	2005 - 2012
	Bottom Trawl	L	6,418,828	5,745,504	1,544,311	8,973,559	5,007,205	91	1,217	2008 - 2012
	Bottom Trawl	L	6,037,792	5,745,504	540,691	6,661,715	5,706,156	81	1,259	2010 - 2012
	Bottom Trawl	OTHER	652,877	599,627	200,584	965,065	399,034	28	177	2005 - 2012
	Bottom Trawl	OTHER	602,815	592,101	221,369	965,065	399,034	23	160	2008 - 2012
	Bottom Trawl	OTHER	485,636	450,723	108,362	607,152	399,034	20	155	2010 - 2012
	Clam Dredge	ALL	633,301	251	1,569,666	4,485,657	0	2	24	2005 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	Clam Dredge	ALL	1,013,282	1,970	1,957,156	4,485,657	0	2	38	2008 - 2012
	Clam Dredge	ALL	1,688,636	578,280	2,439,371	4,485,657	1,970	2	64	2010 - 2012
	SAP Trawl	L	274,482	0	486,992	1,393,051	0	26	71	2005 - 2012
	SAP Trawl	L	439,172	399,364	569,757	1,393,051	0	26	113	2008 - 2012
	SAP Trawl	L	731,953	403,444	572,531	1,393,051	399,364	26	188	2010 - 2012
	SAP Trawl	M	15,798	0	35,871	102,064	0	4	4	2005 - 2012
	SAP Trawl	M	25,277	100	44,185	102,064	0	4	7	2008 - 2012
	SAP Trawl	M	42,129	24,221	53,289	102,064	100	4	12	2010 - 2012
	Scallop Dredge	L	8,749,902	7,669,945	4,610,239	16,613,101	1,719,386	57	90	2005 - 2012
	Scallop Dredge	L	10,272,492	7,894,990	4,501,385	16,613,101	6,060,970	52	79	2008 - 2012
	Scallop Dredge	L	12,618,864	13,348,501	4,404,617	16,613,101	7,894,990	50	71	2010 - 2012
	Scallop Dredge	OTHER	512,758	583,252	312,977	934,188	124,267	7	10	2005 - 2012
	Scallop Dredge	OTHER	588,563	662,930	301,868	934,188	124,267	5	6	2008 - 2012
	Scallop Dredge	OTHER	771,658	717,856	143,409	934,188	662,930	5	6	2010 - 2012

*6A and 6B are different areas but have the same areas currently open to fishing with mobile bottom-tending gears

Table 94 – Fishing effort (in hours fished), and individuals fishing in the areas included in the Georges Bank habitat alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Northern Edge (Alts 3 & 4)	Bottom Trawl	2005 - 2012	1,588.36	55.13	28.81	15.61	36.60
	Bottom Trawl	2008 - 2012	1,993.90	61.40	32.47	16.80	40.69
	Bottom Trawl	2010 - 2012	1,833.09	56.00	32.73	15.54	44.76
	GC Scallop	2005 - 2012	5.09	1.75	2.91	1.25	3.66
	GC Scallop	2008 - 2012	5.59	2.00	2.80	1.25	3.97
	GC Scallop	2010 - 2012	7.81	2.33	3.35	1.24	4.68
	LA Scallop	2005 - 2012	264.00	27.88	9.47	2.85	14.39
	LA Scallop	2008 - 2012	286.45	26.60	10.77	4.07	15.29
	LA Scallop	2010 - 2012	286.15	23.00	12.44	4.07	18.15
Georges Shoal Gear Mod Area (Alt 4)	Bottom Trawl	2005 - 2012	6,404.36	102.75	62.33	20.53	89.84
	Bottom Trawl	2008 - 2012	5,796.35	88.80	65.27	17.38	97.99
	Bottom Trawl	2010 - 2012	4,997.69	76.33	65.47	9.57	114.94
Northern Georges Gear Mod Area (Alt 5)	Bottom Trawl	2005 - 2012	21,520.40	118.13	182.18	96.81	217.90
	Bottom Trawl	2008 - 2012	21,117.03	102.80	205.42	89.02	259.43
	Bottom Trawl	2010 - 2012	18,542.35	92.33	200.82	60.42	284.34
	GC Scallop	2005 - 2012	376.31	4.13	91.23	104.28	59.76
	GC Scallop	2008 - 2012	488.13	5.60	87.17	95.88	63.48
	GC Scallop	2010 - 2012	533.59	4.67	114.34	129.55	63.98
	LA Scallop	2005 - 2012	7,913.12	59.63	132.71	115.83	113.83
	LA Scallop	2008 - 2012	7,238.48	54.40	133.06	117.30	100.60
	LA Scallop	2010 - 2012	6,529.49	53.33	122.43	113.30	87.36
Georges Shoal 1 MBTG (Alt 5)	Bottom Trawl	2005 - 2012	1,171.44	89.50	13.09	2.41	24.40
	Bottom Trawl	2008 - 2012	722.82	78.80	9.17	1.76	17.79
	Bottom Trawl	2010 - 2012	492.78	68.00	7.25	0.92	14.13
	GC Scallop	2005 - 2012	0.01	1.88	0.01	0.00	0.02
	GC Scallop	2008 - 2012	0.01	2.40	0.00	0.00	0.01
	LA Scallop	2005 - 2012	3.41	19.13	0.18	0.00	0.41
	LA Scallop	2008 - 2012	1.41	11.20	0.13	0.00	0.34
	LA Scallop	2010 - 2012	0.44	10.33	0.04	0.00	0.14
EFH Expanded 1/EFH	Bottom Trawl	2005 - 2012	5,658.43	62.00	91.26	54.72	101.17

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Expanded 2 (Alts 6A and 6B)*	Bottom Trawl	2008 - 2012	6,950.99	67.20	103.44	56.55	115.25
	Bottom Trawl	2010 - 2012	6,688.26	63.33	105.60	54.22	126.74
	GC Scallop	2005 - 2012	214.48	4.13	51.99	27.81	60.23
	GC Scallop	2008 - 2012	286.98	5.60	51.25	23.55	63.34
	GC Scallop	2010 - 2012	283.42	4.67	60.73	23.55	72.12
	LA Scallop	2005 - 2012	4,873.66	51.50	94.63	72.98	91.01
	LA Scallop	2008 - 2012	4,258.48	48.80	87.26	58.76	89.30
	LA Scallop	2010 - 2012	3,652.78	47.67	76.63	47.95	80.97
Georges Shoal 2 MBTG (Alt 7)	Bottom Trawl	2005 - 2012	1,580.55	91.13	16.77	1.91	30.68
	Bottom Trawl	2008 - 2012	1,009.65	77.60	12.28	1.50	24.49
	Bottom Trawl	2010 - 2012	631.30	67.67	8.49	0.83	20.68
	GC Scallop	2005 - 2012	0.06	1.75	0.04	0.00	0.11
	GC Scallop	2008 - 2012	0.02	2.40	0.01	0.00	0.02
	GC Scallop	2010 - 2012	0.02	1.67	0.01	0.00	0.03
	LA Scallop	2005 - 2012	2.50	17.88	0.14	0.00	0.43
	LA Scallop	2008 - 2012	0.86	13.20	0.06	0.00	0.25
	LA Scallop	2010 - 2012	0.59	13.00	0.05	0.00	0.09
Northern Georges (Alt 8)	Bottom Trawl	2005 - 2012	25,941.72	116.88	221.96	127.26	250.39
	Bottom Trawl	2008 - 2012	26,712.59	101.40	263.44	126.42	298.50
	Bottom Trawl	2010 - 2012	23,417.56	90.67	258.28	103.38	318.73
	GC Scallop	2005 - 2012	364.57	4.63	78.83	88.40	63.96
	GC Scallop	2008 - 2012	482.57	6.40	75.40	53.62	68.10
	GC Scallop	2010 - 2012	533.51	6.00	88.92	105.39	74.44
	LA Scallop	2005 - 2012	7,752.32	73.75	105.12	84.47	114.19
	LA Scallop	2008 - 2012	7,082.82	61.80	114.61	106.30	102.70
	LA Scallop	2010 - 2012	6,416.55	64.67	99.23	89.58	91.14

*6A and 6B are different areas but have the same areas currently open to fishing with mobile bottom-tending gears

Table 95 – Closed Area I: Average value per haul (calendar year 2007-2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	444	680	641	478	304	1,222	1,293	1,342	1,336	1,410	1,187	445
	Cod	$171	$370	$405	$480	$220	$176	$175	$146	$178	$203	$ 164	$143
		19%	26%	41%	43%	16%	13%	17%	15%	21%	22%	17%	12%
	Haddock	$173	$606	$404	$309	$937	$920	$313	$202	$163	$208	$ 214	$310
		19%	43%	40%	28%	66%	66%	31%	21%	19%	22%	22%	25%
	Yellowtail	$49	$11	$0	$5	$34	$9	$31	$61	$64	$76	$45	$36
		5%	1%	0%	0%	2%	1%	3%	6%	7%	8%	5%	3%
	Lobster	$166	$151	$106	$101	$35	$67	$64	$57	$39	$39	$69	$118
		18%	11%	11%	9%	2%	5%	6%	6%	5%	4%	7%	10%
	Winter Skate	$40	$16	$5	$18	$14	$22	$35	$49	$51	$44	$40	$9
		4%	1%	0%	2%	1%	2%	3%	5%	6%	5%	4%	1%
	Scallops	$46	$21	$0	$5	$24	$12	$27	$44	$16	$18	$14	$3
		5%	1%	0%	0%	2%	1%	3%	5%	2%	2%	1%	0%
	Winter Flounder	$11	$3	$1	$2	$20	$33	$174	$166	$94	$98	$203	$71
		1%	0%	0%	0%	1%	2%	17%	17%	11%	11%	21%	6%
	Witch Flounder	$58	$45	$22	$51	$20	$25	$30	$69	$80	$74	$76	$235
		6%	3%	2%	5%	1%	2%	3%	7%	9%	8%	8%	19%
	Monkfish	$76	$117	$29	$61	$17	$33	$43	$46	$61	$73	$72	$148
		8%	8%	3%	6%	1%	2%	4%	5%	7%	8%	7%	12%
	Plaice	$44	$31	$9	$37	$43	$55	$61	$67	$75	$52	$59	$98
		5%	2%	1%	3%	3%	4%	6%	7%	9%	6%	6%	8%
Ruhle Trawl	Total Hauls					13	94						
	Cod					$7	$187						
						0%	9%						
	Haddock					$2,065	$1,718						
						99%	86%						
	Yellowtail					$5	$32						
						0%	2%						
Fixed Gillnet	Total Hauls						128	196	129	211	93	40	30
	Cod						$128	$247	$431	$256	$677	$612	$292
							20%	47%	74%	55%	86%	71%	67%
	Haddock						$38	$56	$15	$16	$ 10	$14	$9

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							6%	11%	3%	3%	1%	2%	2%
	Pollock						$4	$25	$49	$24	$ 13	$23	$56
							1%	5%	8%	5%	2%	3%	13%
	Lobster						$40	$17	$14	$14	$12	$51	$8
							6%	3%	2%	3%	2%	6%	2%
	Winter Skate						$336	$110	$44	$120	$45	$143	$31
							52%	21%	8%	26%	6%	16%	7%
	Skate						$10	$28	$0	$8	$14	$-	$-
							2%	5%	0%	2%	2%		
	Spiny Dogfish						$73	$29	$6	$0	$-	$-	$-
							11%	6%	1%	0%			
Separator Trawl	Total Hauls	26	15		18	45	204	142	46	115	89	27	11
	Cod	$151	$408		$99	$ 144	$171	$33	$106	$67	$139	$173	$20
		9%	56%		3%	8%	7%	3%	11%	8%	12%	10%	4%
	Haddock	$1,083	$166		$2,868	$1,578	$2,277	$933	$465	$564	$751	$1,055	$350
		65%	23%		92%	87%	88%	91%	49%	67%	63%	62%	66%
	Redfish	$25	$1		$56	$0	$4	$3	$36	$23	$27	$122	$9
		1%	0%		2%	0%	0%	0%	4%	3%	2%	7%	2%
	Pollock	$259	$63		$6	$23	$31	$9	$7	$116	$37	$45	$6
		15%	9%		0%	1%	1%	1%	1%	14%	3%	3%	1%
	Yellowtail	$1	$-		$25	$17	$4	$7	$51	$5	$78	$1	$13
		0%			1%	1%	0%	1%	5%	1%	7%	0%	2%
	Lobster	$89	$9		$36	$5	$16	$10	$5	$2	$4	$17	$42
		5%	1%		1%	0%	1%	1%	1%	0%	0%	1%	8%
Longline	Total Hauls									31			
	Cod									$321			
										79%			
	Haddock									$65			
										16%			
	Redfish									$1			
										0%			

Table 96 – Closed Area II: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	758	85	449	1,560	1,332	1,024	517	835	659	652	798	1,107
	Cod	$57	$247	$227	$327	$137	$129	$60	$96	$68	$45	$64	$144
		5%	17%	13%	17%	8%	11%	4%	7%	6%	3%	5%	8%
	Haddock	$193	$53	$584	$949	$798	$372	$237	$412	$371	$332	$493	$684
		16%	4%	34%	49%	47%	30%	16%	29%	31%	25%	35%	37%
	Yellowtail flounder	$438	$95	$28	$190	$341	$203	$338	$186	$154	$245	$215	$397
		36%	7%	2%	10%	20%	17%	23%	13%	13%	18%	15%	22%
	Scallop	$167	$34	$40	$62	$105	$61	$121	$62	$65	$122	$43	$168
		14%	2%	2%	3%	6%	5%	8%	4%	5%	9%	3%	9%
	Winter flounder	$96	$31	$34	$92	$156	$247	$495	$315	$157	$225	$357	$249
		8%	2%	2%	5%	9%	20%	34%	22%	13%	17%	25%	14%
	Witch flounder	$15	$70	$39	$31	$48	$45	$18	$50	$66	$91	$41	$13
		1%	5%	2%	2%	3%	4%	1%	4%	6%	7%	3%	1%
	Winter skate	$117	$82	$141	$53	$22	$37	$19	$35	$155	$100	$52	$50
		10%	6%	8%	3%	1%	3%	1%	2%	13%	7%	4%	3%
	White hake	$6	$188	$78	$29	$7	$2	$2	$5	$7	$5	$15	$9
		0%	13%	4%	2%	0%	0%	0%	0%	1%	0%	1%	1%
	Lobster	$48	$412	$394	$103	$21	$61	$84	$149	$56	$62	$56	$22
		4%	29%	23%	5%	1%	5%	6%	11%	5%	5%	4%	1%
	Monkfish	$38	$80	$99	$40	$25	$39	$52	$44	$76	$86	$49	$49
		3%	6%	6%	2%	1%	3%	4%	3%	6%	6%	3%	3%
Separator Trawl	Total Hauls	151	29	80	179	78	73	33	17	54	29	140	159
	Cod	$109	$91	$159	$516	$189	$31	$6	$19	$31	$71	$129	$193
		5%	4%	5%	18%	6%	2%	1%	1%	2%	7%	7%	8%
	Haddock	$1,915	$689	$2,567	$1,686	$2,554	$1,580	$956	$1,223	$1,319	$648	$1,401	$1,988
		83%	30%	87%	60%	83%	88%	84%	94%	84%	66%	73%	82%
	Pollock	$145	$337	$17	$13	$4	$9	-	$2	$21	$16	$130	$37
		6%	14%	1%	0%	0%	1%		0%	1%	2%	7%	2%
	Yellowtail flounder	$28	$28	$9	$153	$127	$19	$107	$2	$8	$17	$70	$52
		1%	1%	0%	5%	4%	1%	9%	0%	1%	2%	4%	2%
	Lobster	$28	$184	$91	$176	$1	$68	$9	$16	$19	$5	$13	$5
		1%	8%	3%	6%	0%	4%	1%	1%	1%	1%	1%	0%

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Monkfish	$9	$16	$17	$16	$2	$22	$14	$8	$27	$55	$5	$6
		0%	1%	1%	1%	0%	1%	1%	1%	2%	6%	0%	0%
	Winter flounder	$32	$6	$26	$167	$191	$29	$13	$0	$0	$-	$119	$93
		1%	0%	1%	6%	6%	2%	1%	0%	0%		6%	4%
	Witch flounder	$4	$35	$7	$19	$0	$18	$5	$18	$93	$60	$19	$6
		0%	1%	0%	1%	0%	1%	0%	1%	6%	6%	1%	0%
	White hake	$24	$881	$32	$43	$-	$6	$-	$3	$18	$74	$10	$40
		1%	38%	1%	2%		0%		0%	1%	8%	1%	2%
Longline	Total Hauls					79	103						
	Cod					386	275						
						30%	23%						
	Haddock					881	900						
						69%	76%						
Ruhle Trawl	Total Hauls		6		30	50	49						
	Cod		$14		$567	$73	$5						
			3%		25%	2%	0%						
	Haddock		$325		$1,416	$2,994	$969						
			74%		62%	96%	94%						
	Yellowtail flounder		$95		$193	$41	$15						
			21%		9%	1%	1%						

Table 97 – Recreational revenue estimated within a 10 nautical mile buffer of Closed Area I and Closed Area II, which are currently closed to recreational groundfishing. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate data censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CAIIbuffer	2006 - 2012	-	-	-	-	-	-
CAIIbuffer	2008 - 2012	-	-	-	-	-	-
CAIIbuffer	2010 - 2012	-	-	-	-	-	-
CAIbuffer	2006 - 2012	75,245.64	9.86	409.71	2,002.74	1,117.74	2,394.29
CAIbuffer	2008 - 2012	74,863.38	9.2	406.2	2,354.19	1,117.74	2,604.09
CAIbuffer	2010 - 2012	58,266.78	7.67	320	2,427.78	1,117.74	2,555.87

Table 98 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Georges Bank alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Georges Bank		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
CT										**3**			
MA		**124**	**87**	**140**	**98**	**135**	**94**	**131**	**90**	**137**	**94**	**154**	**104**
	Boston	9		11				9		11		11	
	Fairhaven		13		16		15		14		14		17
	Gloucester	24	7	24	8	24	9	24	8	23	8	24	8
	New Bedford	96	60	107	64	103	61	101	60	104	62	121	70
	Peabody		3		3				3		3		3
ME		**3**	**19**	**4**	**20**	**5**	**20**	**3**	**19**	**4**	**20**	**5**	**21**
	Portland	3	10	4	9	5	10	3	9	4	10	5	10
	Westbrook		3		3		3		3		3		3
NC			**6**		**6**		**4**		**6**		**3**		**6**
NJ			**7**		**7**	**3**	**11**		**8**	**4**	**14**	**4**	**16**
	Atlantic City										3		3
	Cape May		5		5		5		5		8		10
NY					**3**		**3**		**3**		**3**		**4**
RI		**4**	**8**	**6**	**12**	**7**	**12**	**6**	**12**	**8**	**12**	**9**	**12**
	Newport												
	Point Judith	4		6		6	6	7		6		7	
	Wakefield		4		6				6		6		6

Table 99 – Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the Georges Bank Alternatives. Ports with less than 3 vessels each were included in the state totals only. * Changes in revenue for option 2 only listed for ports with 3 or more vessels affected by option 2 gear exemption.

Georges Bank										
	Alternative	**3**	**4**	**4**	**5**	**6**	**7**	**7**	**8**	**8**
	Option	**1,2,3,4**	**1,3,4**	**2***	**1,2,3,4**	**1,2,3,4**	**1,3,4**	**2***	**1,3,4**	**2***
St	**Port**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**
CT	**Total**						**2,388.16**	**2,388.16**	**4,969.66**	**4,969.66**
MA	**Total**	**1,996,388.26**	**7,352,247.91**	**6,562,938.17**	**34,748,073.92**	**10,240,151.05**	**2,328,392.56**	**1,694,767.54**	**24,606,613.56**	**23,793,007.84**
	BOSTON	15476.29	113,248.71	113,248.71	485,793.65	74,945.05	74,332.11	74,332.11	353,365.90	353,365.90
	GLOUCESTER	52169.25	302,620.60	302,620.60	1,149,381.30	210,895.34	113,913.03	113,913.03	986,496.78	986,496.78
	NEW BEDFORD	1,926,169.86	6,904,162.00	6,114,852.26	32,869,126.84	9,909,203.94	2,126,266.42	1,494,875.55	23,081,159.42	22,269,086.80
ME	**Total**	**106.74**	**915.27**	**915.27**	**4,586.95**	**721.39**	**1,172.33**	**1,172.33**	**5,038.75**	**5,038.75**
	PORTLAND	106.74	915.27	915.27	4,586.95	721.39	1,172.33	1,172.33	5,038.75	5,038.75
NJ	**Total**				**174,349.40**	**1,245.51**	**20,270.13**	**20,270.13**	**37,251.99**	**37,251.99**
RI	**Total**	**1357.83**	**15,008.36**	**15,008.36**	**79,520.28**	**11,945.81**	**9,901.40**	**9,901.40**	**65,581.86**	**65,581.86**
	POINT JUDITH	1357.83	15,008.36	15,008.36	74,860.47	11,945.81	6,406.42	6,406.42	64,307.43	64,307.43

Table 100 – Sum of 2012 party/charter recreational fishing revenue associated with the Closed Area I buffer. Ports with less than 3 vessels each were included in the state totals only.

State	Number of Vessels	Revenue
MA	6	36,140.26

4.2.3.4.1 Alternative 1 (No Action)

The no action habitat management alternative in the Georges Bank region includes the Closed Area I and Closed Area II habitat and groundfish closure areas. See Alternative 2 below for general discussions of the economic impacts of removing these closures. In summation, the economic impact of Alternative 1/No Action is expected to be highly negative. Although the groundfish fishery is gaining some benefits from no action management areas in Georges Bank, these benefits are not expected to surpass the substantial cost of current management to the scallop fishery. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo. Given the vulnerability in the groundfish fishery, benefits to groundfish may be felt more acutely than lost potential benefits to the scallop fishery, resulting in neutral social impacts overall. All other alternatives are compared to No Action in the sections that follow.

4.2.3.4.2 Alternative 2 (No Habitat Management Areas)

This alternative would remove the current Closed Area I and Closed Area II Habitat and Groundfish Closure Areas and would not designate any additional habitat management areas in the region. This alternative would not affect the HAPC designation within Closed Area II. The Closed Area I and Closed Area II groundfish closures would also be removed on a year round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Table 95 and Table 96 represent the species contributing substantially to the revenue of hauls within a 10 nautical mile buffer of the current Closed Area I and Closed Area II management areas. In the vicinity of Closed Area I cod and haddock are the dominant species across all gear types, with winter skate important to sink gillnet revenue as well. Haddock and cod again play an important role across all gear types in the waters around Closed Area II. In addition, yellowtail flounder, winter flounder, and lobster generate substantial revenue for generic bottom trawl, while Ruhle trawl lands some quantity of yellowtail flounder in the winter and early spring. Georges Bank cod and Georges Bank yellowtail flounder are overfished, and overfishing is occurring, and thus Alternative 2 is unlikely to generate any significant benefits from these two species. Georges Bank winter flounder and Georges Bank haddock are not overfished, and overfishing is not occurring. Furthermore, the analysis in Framework 48 suggested that a substantial concentration of haddock existed within Closed Area II, which could lead to additional flexibility in terms of higher revenue generated and lowered costs due to increased CPUE of this species. The analysis within Framework 48 also indicated that cod, haddock, and winter flounder within the boundaries of Closed Area II are likely larger than the surrounding areas open to fishing and thus could generate additional revenue both from decreasing the ratio of unwanted bycatch (undersized fish), and capitalizing on any price premium on larger individuals that might exist in the marketplace. The magnitude of this benefit is uncertain, and depends on the size and duration of the increase in catch per unit effort (CPUE) for this species, as well as the ratio of large/small individuals, which cannot be quantified to any level of confidence. However, it is logical to expect that effort will flow into the reopened closed until CPUE equates inside and outside the currently closed areas, and thus the benefits could be transitory.

It should be noted that Special Access Programs allow access to the southern portions of Closed Area II below latitude 41° 30’ and the northern portion above latitude 42° 10’ for haddock

fishing between May 1 and December 31 and May 1 and January 31 respectively. Thus, the magnitude of the benefit generated from additional access to this species depends on the relative concentration of haddock in the areas and times not currently open to groundfish fishing.

Additional landings of non-target stocks could provide economic benefits to the groundfish fishery if existing closures reopen.[16] Lobster consistently appears as an important non-target species for hauls surrounding Closed Area I and Closed Area II. This general trend is particularly true for bottom trawls. A large amount of offshore lobster pot effort is concentrated in Closed Area II, perhaps due to a greater abundance of lobster in the area, and/or the lower levels of gear conflict. If the lobster pots are utilized in this area due to decreased gear interactions, then groundfish fishermen would not likely see any increase in revenue associated with lobster landings by accessing these areas. If, however, the concentration of lobster pot effort in Closed Area II indicates locally high lobster abundance, then groundfish fishermen could benefit from access to these areas due to higher catch rates. Closed Area II is the area most likely to provide this benefit to fishermen, if it exists. A similar argument can be made for scallops in Closed Area I and II. Both of these closed areas are subject to significant effort from the scallop fishery, and to the extent that groundfish fishermen will gain access to areas with high scallop biomass, they could expect increased fishing revenue. These benefits are likely to only be slightly positive in magnitude, given the current fishing allowed through exemptions to the area.

Other fisheries may derive benefits as well. Although there are potential benefits associated with increased access to the skate complex, the biological analysis within Framework 48 failed to identify how these benefits would be generated. A more thorough economic analysis of access to Closed Area I and Closed Area II for the LA and GC scallop fishermen can be found in section 4.6.4.1.1.2. Although successful exploratory fishing for surfclam and ocean quahog has recently been conducted on Georges Bank, the portions of Georges Bank recently reopened to the clam fishery fall outside Closed Areas I and II, and thus Alternative 2 is not expected to benefit the surfclam/ocean quahog fishery.

Increased fishing gear interactions and potential displacement of existing fishing effort using non-groundfish/non-mobile bottom tending gear within Closed Area I and Closed Area II are other potential costs of this alternative. For example, it has already been noted that Closed Area II currently supports a large amount of lobster pot fishing. The increased costs accruing to the lobster pot fishery due to gear conflicts, for example losses of pots if strings are trawled over, depend on the flow of effort into the area, and the gear conflict avoidance measures taken by both lobstermen and groundfish or scallop fishermen. If, for example, mobile gear fishermen take pains in avoiding pot strings, then these costs are expected to be minimal. However, the lobster pot/mobile gear interaction is likely to be idiosyncratic, given that there is no manner to ensure due care is taken in avoidance by either groundfish fishermen or lobstermen. This effect is likely to be slightly negative, given the magnitude of mobile bottom-tending gear effort currently surrounding Closed Area II. Recreational groundfishing is currently prohibited from Closed Area I and Closed Area II. Table 97 details the recreational fishing within a 10 nautical mile buffer of

[16] The following analysis depends on fishermen currently landing less than the permitted amount of non-groundfish species. If, instead, fishermen are already landing the entirety of their permitted landings, then the effect of changes described below are likely neutral.

Closed Area I and Closed Area II, which indicates very little recreational fishing currently occurs in the vicinity of these closures. Given the distance these areas are from shore and the lack of substantial current recreational effort in the vicinity, it is unlikely that allowing recreational fishing in either Closed Area I or Closed Area II would result in substantial recreational effort redistributing into these areas. This in turn suggests that Alternative 2 would result in neutral to slightly positive impacts for the recreational fishery.

In the short term, Alternative 2 is expected to generate high positive impacts when compared to Alternative 1/No Action, as all fishermen gain additional flexibility in when and how they are able to fish. High positive impacts are also expected in the long term, and are mainly driven by the scallop fishery. Although the groundfish fishery is expected to experience negative economic impacts when compared to the status quo, these impacts are not expected to surpass the additional positive benefits accrued to the scallop fishery.

The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as fishermen would gain access to new fishing areas. There are likely to be negative impacts in the form of gear conflict with existing lobster effort in these areas. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost. Given the vulnerability in the groundfish fishery long-term negative impacts to groundfish may be acutely felt.

4.2.3.4.3 Alternative 3

Alternative 3 would remove the current Closed Area I Habitat Closure Areas and would modify the Closed Area II Habitat Closure to create the Northern Edge HMA. The Closed Area I and Closed Area II groundfish closures would also be removed on a year-round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Scallop dredges and bottom trawl generate the largest revenue from the portions of Northern Edge HMA currently open to fishing (Figure 27). Closed Area II and its surrounding areas have long been important for vessels > 70 ft in both of these fisheries (Table 93). Mean bottom trawl revenue per trip is $296 (1.3% of an average trip's revenue) for this largest vessel class in the Northern Edge HMA. Scallop revenue per trip for vessels > 70 ft is substantially higher at $11,970 (3.9% of an average trip's revenue). SAP trawl revenue displacement is estimated to be $519 per trip (3.2% of an average trip's revenue). The total revenue estimated to be displaced within the currently open sections of the Northern Edge HMA is 0.2% of the bottom trawl, 1.1% of total SAP trawl, and 0.3% of the scallop dredge average annual revenue reported within VTR for relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for total VTR revenue for these gear types). The small size of the Northern Edge area currently open to fishing makes interpretation of the VTR analysis somewhat uncertain, as the average annual number of trips that are estimated to spend at least of a portion of their time in the area is high, but the overall revenue estimated to fall in the area is low. This result could indicate either that the area is on the outskirts of more productive grounds, or that the area actually falls within an important center of fishing and the low revenue estimates are a result of the very small sliver of this area that is currently open to fishing. Given other information available (see, for instance Maps 50 – 53, 70 – 71 in Volume 1, which details the current distribution of effort around Closed Area II), it is likely that this area is an important fishing ground, for both bottom trawl and scallop dredge

fishermen. As Table 93 indicates, 65% of all revenues currently generated from open areas of Northern Edge HMA would be affected by options being considered within Alternative 3. This is equal to $953,323 annually in the years 2010 - 2012.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would be expected to displace $953,323, given the VTR analysis. The full impact of this alternative on the scallop fishery is identified in Section 4.6.4.1.1.2, and is expected to be on the order of two magnitudes larger than what is estimated through the VTR analysis. This disparity results from the fact that the majority of the Northern Edge area falls within the borders of the Closed Area II Habitat Closure Area, and thus is currently closed to scallop dredges. As compared to No Action, the impact on bottom trawl fishermen is expected to be neutral in the short run, but negative in the long run. This is because Alternative 3 would provide additional access to areas not currently open to fishing within the current borders of Closed Area II, but the portion of the Northern Edge currently open to fishing that would close to mobile bottom tending gear under Alternative 3 seems to be an important, but small, area of concentrated fishing effort.

Increased fishing gear interactions and potential displacement of existing fishing effort using non-groundfish/non-mobile bottom tending gear within the exemption areas are other potential costs of this alternative. Interactions with the lobster fishery are discussed under Alternative 2.

<u>In the short-term, Alternative 3, Option 1 is expected to induce a highly positive impact, mainly accrued by the scallop fishery. The bottom trawl fishery is expected to experience moderately negative impacts in the long-term when compared to Alternative 1/No Action, but the impact will likely be outweighed by the substantial increase in economic surplus expected to be generated from the scallop fishery. Given the fact that the Closed Area II Habitat Closure Area and the Northern Edge HMA are relatively similar, the longer term benefit to the scallop fishery is likely to be generated from access to the northern portion of Closed Area I. The longer term benefits are thus expected to be moderately positive, but are more uncertain as they depend to some extent on the expected impact of Alternative 3, Option 1 on groundfish productivity (see section 4.2.2.7.2).</u>

<u>Option 2 is expected to have a neutral effect on the surfclam and ocean quahog fishery, when compared to Alternative 1/No Action, given that the Northern Edge HMA falls largely within a portion of the Georges Bank paralytic shellfish poisoning closure that was not opened to clam dredging in 2013 because it overlaps with Closed Area II.</u> As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. <u>This, coupled with the expected negative impact on seabed habitats identified in 4.2.1.4.3, indicates that Options 3 and 4 would be expected to have a highly positive impact as compared to Options 1 and 2, although marginally smaller overall due to the long-term impact on the groundfish fishery.</u>

There are positive non-economic social impacts associated with Alternative 3 and the access gained to new fishing areas. Many of these benefits relate to the scallop fishery. Many of the

identified communities, particularly New Bedford and Fairhaven, Massachusetts and Cape May, New Jersey include vessels using scallop dredges which would benefit from gear modification Options 3 and 4. New Bedford has relatively high indicators of social vulnerability and indicators demonstrate Cape May is vulnerable to gentrification. Both towns have high levels of dependence on commercial fishing (see table in the Human Community section of Volume 1). There may be negative long-term impacts if benefits to fish populations from the current closures are lost. Given the current vulnerability in the groundfish fishery, impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.2.3.4.4 Alternative 4

Alternative 4 would remove the current Closed Area I Habitat Closure Areas and would modify the Closed Area II Habitat Closure to create the Northern Edge HMA. The Georges Shoal Gear Modification Area would also be designated. The Closed Area I and Closed Area II groundfish closures would also be removed on a year round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Table 93 overviews the current revenue being generated within currently open areas of Alternative 4. Scallop dredge and bottom trawl generate the largest revenues. Closed Area II and its surrounding areas have long been important for vessels > 70 ft in both of these fisheries, as highlighted by Table 93. Mean bottom trawl revenue estimated to be impacted per trip is $1,766 (7.6% of an average trip's revenue) for this largest vessel class in Georges Shoal Gear Modification Area and $1,250 (5.6% of an average trip's revenue) for all other vessel classes. Average impacted revenue estimated for SAP trawl trips equals $866 (4.8% of an average trip's revenue) for vessels >70 ft, and $379 (2.5% of an average trip's revenue) for vessels between 50 and 70 ft. Discussion of the Northern Edge impacts can be found in Alternative 3. The combined revenue within the areas of Alternative 4 represents 1.9% of the bottom trawl, 4.1% of SAP trawl, and 0.3% of scallop dredge average annual revenue reported within the VTR between 2010 and 2012 (see section 4.5 of Volume I for magnitude of VTR revenue in 2012 and statistical areas used). As Table 93 indicates, 50% ($3,231,195) of all revenues currently generated from Northern Edge HMA and Georges Shoal GMA would be affected by mobile bottom-tending gear closure.

Table 94 presents the VMS analysis for the Georges Shoal GMA, which identifies the importance of this area for bottom trawl fishermen. This is apparent in terms of both hours and individuals fishing within the bounds of the Georges Shoal GMA.

There is no recreational fishing currently reported within the boundaries of Northern Edge. Although some recreational fishing has been reported within the boundaries of the Georges Shoals GMA, this information is not presented due to privacy concerns.

See the discussion of Alternative 3 for a full description of the impacts expected from a Northern Edge HMA. <u>The Georges Shoal GMA is expected to induce uncertain impacts to both the trawl fisheries and habitat very similar to those associated with Option 3 and 4 in Alternative 3. Therefore, the cumulative impacts of both areas combined are expected to be highly positive when compared to No Action in both in the long and short-term.</u> <u>These positive benefits mainly accrue to the scallop dredge fishery, which gains access to areas of high scallop biomass off-</u>

limits to them in No Action Alternative 1. Conversely, the groundfish fishery is expected to experience slightly negative impacts in the short-term and and marginally negative impacts in the long-term. The positive benefits are expected to be smaller than consistent options in Alternative 3, given the additional inefficiency induced by gear restrictions with no clear habitat benefits.

The social impacts associated with the Northern Edge HMA are discussed in Alternative 3. The social impacts of the Georges Shoal GMA are uncertain due to the uncertain effects of the gear modification on the habitat and catch rates.

4.2.3.4.5 Alternative 5

Alternative 5 would remove the Closed Area I and II Habitat Closure Areas. This alternative would establish the Georges Shoal mobile-bottom tending gear HMA and establish the Large Georges Shoal Gear Modification Area (GMA). The Closed Area I and II groundfish closures would also be removed on a year round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Figure 29 and Figure 30 illustrate the gears currently employed within the boundaries of the Northern Georges GMA and Georges Shoal 1 Mobile Bottom Tending Gear areas being considered in Alternative 5. Revenue generated within the Northern Georges GMA is dominated by scallop dredge and bottom trawl fishermen, while in the Georges Shoal 1 Mobile Bottom Tending Gear area, clam dredge and bottom trawl are the two most prolific revenue sources (see Table 93 for details). Note that the bottom trawl and SAP trawl revenues associated with the Georges Shoal 1 Mobile Bottom Tending Gear area are also contained within the totals for the Northern Georges GMA, as the mobile bottom-tending gear closure is a subset of the larger gear modification area. Though double counting, the results are presented in this way because the management options for the areas are different. Mean revenue per trip in the Northern Georges GMA is $4,702 (20.5% of an average trip's revenue) for bottom trawl vessels > 70 ft, and $3,215 (14.6% of an average trip's revenue) for all other bottom trawl vessel classes. SAP trawl trips in the area generate similar mean revenue, with $3,743 per trip for vessels > 70 ft (19.4% of an average trip's revenue), and $2,065(13.6% of an average trip's revenue) for vessels between 50 ft and 70 ft. The Georges Shoal 1 Mobile Bottom Tending Gear area encapsulates a much smaller portion of the trawl revenue, with a mean per trip revenue of $483 for vessels > 70 ft (2.1% of an average trip's revenue), and $460 per trip (2.1% of an average trip's revenue) for other vessel classes of bottom trawls, and SAP trawl per trip revenue estimated to be $798 for vessels > 70 ft (3.9% of an average trip's revenue) and $623 (4.1% of an average trip's revenue) for vessels between 50 ft and 70 ft. The VTR analysis suggests that the MBTG area encapsulates 11% of the revenue generated by SAP and bottom trawls combined in the Northern Georges GMA.

The Georges Shoal 1 Mobile Bottom Tending Gear area hosted a substantial amount of the exploratory fishing conducted by the surfclam and ocean quahog fishery over the past three years, as represented by the clam dredge revenue (Table 93). Due to the Georges Bank Paralytic Shellfish Poisoning area closure, the VTR analysis under-represents the future revenue generating potential of this area to the surfclam and ocean quahog fishery, particularly given two actions in January and August of 2013 in which areas in this portion of Georges Bank are now open to more general surfclam and ocean quahog fishing

(http://www.nero.noaa.gov/nr/2013/August/13clamsreopengbcaphl.pdf). The true value of this area to the surfclam and ocean quahog fishery is thus higher than what can be gleaned from the VTR analysis of past effort. The mean revenue per trip from clam dredge activity estimated to fall within the Georges Shoal Mobile Bottom Tending Gear area is $27,742 over the last three year period. Conversely, the mean scallop dredge revenue per trip is $4,606, suggesting that the most productive scallop beds in this part of Georges Bank do not fall within the Georges Shoal 1 Mobile Bottom Tending Gear area. The revenue in these areas account for 5.4% of bottom trawl, 17.6% of SAP trawl, 0.1% of scallop, and 11% of clam average annual revenue from logbooks between 2010 – 2012 in Georges Bank, Gulf of Maine, and Southern New England (see section 4.5 of Volume I for total VTR revenue estimates in 2012, and relevant statistical areas).

These general results are mirrored by the VMS analysis (Table 94). Bottom trawl effort is particularly high in the Northern Georges GMA, and only 3% of this effort is estimated to fall within the Mobile Bottom Tending Gear area. The VMS analysis also indicates that both general category and limited access scallop effort in the Mobile Bottom Tending Gear area is low relative to the surrounding waters. Similar to the VTR analysis, the Northern Georges GMA and Georges Shoal 1 Mobile Bottom Tending Gear area double count the effort estimates, and thus effort cannot be summed across areas.

Although there have been some recreational trips reported within the boundaries of the Large Georges Shoal Area, this information is not presented due to privacy concerns.

Given the above discussion, and the lack of scallops falling within the mobile bottom tending gear area (see Section 4.6.4.1.1.2), Alternative 5 is expected to generate moderate positive net impacts in both the short and long-term when compared to No Action. These benefits accrue mainly to the scallop fishery, and are generated despite expected moderately negative impacts in the groundfish and clam fisheries. The groundfish negative impact is due to expected long run negative impacts on groundfish habitat, while the surfclam and ocean quahog fisheries face both short run and long run displacement of effort from productive fishing grounds. The positive net benefits are expected to be smaller in magnitude than Alternative 2, mainly due to the inefficiency induced in the groundfish fishery with negative to neutral impacts on groundfish habitat (see Section 4.2.2.7.4). The magnitude of the positive benefits are expected to be larger than commensurate options in Alternatives 3 and 4, primarily due to the larger positive benefits expected for the scallop fishery.

The social impacts of Alternative 5 in comparison to Alternative 1/No Action are highly uncertain given the potential tradeoffs between decreased catch rates and increased fishing time when using the modified gear. There are likely to be negative impacts from gear conflicts created by opening the current closures, particularly with lobster gear in Closed Area II. However there are also positive impacts to other gear types gaining access to these previously closed areas, particularly the scallop fishery. Given these uncertainties, it is likely that the social impacts of Alternative 5 will be somewhat negative. Given the vulnerability in the groundfish fishery negative impacts to groundfish may be felt more acutely than lost benefits to the scallop fishery.

4.2.3.4.6 Alternative 6A and 6B

Alternative 6 would remove the current Closed Area I Habitat Closure Areas and would modify the Closed Area II Habitat Closure to either designate all of Closed Area II extended west to 67° 30' W longitude as a habitat management area (EFH Expanded 1, Alternative 6A), or all of Closed Area II extended west to 67° 30' W longitude except that there would be an 8 nm open area buffer along the EEZ (EFH Expanded 2, Alternative 6B). The Closed Area I and II groundfish closures would also be removed on a year round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Figure 31 illustrate the gears currently employed within the currently open sections of Alternatives 6A and 6B. Given that the majority of this alternative falls within the current Closed Area II Habitat Closure Area, Options A and B are equal in regards to current effort by mobile bottom tending gear. Similar to the Northern Edge HMA, scallop dredge and bottom trawl are the most prolific gears. Table 93 provides more detail for the mobile bottom tending gear currently fishing within the open area of Alternative 6. Between 2010 and 2012, scallop dredge trips are estimated to have generated an average of $86,475 per trip to this area (29.2% of an average trip's revenue), across all vessel categories. Per trip, large bottom trawl vessels are estimated to have generated an average of $1,486 (6.4% of an average trip's revenue), while all other bottom trawl vessel categories generated a lower trip average of $848 (3.9% of an average trip's revenue). SAP trawl trips of all vessel categories combined estimated to have generated an average of $1,713. Combined, the revenue expected to be impacted represents 1.0% of bottom trawl, 4.7% of SAP trawl, and 2.6% of scallop average annual revenue reported in the VTR between 2010 and 2012 (see section 4.5 of Volume I for total 2012 VTR revenue and statistical areas of relevance). Although some clam dredge activity was estimated to have occurred within the bounds of Alternative 6, confidentiality issues keep this data from being presented at the gear level. Nevertheless, the majority of the exploratory fishing that has occurred on Georges Bank in the last three years seems to have fallen outside of the bounds of the Alternative 6A and B areas.

The economic impact to the scallop fishery is explored in Section 4.2.2.7.4. Maps in this section show scallop number per tow in the NEFSC scallop dredge survey, which indicates that the area of Alternative 6 currently open to scallop fishing has historically been a concentration of substantial biomass. These analyses suggest that Option A would generate moderately negative impacts to the scallop fishery when compared to Alternative 1/No Action, and this impact is expected to greatly outweigh any long-term benefits to the groundfish fishery from conservation measures. Given this, <u>Alternative 6A is expected to induce overall moderately negative impacts in the sort term, and highly negative impacts in the long term, when compared to the no action Alternative 1.</u>

Alternative 6B is expected to generate highly positive benefits for the scallop fishery in both the short-term and long-term when compared to Alternative 1/No Action, given the relative long-term yield estimates of the areas presented in section 4.2.2.7.4. Positive benefits are also expected for the groundfish fishery in the short-term, although the long-term impact is expected to be negative due to Alternative 6B's expected impact on groundfish habitat (see section 4.2.2.7.5). <u>The overall impact from Alternative 6B, Options 1 and 2 are thus expected to be highly positive in both the short-term and long-term, with the majority of the benefits accruing to the scallop fishery.</u>

The exploratory fishing conducted by the surfclam and ocean quahog fishery is estimated to have been concentrated outside of the boundaries of Alternative 6, and the majority of the area encapsulated by Alternative 6 falls within an area that is still closed under the Georges Bank PSP closure. Therefore Options 1 and 2 are expected to generate impacts negligibly different from one another, for both Alternative 6A and Alternative 6B.

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative impact on seabed habitats, indicates that Options 3 and 4 would be expected to have a larger negative impact for bottom trawl fishermen as compared to Options 1 and 2 of 6A. However, Options 3 and 4 would allow the scallop dredge fishery to operate within the area, which means that the aggregate effects are expected to be highly positive when compared to Options 1 and 2. Options 3 and 4 would also be expected to lead to somewhat larger positive benefits than Options 1 and 2 of 6B.

The social impacts of Alternative 6A are expected to be moderately negative. This is mainly due to the economic impacts on the scallop industry described above. These impacts are concentrated on vessels associated with communities in Massachusetts, particularly New Bedford, which has indicators of high levels of fishing dependence and relatively high levels of social vulnerability (see Affected Environment table). The short term impacts to the groundfish industry are expected to be positive, however there may be negative, long term impacts if benefits to fish populations from the current closures are lost. Given the current vulnerability in the groundfish fishery, impacts to the groundfish industry may be felt more acutely than impacts to the scallop fishery resulting in overall short-term, non-economic social impacts that are less negative than those described in the economic analysis above.

The social impacts of Alternative 6B are expected to be positive. In the short term, there will be positive impacts to both the scallop and groundfish fishery as they gain access to new fishing areas. The long term social impacts on the groundfish fishery are expected to be negative given the expected impacts on groundfish habitat.

4.2.3.4.7 Alternative 7

Alternative 7 would remove the current Closed Area I Habitat Closure and modify the Closed Area II Habitat Closure to create the EFH South HMA and create the new Georges Shoal 2 Mobile Bottom Tending Gear HMA. The Closed Area I and II groundfish closures would also be removed on a year round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Figure 32 highlights revenue generated in Alternative 7 areas currently open to fishing, as a proportion of the total revenue. The majority of revenue is generated by fishermen employing clam dredges, with a substantial portion of revenue also being generated by bottom trawl, scallop dredge, and midwater trawl fishermen. Table 93 details the mobile bottom tending gear revenues

in the vicinity of the Georges Shoal 2 HMA that would be affected by Alternative 7. Bottom trawl vessels > 70 ft. in length generate the bulk of the revenue being generated by the areas encompassed by Alternative 7, with average trip revenue estimated to be $850 (3.7% of an average trip's revenue) in the 2010-2012 period. At $763 (3.5% of an average trip's revenue), the other sized bottom trawl vessels generated similar impacted trip revenue during the same time period, but average a much lower number of trips per year. This is intuitive given both of these areas are a long distance from shore. The average trip revenue is much higher for scallop dredge boats, with an average of $6,046 (2.0% of an average trip's revenue) for vessels > 70 ft. and $2,306 (1.1% of an average trip's revenue) for all other vessel categories. The total revenue estimated to be displaced by the Georges Shoal 2 area represents 0.9% of bottom trawl, 1.8% of SAP trawl, 10.4% of clam dredge, and 0.2% of scallop dredge average annual revenue reported within VTR and clam logbooks between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance). Given the scallop revenue estimated to fall within some of the other alternatives within Georges Bank, the relatively low revenue estimated to be impacted by Alternative 7 suggests that this area is not a major center of scallop fishing. The revenue displacement estimated for the SAP trawl vessels is not insubstantial, with an average trip revenue of $484 (2.5% of an average trip's revenue) for vessels >= 70 ft. and $356 (2.3% of an average trip's revenue) for vessels >= 50 ft. and < 70 ft. Nevertheless, comparatively trips by fishermen utilizing this gear are expected to be impacted to a much lesser extent than more traditional bottom trawl gears.

The Georges Shoal 2 area hosted a substantial amount of the exploratory fishing conducted by the surfclam and ocean quahog fishery over the past three years, as represented by the clam dredge revenue (Table 93). Due to the Georges Bank Paralytic Shellfish Poisoning area closure, the VTR analysis under-represents the future revenue generating potential of this area to the surfclam and ocean quahog fishery, as noted above. The mean revenue per trip from clam dredge activity estimated to fall within the Georges Shoal Mobile Bottom Tending Gear area is $20,527 over the last three year period.

The VMS analysis in Table 94 shows a relatively steep drop-off in bottom trawl fishing effort within the bounds of the Georges Shoal 2 area in the 2010 – 2012 period, when compared to longer-run averages. Additionally, the analysis suggests almost no scallop effort expended in the area by either limited access or general category permitted vessels. Confidence in these findings is bolstered by the fact that representatives of the scallop fishery in particular were integral to the development of Alternative 7. Comparing the results of Table 93 and Table 94 across areas indicates that the Georges Shoal 2 area seems to avoid the most heavily fished portions of Georges Bank.

The entirety of the EFH South HMA falls within the current Closed Area II Habitat Closure. There is therefore no current fishing permitted within this area with mobile bottom tending gear.

<u>The social impacts of Alternative 7 are expected to be moderately positive in the short term as fishermen gain access to new fishing areas. Given the expected impact on groundfish habitat (4.2.2.7.6) it is likely that the long term social impact on the groundfish industry will be moderately negative.</u>

4.2.3.4.8 Alternative 8

Alternative 8 would remove the current Closed Area I Habitat Closure and expand the Closed Area II Habitat Closure significantly to create the Northern Georges HMA. The Closed Area I and II groundfish closures would also be removed on a year-round basis, subject to selection of Georges Bank Spawning Alternative 2 or 3.

Figure 33 presents the revenue generated within the portions of the Northern Georges Bank HMA currently open to fishing. Scallop dredge dominates the revenue, with bottom trawl also generating a substantial percentage. Table 93 presents a more detailed overview of the mobile bottom tending gear that would be impacted by Alternative 8. Bottom trawl vessels > 70 ft. encompass 93% of the revenue for this gear, with average trip revenue impacted estimated at $4,794 (20.6% of an average trip's revenue) in 2010 – 2012. All other bottom trawl vessels average slightly less revenue per trip during the same time period, with $3,126 (13.5% of an average trip's revenue) estimated to be affected by Alternative 8, but with much fewer trips to the area. The combined revenue represents 5.3% of the average annual revenue reported by bottom trawls in VTR for relevant statistical areas between 2010 and 2012. The per trip SAP trawl revenue impacted is similar across all vessel categories, with vessels > 70 ft. averaging $3,893 (19.4% of an average trip's revenue) and all other categories averaging $3,611 (23.9% of an average trip's revenue). This estimate corresponds to 15.4% of average annual revenue between 2010 and 2012 in relevant statisistical areas. Scallop vessels > 70 ft. generate 94% of the revenue expected to be impacted by Alternative 8 in the 2010-2012 period, with average trip revenue impacted estimated to be $178,569 (60.5% of an average trip's revenue). All other categories of scallop dredge vessels fishing in the area would be expected to have $121,841 (76.0% of an average trip's revenue) displaced on each trip due to Alternative 8. The revenue represents 6.5% of the total scallop dredge revenue reported in VTR.

The Northern Georges Bank HMA hosted a substantial amount of the exploratory fishing conducted by the surfclam and ocean quahog fishery over the past three years, as represented by the clam dredge revenue (Table 93). As noted above, the VTR analysis under-represents the future revenue generating potential of this area to the surfclam and ocean quahog fishery. The mean revenue per trip from clam dredge activity estimated to fall within the Northern Georges HMA is $26,385 over 2010 – 2012. The total clam revenue impacted represents 11.4% of average annual revenue within the clam logbooks between 2010 and 2012 for relevant statistical areas (see section 4.5 of Volume I for statistical areas).

Table 94 presents the VMS analysis for the Northern Georges Bank HMA area, which supports the VTR analysis in terms of importance of the area to both bottom trawl and scallop dredge fishing. The analysis indicates that a large number of limited access scallop and bottom trawl fishermen intensively utilize the Northern Georges Bank area, as seen by the average annual individuals and mean individual annual effort in Table 94. A much smaller number of general category scallop vessels seem to be active in the area, although those individuals also seem to utilize the area relatively intensively.

Although there has been some recreational fishing historically reported in the Northern Georges Bank HMA, confidentiality issues preclude its presentation.

Alternative 8 is expected to cumulatively induce highly negative impacts both in the short and long run. The magnitude of this impact is expected to be larger than any other alternative under consideration.

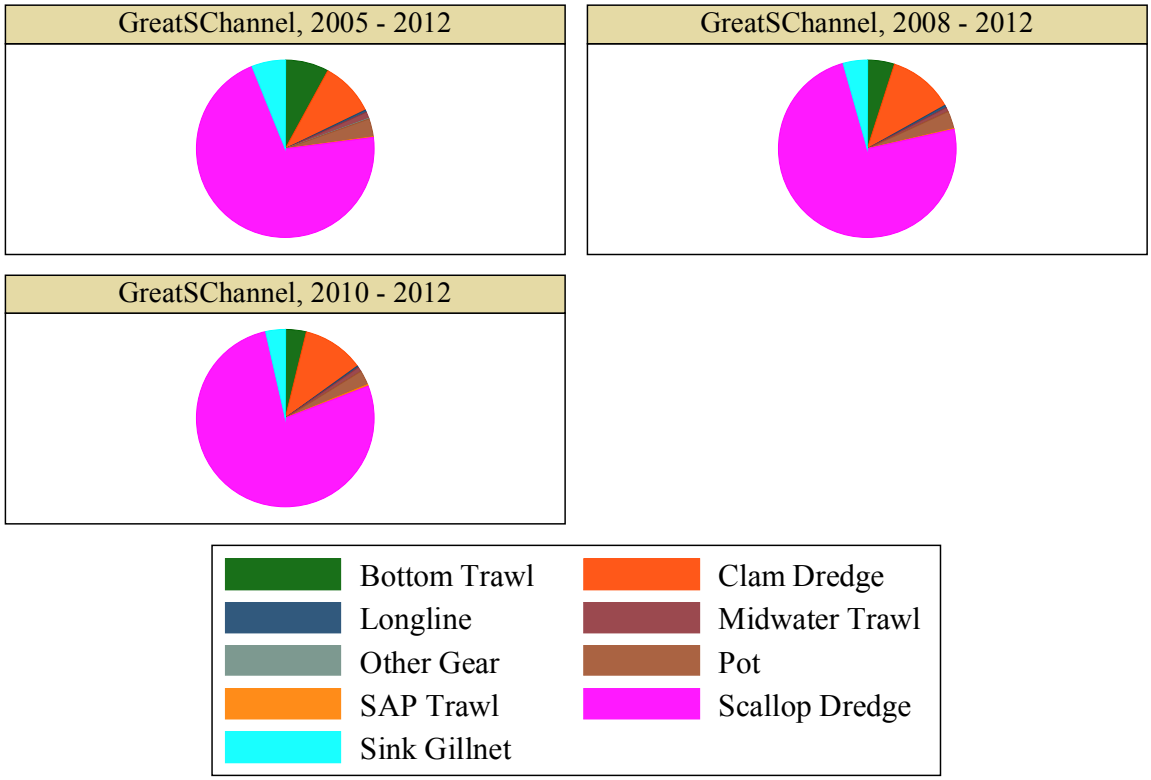
The social impacts of Alternative 8 will be concentrated on vessels associated with communities in Table 99. Given the expected economic impacts to the scallop and clam fishery as well as the neutral or slightly negative impacts to juvenile groundfish habitat (Section 4.2.2.7.7) it is likely that in both the short and long term the social impacts of Alternative 8 will be moderately negative. There may be some indirect, slightly positive social impacts to stakeholders concerned with ocean conservation who are supportive of the larger areas associated with this alternative.

4.2.3.5 ***Great South Channel/Southern New England***

Tables and figures related to analysis of the social and economic impacts of the Great South Channel/Southern New England habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

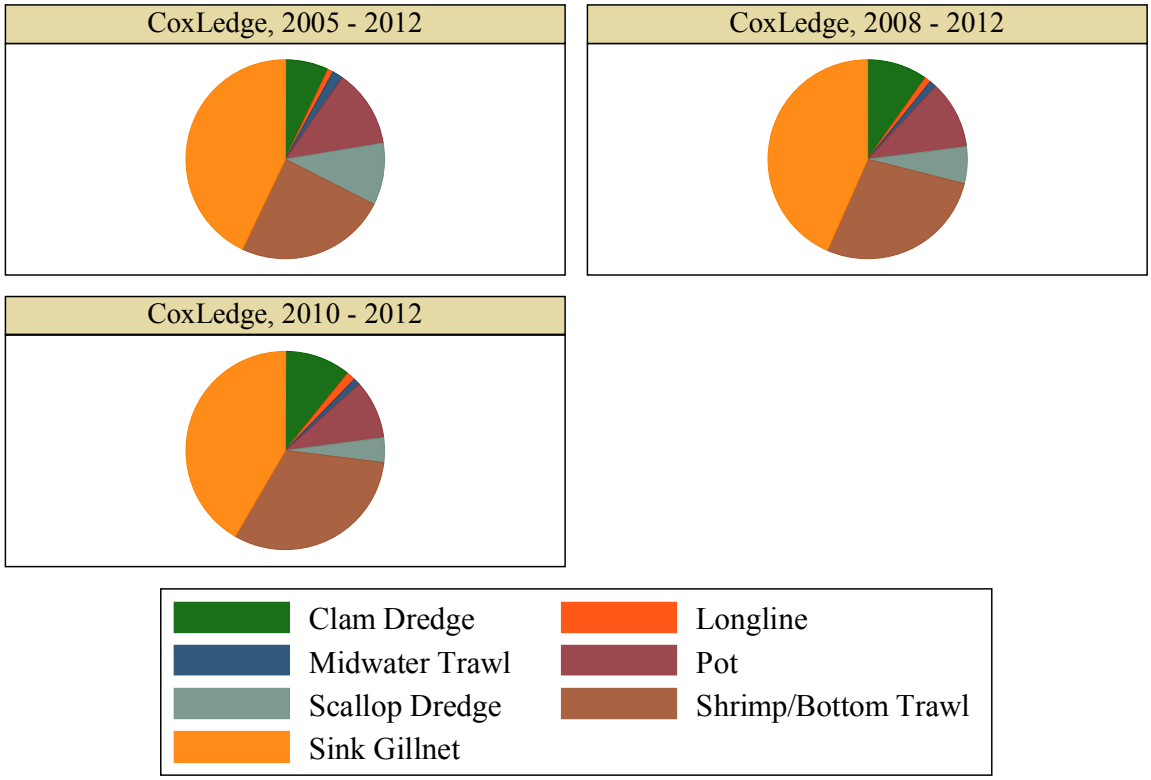
Framework 50 of the Northeast Multispecies Fisheries Management Plan permits the landing of Southern New England/Mid-Atlantic winter flounder, worth an estimated $5.2 million, which is a departure from the recent past and thus not represented in the VTR analysis of these sections. Industry has expressed concerns that the Great South Channel encapsulates a significant portion of the biomass for this species in southern New England. In order to investigate this claim, revenue generated from observed haul level winter flounder landings prior to Amendment 16, which prohibited landings of Southern New England/Mid-Atlantic Winter Flounder, were compared between the Great South Channel area (Alternative 4) and a 10 nautical mile buffer surrounding Nantucket Lightship. This includes the years 2007 – 2009. A two-tailed test for the equality of variance between the two samples was significant at the 1% level (p-value = 0.0000), meaning that a t-test is inappropriate. Instead, a nonparametric Wilcoxon rank sum test for the equality of the winter flounder revenue distributions between the two areas was conducted. The null hypothesis of equality between the two samples was rejected, again at the 1% level (p-value = 0.0000), with Great South Channel presenting the higher mean haul level revenue of the two areas, by $98. Additionally, a test of proportions was conducted in order to understand whether the proportion of hauls on which winter flounder was caught differed significantly between the two areas. Again, the test was significant at the 1% level, with winter flounder landed on 64% of hauls within the Great South Channel, while the species was landed on only 30% of hauls within Nantucket Lightship. Although there are reasons, including potential shifts in distributions between the historical and current population of Southern New England/Mid-Atlantic winter flounder or differences in density inside Nantucket Lightship versus in a 10 nautical mile buffer surrounding Nantucket Lightship, the analysis above suggests that catch rates are likely to differ significantly between Great South Channel and Nantucket Lightship. These results would hold for the Great South Channel East/Extended area (Alternative 3), given that the Great South Channel area is nested within the extended area. It is unclear whether this same result holds for the Nantucket Shoals and Nantucket Shoals West areas, and additional analysis would be needed before any conclusion could be made in these areas.

Figure 34 – Great South Channel East HMA (Alt 3) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 22,732,371; 2008 – 2012 = $ 24,429,534; 2010 – 2012 = $ 36,185,396



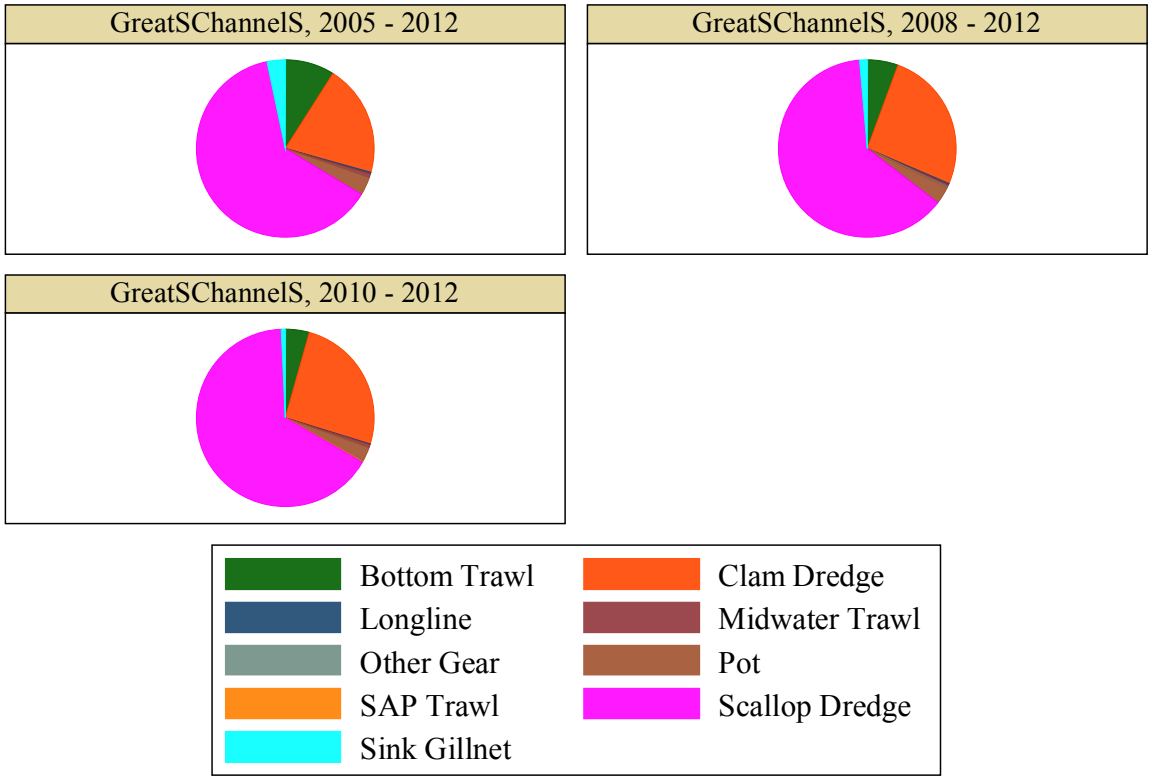
Graphs by Area and years

Figure 35 – Cox Ledge HMA (Alts 3-6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 814,471; 2008 – 2012 = $ 895,190; 2010 – 2012 = $ 1,070,794



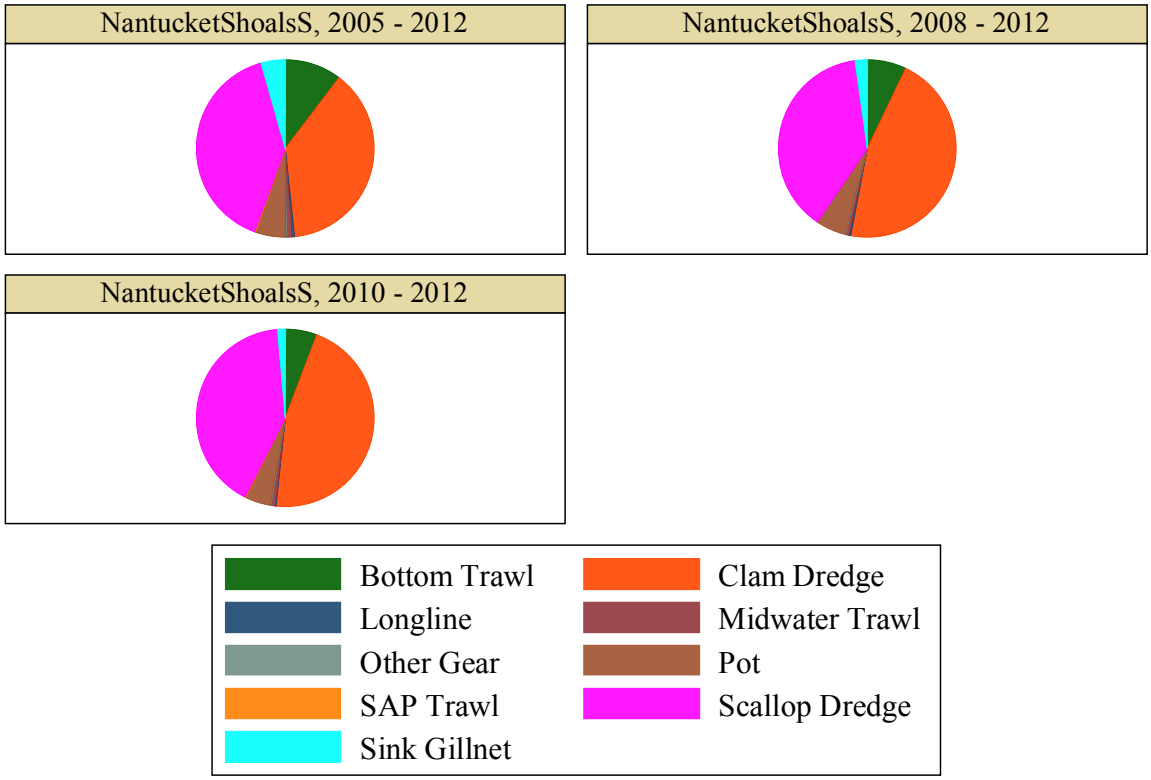
Graphs by Area and years

Figure 36 – Great South Channel HMA (Alt 4) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863



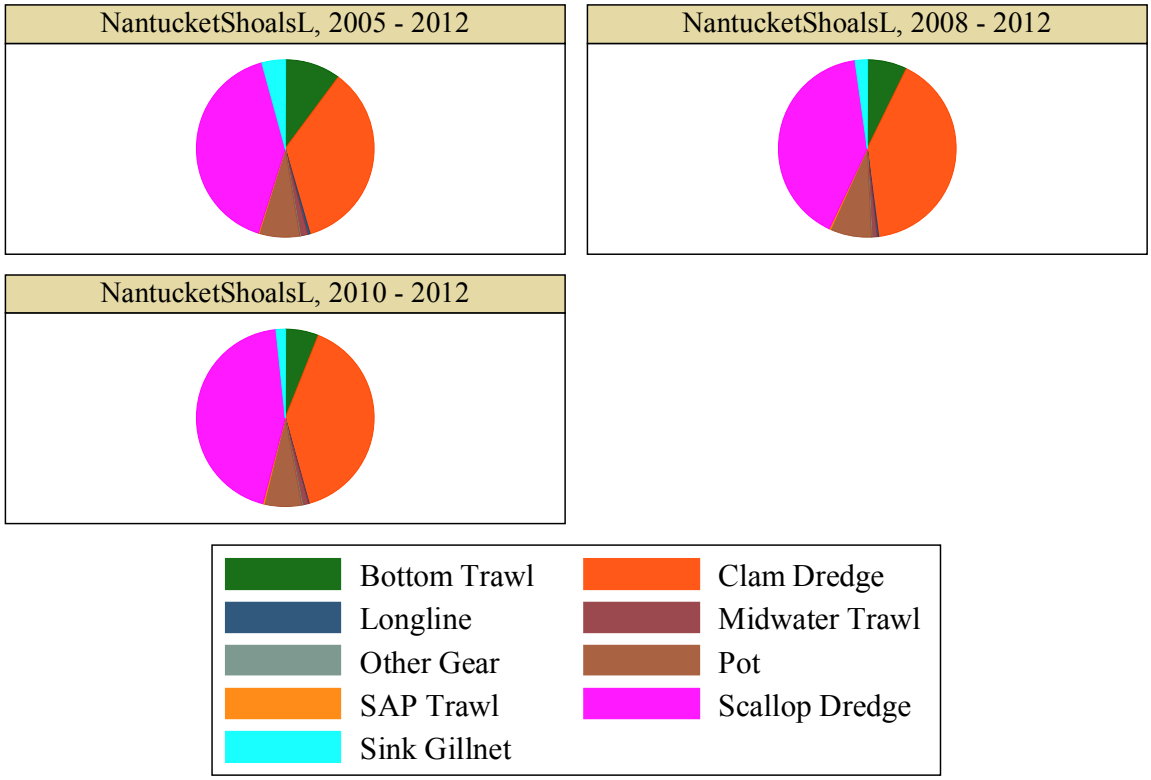
Graphs by Area and years

Figure 37 –Nantucket Shoals HMA (Alt 5) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863



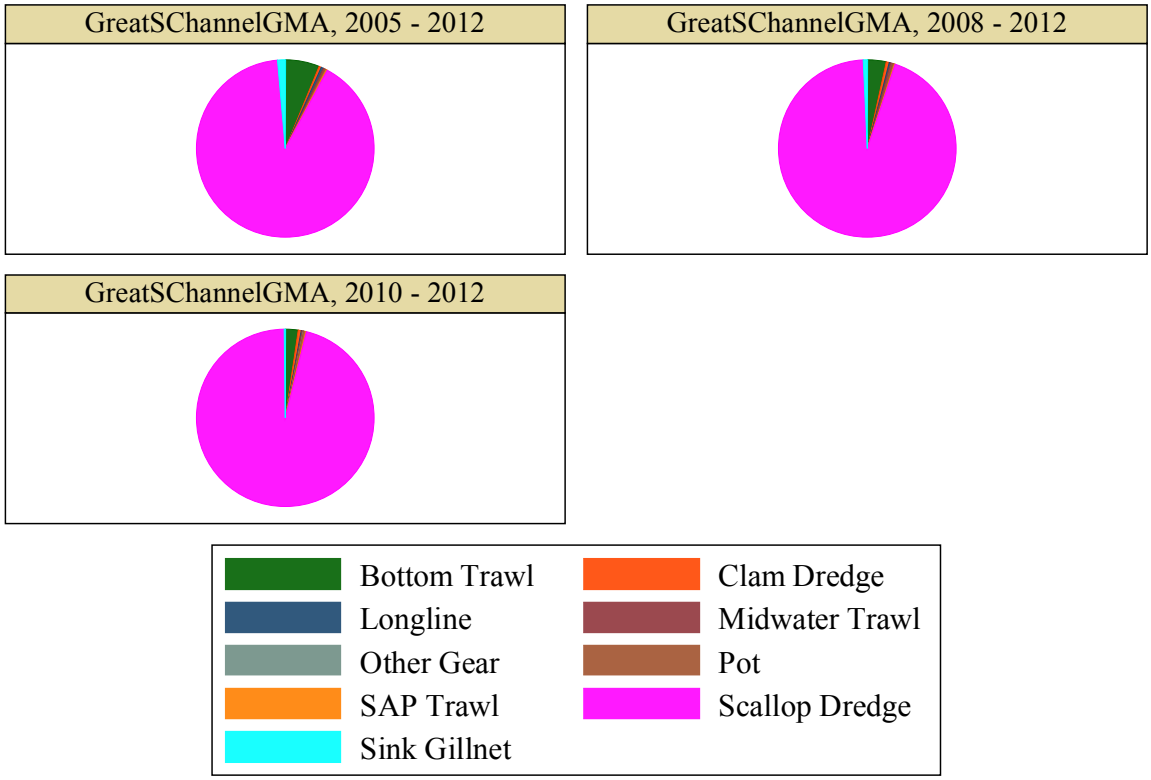
Graphs by Area and years

Figure 38 –Nantucket Shoals West HMA (Alt 6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 7,585,618; 2008 – 2012 = $ 8,118,389; 2010 – 2012 = $ 11,383,584



Graphs by Area and years

Figure 39 – Great South Channel Gear Modification Area (Alt 6) revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 38,690,902; 2008 – 2012 = $ 43,448,967; 2010 – 2012 = $ 65,038,480



Graphs by Area and years

Table 101 – Nantucket Lightship: Average value per haul/set (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data

		Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Bottom Trawl	Total Hauls	93	170	32	142	63	104	23	67	18	9	16	
	Cod	$7	$5	$4	$15	$5	$9	$40	$137	$168	$4	$175	
		1%	0%	0%	1%	1%	1%	9%	26%	24%	1%	52%	
	Haddock	$6	$7	$5	$9	$10	$504	$92	$4	$2	$0	$0	
		1%	1%	0%	1%	1%	49%	21%	1%	0%	0%	0%	
	Yellowtail	$182	$215	$7	$49	$134	$31	$23	$17	$2	$1	$1	
		19%	17%	1%	5%	17%	3%	5%	3%	0%	0%	0%	
	Monkfish	$128	$130	$83	$179	$313	$37	$76	$36	$6	$5	$5	
		14%	11%	8%	18%	40%	4%	17%	7%	1%	1%	2%	
	Winter Skate	$221	$562	$175	$442	$207	$8	$12	$14	$260	$300	$51	
		24%	46%	17%	45%	27%	1%	3%	3%	37%	75%	15%	
	Winter Flounder	$58	$7	$8	$2	$12	$331	$116	$256	$0	$62	$78	
		6%	1%	1%	0%	2%	32%	26%	49%	0%	15%	23%	
	Summer Flounder	$108	$110	$685	$197	$27	$28	$3	$10	$80	$24	$4	
		12%	9%	67%	20%	4%	3%	1%	2%	12%	6%	1%	
	Witch Flounder	$1	$9	$7	$37	$65	$5	$34	$0	$0	$0	$0	
		0%	1%	1%	4%	8%	1%	8%	0%	0%	0%	0%	
	Skate	$38	$101	$50	$45	$1	$0	$0	$0	$167	$0	$3	
		4%	8%	5%	5%	0%	0%	0%	0%	24%	0%	1%	
	Scallop	$186	$82	$3	$3	$0	$4	$0	$1	$0	$0	$0	
		20%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	Lobster	$1	$1	$0	$0	$2	$29	$44	$39	$2	$3	$18	
		0%	0%	0%	0%	0%	3%	10%	8%	0%	1%	5%	
Fixed Gillnet	Total Hauls	44	71	60	76	156	33						17
	Monkfish	$588	$536	$256	$598	$669	$657						$631

		Month											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
		77%	55%	32%	65%	85%	95%						67%
	Winter Skate	$170	$332	$507	$318	$110	$23						$293
		22%	34%	64%	35%	14%	3%						31%
	Skate	$0	$109	$16	$0	$2	$0						$9
		0%	11%	2%	0%	0%	0%						1%

Table 102 – Mobile bottom-tending gear in currently open portions of the Great South Channel Alternative 3 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Cox Ledge (Alts 3-6)	Clam Dredge	ALL	57,218	49,156	57,190	153,413	984	5	68	2005 - 2012
	Clam Dredge	ALL	87,709	91,732	50,836	153,413	11,518	6	99	2008 - 2012
	Clam Dredge	ALL	115,175	100,379	33,396	153,413	91,732	6	114	2010 - 2012
	Scallop Dredge	L	29,052	28,940	18,997	51,628	1,678	12	112	2005 - 2012
	Scallop Dredge	L	24,401	22,592	16,710	45,111	1,678	9	83	2008 - 2012
	Scallop Dredge	L	23,127	22,592	21,722	45,111	1,678	10	43	2010 - 2012
	Scallop Dredge	M	20,461	15,927	21,910	67,869	686	11	145	2005 - 2012
	Scallop Dredge	M	12,793	5,610	13,656	31,034	686	6	109	2008 - 2012
	Scallop Dredge	M	9,107	2,962	12,665	23,673	686	5	49	2010 - 2012
	Scallop Dredge	S/U	32,708	18,850	35,426	113,251	5,124	17	157	2005 - 2012
	Scallop Dredge	S/U	15,759	16,869	8,768	27,720	5,124	11	86	2008 - 2012
	Scallop Dredge	S/U	10,560	9,686	5,921	16,869	5,124	8	58	2010 - 2012
	Shrimp/Bottom Trawl	L	40,645	42,363	14,773	68,231	22,663	47	515	2005 - 2012
	Shrimp/Bottom Trawl	L	36,436	38,893	10,844	46,999	22,663	44	491	2008 - 2012
	Shrimp/Bottom Trawl	L	35,796	38,893	11,892	45,833	22,663	48	487	2010 - 2012
	Shrimp/Bottom	M	153,160	91,547	139,297	448,705	32,213	50	1,05	2005 -

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	Trawl								1	2012
	Shrimp/Bottom Trawl	M	203,243	179,333	157,735	448,705	61,751	48	1,079	2008 - 2012
	Shrimp/Bottom Trawl	M	293,070	251,171	139,488	448,705	179,333	49	1,139	2010 - 2012
	Shrimp/Bottom Trawl	S/U	7,058	6,279	3,521	14,883	4,133	23	304	2005 - 2012
	Shrimp/Bottom Trawl	S/U	8,656	7,758	3,622	14,883	5,480	21	273	2008 - 2012
	Shrimp/Bottom Trawl	S/U	10,241	8,083	4,023	14,883	7,758	20	279	2010 - 2012
Great South Channel East/Extended (Alt 3)	Bottom Trawl	L	1,589,391	1,459,779	931,448	3,279,062	405,329	97	796	2005 - 2012
	Bottom Trawl	L	1,039,036	1,194,849	478,962	1,512,271	405,329	86	802	2008 - 2012
	Bottom Trawl	L	1,198,334	1,407,287	455,867	1,512,271	675,445	92	1,044	2010 - 2012
	Bottom Trawl	M	165,090	163,089	80,735	314,978	58,429	52	286	2005 - 2012
	Bottom Trawl	M	125,024	129,270	57,652	203,490	58,429	46	283	2008 - 2012
	Bottom Trawl	M	137,994	129,270	61,599	203,490	81,222	47	315	2010 - 2012
	Bottom Trawl	S/U	31,616	29,760	19,006	64,815	12,652	22	255	2005 - 2012
	Bottom Trawl	S/U	30,770	27,927	20,536	64,815	12,990	19	206	2008 - 2012
	Bottom Trawl	S/U	37,644	31,592	24,708	64,815	16,524	18	231	2010 - 2012
	Clam Dredge	ALL	2,231,270	1,672,132	1,768,077	5,704,136	534,663	8	272	2005 - 2012
	Clam Dredge	ALL	2,900,127	2,516,257	1,962,642	5,704,136	545,820	9	358	2008 - 2012
	Clam Dredge	ALL	4,016,726	3,829,786	1,602,140	5,704,136	2,516,257	12	507	2010 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	SAP Trawl	ALL	30,108	0	63,099	180,154	0	13	22	2005 - 2012
	SAP Trawl	ALL	48,173	10,059	76,680	180,154	0	13	35	2008 - 2012
	SAP Trawl	ALL	80,288	50,650	88,836	180,154	10,059	13	58	2010 - 2012
	Scallop Dredge	L	12,919,203	9,186,329	12,633,294	39,748,220	1,289,888	164	497	2005 - 2012
	Scallop Dredge	L	14,752,988	8,655,284	15,721,955	39,748,220	1,289,888	148	412	2008 - 2012
	Scallop Dredge	L	22,841,630	20,121,390	15,723,944	39,748,220	8,655,284	205	594	2010 - 2012
	Scallop Dredge	M	1,603,713	1,143,571	1,463,980	4,782,829	239,651	33	349	2005 - 2012
	Scallop Dredge	M	1,730,217	921,938	1,882,001	4,782,829	239,651	23	225	2008 - 2012
	Scallop Dredge	M	2,659,122	2,272,598	1,959,252	4,782,829	921,938	30	273	2010 - 2012
	Scallop Dredge	S/U	1,617,857	1,502,562	1,145,197	3,289,623	204,571	39	947	2005 - 2012
	Scallop Dredge	S/U	1,622,333	1,194,299	1,465,433	3,289,623	204,571	19	597	2008 - 2012
	Scallop Dredge	S/U	2,512,441	3,053,401	1,147,638	3,289,623	1,194,299	20	797	2010 - 2012
Great South Channel (Alt 4)	Bottom Trawl	L	864,296	806,539	563,254	1,843,042	127,876	88	596	2005 - 2012
	Bottom Trawl	L	533,088	678,924	323,628	831,580	127,876	72	541	2008 - 2012
	Bottom Trawl	L	580,318	781,499	392,626	831,580	127,876	71	653	2010 - 2012
	Bottom Trawl	M	96,208	90,334	60,205	198,526	10,550	40	181	2005 - 2012
	Bottom Trawl	M	70,291	77,318	52,650	149,589	10,550	34	175	2008 - 2012
	Bottom Trawl	M	79,153	77,318	69,537	149,589	10,550	32	164	2010 -

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
										2012
	Bottom Trawl	S/U	8,929	9,330	6,447	18,810	658	18	164	2005 - 2012
	Bottom Trawl	S/U	6,784	9,254	4,932	12,112	658	14	104	2008 - 2012
	Bottom Trawl	S/U	7,392	9,406	5,987	12,112	658	13	110	2010 - 2012
	Clam Dredge	ALL	2,207,120	1,656,176	1,741,516	5,646,122	533,721	8	272	2005 - 2012
	Clam Dredge	ALL	2,862,667	2,504,223	1,935,987	5,646,122	545,615	9	358	2008 - 2012
	Clam Dredge	ALL	3,964,059	3,741,833	1,582,694	5,646,122	2,504,223	12	507	2010 - 2012
	SAP Trawl	ALL	5,452	0	10,254	29,540	0	11	13	2005 - 2012
	SAP Trawl	ALL	8,723	5,995	12,180	29,540	0	11	21	2008 - 2012
	SAP Trawl	ALL	14,539	8,082	13,033	29,540	5,995	11	35	2010 - 2012
	Scallop Dredge	L	6,135,054	3,815,659	6,475,767	20,674,308	800,514	137	406	2005 - 2012
	Scallop Dredge	L	6,337,287	2,772,530	8,142,704	20,674,308	800,514	107	280	2008 - 2012
	Scallop Dredge	L	9,371,129	4,858,787	9,854,912	20,674,308	2,580,292	136	376	2010 - 2012
	Scallop Dredge	M	547,707	278,272	666,258	2,095,588	102,676	29	247	2005 - 2012
	Scallop Dredge	M	553,811	184,815	864,479	2,095,588	102,676	17	138	2008 - 2012
	Scallop Dredge	M	823,064	270,928	1,105,244	2,095,588	102,676	21	152	2010 - 2012
	Scallop Dredge	S/U	154,635	119,898	136,834	358,762	9,146	36	497	2005 - 2012
	Scallop Dredge	S/U	69,425	61,294	58,734	164,314	9,146	15	212	2008 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	Scallop Dredge	S/U	78,251	61,294	78,962	164,314	9,146	14	237	2010 - 2012
Nantucket Shoals (Alt 5)	Bottom Trawl	L	570,316	576,026	353,624	1,179,726	90,657	88	592	2005 - 2012
	Bottom Trawl	L	374,087	442,386	224,900	584,302	90,657	72	538	2008 - 2012
	Bottom Trawl	L	414,236	567,750	280,350	584,302	90,657	71	647	2010 - 2012
	Bottom Trawl	M	79,626	75,473	45,170	160,701	11,767	41	241	2005 - 2012
	Bottom Trawl	M	73,788	71,013	55,795	160,701	11,767	35	215	2008 - 2012
	Bottom Trawl	M	81,160	71,013	74,984	160,701	11,767	33	189	2010 - 2012
	Bottom Trawl	S/U	15,080	16,098	8,592	25,001	2,365	20	361	2005 - 2012
	Bottom Trawl	S/U	13,008	12,344	8,595	23,145	2,365	17	298	2008 - 2012
	Bottom Trawl	S/U	15,120	19,851	11,169	23,145	2,365	16	355	2010 - 2012
	Clam Dredge	ALL	2,453,553	2,058,049	1,684,963	5,712,961	644,828	8	274	2005 - 2012
	Clam Dredge	ALL	3,020,217	3,066,067	1,907,591	5,712,961	644,828	9	360	2008 - 2012
	Clam Dredge	ALL	4,170,150	3,731,422	1,376,908	5,712,961	3,066,067	12	510	2010 - 2012
	SAP Trawl	ALL	3,318	0	6,689	19,379	0	11	11	2005 - 2012
	SAP Trawl	ALL	5,309	3,367	8,068	19,379	0	11	18	2008 - 2012
	SAP Trawl	ALL	8,848	3,797	9,123	19,379	3,367	11	29	2010 - 2012
	Scallop Dredge	L	2,247,293	1,428,113	2,566,978	7,859,841	159,673	101	262	2005 - 2012
	Scallop Dredge	L	2,229,058	956,143	3,223,209	7,859,841	159,673	75	173	2008 -

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
										2012
	Scallop Dredge	L	3,306,533	1,900,083	4,038,158	7,859,841	159,673	92	221	2010 - 2012
	Scallop Dredge	M	226,102	110,925	297,746	921,425	19,961	23	170	2005 - 2012
	Scallop Dredge	M	229,945	58,357	387,653	921,425	19,961	13	95	2008 - 2012
	Scallop Dredge	M	347,611	101,449	498,604	921,425	19,961	15	114	2010 - 2012
	Scallop Dredge	S/U	98,242	77,045	92,458	255,234	5,956	33	396	2005 - 2012
	Scallop Dredge	S/U	42,304	28,860	34,191	90,695	5,956	14	171	2008 - 2012
	Scallop Dredge	S/U	53,349	63,395	43,253	90,695	5,956	12	205	2010 - 2012
Great South Channel Gear Mod Area (Alt 6)	Bottom Trawl	L	2,207,843	1,916,766	1,370,059	4,836,469	638,137	98	732	2005 - 2012
	Bottom Trawl	L	1,388,785	1,640,367	638,480	2,177,729	638,137	84	671	2008 - 2012
	Bottom Trawl	L	1,376,020	1,640,367	471,293	1,655,802	831,890	92	874	2010 - 2012
	Bottom Trawl	M	131,637	86,331	114,172	339,215	16,297	36	139	2005 - 2012
	Bottom Trawl	M	56,397	61,349	34,125	103,969	16,297	31	124	2008 - 2012
	Bottom Trawl	M	78,004	68,693	22,785	103,969	61,349	33	150	2010 - 2012
	Bottom Trawl	S/U	5,498	3,620	4,964	14,261	888	8	32	2005 - 2012
	Bottom Trawl	S/U	3,073	2,321	2,401	6,589	888	6	25	2008 - 2012
	Bottom Trawl	S/U	2,630	2,321	1,634	4,396	1,173	6	31	2010 - 2012
	SAP Trawl	ALL	48,830	0	94,631	266,653	0	15	25	2005 - 2012

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
	SAP Trawl	ALL	78,129	23,463	113,181	266,653	0	15	40	2008 - 2012
	SAP Trawl	ALL	130,214	100,526	124,284	266,653	23,463	15	66	2010 - 2012
Nantucket Shoals West (Alt 6)	Bottom Trawl	L	633,138	625,418	335,090	1,245,329	204,070	99	703	2005 - 2012
	Bottom Trawl	L	446,622	468,734	188,460	626,400	204,070	85	677	2008 - 2012
	Bottom Trawl	L	520,102	624,436	182,415	626,400	309,470	92	849	2010 - 2012
	Bottom Trawl	M	99,294	87,403	47,127	200,484	54,946	48	338	2005 - 2012
	Bottom Trawl	M	98,759	83,630	58,921	200,484	54,946	44	338	2008 - 2012
	Bottom Trawl	M	115,355	83,630	74,516	200,484	61,953	45	335	2010 - 2012
	Bottom Trawl	S/U	31,843	34,299	13,373	48,933	16,506	25	535	2005 - 2012
	Bottom Trawl	S/U	30,869	28,333	14,441	48,933	16,506	23	505	2008 - 2012
	Bottom Trawl	S/U	39,895	42,420	10,529	48,933	28,333	22	632	2010 - 2012
	Clam Dredge	ALL	2,694,273	2,383,494	1,754,285	5,897,333	725,622	8	277	2005 - 2012
	Clam Dredge	ALL	3,320,111	3,674,163	1,934,318	5,897,333	725,622	9	360	2008 - 2012
	Clam Dredge	ALL	4,521,035	3,991,610	1,202,431	5,897,333	3,674,163	12	510	2010 - 2012
	SAP Trawl	ALL	11,806	0	24,756	70,551	0	13	19	2005 - 2012
	SAP Trawl	ALL	18,889	3,513	30,088	70,551	0	13	31	2008 - 2012
	SAP Trawl	ALL	31,482	20,383	34,870	70,551	3,513	13	51	2010 - 2012
	Scallop Dredge	L	2,717,833	2,170,291	2,473,056	7,935,455	273,143	129	327	2005 -

Area	Gear	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
										2012
	Scallop Dredge	L	2,953,748	1,924,669	3,063,101	7,935,455	273,143	116	265	2008 - 2012
	Scallop Dredge	L	4,510,166	3,670,374	3,092,140	7,935,455	1,924,669	160	372	2010 - 2012
	Scallop Dredge	M	269,536	178,862	289,018	929,640	48,756	28	189	2005 - 2012
	Scallop Dredge	M	294,678	102,134	373,504	929,640	48,756	19	123	2008 - 2012
	Scallop Dredge	M	455,341	334,251	426,836	929,640	102,134	24	160	2010 - 2012
	Scallop Dredge	S/U	102,472	82,210	91,793	257,792	20,699	35	418	2005 - 2012
	Scallop Dredge	S/U	47,361	28,868	34,415	100,284	20,699	17	202	2008 - 2012
	Scallop Dredge	S/U	61,706	64,136	39,848	100,284	20,699	17	254	2010 - 2012

Table 103 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the areas included in the Great South Channel/Southern New England habitat alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Shrimp Trawl effort is not reported due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Cox Ledge (Alts 3-6)	Bottom Trawl	2005 - 2012	40.57	65.13	0.62	0.06	1.54
	Bottom Trawl	2008 - 2012	40.56	63.80	0.64	0.09	1.56
	Bottom Trawl	2010 - 2012	42.03	65.00	0.65	0.13	1.56
	GC Scallop	2005 - 2012	27.25	12.63	2.16	0.37	4.72
	GC Scallop	2008 - 2012	15.30	10.20	1.50	0.21	2.89
	GC Scallop	2010 - 2012	10.10	4.67	2.16	0.29	3.67
	LA Scallop	2005 - 2012	94.35	53.75	1.76	0.03	6.58
	LA Scallop	2008 - 2012	45.62	34.40	1.33	0.04	4.99
	LA Scallop	2010 - 2012	19.16	28.00	0.68	0.01	3.68
Great South Channel East/Extended (Alt 3)	Bottom Trawl	2005 - 2012	3,802.93	111.63	34.07	0.90	91.14
	Bottom Trawl	2008 - 2012	1,730.40	93.60	18.49	0.88	66.78
	Bottom Trawl	2010 - 2012	1,176.55	80.33	14.65	1.15	45.54
	GC Scallop	2005 - 2012	1,706.94	63.63	26.83	4.07	52.16
	GC Scallop	2008 - 2012	1,470.81	51.80	28.39	1.91	60.91
	GC Scallop	2010 - 2012	1,776.07	46.00	38.61	2.04	75.55
	LA Scallop	2005 - 2012	13,559.23	283.75	47.79	1.96	101.20
	LA Scallop	2008 - 2012	10,703.60	238.60	44.86	1.19	92.49
	LA Scallop	2010 - 2012	13,548.11	258.33	52.44	1.93	101.09
Great South Channel (Alt 4)	Bottom Trawl	2005 - 2012	1,641.46	105.25	15.60	0.65	49.20
	Bottom Trawl	2008 - 2012	758.79	90.00	8.43	0.62	38.33
	Bottom Trawl	2010 - 2012	349.57	78.00	4.48	0.72	11.64
	GC Scallop	2005 - 2012	80.45	51.25	1.57	0.26	4.36
	GC Scallop	2008 - 2012	57.39	43.00	1.33	0.16	5.07
	GC Scallop	2010 - 2012	53.71	36.33	1.48	0.06	6.83
	LA Scallop	2005 - 2012	2,027.16	271.13	7.48	0.39	29.41

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
	LA Scallop	2008 - 2012	1,388.10	229.60	6.05	0.33	22.05
	LA Scallop	2010 - 2012	1,401.53	249.00	5.63	0.41	20.12
Nantucket Shoals (Alt 5)	Bottom Trawl	2005 - 2012	666.10	105.00	6.34	0.65	19.27
	Bottom Trawl	2008 - 2012	394.04	90.20	4.37	0.64	14.66
	Bottom Trawl	2010 - 2012	251.70	78.33	3.21	0.71	9.40
	GC Scallop	2005 - 2012	55.58	51.63	1.08	0.15	2.29
	GC Scallop	2008 - 2012	36.84	43.20	0.85	0.07	1.93
	GC Scallop	2010 - 2012	24.22	36.67	0.66	0.02	1.76
	LA Scallop	2005 - 2012	565.24	270.88	2.09	0.25	11.21
	LA Scallop	2008 - 2012	356.67	230.00	1.55	0.19	8.53
	LA Scallop	2010 - 2012	393.38	247.33	1.59	0.23	8.86
Great South Channel Gear Mod Area (Alt 6)*	Bottom Trawl	2005 - 2012	8,869.55	115.38	76.88	2.51	175.30
	Bottom Trawl	2008 - 2012	5,065.59	97.00	52.22	1.21	139.88
	Bottom Trawl	2010 - 2012	2,916.86	84.33	34.59	1.62	95.58
Nantucket Shoals West (Alt 6)	Bottom Trawl	2005 - 2012	693.25	105.50	6.57	0.81	19.25
	Bottom Trawl	2008 - 2012	423.48	91.00	4.65	0.79	14.76
	Bottom Trawl	2010 - 2012	275.85	79.33	3.48	0.90	9.49
	GC Scallop	2005 - 2012	65.37	52.00	1.26	0.22	2.69
	GC Scallop	2008 - 2012	44.87	43.40	1.03	0.10	2.57
	GC Scallop	2010 - 2012	28.46	36.67	0.78	0.04	2.11
	LA Scallop	2005 - 2012	688.08	275.00	2.50	0.39	11.96
	LA Scallop	2008 - 2012	441.58	234.60	1.88	0.27	9.36
	LA Scallop	2010 - 2012	486.45	252.00	1.93	0.29	9.65

*Because dredge gears would not be regulated in this area, scallop dredge effort estimates are not shown.

Table 104 – Party/charter recreational fishing revenue associated with the areas included in the Great South Channel/Southern New England habitat alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Nantucket Lightship (Alt 1)	2006 - 2012	21,544.43	3.00	127.00	2,600.19	1,117.74	2,373.03
	2008 - 2012	19,068.30	1.80	105.00	4,540.07	5,216.12	2,496.65
	2010 - 2012	16,472.45	1.67	89.00	4,492.49	5,216.12	2,628.00
CoxLedge (Alts 3-6)	2006 - 2012	105,303.00	12.00	974.14	2,340.07	2,034.52	1,755.97
	2008 - 2012	109,873.91	11.40	1,016.00	2,357.81	2,034.52	1,765.19
	2010 - 2012	106,187.16	12.33	971.00	2,123.74	1,820.36	1,615.31
Great South Channel East/Extended (Alt 3)	2006 - 2012	80,829.54	9.14	459.14	2,595.44	1,117.74	2,598.89
	2008 - 2012	35,831.25	6.80	198.40	1,905.92	931.45	2,161.29
	2010 - 2012	9,438.69	4.67	50.67	884.88	838.31	428.48
Great South Channel (Alt 4)	2006 - 2012	64,469.76	6.00	365.86	3,049.25	1,117.74	2,709.01
	2008 - 2012	31,024.97	4.20	172.60	2,543.03	1,117.74	2,455.78
	2010 - 2012	6,458.05	2.67	34.67	1,019.69	931.45	462.06
NantucketShoals (Alt 5)	2006 - 2012	40,207.49	6.43	221.57	1,481.33	1,117.74	1,605.44
	2008 - 2012	36,047.85	5.40	195.80	1,802.39	931.45	2,016.68
	2010 - 2012	9,252.40	3.00	49.67	957.15	931.45	184.45
Great South Channel Gear Mod Area (Alt 6)	2006 - 2012	96,898.40	5.14	538.14	4,743.28	5,588.70	2,772.29
	2008 - 2012	46,132.36	3.60	251.40	4,271.51	5,047.22	2,834.63
	2010 - 2012	24,466.09	3.33	131.33	2,823.01	1,117.74	2,193.29
Nantucket Shoals West (Alt 6)	2006 - 2012	55,776.01	7.71	305.14	1,323.50	931.45	1,428.93
	2008 - 2012	49,050.89	6.80	265.60	1,459.85	931.45	1,693.14
	2010 - 2012	22,603.19	5.00	121.33	1,027.42	931.45	828.13

Table 105 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Great South Channel/Southern New England Areas potentially impacted by the management alternatives.

Great South Channel/Southern New England		Alternative 3		Alternative 4		Alternative 5		Alternative 6	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
CT		**19**	**11**	**19**	**11**	**19**	**11**	**19**	**11**
	New London	5		5		5		5	
	Stonington	14		14		14		14	
MA		**382**	**237**	**364**	**226**	**337**	**215**	**341**	**216**
	Barnstable	13		13		13		15	
	Boston	18		17		17		18	
	Chatham	13	3	12	3	12	3	12	3
	Chilmark	6		6		6		6	
	Fairhaven	11	34	10	34	10	30	10	3
	Falmouth	4		4		5		5	
	Gloucester	10	15	10	13	27	14	28	14
	Harwich				3		3		
	Harwichport	38		29		6		6	3
	Hyannis	6		6		5		6	
	Mattapoisset			3					
	Nantucket	4		4		10		11	
	New Bedford	281	131	274	128	248	120	254	122
	Peabody		3		3		3		3
	Provincetown	5							
	South Dartmouth		3		3		3		3
	Westport		3		3		3		
	Woods Hole	7		7		6		7	
ME		**5**	**29**	**5**	**27**	**5**	**27**	**5**	**27**
	Portland	5	11	5	11	5	11	5	11
NC		**3**	**34**	**6**	**34**	**6**	**34**	**7**	**35**
	Bayboro		3		3		3		3
	Beaufort	46		4		3		3	

Great South Channel/Southern New England		Alternative 3		Alternative 4		Alternative 5		Alternative 6	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
	Hobucken		4		4		4		4
	New Bern		8		8		8		8
	Newport		3		3		3		
	Oriental		4		4		3		4
	Wanchese		4		4		4		4
NH			**3**		**3**		**3**		**3**
NJ		**7**	**88**	**33**	**86**	**33**	**74**	**36**	**76**
	Barnegat/ Barnegat Light	28	7	7	7	5	4	5	4
	Cape May	9	44	26	44	20	40	21	3
	Cape May Courthouse		8		7		4		41
	Manahawkin		5		5		5		5
	Point Pleasant	19		8		6		7	
NY		**17**	**23**	**19**	**23**	**18**	**23**	**19**	**24**
	Hampton Bays		3		3		3	18	3
	Montauk	16	14	27	14	16	14	16	14
RI		**12**	**59**	**86**	**59**	**84**	**58**	**86**	**59**
	Charlestown		5		5		5		5
	Newport	71		12		10		11	
	North Kingstown		5		5		5		5
	Point Judith/ Narragansett	59	9	71	9	70	9	71	9
	South Kingstown		3		3		3		3
	Wakefield		22		22		21		22
	West Kingston		4		4		4		4
	Westerly		3		3		3		3
VA		**3**	**55**	**58**	**44**	**50**	**35**	**52**	**36**
	Chincoteague	10		3		3		4	
	Gloucester		3		3		3		
	Hampton	25	9	21	9	18	7	18	9

Great South Channel/Southern New England		**Alternative 3**		**Alternative 4**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
	Newport News	22	11	24	10	20	7	21	7
	Seaford	21	9	10	9	9	8	9	8

Table 106. Landing port and associated mobile bottom-tending gear revenues in 2012 potentially impacted by the areas included in the Great South Channel/Southern New England Alternatives. Ports with less than 3 vessels each were included in the state totals only. *Changes in revenue for option 2 only listed for ports with 3 or more vessels affected by option 2 gear exemption.

Great South Channel/Southern New England									
	Alternative	**3**	**3**	**4**	**4**	**5**	**5**	**6**	**6**
	Option	**1,3,4**	**2***	**1,3,4**	**2***	**1,3,4**	**2***	**1,3,4**	**2***
State	**Port**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**
CT	**Total**	**636,902.62**	**636,902.62**	**357,089.62**	**357,089.62**	**154,403.91**	**154,403.91**	**1,477,635.77**	**1,477,635.77**
	NEW LONDON	19,183.65	19,183.65	15,611.45	15,611.45	14,882.74	14,882.74	29,749.33	29,749.33
	STONINGTON	617,718.97	617,718.97	341,478.17	341,478.17	139,521.17	139,521.17	1447,886.44	1,447,886.44
MA	**Total**	**52,870,574.69**	**47,075,645.88**	**28,062,150.93**	**28,062,150.93**	**14,802,230.18**	**89,98,387.84**	**116,762,660.32**	**110,387,142.79**
	BARNSTABLE	40,902.07	40,902.07	10,112.36	10,112.36	13,593.12	13,593.12	65,873.81	65,873.81
	BOSTON	122,347.68	122,347.68	68,521.64	68,521.64	60,149.98	60,149.98	123,145.44	123,145.44
	CHATHAM	1,950,741.68	1,950,741.68	97,881.87	97,881.87	65,297.30	65,297.30	1,366,566.31	1,366,566.31
	CHILMARK	721.05	721.05	687.03	687.03	707.67	707.67	734.64	734.64
	FAIRHAVEN	4,710,293.15	3,485,439.21	2,997,800.08	1,794,812.56	1,903,158.55	688,681.57	7,124,156.10	5,678,720.53
	FALMOUTH	746.63	746.63	714.51	714.51	1,983.33	1,983.33	4,199.00	4,199.00
	GLOUCESTER	200,212.97	200,212.97	81,050.49	81,050.49	54,159.15	54,159.15	499,376.28	499,376.28
	HARWICHPORT	1,515,620.29	1,515,620.29	16,145.52	16,145.52	10,278.20	10,278.20	203,411.63	203,411.63
	HYANNIS	8,357.08	8,357.08	6,670.09	6,670.09	9,917.44	9,917.44	16,290.22	16,290.22
	NANTUCKET	182,374.33	182,374.33	9,581.74	9,581.74	12,691.17	12,691.17	36,522.58	36,522.58
	NEW BEDFORD	42,582,388.02	39,500,216.02	23,278,913.23	20,218,617.26	11,162,449.23	8,061,430.76	105,626,236.38	102,310,490.79
	OTHER BARNSTABLE	1,487,820.15		1,473,548.98		1,487,590.52		1,608,739.24	
	PROVINCETOWN	14,085.88	14,085.88						
	WOODS HOLE	24,896.44	24,896.44	8,652.27	8,652.27	7,509.34	7,509.34	51,375.97	51,375.97
ME	**Total**	**6,866.35**	**6,866.35**	**3,994.39**	**3,994.39**	**4,314.02**	**4,314.02**	**11,473.36**	**11,473.36**
	PORTLAND	6,866.35	6,866.35	3,994.39	3994.39	4,314.02	4,314.02	11,473.36	11,473.36
NC	**Total**	**4,908.27**	**4,908.27**	**4,203.53**	**4203.53**	**2,705.43**	**2,705.43**	**13,525.15**	**13,525.15**
	BEAUFORT	1,971.03	1,971.03	1,649.38	1649.38	819.93	819.93	8,995.88	8,995.88
NJ	**Total**	**501,409.07**	**501,409.07**	**348,304.91**	**348304.91**	**107,942.25**	**107,942.25**	**2,473,429.20**	**2,473,429.20**

Great South Channel/Southern New England									
	Alternative	**3**	**3**	**4**	**4**	**5**	**5**	**6**	**6**
	Option	**1,3,4**	**2***	**1,3,4**	**2***	**1,3,4**	**2***	**1,3,4**	**2***
State	**Port**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**	**Total Revenue**
	BARNEGAT	100,447.26	100,447.26	78,320.22	78320.22	20,455.38	20,455.38	513,039.24	513,039.24
	CAPE MAY	315,570.64	315,570.64	215,935.20	215935.20	66,903.15	66,903.15	1,624,945.57	1,624,945.57
	POINT PLEASANT	82,997.99	82,997.99	51,656.30	51656.30	18,190.53	18,190.53	333,051.21	333,051.21
NY	**Total**	**46,042.76**	**46,042.76**	**38,284.20**	**38284.20**	**36,080.46**	**36,080.46**	**76,787.39**	**76,787.39**
	MONTAUK	45,881.55	45,881.55	38,123.00	38123.00	35,919.25	35,919.25	76,626.18	76,626.18
RI	**Total**	**1,034,312.76**	**1,034,312.76**	**745,835.84**	**745835.84**	**573,331.40**	**573,331.40**	**2,114,869.78**	**2,114,869.78**
	NEWPORT	533,590.09	533,590.09	367,540.95	367540.95	248,596.19	248,596.19	1,206,583.34	1,206,583.34
	POINT JUDITH	492,145.21	492,145.21	369,721.84	369721.84	316,186.55	316,186.55	899,603.70	899,603.70
VA	**Total**	**496,404.51**	**496,404.51**	**389,521.60**	**389521.60**	**82,156.67**	**82,156.67**	**2,432,363.27**	**2,432,363.27**
	CHINCOTEAGUE	700.69	700.69	640.06	640.06	472.34	472.34	1,001.76	1,001.76
	CITY OF SEAFORD	233,041.85	233,041.85	196,726.00	196726.00	45,108.38	45,108.38	703,197.90	703,197.90
	HAMPTON	150,161.09	150,161.09	110,667.98	110667.98	23,924.75	23,924.75	926,964.28	926,964.28
	NEWPORT NEWS	112,500.87	112,500.87	81,487.56	81487.56	12,651.20	12,651.20	801,199.34	801,199.34

Table 107 – Total number of vessels conducting recreational fishing trips in 2012. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

		Alternative 1 (Nantucket Lightship)		Alternative 3		Alternative 4		Alternative 5		Alternative 6	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA	**Total**	**7**	**6**	**5**	**3**	**3**		**7**	**6**	**10**	**8**
NY	**Total**			**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
	Montauk			3		3		3		3	
RI	**Total**			**5**	**6**	**5**	**6**	**5**	**6**	**5**	**6**
	Point Judith			4		4		4		4	

Table 108 – Sum of 2012 party/charter recreational fishing revenue associated with the Great South Channel/Southern New England Alternatives. Ports with less than 3 vessels each were included in the state totals only.

Alternative		**1**	**3**	**4**	**5**	**6**
State	**Port**	**Value**	**Value**	**Value**	**Value**	**Value**
MA	**Total**	**38748.32**	**11,736.27**	**10,059.66**	**35,953.97**	**63,338.60**
NY	**Total**		**4,514.10**	**4,514.10**	**4,514.10**	**4,514.10**
	MONTAUK		4,514.10	4,514.10	4,514.10	4,514.10
RI	**Total**		**55,574.52**	**55,574.52**	**55,574.52**	**55,574.52**
	POINT JUDITH		55,146.20	55,146.20	55,146.20	55,146.20

4.2.3.5.1 Alternative 1 (No Action)

Alternative 1/No Action includes the Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area. See the Alternative 2 section below for the impacts resulting from no habitat management areas in the Great South Channel/Southern New England sub-region. The expected neutral to slightly negative impact the no action alternative has on seabed habitat (see section 4.2.1.5.1), and the potential of shifting effort onto more susceptible habitats suggest that the cumulative economic impact of the current closure is negative both in the short and long run, although there is a high degree of uncertainty in this conclusion. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo. All other alternatives are compared to No Action in the sections that follow.

4.2.3.5.2 Alternative 2 (No Habitat Management Areas)

Alternative 2 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would not designate any additional habitat management areas in the region.

Table 101 details the haul level revenue generated from the 10 nautical mile buffer surrounding the Nantucket Lightship groundfish and habitat closures. Monkfish and winter skate represent the dominant species for both bottom trawl and fixed gillnet for the winter and spring months. Bottom trawl also generates substantial revenue from a broad mix of additional species throughout the year. Overfishing is occurring on winter skate, though the stock is not overfished, while cod and witch flounder are currently overfished, and overfishing is occurring. The benefits derived for these species are thus likely to be minimal. Framework 50 allows for retention of winter flounder in the Southern New England stock area. Although the analysis of haul level data described above suggests that Nantucket Lightship will generate less benefit from this species when compared to currently open portions of Great South Channel, additional access to this species through Alternative 2 will likely provide a slightly positive benefit to groundfish fishermen. Species within the skate complex vary with regard to overfished and overfishing status. The remaining stocks in Table 101 are not overfished, and overfishing is not occurring. The analyses in Framework 48 indicated that a small positive benefit would be expected from increased access to scallop biomass by bottom trawls, and the skate complex could generate additional benefits to the same individuals but the mechanism for the latter is unclear from the data available. Other species would be expected to provide negligible positive benefits to currently excluded fishermen within Nantucket Lightship. The Scallop PDT has conducted a more extensive analysis of the benefits and costs of area management alternatives for limited access and general category scallop permitted vessels in Great South Channel/Southern New England, including Nantucket Lightship. The current Nantucket Lightship Habitat Closure has relatively low levels of scallop biomass when compared to the northern portions of Closed Area I and Closed Area II, and thus this fishery does not drive the benefit analysis within Alternative 2, because much of the available biomass is already fished within the Nantucket Lightship Scallop Access Area, which encompasses the portion of the groundfish closure east of the habitat closure.

Surfclam and ocean quahog harvesting is currently allowed in the southern portion of the Temporary PSP Closure Area, which would include Nantucket Lightship under Alternative 2.

Clam dredges are currently allowed access to the groundfish closures within Nantucket Lightship, although they are excluded from the habitat closure. The majority of trips within/surrounding Nantucket Lightship are reported on the northern edge of the habitat closure, along Nantucket Shoals, and abut areas currently closed to clam dredging. It is likely that under Alternative 2 some of this effort would displace into areas currently closed to the fishery. However, the extent of this displacement depends on relative catch rates inside versus outside of the Nantucket Lightship Habitat Closure, and is uncertain due to the lack of current effort in the area from which to gauge relative CPUE. Historical reporting (e.g. May 2013 MAFMC Ocean Quahog Information Document, Atlantic Surfclam Information Document) suggests that the waters in and around Nantucket Lightship are relatively productive for both surfclam and ocean quahog, and thus Alternative 2 is likely to provide a slightly positive benefit to the fishery.

Table 104 presents data on party/charter recreational fishing reported within Nantucket Lightship. The data suggests that a small number of recreational businesses fish relatively intensively within the borders of Nantucket Lightship, with each individual generating on the order of $9,400/year in the current closures. This small number of individuals suggests that, although there is potential for increased gear interactions, the impact on the recreational industry is likely to be negative but negligible. Table 107 identifies the communities associated with these trips in 2012. These are all associated with Massachusetts, however due to privacy concerns individual communities are not identified.

Overall, the short-term impacts are expected to be slightly positive when compared to No Action, and accrue mainly to the surfclam and ocean quahog fishery. In the long run, the expected impact is neutral to slightly positive when compared to the status quo, particularly given the neutral to slightly negative impact no action has on seabed habitats (see section 4.2.1.5.1) and the potential that the current closure could be shifting effort onto more susceptible seabed. Any positive benefits accrue mainly to the surfclam and ocean quahog fishery. In the long-term, some negative impacts are expected for the groundfish fishery when compared to the status quo (see section 4.2.2.8.1). However, these negative impacts are potentially outweighed by the positive benefits that would be expected to be generated for the surfclam and ocean quahog fishery. The benefits generated from Alternative 2 are expected to be similar to Alternative 4, larger than Alternatives 3, 5 and 6, and are highly uncertain.

The short-term social impacts of Alternative 2 in comparison to the No Action alternative are expected to be slightly positive as fishermen would gain access to new fishing areas. There are also potential long-term slightly negative social impacts if benefits to fish populations from the current closed areas are lost.

4.2.3.5.3 Alternative 3

Alternative 3 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel i.e. the Great South Channel East HMA. Two additional habitat management areas would also be designated on Cox Ledge.

Figure 34 and Figure 35 overview the gear active in the vicinity of Great South Channel East and Cox Ledge. The preponderance of revenue in Great South Channel East is generated by scallop

dredge gear, while Cox Ledge has a substantial amount of revenue from both sink gillnet and shrimp/bottom trawl trips. Table 102 provides more details on the mobile bottom-tending gear directly impacted by Alternative 3. In Cox Ledge, the mean impacted revenue per trip for shrimp and bottom trawl vessels between 50 ft and 70 ft, which accounts for 86% of all the trawl revenue in this area, is $257 (2.1% of an average trip's revenue). This result is likely due at least in part to the fact that Cox Ledge is small enough that it fails to fully encompass shrimp and bottom trawl trips. Additionally, the VTR points suggest that Cox Ledge abuts more productive centers for shrimp and bottom trawl fishing, as opposed to being centers themselves. Mean clam dredge revenue impacted per trip in Cox Ledge is estimated to be $1,010 (5.5% of an average trip's revenue), with fewer active individuals. This suggests that a small number of individuals are more intensively using the waters around Cox Ledge, although again the small size of these areas likely drives some of the analytical results. Mean scallop dredge revenue per trip is $538 (0.8% of an average trip's revenue) for vessels > 70 ft, $186 (3.9% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $18 (0.4% of an average trip's revenue) for vessels < 50 ft.

The mean scallop dredge revenue from Great South Channel East is estimated to be $38,454 (21.5% of an average trip's revenue) for vessels > 70 ft, $9,740 (27.7% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $3,152 (59.6% of an average trip's revenue) for vessels < 50 ft. Clam dredge is also estimated to be highly active in this area, with a mean per trip revenue impact of $7,923 (78.9% of an average trip's revenue). Trip revenue from bottom trawls are estimated to be $1,148 (6.0% of an average trip's revenue) for vessels > 70 ft, $438 for vessels between 50 ft and 70 ft, and $163 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $1,384. The affected revenue represents 13.6% of the scallop dredge, 27.8% of clam dredge, 1.6% of SAP trawl, and 0.8% of bottom trawl average annual revenue reported within VTR and clam logbooks in relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance).

Table 103 presents the VMS analysis. Bottom trawl effort is estimated to be minimal within Cox Ledge, and the mean individual effort is just under 40 minutes a year, again lending credence to the assertion that this area is not a center of bottom trawl fishing, although the small size of Cox Ledge again plays a role in the results. Both limited access and general category scallop vessel effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The limited access and general category effort in Great South Channel East is consistently high, as would be expected given VTR analysis. The impact of Alternative 3 to the scallop industry is discussed in section 4.6.4.1.1.2, which further highlights the large biomass concentration, and high productivity, of scallops within the Great South Channel East area. However, the bottom trawl effort seems to follow a downward trend not witnessed in the VTR analysis, with the 2010 – 2012 annual effort at only 31% of the 2005 – 2012 average. Nevertheless, a substantial amount of bottom trawl effort is still estimated to fall within Great South Channel East.

Table 104 overviews the recreational fishing reported in Cox Ledge and Great South Channel East. Although the revenue reported within Cox Ledge is consistently high across all time periods, the Great South Channel East HMA has seen a decrease of 88% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 89% for the number of angler trips.

Table 107 identifies the communities associated with these trips in 2012, which are located in Massachusetts, New York, and Rhode Island. Due to confidentiality concerns many individual communities are not identified, however, Montauk, New York is identified as an impacted community, which also has high levels of dependence on recreational fishing (Affected Environment Table).

Overall, a full exclusion of mobile bottom tending gear, as in Option 1, is expected to impact 91%, or $33,151,887 of the total revenue generated from Great South Channel East and Cox Ledge areas. Scallop dredge in the Great South Channel East area accounts for 82% of this revenue number. Given the discussion of section 4.6.4.1.1.2, it is unlikely that this revenue can be generated from a redistribution of effort to alternate sites, meaning that there will be a highly negative impact to the scallop fishery from Alternative 3. Both the short-term and long-term net impacts of Alternative 3 are thus expected to be highly negative, and concentrated within the scallop fishery. The magnitude of the loss to the scallop fishery is expected to dwarf the expected moderate positive benefits to the groundfish fishery of habitat conservation in this area.

Option 2 would exempt $4,131,900 worth of revenue that would otherwise be displaced from the surfclam and ocean quahog fishery. However, when compared to Alternative 1/No Action, both the short run and long run impacts of Option 2 are expected to be highly negative, given the impact on the scallop fishery. The communities of Fairhaven and New Bedford, Massachusetts (at the port of landing level) and Cape May and Manahawkin, New Jersey (at the registered city level) will benefit from hydraulic clam dredge exemptions (Table 105).

As discussed previously both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. However, given the relative value of the fisheries, the exemption to scallop and clam dredges in the area is expected to lead to overall moderately positive impacts from these alternatives for both Options 3 and 4, as compared to no action in both the short and long run. In addition to vessels using hydraulic clam dredges, many vessels in the communities identified in Table 105 use scallop dredges and would also benefit from selection of the gear modification options (Option 3-4).

The social impacts of Alternative 3 in comparison to Alternative 1/No Action are expected to be moderately negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

In summary, Alternative 3 is expected to produce outcomes more negative, and more certainly, than commensurate options for all other alternatives being considered for the Great South Channel/Southern New England.

4.2.3.5.4 Alternative 4

Alternative 4 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel. Two additional habitat management areas would also be designated on Cox Ledge.

Figure 36 and Figure 35 overview the gear active in the vicinity of Great South Channel and Cox Ledge HMAs. The Great South Channel area is nested within the borders of Great South Channel East area in Alternative 3, and thus the discussion will look to compare the two areas. Similarly to the larger Great South Channel East, revenue associated with Great South Channel is predominantly associated with scallop dredges, although a relatively large proportion is also generated by clam dredge. In Cox Ledge (discussed in detail under Alternative 3), a substantial amount of revenue is generated from both sink gillnet and shrimp/bottom trawl trips. Table 102 provides more details on the mobile bottom-tending gear directly impacted by Alternative 4.

The mean scallop dredge revenue from Great South Channel HMA is estimated to be $24,923 (13.5% of an average trip's revenue) for vessels > 70 ft, $5,415 (11.4% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $330 (5.0% of an average trip's revenue) for vessels < 50 ft. This is respectively 65%, 56%, and 10% of the per-trip revenue for the same vessel categories estimated for Great South Channel East area. Overall, the annual scallop dredge revenue for Great South Channel HMA represents 37% of what is estimated to be derived from Great South Channel East. Nevertheless, the VTR analysis potentially overestimates the revenue generated from vessels employing scallop dredges in Great South Channel. This is assumed because the alternative was developed with input from Limited Access Scallop industry representatives in order to mitigate the greatest portion of the impact to the scallop fishery. The original proposal from Limited Access industry representatives suggests that the majority of Limited Access scallop revenue is generated deeper than the 35 m depth contour, but depth based boundaries are not accounted for in the VTR analysis. The more spatially refined VMS analysis below sheds additional light on this issue.

Clam dredge is also estimated to be highly active in this area, with a mean per trip revenue impact of $7,819 (77.8% of an average trip's revenue), with both the per trip and annual revenue representing 99% of that estimated for the larger Great South Channel East area. Impacted trip revenue from bottom trawls are estimated to be $889 (4.4% of an average trip's revenue) for vessels > 70 ft, $483 (3.1% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $67 (1.6% of an average trip's revenue) for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $415 (2.6% of an average trip's revenue). For generic bottom trawls these revenues are 77%, 110%, 41%, and 30% of the same respective per-trip revenues estimated for Great South Channel East. All told, the bottom/SAP trawl annual revenue encapsulates 47% of the revenue estimated for these gear types in the Great South Channel East HMA. Together, the revenue estimated to be impacted by Alternative 4 represents 5.0% of scallop dredge, 27.5% of clam dredge, 0.3% of SAP trawl, and 0.8% of bottom trawl average annual revenue reported within the VTR and clam logbooks in relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance).

Table 103 presents the VMS analysis. As described under Alternative 3, bottom trawl effort is minimal within Cox Ledge, and the area does not appear to be a center of bottom trawl fishing. Both limited access and general category scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The limited access and general category scallop effort estimated for Great South Channel HMA, respectively at 10% and 3%, is a small fraction of what was estimated for Great South Channel East in Alternative 3. VMS data are likely more representative of the scallop fishing in this area. The Scallop PDT's analyses (Section 4.6.4.1.1.2) indicate that the majority of the scallop biomass in the vicinity does not fall within the bounds of the Great South Channel area being considered within Alternative 4. The bottom trawl effort estimates from VMS align more closely with the VTR estimates, with annual effort estimated to represent 30% of the effort within the encompassing Great South Channel East area. An average individual fishing with bottom trawl is estimated to annually spend 1 hour and 20 minutes within the border of Great South Channel HMA.

Table 104 overviews the recreational fishing reported in Cox Ledge and Great South Channel HMAs. Although the revenue reported within Cox Ledge is consistently high across all time periods, the Great South Channel has seen a decrease of 90% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 91% for the number of angler trips. Table 107 identifies the communities associated with these trips in 2012, which are located in Massachusetts, New York, and Rhode Island. Due to privacy concerns, many individual communities are not identified. However Montauk, New York is identified as an impacted community which also has high levels of dependence on recreational fishing (see table in the Communities section in Volume 1).

A complete exclusion of mobile bottom tending gear from the Great South Channel and Cox Ledge areas would be expected to impact 87%, or $4,645,461, in the most recent three year period, plus revenue generated from concentrations of winter flounder not in historical VTR data for this area as described in the introduction to this sub-region. The majority of this impact falls upon the surfclam and ocean quahog fishery. Although the surfclam and ocean quahog fishery is managed under an ITQ system, there has been a shift of fishing effort out of the mid-Atlantic northward (see 56th SAW). This means that HMAs in the Great South Channel/Southern New England area affect areas of the ocean upon which the surf clam and ocean quahog fisheries are becoming more dependent. Assessing the expected impact to these fisheries means understanding not only the trade-off between opening the habitat closure in Nantucket Lightship and closing some other portion of Great South Channel/Southern New England, but also how the recent opening of waters on Georges Bank is likely to affect future effort within the Great South Channel/Southern New England area. The shift in effort into the Great South Channel/Southern New England area suggests that it is more profitable than more southerly areas. Though extremely uncertain, the opening of productive grounds in Georges Bank is thus expected to draw additional effort northward, as opposed to shifting effort from Great South Channel/Southern New England. This, coupled with the expected impacts documented in section 4.6.8.2, suggests that the short-term and long-term economic impacts of Alternative 4 are likely to be highly negative for the clam fishery when compared to no action/Alternative 1.

Likewise, given the differential seen in historical catches of winter flounder at the haul level presented in the introduction to the Great South Channel/Southern New England section, and the substantial revenue currently generated within the bounds of the Great South Channel area, the net impacts to the bottom trawl fishery are, in the short run, expected to be negative when compared to Alternative 1/No Action. As highlighted in Section 4.2.2.8.3, the impacts of this alternative as compared to no action are highly uncertain due to a general lack of survey data around Nantucket Shoals, although the habitat seems more susceptible to fishing impacts than the Alternative 1/No Action areas.

Overall, the net short-term impacts are expected to be moderately negative when compared to Alternative 1, and accrue mainly to the bottom/SAP trawl and clam dredge fisheries. The long-term net impacts are highly uncertain, but expected to be neutral to moderately positive, with a trade-off between the impact on the clam dredge fishery and potential increases in groundfish productivity. The net economic benefits are expected to be on the same order of magnitude as Alternative 2, but larger than Alternatives 3, 5 and 6, with the trade-off being between the clam and groundfish fisheries.

Option 2 is expected to mitigate the impact on the clam dredge fishery, and thus the bulk of the impact on mobile bottom-tending gear. The overall short run net impact is therefore expected to be moderately positive when compared to Alternative 1/No Action. However, Option 2 is also expected to mitigate any long run benefits to the groundfish fishery that might otherwise accrue under Option 1. Thus, the overall long run benefit is expected to be neutral to moderately negative when compared to no action.

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. Both Option 3 and 4 mitigate the impact on the clam dredge fishery, at the expense of some of the groundfish fishery benefits, for an overall positive short-run impact. Coupled with the expected neutral to moderately negative impacts of these gear restrictions on seabed habitats, this indicates that Options 3 and 4 would be expected to induce a net negative impact as compared to no action in the long run.

The social impacts of Alternative 4 in comparison to the no action alternative are expected to be moderately negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Many vessels in the communities identified in Table 105 are associated with trips utilizing scallop dredges and would benefit from selection of the gear modification options (Options 3 and 4). The communities of Fairhaven and New Bedford, Massachusetts (at the port of landing level) and Cape May and Manahawkin, New Jersey (at the registered city level) will benefit from hydraulic clam dredge exemptions. Moderate positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.2.3.5.5 Alternative 5

Alternative 5 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals. This Nantucket Shoals HMA overlaps with the areas proposed via Alternatives 3 and 4, but is generally further to the west. Two additional habitat management areas would also be designated on Cox Ledge.

Figure 35 and Figure 37 overview the gear active in the vicinity of Cox Ledge and Nantucket Shoals. Scallop dredge and clam dredge generate the majority of revenue from Nantucket Shoals, while Cox Ledge has a substantial amount of revenue from both sink gillnet and shrimp/bottom trawl trips. Table 102 provides more details on the mobile bottom tending gear directly impacted by the management options being considered within Alternative 5. Fishing effort in the Cox Ledge HMA is detailed under Alternative 3.

The mean scallop dredge revenue from Nantucket Shoals is estimated to be $14,961 (6.9% of an average trip's revenue) for vessels > 70 ft, $3,049 (7.0% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $260 (4.2% of an average trip's revenue) for vessels < 50 ft. The total scallop dredge revenue estimated to fall within the Nantucket Shoals area is 13% of that of the overlapping Great South Channel East area, and 36% of Great South Channel. Clam dredge is estimated to generate a mean per trip revenue of $8,177 (81.7% of an average trip's revenue) within Nantucket Shoals, and total revenue is 4% higher than the Great South Channel East and 5% higher than the Great South Channel areas. Trip revenue from bottom trawls is estimated to be $640 (3.2% of an average trip's revenue) for vessels > 70 ft, $429 (3.0% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $43 (1.8% of an average trip's revenue) for vessels < 50 ft, while the revenue for SAP trawls of all vessel sizes averages $305 (2.0% of an average trip's revenue). Total combined bottom trawl and SAP trawl revenues are estimated to be 36% of those associated with Great South Channel East, and 76% of that generated from Great South Channel. In total, Alternative 5 is expected to impact 1.8% of scallop dredge, 28.8% of clam dredge, 0.2% of SAP trawl and 0.7% of bottom trawl average annual revenue reported within VTR and clam logbooks in relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance).

Table 103 presents the VMS analysis. As noted above, Cox Ledge does not appear to be a center of bottom trawl fishing, and both limited access and general category scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The limited access scallop effort in Nantucket Shoals is relatively low and is estimated to be 3% of the effort falling within the Great South Channel East, and 28% of that associated with Great South Channel. General category scallop effort is substantially lower, estimated to be 40 minutes per year for the average individual, a level 45% of that estimated for Great South Channel HMA, and 1% of the Great South Channel East HMA. The minimal scallop fishing effort in the Nantucket Shoals HMA is consistent with the scallop PDT analysis (Section 4.6.4.1.1.2). Bottom Trawl effort in the Nantucket Shoals HMA is again estimated to be lower than both Great South Channel East and Great South Channel, respectively representing 21% and 72% of the effort associated with the two adjoining areas

Table 104 overviews the recreational fishing reported in Cox Ledge and Nantucket Shoals. Although the revenue reported within Cox Ledge is consistently high across all time periods, Nantucket Shoals has seen a decrease of 77% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 78% for the number of angler trips.

Given the analyses above, a complete exclusion of mobile bottom tending gear, as per Option 1, would be expected to impact the clam fishery most heavily, as this area seems to fall further afield from the centers of groundfish and scallop fishing in the Great South Channel/Southern New England area. Nevertheless, in the short-term, the impact across all fisheries would be expected to be slightly negative. The long-term impact on the groundfish fishery is uncertain (see section 4.2.2.8.4), but likely slightly negative when compared to No Action. When compared to some of the other alternatives under consideration, particularly Alternatives 3 and 4, Alternative 5 shifts away from both the most vulnerable habitat in the Great South Channel/Southern New England area and what seems to be higher concentrations of groundfish that would benefit from the conservation measure.

Option 2 is expected to mitigate the impact on the clam dredge fishery, but also decrease any potential benefits that would otherwise accrue to the groundfish fishery. The impacts to the clam dredge fishery would be equal to those associated with Alternative 2 (see above), and thus the long run net impacts are expected to slightly negative to slightly positive, with slightly negative impacts expected to accrue to the groundfish fishery. The impacts are likely to be smaller in magnitude than Alternatives 2 and 4, but larger than 3 and 6.

As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected neutral to negative impact on seabed habitats identified in section 4.2.1.5.5, indicates that both Option 3 and 4 would be expected to induce a net negative economic impact as compared to No Action in the long-term.

Table 105 identifies the communities associated with these trips in 2012, which are located in Massachusetts, New York, and Rhode Island. Due to confidentiality concerns many individual communities are not identified however Montauk, New York is identified as an impacted community which also has high levels of dependence on recreational fishing (see Table in the Communities section of Volume 1).

The social impacts of Alternative 5 in comparison to Alternative 1/No Action are expected to be moderately negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Many vessels in the communities identified in Table 105 are associated with trips utilizing scallop dredges and would benefit from selection of the gear modification options (Options 3 and 4). The communities of Fairhaven and New Bedford, Massachusetts (at the port of landing level) and Cape May and Manahawkin, New Jersey (at the registered city level) would benefit from hydraulic clam dredge

exemptions in Option 2. Moderate positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.2.3.5.6 Alternative 6

Alternative 6 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals (Nantucket Shoals West HMA). An additional area further east in the Great South Channel would be designated as a gear modification area (Great South Channel GMA). Two additional habitat management areas would also be designated on Cox Ledge.

Figure 35, Figure 38, and Figure 39 overview the gears active in the vicinity of Cox Ledge, Nantucket Shoals West, and Great South Channel Gear Modification Area (GMA). Scallop dredge and clam dredge generate the majority of revenue from Nantucket Shoals West, scallop dredge revenue dwarfs the revenue generated from all other gears within the Great South Channel GMA area, and Cox Ledge has a substantial amount of revenue from both sink gillnet and shrimp/bottom trawl trips. Table 102 provides more details on the mobile bottom-tending gear directly impacted by Alternative 6. Revenues in Cox Ledge are described under Alternative 3.

The mean scallop dredge revenue from Nantucket Shoals West is estimated to be $12,124 (6.6% of an average trip's revenue) for vessels > 70 ft, $2,846 (6.1% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $243 (4.1% of an average trip's revenue) for vessels < 50 ft. The total scallop dredge revenue estimated to fall within the Nantucket Shoals West area is 36% of the scallop dredge revenue within Nantucket Shoals, 18% of that of the adjoining Great South Channel East area, and 49% of Great South Channel. Clam dredge is estimated to generate a mean per trip revenue of $8,865 (88.6% of an average trip's revenue) within Nantucket Shoals West, and total revenue is 8% higher than Nantucket Shoals, 14% higher than the Great South Channel East and 12% higher than the Great South Channel areas. Impacted per-trip revenue from bottom trawls is estimated to be $613 (3.2% of an average trip's revenue) for vessels > 70 ft, $344 (3.1% of an average trip's revenue) for vessels between 50 ft and 70 ft, and $63 (2.8% of an average trip's revenue) for vessels < 50 ft, while the revenue for SAP trawls of all vessel sizes averages $617 (4.1% of an average trip's revenue). Total combined bottom trawl and SAP trawl revenues are estimated to be 36% higher than Nantucket Shoals, 51% lower than Great South Channel East, and 4% higher than Great South Channel. The impacted revenue within the boundaries of the Nantucket Shoals West and Cox Ledge HMAs represents 0.8% of bottom trawl, 31.2% of clam dredge, 0.6% of SAP trawl, and 2.5% of scallop dredge average annual revenue within the VTR and clam logbooks in relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance).

The Great South Channel GMA also generates a substantial amount of bottom and SAP trawl revenue. The mean per-trip bottom trawl revenue estimated to fall within the GMA is $1,574 (7.7% of an average trip's revenue) for vessels > 70 ft, $520 (2.8% of an average trip's revenue) for vessels between 50 ft and 70 ft, and$85 (0.8% of an average trip's revenue) for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $1,973 (11.0% of an average

trip's revenue). Both the number of individuals and trips estimated to be affected by any gear modifications are relatively high. The impacted revenue within the boundaries of the Greast South Channel GMA represents 1.2% of bottom trawl revenue and 2.6% of SAP trawl revenue reported within VTR in relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume I for 2012 total VTR revenue estimates and statistical areas of relevance).

Table 103 presents the VMS analysis. As noted above, Cox Ledge does not appear to be a center of bottom trawl fishing, and both limited access and general category scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The limited access scallop effort in Nantucket Shoals West is relatively low, and is estimated to be 4% of the effort falling within the Great South Channel East, 45% of that associated with Great South Channel, and 124% of Nantucket Shoals. General category scallop effort is substantially lower, estimated to be 47 minutes per year for the average individual, a level 1% of the Great South Channel East level, 53% of that estimated for Great South Channel, and 118% of Nantucket Shoals. The minimal scallop fishing effort in the Nantucket Shoals HMA is consistent with the scallop PDT analysis (Section 4.6.4.1.1.2). Bottom trawl effort is estimated to be lower than both Great South Channel East and Great South Channel, respectively representing 23% and 79% of the effort associated with these two areas, although it is 110% of Nantucket Shoals because the Nantucket Shoals west area is overlapping and slightly larger. It is unclear what is driving the difference between the VMS and VTR analysis, with the VTR suggesting that Nantucket Shoals West generates higher bottom/SAP trawl revenue than Great South Channel, and the VMS analysis suggesting that effort is lower in Nantucket Shoals West than Great South Channel. However, it is possible that some of the effort accounted for in the VTR is not in the VMS analysis due to the fact that VMS is not required on all vessels.

The VMS analysis indicates a substantial amount of effort associated with bottom trawls in the Great South Channel GMA, in terms of number of individuals and annual time, although the 2010 – 2012 annual effort estimate is only 33% of the 2005 – 2012 average suggesting a downward trend.

Table 104 overviews the recreational fishing reported in Cox Ledge, Nantucket Shoals West, and Great South Channel GMA areas. Although the revenue reported within Cox Ledge is consistently high across all time periods, both Nantucket Shoals West and Great South Channel GMA have respectively seen decreases of 59% and 75% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 40% and 76% for the number of angler trips, which is consistent with the other management alternatives in the area.

<u>Option 1, which would potentially apply a mobile bottom tending gear closure to the Nantucket Shoals West and Cox Ledge areas, would be expected to have the largest impact on the clam dredge and bottom trawl fisheries. Given the expected impacts on habitat most susceptible to fishing and groundfish stocks (see sections 4.2.1.5.6 and 4.2.2.8.5), Alternative 6 is expected to generate moderately negative impacts in both the short run and long run when compared to Alternative 1/No Action. These negative impacts accrue mainly to the clam dredge and bottom trawl fisheries.</u> The negative impacts are expected to be larger than commensurate options in all

other Alternatives under consideration for Great South Channel/Southern New England, except for Alternative 3.

Alternatively, Option 2 could be applied to the Nantucket Shoals West and Cox Ledge areas and exempt hydraulic clam dredges from the closure. This is expected to mitigate the impacts on the clam dredge fishery, although the long-run impacts are still expected to be moderately negative given the expected additional impacts on habitat and groundfish stocks.

If this alternative is selected, the Great South Channel Gear Modification Area would be implemented with either Option 3 or Option 4. As discussed previously, both the costs borne by trawl fishermen and the habitat conservation benefits of gear restrictions defined in Options 3 and 4 are highly uncertain. What information exists indicates that Option 3 would be expected to decrease catch per unit effort for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected neutral to negative impact on seabed habitats identified in Section 4.2.1.5.6, indicates that if Option 3 or 4 is applied in the Great South Channel Gear Modification Area, they would be expected to induce a net negative impact as compared to Alternative 1/No Action.

Table 105 identifies the communities associated with these trips in 2012, which are located in Massachusetts, New York, and Rhode Island. Due to confidentiality concerns many individual communities are not identified however Montauk, New York is identified as an impacted community which also has high levels of dependence on recreational fishing (see table in Communities section of Volume 1). The social impacts of Alternative 6 in comparison to the No Action alternative are expected to be moderately negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread.

4.2.4 Protected resources

All of the proposed habitat management alternatives, except for the no action alternatives, would remove year-round groundfish closures and result in gear capable of catching groundfish being allowed into areas where they had previously been restricted. Changes in the patterns of fixed gear use, specifically concentrations of fixed gear, have the greatest potential to influence the magnitude of protected resources impacts in the region. Gillnets and traps/pots have been documented as having the most interactions with whales and dolphins as compared to trawl or hook gear. Sea turtle sightings and interactions with gillnet and trawl gear in most of the areas under consideration in this amendment are rare, except for interactions with scallop dredges in the Great South Channel/Southern New England sub-region. The management measures currently in place for the Northeast multispecies, monkfish, and skate fisheries (i.e., the fisheries that utilize gillnets and bottom trawls) and the scallop fishery all limit the overall amount of fishing effort, mainly through annual catch limits on target stocks. As a result, the changes proposed in this amendment would not be expected to result in an increase in fishing effort overall, just shifts in the location of that effort.

Existing management measures implemented specifically for protected resource conservation should mitigate any impacts of this amendment on the protected resources included in those plans (large whales and porpoises).

The Atlantic Large Whale Take Reduction Plan implements gear restrictions, spatial and seasonally, to minimize interactions between endangered and protected whales and vertical lines from fishing gear as well as to reduce serious injury or mortality, should an interaction occur. Two recent adjustments to this Take Reduction Plan include the "Sinking Groundline Rule", that became effective in April 2009 (September 2, 2008; 73 FR 51228), and the "Vertical Line" rule, that was published June 27, 2014 (79 FR 36586), and will become effective August 26, 2014. These rules have improved, or are expected to improve, management of marine mammal interactions with fishing gear. In addition, when the Atlantic Large Whale Take Reduction Team was working on the vertical line rule to address entanglement risk of vertical lines to large whales, the Team determined that gillnets represent less than 1% of the total vertical lines on the east coast (see Appendix 3A in the most recent Atlantic Large Whale Take Reduction Plan FEIS (NMFS Greater Atlantic Region 2014)) and that the impacts from this gear on large whales is minimal. Therefore, the most recent rule focused on trap/pot vertical line reduction, which is a gear that has been, and would, for the most part, continue to be allowed in the habitat management areas. Areas with the greatest co-occurrence of large whales and gillnet gear will continue to be subject to existing restrictions under the Atlantic Large Whale Take Reduction Plan. Further, should data indicate that gillnet entanglement risk has increased, the Atlantic Large Whale Take Reduction Team would be reconvened to address the problem.

Likewise, the closed areas that are in the closest spatial proximity to known concentrations of harbor porpoises will be subject to pinger requirements under the Harbor Porpoise Take Reduction Plan. The Harbor Porpoise Take Reduction Plan primarily utilizes gear restrictions, including closures, and pinger requirements (as described in the final rule, February 19, 2010; 75 FR 7383), seasonally and spatially, to prevent interactions with fishing gear.

Because a number of the alternatives would potentially open areas to fishing that have been closed for a significant period of time, there are no data to provide insight as to how gear may potentially shift and, if there is a shift, what kind of impact that may have on protected species. As a result, it is not possible to forecast precisely what entanglement risk would exist if the closures are relieved. However, we can adequately examine risk based on overall gillnet effort – i.e., the actual number of nets in the water. Because there is unlikely to be in increase in gillnet effort overall, the overall risk of marine mammal entanglement is unlikely to increase and that the risk of opening closed areas to gillnet fishing is unknown. There could potentially be a decreased level of entanglement risk, as areas in which gillnet gear is currently heavily concentrated become more diffuse.

For the reasons described above and in the 2013 Biological Opinion, the impacts discussed below focus primarily on the impacts of shifting and/or concentrating fixed gears into areas where they were previously prohibited, allowing scallop dredges in areas where they were previously prohibited, and to a lesser degree, the impact of concentrating fixed gear in areas that were previously open to mobile gear. There may be localized increases in effort as a result of some of these alternatives and the impacts from those changes will be discussed as well.

Sea turtles

There have been few documented interactions between commercial fishing gear and sea turtles in the Gulf of Maine region, and only a handful of interactions on Georges Bank and the Great South Channel (Map 83). The majority of sea turtle interactions occur in the Mid-Atlantic region, south and west of the proposed areas in this amendment. If the areas are opened to groundfish gear when sea turtles are present, the impacts would depend on changes in the magnitude and distribution of fishing effort as a result of these openings. There are a number of ways that effort could shift. It could shift temporally, spatially, and potentially between the different gear types. In general, shifts in effort to areas farther south would likely increase impacts to sea turtles. Also, sea turtles are only present in the Northeast Region seasonally. Therefore, increases in effort from late spring through fall, when sea turtles are present in the area, would also be expected to increase the impacts to sea turtles. However, if effort were to shift from areas with higher bycatch rates to those with lower rates, there may be a benefit to sea turtles. The scallop fishery is subject to seasonal dredge gear restrictions, but these are in effect south and west of the management areas in this amendment, where turtle interactions tend to occur. These include the requirements to use chain mats from May 1 to November 30 south of 41º 9.0' N (71 FR 50361, August 23, 2006) and, more recently, turtle deflector dredges from May through October west of 71º W (77 FR 20728, April 6, 2012).

Large cetaceans

Map 84-Map 86 show the geographic distribution of humpback, fin, and minke whale sightings in the northeast region. The seasonality of fishing effort and large whale presence influences the potential for interactions to occur. The highest abundance of migratory North Atlantic right, humpback, fin, and sei whale populations occur from March through November in New England waters, which is also the peak fishing period for gillnet and bottom trawl gear, with gillnet gear peaking in the summer months. Low numbers of whales are present in New England waters through the winter, although a portion of the right whale population appears to remain in the Gulf of Maine year-round. Large whales are primarily susceptible to entanglement in vertical or ground lines associated with gillnets and trap/pot gear. Their large size and mobility presumably allows them to avoid interactions with trawl gear. According to the 2013 Biological Opinion, there were 129 documented large whale entanglement events from 2006-2010 (Table 109) across the seven fisheries discussed in that Opinion. However, only 28 of those events could be categorized to a specific gear, and four of those events resulted in serious injury or mortality. Of those 28 events from known gear, 7 were caused by gillnets, 12 by lobster or other pot/trap gear, 7 by hook and line, and one caused by bottom longline and purse seine.

Table 109 – Gear Analysis for Entangled Large Whale Events (2006-2010)

Gear Type	Entanglement Events	Serious Injury or Mortality
Sink Gillnet	5	
Unspecified Gillnet	2	1
Lobster Gear	10	2
Other Pot/Trap	2	2
Hook and Line	7	
Bottom Longline	1	
Purse Seine	1	
Unknown	101	30
Total	129	35

Small cetaceans

Waring *et al*. (2013) provides the following account of harbor porpoise distribution. During the summer months, harbor porpoises are concentrated in the northern Gulf Of Maine and southern Bay Of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al*. 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000). During the fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline out to deep waters (>1800 m deep) although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region.

Since the most recent amendment to the Harbor Porpoise Take Reduction Plan in 2010 when time/area closures and pinger requirements were expanded, harbor porpoise population abundance estimates have increased (Table 110). Concurrently, estimates of human-caused mortality due to interactions with New England gillnet gear have declined from 792 porpoises per year using data through 2009 down to 340 porpoises per year using data through 2012. Pingers, when used properly, have a 92 percent success rate at eliminating interactions. Preliminary estimates of 5-year average U.S. gillnet bycatch through the years 2011 and 2012 are below the Potential Biological Removal level, which is the maximum number of removals that would still maintain a healthy population.

Table 110 – Recent Harbor Porpoise Bycatch Estimates

	Final Data *through 2009*[1]	Final Data *through 2010*[2]	Preliminary Data *through 2011*[3]	Preliminary Data *through 2012*[3]
Stock Abundance (Min-Max)	60,970–89,054	61,415-79,883	61,415-79,883	61,415-79,883
Potential Biological Removal	701	706	706	706
Annual U.S. Gillnet Bycatch	792	646	396	340
5-Year Average U.S. Gillnet Bycatch	877	786	671	630

[1] Waring *et al*. 2012
[2] Waring *et al*. 2013
[3] C.D. Orphanides, pers. comm., September 16, 2013

Pinnipeds

Pinnipeds, including harbor seals, gray seals, harp seals, and hooded seals are taken in gillnets, trawls, and trap/pot gear used in the Gulf of Maine and Georges Bank. Documented interactions with sink gillnet and bottom trawl fisheries include harbor seal, gray seal, harp seal, and hooded seal. Harbor seals may be more likely to occur in the Northeast region between fall and spring, but are likely year-round residents off the coast of Maine, and gray seals are year-round residents throughout more of coastal Gulf of Maine, towards Rhode Island. Therefore, interactions could occur year-round. The uncommon occurrences of hooded and harp seals in the region are more likely to occur during the winter and spring, allowing for an increased potential for interactions during these seasons.

The level of human-caused mortality and serious injury on all four seal species in the U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size. We assume the potential for entanglements to occur is higher in areas where more gear is set and in areas with higher concentrations of protected species. Overall, however, it is expected that impacts to pinnipeds throughout the area are expected to be negligible.

Atlantic sturgeon

Atlantic sturgeon, which are recently listed under the Endangered Species Act, are taken in a variety of fishing gears, however, the majority of mortality events result from interactions with sink gillnet gear in New England (NMFS 2013), in areas fairly close to shore. Any action that increases gillnet gear in areas where Atlantic sturgeon are likely to occur would be of concern given bycatch mortality in this gear. That concern might be alleviated, however, if effort was being shifted from an area where Atlantic sturgeon are more likely to occur. Specific scenarios are discussed below, but generally, relative to the year-round groundfish closures, opening the Western Gulf of Maine Closure Area to gillnet gear would be of concern given its proximity to waters where Atlantic sturgeon are known to transit and where incidental takes have been documented. Similarly opening the Nantucket Lightship Closed Area may pose some concern, particularly the western part of the area. Opening the Cashes Ledge Closure Area, Closed Area I, and Closed Area II is of significantly less concern, given that sturgeon are not known to occur in these areas in large aggregations.

Atlantic Salmon Impacts

The marine range of the Gulf of Maine Distinct Population Segment extends from the Gulf of Maine (primarily northern portion), to the coast of Greenland (NMFS and USFWS 2005; Fay et al. 2006). In general, smolts, post-smolts, and adult Atlantic salmon may be present in the Gulf of Maine and coastal waters of Maine in the spring (beginning in April); adults may also be present throughout the summer and fall months (Baum 1997; Fay et al. 2006; USASAC 2004; Hyvarinen *et al.* 2006; Lacroix and McCurdy 1996; Lacroix *et al.* 2004, 2005; Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993, Sheehan *et al.* 2012; NMFS and USFWS 2005; Fay et al. 2006).

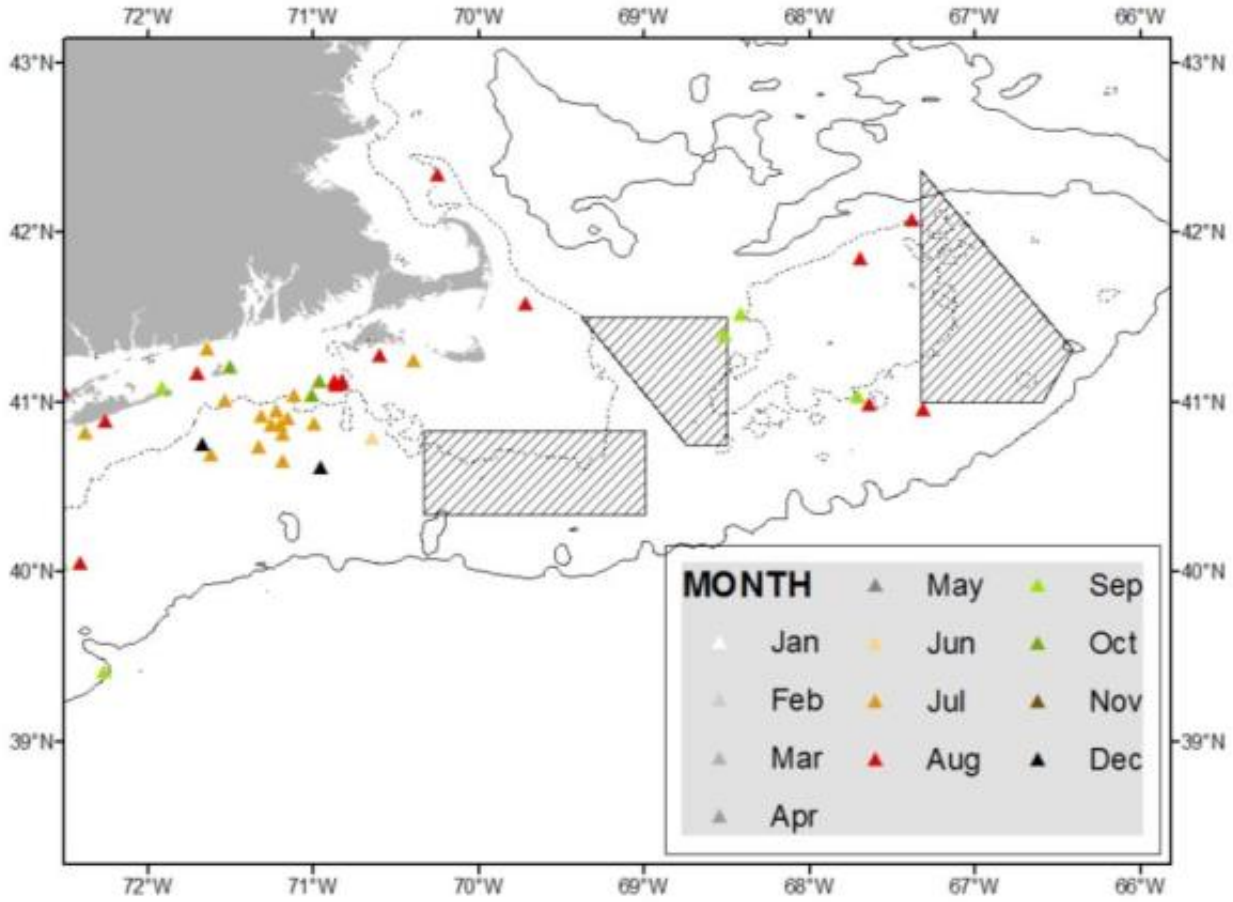
Although Atlantic salmon are known to occur in the marine environment, there has been a low number of observed interactions with fisheries and various gear types. According to the NMFS Batch Biological Opinion (NMFS, 2013), NMFS Northeast Fisheries Science Center's Northeast Fisheries Observer and At-Sea Monitoring Programs documented a total of15 individual salmon incidentally caught on over 60,000 observed commercial fishing trips from 1989 through August 2013 (Kocik et al., 2014). Specifically, Atlantic salmon were observed bycaught on gillnet (11/15) and bottom otter trawl gear (4/15), with 10 of the incidentally caught salmon listed as "discarded" and five reported as mortalities. The genetic identity of these captured salmon is unknown; however, the Biological Opinion considers all 15 fish to be part of the Gulf of Maine Distinct Population Segment, although some may have originated from the Connecticut River restocking program (i.e., those caught south of Cape Cod, Massachusetts).

The above information, specifically the very low number of observed Atlantic salmon interactions in gillnet and trawl gear as reported in the NEFOP database (which includes At-Sea Monitoring data), suggests that interactions with Atlantic salmon are rare events (NMFS 2013; Kirchies et al. 2014). ; however, it is important to recognize that observer program coverage is not 100 percent. As a result, it is likely that some interactions with Atlantic salmon have occurred anywhere within the affected area, but have not observed or reported. Because the majority of commercial fishing in Federal waters occurs on species managed under the Magnuson-Stevens Act, and by extension, subject to annual catch limits that would not be impacted by these alternatives, the proposed action is not expected to result in an increase in fishing effort. The proposed actions would shift effort around and between the closed areas and new habitat management areas. While some of the alternatives (e.g., the no management area alternatives) may result in localized increases in fishing effort compared to the status quo, and others may result in concentrations of different gear types (e.g., areas closed to mobile bottom-tending gear may see concentrations of fixed gears), overall, the level of effort is not expected to increase. Therefore, a negligible to a slight negative impact on Atlantic salmon is likely under any of the alternatives described below.

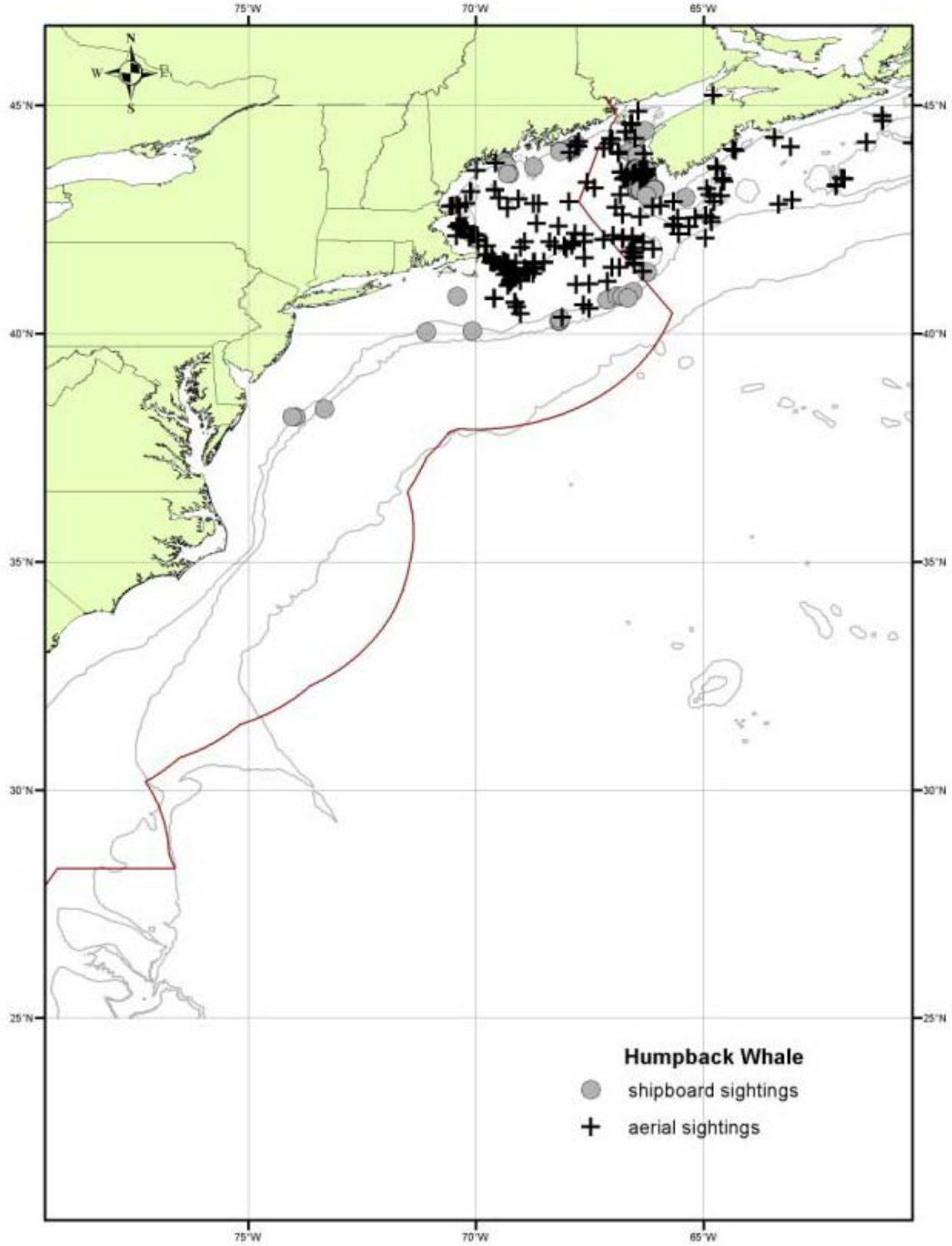
To date, maps detailing gear interactions with Atlantic sturgeon and Atlantic salmon, both in time and space, have yet to be developed. As a result, maps detailing this information will not be provided in this section. It is important to note, the available observer data for Atlantic sturgeon and Atlantic salmon is just a snap shot of where, when, and the form of gear interactions being experienced by these species. As observer coverage is <100%, interactions may be occurring in

areas currently unobserved and thus, additional data is needed, including information on observer coverage effort and seasonality, in order for informative maps to be developed for these species.

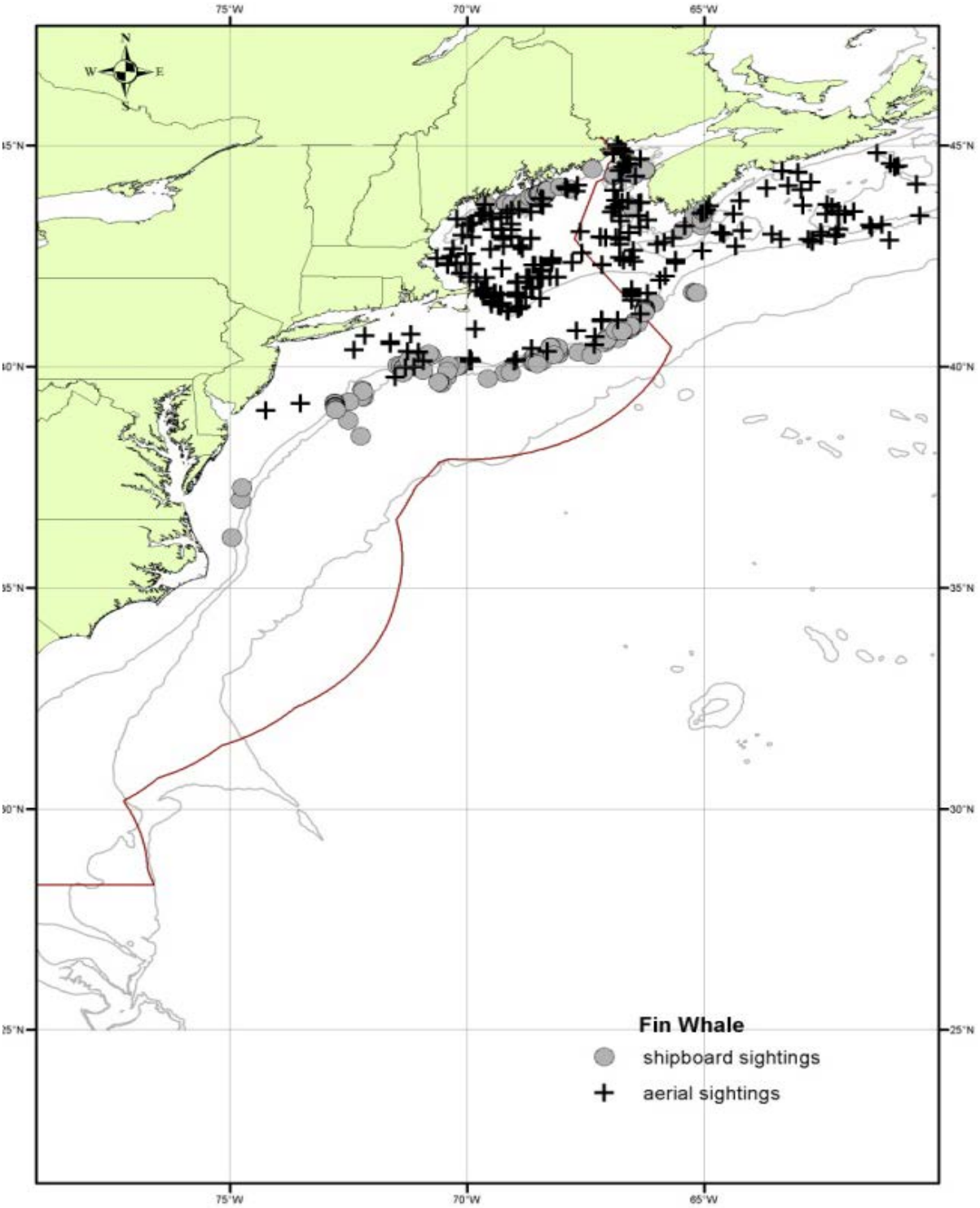
Map 83 – Observed turtle interactions by month in gillnet, bottom trawl, and scallop dredge gears, 1989-2012



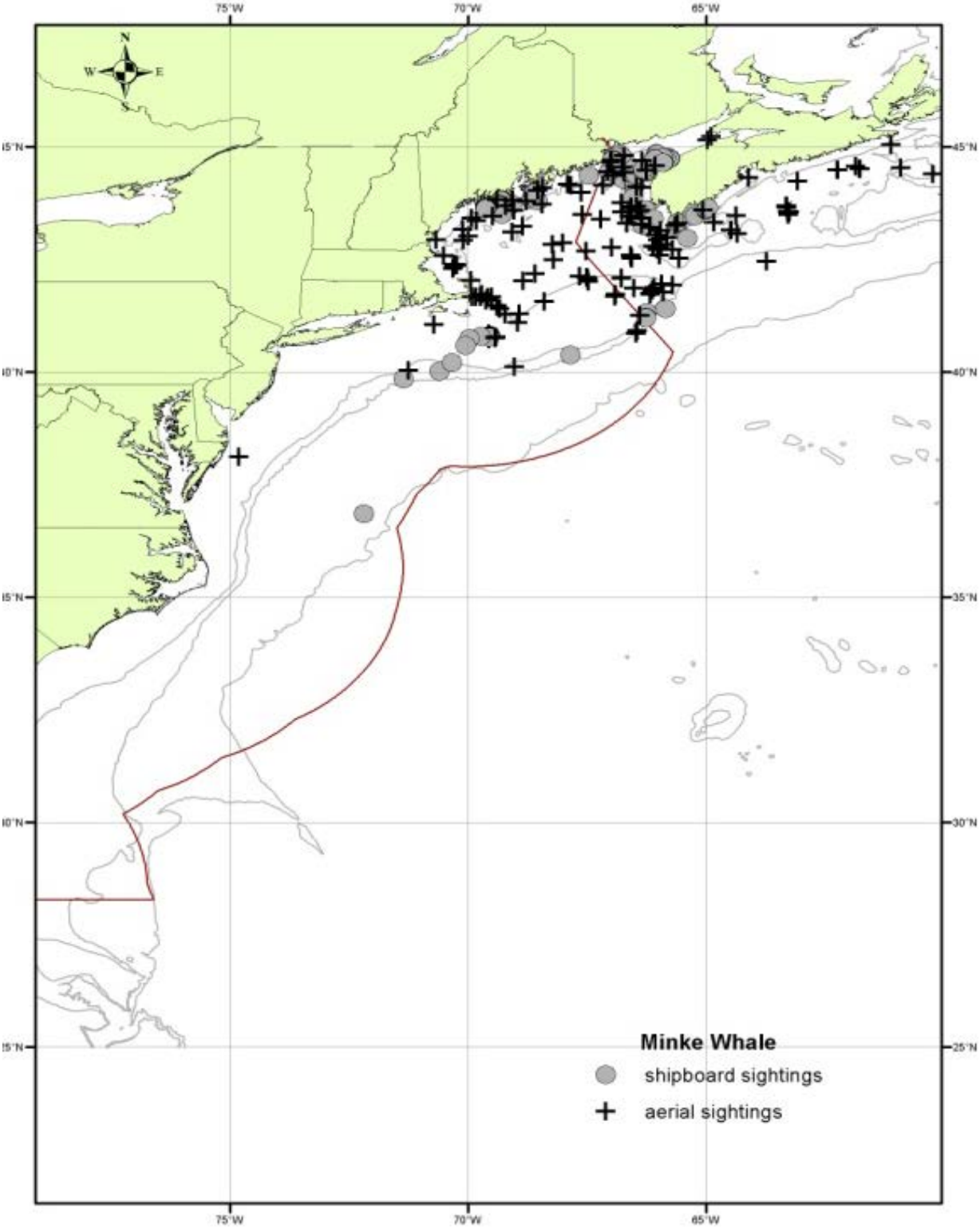
Map 84 – Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



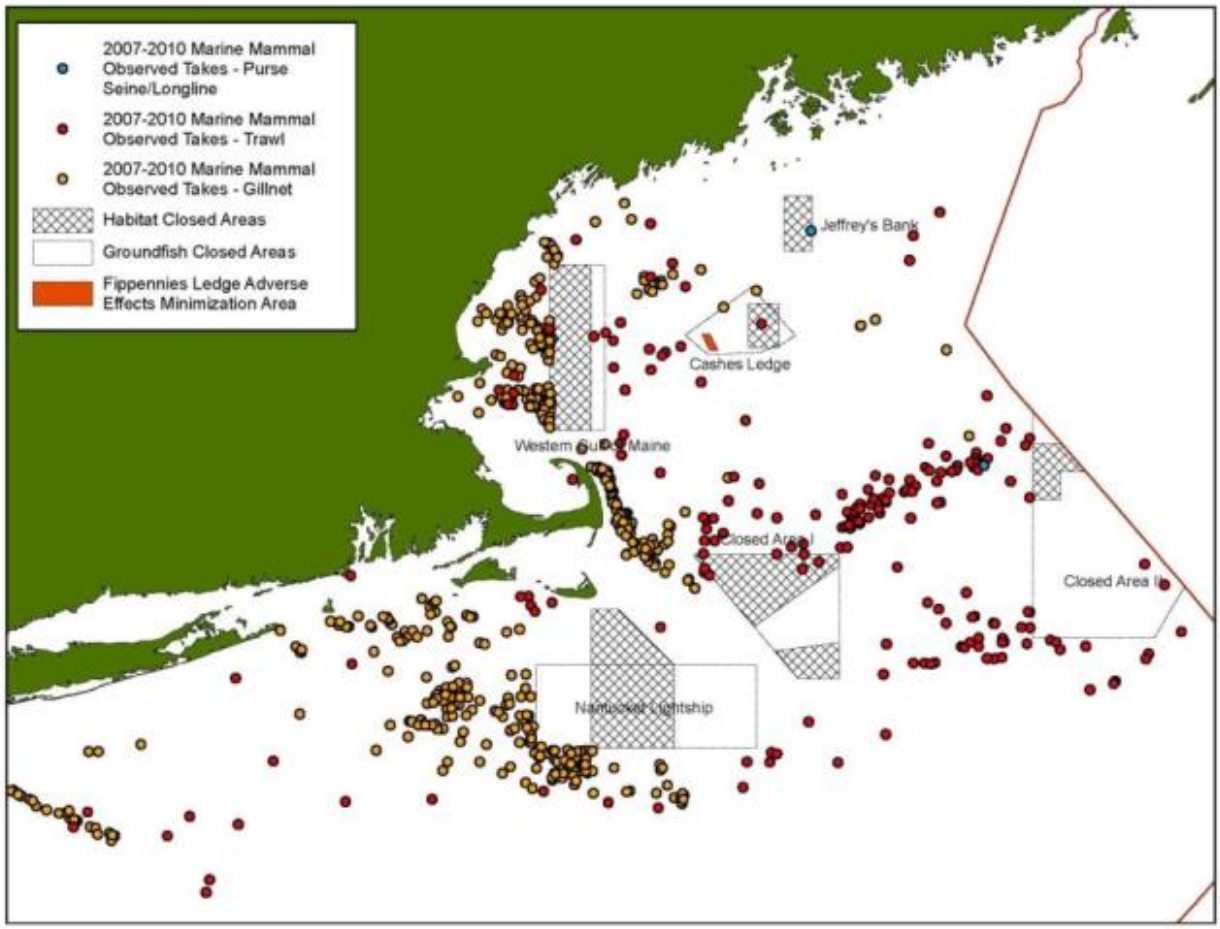
Map 85 – Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



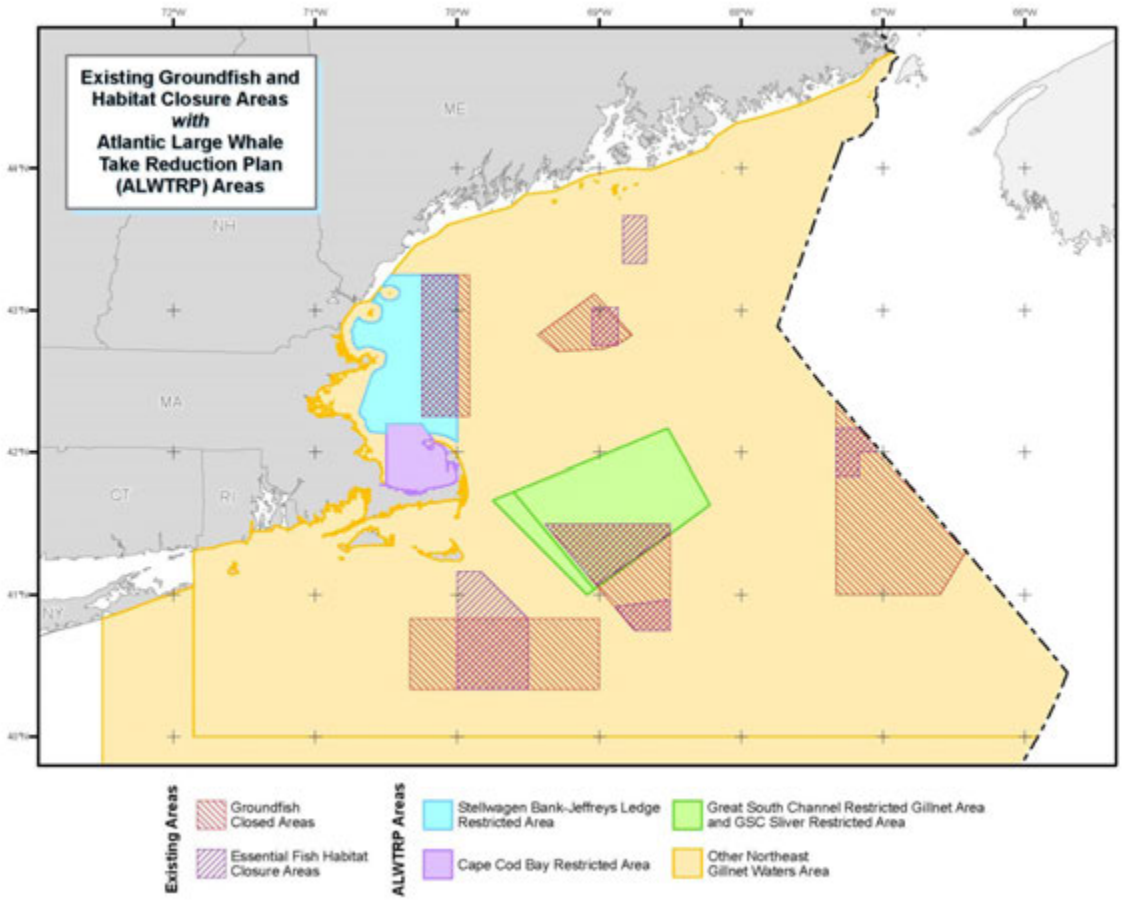
Map 86 – Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



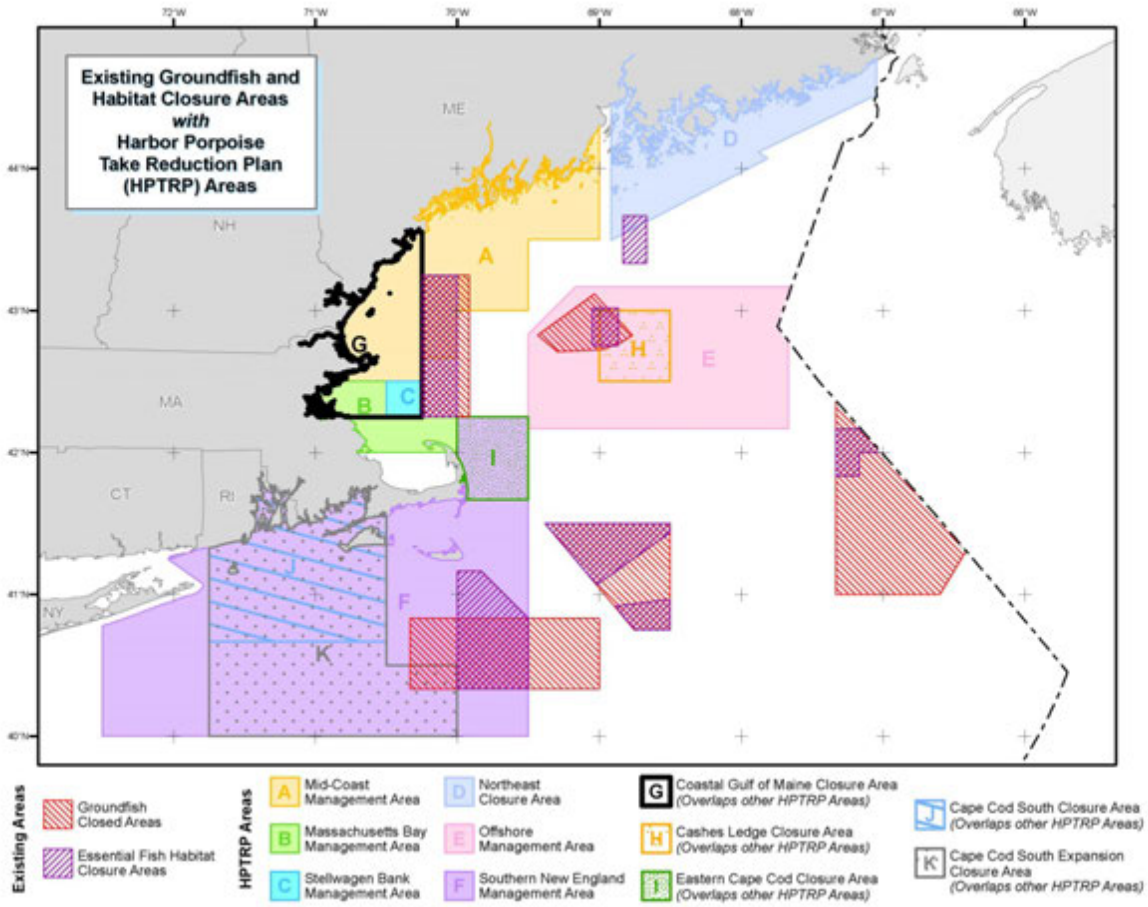
Map 87 – Marine Mammal Takes 2007-2010



Map 88 – Atlantic Large Whale Take Reduction Plan Management Areas, with existing year-round closed areas



Map 89 – Harbor Porpoise Take Reduction Plan Management Areas, with existing year-round closed areas



4.2.4.1 *Eastern Gulf of Maine*

In this sub-region, none of the alternatives currently under consideration would shift fixed gears into areas where they were previously prohibited. However, management Options 1-4 (Alternatives 2 and 3) could prohibit or restrict mobile bottom-tending gear use, which may lead to some concentration of fixed gear into areas newly closed to mobile bottom tending gear. Management Option 5 (Alternative 2 only) would prohibit all gears capable of catching groundfish from being used in the proposed management areas, which would include sink gillnets and some other types of fixed gears. This measure might shift gillnet effort within the sub-region into locations outside the proposed habitat management areas. However, any changes in fixed gear fishing are likely to be small in magnitude, because mobile bottom-tending gear and gillnet use constitute a small fraction of overall effort in each of the proposed habitat management areas (see pie charts in the human communities and the fishery impacts section).

4.2.4.1.1 Impacts to sea turtles

Sea turtles are rarely sighted in the eastern Gulf of Maine, and bycatch in any gear in the sub-region region has not been documented (Map 83) in recent years.While locational shifts in effort

are possible under the action alternatives, increases in effort and seasonal shifts in effort are not expected. There are no obvious spatial patterns in sea turtle sightings or takes in the Gulf of Maine, such that any alternative would be expected to have greater impacts to turtles over any other alternative. Combining the low rates of sightings and takes with the lack of spatial pattern, the expected impacts to sea turtles from any of the action alternatives within the Eastern Gulf of Maine sub-region are expected to be negligible when compared to the baseline environmental condition.

4.2.4.1.2 Impacts to marine mammals

The Atlantic Large Whale Take Reduction Plan's "Other Northeast Waters" regulations (Map 88) cover all of the proposed habitat management areas in this sub-region and would be expected to continue to mitigate the impact of gillnet fishing on large whales. The Harbor Porpoise Take Reduction Plan (Map 89) seasonal gillnet closure (Northeast Closure Area; August 15-September 13) completely overlaps each of the potential habitat management areas in this sub-region, except for the Toothaker Ridge habitat management area. This closure, which was implemented in the original Harbor Porpoise Take Reduction Plan in 1998, is expected to continue to mitigate the impacts of gillnet fishing on porpoises.

Overall, the limited shifts in the type and location of fishing gear usage, combined with the mitigating measures in the Harbor Porpoise Take Reduction Plan and Atlantic Large Whale Take Reduction Plan mean that impacts of the habitat management alternatives in this sub-region on marine mammals are likely to be neutral when compared to the baseline environmental condition.

4.2.4.1.3 Impacts to Atlantic sturgeon

As discussed above, Atlantic sturgeon are found throughout the Gulf of Maine, close to shore, and mortality events are primarly from gillnet gear. The proposed habitat management areas in the Eastern Gulf of Maine sub-region are more coastal than most of the other proposed areas (although not within state jurisdiction, or inside of the 3-mile limit.) However, there is little to no gillnet fishing in this sub-region, so even concentrations of it would likely have little to no impact. Therefore, the impacts of the habitat management alternatives in this sub-region on Atlantic sturgeon are likely negligible when compared to the baseline environmental condition.

4.2.4.1.4 Impacts to Atlantic salmon

As described above, shifts in effort in the Eastern Gulf of Maine sub-region are not likely to significantly impact the Gulf of Maine Distinct Population Segment of Atlantic salmon. Concentrations of gillnet gear within the Eastern Maine habitat management areas (proposed under Alternatives 2 and 3) with only a restriction on mobile bottom tending gear (management measures 1 and 2) may result in some increase in gillnet interactions with Atlantic salmon. However, because observed interactions with Atlantic salmon have been rare in recent years (15 fish observed encountered throughout the Northeast region in nearly 25 years; 2-3 fish in this

sub-region[17], Kirchies et al. 2014), this impact is expected to be only slightly negative. It is unknown how or if effort may change if the gear restricted options (management measures 3 and 4) were implemented, but the expectations range from no change in effort (if the gear modifications have a minimal impact on catchability) to a *de facto* ban on trawl gear (if the gear modifications result in very poor catchability). Therefore, those alternatives are expected to result in a negligible impact on the Atlantic salmon when compared to the baseline environmental condition.

4.2.4.2 ***Central Gulf of Maine***

4.2.4.2.1 Impacts to sea turtles

Sea turtles are rarely sighted in the central Gulf of Maine, and while bycatch in any gear in the region has been documented (Map 83), these events are much rarer than in the mid-Atlantic where sea turtles are more commonly found. While locational shifts in effort are possible under the action alternatives, increases in effort and seasonal shifts in effort are not expected. There are no obvious spatial patterns in sea turtle sightings or takes in the Gulf of Maine, such that any alternative would be expected to have greater impacts to turtles over any other alternative. Combining the low rates of sightings and takes with the lack of spatial pattern, the expected impacts to sea turtles from any of the action alternatives within the Central Gulf of Maine sub-region are expected to be negligible when compared to the baseline environmental condition.

4.2.4.2.2 Impacts to marine mammals

Each of the action alternatives (Alternative 2-4) would allow gillnets into the Cashes Ledge Closure Area, an area in which they have previously been prohibited. Sightings of large whales, particularly humpback, fin, and minke whales, are relatively common in the Central Gulf of Maine region (Map 84-Map 86). As a result, Alternatives 2-4 could have negative impacts on large whales in this region. However, the universal requirements under the Atlantic Large Whale Take Reduction Plan would still apply and would be expected to mitigate those impacts, or at least reduce the likelihood that an interaction would result in serious injury or mortality. Further, this region, including Cashes Ledge and Platts Bank, would remain subject to the seasonal pinger requirements of the Harbor Porpoise Take Reduction Plan (Offshore Management Area; November through May, Map 89). In addition, the Modified Cashes Ledge Habitat Management Area (Alternatives 3 and 4) is completely within the Cashes Ledge Closure Area, which is closed to gillnet fishing in the month of February. This closure was designed to minimize interaction of harbor porpoises with gillnet gear during the time of year in which porpoises are most abundant in that region, which would likely help mitigate the negative impacts from the potential for increased interactions.

[17] Data sources are not refined enough to identify the exact location of interactions with salmon. Values are an approximation based on statistical areas within the sub-regions, defined by the spatial extent of the proposed habitat management areas within that-sub-region. Interactions from statistical areas in more than one sub-region are credited to both potential sub-region.

Unlike in the Eastern Maine sub-region which currently has no restrictions on mobile gear, Alternatives 3-4 in the Central Gulf of Maine would result in mobile gear being allowed into portions of the existing closed areas (Cashes Ledge Closure Area, the western part of the Cashes Ledge Habitat Closure Area, and the northern part of the Jeffreys Bank Habitat Closure Area). Alternative 2 would allow these gears to be used throughout the sub-region. There have been a handful of interactions between trawl gear and marine mammals (Map 84-Map 87) in the central Gulf of Maine and allowing increased trawl gear access may result in increased interactions with smaller cetaceans. However, large cetaceans are not generally impacted by trawls, as their large size and speed allows the animals to avoid the relatively slow moving trawl gear, and there have been few sightings of sea turtles in this region, so these types of protected resources would not be significantly affected.

Overall, increased access for fixed gears capable of catching groundfish and mobile-bottom tending gears under Central Gulf of Maine Alternatives 2-4, mitigated by overlapping Atlantic Large Whale Take Reduction Plan and Harbor Porpoise Take Reduction Plan measures, would likely have slightly negative impact on marine mammals when compared to the baseline environmental condition.

4.2.4.2.3 Impacts to Atlantic sturgeon

As discussed above, Atlantic sturgeon are found throughout the Gulf of Maine, close to shore, and primarily taken in gillnet gear. The proposed habitat management areas in the Central Gulf of Maine sub-region are farther offshore and generally in areas not known to have high concentrations of interactions with sturgeon. Therefore, the impacts of the habitat management alternatives in this sub-region on Atlantic sturgeon are likely negligible when compared to the baseline environmental condition.

4.2.4.2.4 Impacts to Atlantic salmon

As described above, shifts in effort in the Central Gulf of Maine sub-region are not likely to impact the Gulf of Maine Distinct Population Segment of Atlantic salmon. Available information suggests that in this sub-region, Atlantic salmon interactions with gillnet gear are rare events (15 fish observed encountered throughout the Northeast region in nearly 25 years; 1-2 fish in this sub-region, Kirchies et al. 2014), therefore, shifting effort is likely to result in negligible impacts to Atlantic salmon. It is unknown how or if effort may change if the gear restricted options (management measures 3 and 4) were implemented, but the expectations range from no change in effort (if the gear modifications have a minimal impact on catchability) to a *de facto* ban on trawl gear (if the gear modifications result in very poor catchability). Therefore, those alternatives are expected to result in a negligible impact on the Atlantic salmon when compared to the baseline environmental condition.

4.2.4.3 ***Western Gulf of Maine***

In general, shifting of effort in the Western Gulf of Maine sub-region is likely to have the greatest impact on protected resources. The action alternatives would result in mobile gear closures in Bigelow Bight (Large—Alternatives 3 and 4; Small—Alternative 5), the Stellwagen Bank portion of the existing Western Gulf of Maine Closure Area (Large—Alternatives 3 and 6;

Small—Alternatives 4 and 5), the Jeffreys Ledge portion of the existing closed area (Alternatives 4 and 5) or would only require modified trawl gear in the majority of the region. The action alternatives would all allow gillnets into an area where they have previously been prohibited, although seasonal restrictions under the Harbor Porpoise Take Reduction Plan would continue. There is a significant amount of gillnet fishing along the western edge of the existing Western Gulf of Maine Closure Area (Map 87). Redistributing these gillnets, whose overall quantity would not be expected to change as a result of this action, may actually be beneficial for marine mammals by at least producing some gaps in the "wall" of gillnets. However, it is difficult to know how effort may shift; particularly if the Stellwagen Bank DHRA is implemented. This DHRA would continue the gillnet prohibition in a large part the southern portion of the existing closed area; resulting in no change from the no action alternative.

4.2.4.3.1 Impacts to sea turtles

Sea turtles are rarely sighted in the western Gulf of Maine, and while bycatch in commercial fishing gear, including trawls and gillnets, in the region has been documented, these event are much rarer than in the mid-Atlantic where sea turtles are more commonly found (Map 83). While locational shifts in effort are possible under the action alternatives, increases in effort and seasonal shifts in effort are not expected. There are no obvious spatial patterns in sea turtle sightings or takes in the western Gulf of Maine, such that any alternative would be expected to have greater impacts to turtles over any other alternative. Combining the low rates of sightings and takes with the lack of spatial pattern, the expected impacts to sea turtles from any of the action alternatives within the Western Gulf of Maine sub-region are expected to be negligible when compared to the baseline environmental condition.

4.2.4.3.2 Impacts to marine mammals

The western Gulf of Maine is an important forge area for dolphins and large whales. Shifting effort within this region is likely to have impacts on these protected species. As described above, Alternatives 2-7 in this sub-region would result in fixed gears, specifically gillnets, being allowed to fish in areas from which they were previously prohibited. Alternatives 2 (no habitat closure areas) and 7 (mobile gear modifications only) would result in no year round mobile bottom-tending gear closure areas. It is difficult to predict how fixed gear effort would shift under these circumstances, however, there would likely not be concentrations of gillnet fishing along the edge of the Western Gulf of Maine Closure Area as there is now. Breaking up this concentrated effort may have a slightly positive impact on marine mammals.

Alternatives 3, 4, and 5 would implement a mobile gear closure in the Bigelow Bight area, which may result in concentrations of gillnet gear closer to shore. Mobile gear closures within portions of the existing closed area would continue under Alternatives 3, 4, 5, and 6, in either the Large or Small Stellwagen areas or the part of Jeffreys Ledge that is within the closed area, but fixed gear restrictions would be lifted. In combination, these changes may have impacts on marine mammals in this region; however, it is difficult to predict how effort would shift. Increased gillnet activity in the existing closed area may have a slightly positive impact on marine mammals because the "wall" of gillnets along the western edge may be dispersed. If, however, the wall simply moves east, without breaking up significantly, there may be a negative impact because of higher concentrations of mammals in the area.

Mitigating all of the impacts in this sub-region are the requirements for all vessels fishing with gillnets under the Harbor Porpoise Take Reduction Plan. These include seasonal pinger requirements, seasonal gillnet closures in Massachusetts Bay and Eastern Cape Cod (Map 89). Pingers have a very high success rate (92 percent) of eliminating interactions, when used properly. Compliance has been an issue in the past; however, NMFS has been working with vessel owners to improve compliance. In addition, there are gear requirements in the Atlantic Large Whale Take Reduction Plan's Stellwagen Bank Restricted Area (Map 88) that would likely mitigate the impacts to large whales.

Overall, impacts to marine mammals from the action alternatives in the Western Gulf of Maine sub-region range from slightly positive to highly negative when compared to the baseline environmental condition.

4.2.4.3.3 Impacts to Atlantic sturgeon

Opening the Western Gulf of Maine Closure Area, especially to fixed gears, would be of concern given its proximity to waters where Atlantic sturgeon are known to transit and where incidental takes have been documented. In addition, the potential to concentrate gillnet fishing (i.e., if mobile bottom tending gear is excluded) in either the Large or Small Bigelow Bight HMAs (Alternatives 3, 4, and 5) would likely have highly negative impacts on Atlantic sturgeon because these areas are closer to shore, where sturgeon are more common. Alternatives 3 and 4, which would close the larger Bigelow Bight area to mobile bottom-tending gear, would be expected to have larger impacts on Atlantic sturgeon than Alternative 5, which includes the smaller Bigelow Bight HMA. Alternatives 2 and 7 would not be expected to concentrate gillnet fishing in any portion of the western Gulf of Maine because they would not create or maintain mobile bottom-tending gear restricted areas that could facilitate fixed gear use. Therefore these alternatives would be expected to result in a neutral impact to Atlantic sturgeon.

Overall, the impacts to Atlantic sturgeon from the habitat management area alternatives in the Western Gulf of Maine range from neutral for Alternatives 1, 2, 6, and 7 to highly negative for Alternatives 3, 4, and 5 when compared to the baseline environmental condition.

4.2.4.3.4 Impacts to Atlantic salmon

As described above, shifts in effort in the Western Gulf of Maine sub-region are not likely to significantly impact the Gulf of Maine Distinct Population Segment of Atlantic salmon. Concentrations of gillnet gear within the western Gulf of Maine habitat management areas, with only a restriction on mobile bottom tending gear (management measures 1 and 2), may result in some increase in gillnet interactions with Atlantic salmon. However, because observed interactions with Atlantic salmon have been rare in recent years (15 fish observed encountered throughout the Northeast region in nearly 25 years; 1-3 fish in this sub-region, Kirchies et al. 2014), this impact is expected to be only slightly negative. It is unknown how or if effort may change if the gear restricted options (management measures 3 and 4) were implemented, but the expectations range from no change in effort (if the gear modifications have a minimal impact on catchability) to a de facto ban on trawl gear (if the gear modifications result in very poor catchability). Therefore, those alternatives are expected to result in a negligible impact on the Atlantic salmon when compared to the baseline environmental condition.

4.2.4.4 ***Georges Bank***

4.2.4.4.1 Impacts to sea turtles

Hard-shelled sea turtles in the Northeast Region occur as far north as Canada, but are more commonly found south of Cape Cod. The leatherback sea turtle ranges farther north than any other species. As coastal water temperatures warm in the spring, sea turtles begin to migrate up the U.S. Atlantic coast, occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September, but some turtles may remain in Mid-Atlantic and Northeast areas until late fall.

Incidental captures of sea turtles in fishing gear on Georges Bank have been very rare (fewer than 10 takes have occurred in trawl gear over almost 25 years). Fisheries observers have documented captures around the region in bottom tending gears, including bottom otter trawls and scallop dredge gear (Map 83). There is a slight risk to turtles from opening the Closed Area I to trawl gear as turtle interactions have been observed in the region in August and September.

If the northern portion of Closed Area II is opened to fishing there is a strong potential for increased scallop effort, which would result in the potential for increased interactions between scallop dredges and turtles on Georges Bank; however, if effort were to shift from southern areas of the Bank with higher bycatch rates to northern areas with lower bycatch rates, there may be a benefit to sea turtles. Generally, interactions in the current scallop fishing grounds of Georges Shoal are rare.

<u>Overall, the impacts to sea turtles from any of the action alternatives (Alternatives 2-8) on Georges Bank, including those that would result in increased scallop fishing, are expected to be negligible when compared to the baseline environmental condition.</u>

4.2.4.4.2 Impacts to marine mammals

White-sided dolphins are present in on southern Georges Bank from June through December, with lower presence from January through May. Common dolphins are found on Georges Bank from January through May and through mid-summer to the fall. Pilot whales move to Georges Bank in the late spring and remain until the late fall (Waring et al. 2012).

<u>Opening Closed Area I to trawl gear via Alternatives 2-8 would create some concerns in light of recorded marine mammal takes in and around the closed area.</u> There is a corridor of observed marine mammal takes along the northern margin of the bank from Closed Area I to Closed Area II (Map 87). These takes are observed throughout the year and are largely pilot whales and white-sided dolphins, with fewer recorded takes of common dolphins and gray seals. Specifically, small cetacean takes in trawls have been recorded within the northern portion of the existing Closed Area I Habitat Closed Area. There is another corridor of takes extending along the southern part of the bank from Closed Area I to Closed Area II (Map 87). Takes recorded here are mainly common dolphins, pilot whales, and gray seals, and were observed in nearly all months of the year. Since these takes were recorded close to or within the boundaries of Closed Area I, it is possible that interactions could increase if effort were to shift into Closed Area I under Alternatives 2-8. This would most likely impact pilot whales in this region. Currently,

bycatch levels of marine mammals in trawl gear are not exceeding acceptable levels established under the Marine Mammal Protection Act (Waring et al. 2012).

Several species of marine mammals have been documented by fisheries observers as bycatch incidental to bottom trawl fishing around the region surrounding Closed Area II, especially along the northern and southern portions of the groundfish closure area, including white-sided dolphin, common dolphin, pilot whale, harbor porpoise, Risso's dolphin, and minke whales (Waring et al. 2012). Takes have been recorded just outside the northern and southern edges of the closure, and there are two documented takes within the closure itself, likely within the yellowtail flounder/haddock Special Access Program, as one take was a white-sided dolphin in August and the other was two common dolphins taken in October. Because trawl takes were recorded close to or within the boundaries of Closed Area II, it is possible that an effort shift into Closed Area II could increase the likelihood of interactions.

Presence of these animals (white-sided dolphin, common dolphin, pilot whale, harbor porpoise, Risso's dolphin, and minke whales) has been documented in the area around Closed Area II during the summer, winter, and spring months by dedicated shipboard and/or aerial protected species research surveys. From the NEFSC's dedicated marine mammal abundance surveys and the observer program, we know that these animals are present in and around the region of Closed Area II year-round to varying degrees of frequency depending on the species and time of year. It is unclear if bycatch levels will remain consistent in the areas of historical takes or if these bycatch levels will be reduced or increased due to shifts in fishing effort.

<u>Atlantic Large Whale Take Reduction Plan restrictions mitigate negative impacts associated with removal of existing management areas.</u> Closed Area I overlaps with the Great South Channel Critical Habitat Area (Map 88) that has been designated for right whales (the overlapping portion is the northern habitat closed area portion). This area was designated as critical habitat based on the seasonally high abundance of right whales that aggregate in the area in order to feed. Closed Area I is proposed to become a seasonal, spawning closed area in the months of February through April. The Great South Channel Restricted Gillnet Area covers the entirety of the Closed Area I North Habitat Closure Area and is closed to gillnets from April through June each year. While an increase in interactions would be likely in the summer and fall, the area would remain closed during the highest concentration of right whale activity under the regulations of the Atlantic Large Whale Take Reduction Plan, lessening the impacts to some degree.

<u>As a result, the impacts to marine mammals would be expected to be slightly negative to neutral for the alternatives on Georges Bank, when compared to the baseline environmental condition.</u>

4.2.4.4.3 Impacts to Atlantic sturgeon

Based on the available NMFS observer data, observed captures of Atlantic sturgeon are low on Georges Bank relative to other areas. While Atlantic sturgeon may occur in these areas, distribution and incidental catch information suggests that these areas are not within the preferred depth range of Atlantic sturgeon. There are no known Atlantic sturgeon aggregation areas in or near any part of the existing closed areas. Observed mortality of Atlantic sturgeon captured in trawl gear is very low. We have no records of sturgeon bycatch on commercial hook gear in this region. There is limited Northeast Fisheries Observer Program data on lobster trap

fishing, but there is no information to suggest that Atlantic sturgeon is reasonably likely to be captured in pot/trap gear (either the trap itself or entangled in lines). (NMFS 2013)

The most recent data concerning Atlantic sturgeon abundance together with the information as discussed above makes it likely that shifting effort among the no action and action habitat management areas in the Georges Bank sub-region would have a negligible impact, when compared to the baseline environmental condition, with respect to any of the five Atlantic sturgeon DPSs.

4.2.4.4.4 Impacts to Atlantic Salmon

Observed encounters in the Georges Bank sub-region have been low over the past 25 years (3 in 25 years, Kirchies et al. 2014). It is unknown whether those salmon originated from the Gulf of Maine Distinct Population Segment orwhether these fish were from the Connecticut River restocking program. The Biological Opinion, in the interest of being precautious, considers impacts to these fish as if they were from the Gulf of Maine. As described above, because available data suggest that Atlantic salmon interactions are rare events, and effort is not expected to increase, the implementation of any of the proposed habitat management areas with management measures 1 or 2 are expected to result in negligible impacts to the Gulf of Maine Distinct Population Segment of Atlantic salmon. It is unknown how or if effort may change if the gear restricted options (management measures 3 and 4) were implemented, but the expectations range from no change in effort (if the gear modifications have a minimal impact on catchability) to a de facto ban on trawl gear (if the gear modifications result in very poor catchability). Therefore, those alternatives are expected to result in a negligible impact on the Atlantic salmon when compared to the baseline environmental condition.

4.2.4.5 ***Great South Channel/Southern New England***

4.2.4.5.1 Impacts to sea turtles

As mentioned in the other sub-regional sections, hard-shelled sea turtles in the Northeast Region occur as far north as Canada, but are more commonly found south of Cape Cod. There are few interactions in the currently open areas in the Great South Channel sub-region by any gear (Map 83). While scallop dredge gear generally has more frequent interactions with sea turtles as compared to other gear types, there are few dredge interactions in the sub-region, including in the Nantucket Lightship Scallop Access Area, and the alternatives considered should not increase scallop dredge activity. Therefore, the impacts to sea turtles would likely be negligible when compared to the baseline environmental condition.

4.2.4.5.2 Impacts to marine mammals

Harbor porpoise bycatch information indicates harbor porpoises are present in this sub-region mainly from December through May; sightings data (not effort corrected) confirm this and confirm seasonal presence in this area. There have been documented interactions with marine mammals, primarily with gillnets, in this sub-region (Map 87). Monkfish gillnet gear is the primary gear interacting with porpoises and seals in this area. This type of gear has characteristics that have traditionally been associated with high marine mammal bycatch rates (e.g., 12 inch mesh, long soak durations, and long gear lengths).

If large mesh (e.g. monkfish, skates) gillnet effort shifts into the newly opened areas under any of the action alternatives (2-6) that could create additional interactions and/or shift interactions from the present location near the western/southwestern border into a new one (e.g., around Nantucket Shoals). Specifically, gillnet effort shifts into the currently closed Nantucket Lightship Closure Areas could result in placing gear in the path of traveling whales. However, it is unknown to what extent effort and gear use would shift, and how that would impact relative risk to large whales. Acknowledging the many difficulties surrounding adequate documentation of large whale entanglements in fishing gear (e.g., nature of the interactions, where and how interactions occur and in what specific gear, etc.), if gillnet effort increases in this area, there could be an increase in right whale and humpback whale entanglement levels in fixed fishing gear.

Mitigating these negative impacts, the high level of gillnet interactions around the southwestern corner of Nantucket Lightship Closed Area may be a result of the prohibition on gillnets within the area. Similar to the western Gulf of Maine, allowing gillnets to spread throughout the region, without increasing the overall amount of effort, may provide a benefit for protected species. Also mitigating these impacts, the Harbor Porpoise Take Reduction Plan Southern New England Management Area (Map 89), which overlaps the majority of the existing and proposed habitat management areas, requires gillnets to have pingers from December through May. In addition, there is a seasonal harbor porpoise closure area in this sub-region, the Cape Cod South Closure Area, which is closed to gillnets in March, and overlaps the two small Cox Ledge habitat management areas.

In examining trawl gear interactions with marine mammals, there appear to be fewer recorded interactions around the Great South Channel than on Georges Bank (Map 87). A handful of documented trawl gear takes have been recorded just below the southeast corner of the Nantucket Lightship Closed Area in the spring, mainly consisting of pilot whales, but also including common and white-sided dolphins. This is likely a product of a lack of trawl fishing effort in this particular area.

While the risk of large whale entanglement with trawl or hook and line gear is extremely low, these animals are known to interact with fixed gear fisheries such as gillnet gear (discussed above) and traps/pots. There has been some concern raised related to the potential for lobster trap/pot gear effort to shift away from Nantucket Lightship Closed Area as a result of allowing trawl gear access to this area. It is unclear where this effort would shift to, and if it would shift into areas with higher abundances of or interaction rates with endangered large whales (e.g., the Great South Channel Critical Habitat Area). However, gillnets would be subject to the closure from April through June in the Great South Channel Restricted Gillnet Area (Map 88). This would mitigate the impact, as this is the season when whales are most abundant in this region.

It is possible that localized effort shifts in this particular area could result in an increase in interactions, particularly in gillnets. The probability of interactions with harbor porpoises and large whales will be reduced because of the pinger requirements under the Harbor Porpoise Take Reduction Plan and gillnet gear modification requirements under the Atlantic Large Whale Take Reduction Plan.

Combining potential effort shifts with the mitigating factors in the Harbor Porpoise Take Reduction Plan and Atlantic Large Whale Take Reduction Plan, the impacts from the habitat management alternatives in the Great South Channel/Southern New England sub-region on marine mammals are likely to be slightly negative when compared to the baseline environmental condition.

4.2.4.5.3 Impacts to Atlantic sturgeon

As described in NMFS 2013, there is relatively limited distribution of Atlantic sturgeon in the Great South Channel/Southern New England sub-region, and there have been few observed interactions in this region, despite a heavy concentration of observer days. The proposed habitat management areas are adjacent to the marine range of the area generally inhabitated by the New York Bight Distinct Population Segment of Atlantic sturgeon, which is listed as endangered, as well as the marine range of the area generally inhabitat by the Gulf of Maine Distinct Population Segment, which is listed as threatened (NMFS 2013). Concentration of gillnet gear in the areas closed to mobile bottom-tending gear may result in increased interaction between fixed gear and Atlantic sturgeon. However, if these closed areas pull gillnet effort away from areas relatively closer to shore, there may be an overall benefit to sturgeon. As depicted in Stein et al. (2004a), there were no observed takes of Atlantic sturgeon in commercial fishing gear (otter trawls, sink gillnets, or drift gillnets) south and east of Nantucket Island, where the majority of the proposed habitat management areas would be. While there is scarce information in this region, the action alternatives in this region would be expected to have a neutral impact on sturgeon when compared to the baseline environmental condition.

4.2.4.5.4 Impacts to Atlantic salmon

Several of the observed encounters described in the Biological Opinion (NMFS 2013) appear to have been in the Southern New England/Great South Channel sub-region (Kirchies et al. 2014). While it would be unlikely that salmon encountered in this sub-region would have originated in the Gulf of Maine Distinct Population Segment, but rather more likely from the Connecticut River restocking program population, for purposes of analyses, they are considered part of the Gulf of Maine population. As described above, because available data suggests that Atlantic salmon interactions are uncommon events, and effort is not expected to increase, the implementation of any of the proposed habitat management areas with management measures 1 or 2 are expected to result in negligible impacts to the Gulf of Maine Distinct Population Segment of Atlantic salmon. It is unknown how or if effort may change if the gear restricted options (management measures 3 and 4) were implemented, but the expectations range from no change in effort (if the gear modifications have a minimal impact on catchability) to a de facto ban on trawl gear (if the gear modifications result in very poor catchability). Therefore, those alternatives are expected to result in a negligible impact on the Atlantic salmon when compared to the baseline environmental condition.

4.3 Alternative to improve groundfish spawning protection

These alternatives, described in section 2.2, are designed to protect spawning groundfish and are based largely on existing management areas. This section evaluates their impacts on the physical

and biological environment, large mesh groundfish stocks and their habitats, human communities and the fishery, and protected resources. Additional discussion of the impacts of these alternatives on non-large mesh groundfish resources, and fishery-specific human impacts, are discussed in section 4.6.

4.3.1 Physical and biological environment

Spawning protection alternatives generally restrict gears capable of catching groundfish. Some of the areas included in the no action alternatives are currently implemented on a year round basis, but all of the areas included in the action alternatives would be implemented seasonally. Seasonal areas generally have a negligible benefit in terms of increasing benthic habitat protection, because any restrictions on fishing would be temporary, and many benthic, structure-forming invertebrates have recovery times exceeding one year, such that more continuous protection from impact would be required to maintain seabed habitat structures. The habitat vulnerability section of the Affected Environment (Volume 1) as well as Appendix D discuss habitat recovery times in greater detail.

Seasonal restrictions on fishing could afford some protection to the habitats used by invertebrate fauna that are a prey source for managed species. (Prey availability and the quality and quantity of prey habitat are elements of EFH). In this way, seasonal closures could provide limited habitat benefits by temporarily increasing the abundance of prey. The amount of benefit would depend on whether episodic prey recruitment events coincided with the duration of the spawning closure. Such overlaps may exist in some areas and in some years since prey recruitment and spawning closures tend to occur in the spring time. There presumably could be a more lasting effect – extending beyond the end of the closure – if prey organisms that recruit to bottom habitats that are undisturbed by fishing during the closure survive in greater numbers than they would have if fishing had continued unabated.

However, recovery of more vulnerable structure forming habitat features from fishing impacts takes longer. Thus, continual protection from mobile bottom-tending gear fishing is needed to best protect structure-forming organisms such as sponges or bryozoans and geological features like cobble piles. Overall, seasonal closures to gear capable of catching groundfish will provide limited if any benefits in terms of protecting seabed structures and enhancing the habitat value that those structures provide to managed resources.

4.3.1.1 ***Gulf of Maine***

4.3.1.1.1 Alternative 1 (No Action, preferred)

This alternative includes year-round closure of the Cashes Ledge and Western Gulf of Maine closed areas, the sector and common pool rolling closures, and the Gulf of Maine Cod Spawning Protection Area (the “Whaleback” area). Seabed habitat impacts of the year-round fishing restrictions in these areas are discussed in sections 4.2.1.2.1 (Cashes Ledge) and 4.2.1.3.1 (Western Gulf of Maine).

Because they are closed seasonally, the sector and common pool rolling closures and the Gulf of Maine Cod Spawning Protection area do not provide positive seabed habitat protection benefits. To the extent that they preclude efficient capture of groundfish aggregated for spawning

purposes, they could actually have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits in other locations during the closed season, or within the closure during another season. These impacts are highly uncertain. Further, the magnitude of any impact along these lines associated with the common pool rolling closure areas is likely negligible. The common pool rolling closures apply to relatively few vessels, and therefore have little effect on the overall distribution of fishing effort during the closure months. The sector rolling closures and the Gulf of Maine Cod Spawning Protection Area affect more vessels and therefore have a greater effect on the overall distribution of fishing. The inshore Gulf of Maine areas covered by these rolling closures have vulnerable habitat types, so the potential increases in fishing time could have negative effects. If these management areas were generally in low vulnerability habitats, the conclusion would be different.

In summary, positive seabed habitat impacts of the year-round closure of the Cashes Ledge and Western Gulf of Maine areas aside, this Alternative 1/No Action has highly uncertain but likely slightly negative impacts on seabed habitats.

4.3.1.1.2 Alternatives 2A and 2B

Impacts of the removal of the year-round fishing restrictions in the Cashes Ledge and Western Gulf of Maine groundfish closures are discussed in sections 4.2.1.2.3, 4.2.1.2.4, 4.2.1.3.3, 4.2.1.3.4, 4.2.1.3.5, and 4.2.1.3.6. Seabed impacts associated with maintenance of the existing sector rolling closures and Gulf of Maine Cod Spawning Protection Area may be slightly negative, if these areas lead to increased fishing time because vessels cannot target spawning aggregations. As discussed above, these impacts are highly uncertain. To the extent such negative impacts exist, there would also be slightly negative impacts of designating the Massachusetts Bay Spawning Protection Area.

No difference in impacts between Option A and Option B is expected because seabed impacts of recreational hook and line fishing are assumed to be negligible, such that their prohibition from the areaas compared to an exemption from the prohibition would not influence the magnitude of habitat impacts.

In summary, moderately negative seabed habitat impacts of removing the Cashes Ledge and Western Gulf of Maine areas aside, Alternatives 2A and 2B have highly uncertain but likely slightly negative impacts on seabed habitats due to possible increased in fishing time.

4.3.1.1.3 Alternative 3

As noted above, there could be slight negative impacts of effort displacement associated with designation of the Massachusetts Bay Spawning Protection Area.

4.3.1.2 ***Georges Bank and Southern New England***

4.3.1.2.1 Alternative 1 (No Action)

This alternative includes year round closure of the Georges Bank groundfish closed areas, Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area, as well as a seasonal closure during the month of May. Seabed habitat impacts of the year-round fishing restrictions in these

areas are discussed in sections 4.2.1.4.1 (Closed Area I and Closed Area II) and 4.2.1.5.1 (Nantucket Lightship Closed Area). Any impacts to seabed habitats resulting from the May seasonal closure are probably negligible. Restrictions on fishing in this area apply to a small number of vessels, such that the area has limited overall impact on the distribution of fishing effort in the Georges Bank region.

To the extent that year-round fishing restrictions in Closed Area I, Closed Area II, and Nantucket Lightship Closed Area preclude efficient capture of groundfish, scallops, or other fishery resources contained within the closed areas, they could have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits from other locations. For resources that are mobile, and move in and out of the closures, this may be less of a concern, as these fish could be harvested outside the closed area boundaries. For resources that are sedentary, particularly scallops, any increases in fishing time that result from application of these closures could have a greater impact. However, areas within the groundfish closures that have high concentrations of scallops and are not within existing habitat management areas are fishable by the scallop industry on a rotational basis (i.e. rotational access fisheries in central Closed Area I, southern Closed Area II, and eastern Nantucket Lightship Closed Area). Any impacts resulting from inability to efficiently harvest scallops within these habitat closures are more appropriately associated with the no action habitat management alternatives, even though the habitat areas overlap the groundfish areas. The same holds true for impacts associated with displacement of the clam fishery in the habitat closed area portion of the Nantucket Lightship Closed Area.

The analyses prepared for Framework 48 to the Northeast Multispecies FMP, as well as the analyses in the economic impacts sections of this document, evaluate the extent to which fishing might be more efficiently prosecuted if the groundfish areas were not closed. While such assessments are difficult to make, it appears that catch rates of groundfish would not be significantly higher inside the closed areas, and therefore you would not expect their removal or conversion to seasonal areas to result in a large reduction in fishing time, area swept, and thereby seabed habitat impacts. However, more flexibility in fishing location would probably result in a reduction in fishing time, not an increase, if we assume that fishermen strive to operate efficiently to minimize their variable costs. Thus, keeping these areas in place year-round via Alternative 1/No Action may have a low, highly uncertain, negative impact on seabed habitats.

4.3.1.2.2 Alternatives 2A and 2B (2B preferred)

Direct impacts of the removal of year-round closed areas on the protection of seabed habitats in this region are discussed in 4.2.1.4.2-4.2.1.4.8 (Closed Areas I and II), and 4.2.1.5.2-4.2.1.5.6 (Nantucket Lightship Closed Area).

To the extent that seasonal implementation of Closed Area I and Closed Area II precludes efficient capture of groundfish, scallops, or other fishery resources contained within the closed areas, they could have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits. In general, it is difficult to predict how spatial and temporal distribution of groundfishing effort would vary if these closures were kept in place seasonally, as this alternative specifies, instead year-round, as in the no action alternative. However, removal of the Nantucket Lightship groundfish closure and the May closed

areas, combined with limited seasonal application of Closed Area I and Closed Area II, probably would improve operational efficiency and therefore reduce fishing time, area swept, and seabed impacts.

In summary, the combined changes in area management will result in increased flexibility in fishing location choice relative to Alternative 1/No Action, and therefore Alternative 2 is expected to have slightly positive impacts on seabed habitats. These magnitude and direction of these impacts are uncertain and depend on spatial shifts in fishing effot and changes in capture efficiency, both of which are difficult to estimate. Positive impacts to habitats will result if fishing is displaced away from more vulnerable seabed and/or if catch rates increase such that bottom contact time decreases. No difference in impacts between Option A and Option B is expected because seabed impacts of recreational hook and line fishing are assumed to be negligible, such that their prohibition from the area as compared to an exemption from the prohibition would not influence the magnitude of habitat impacts.

4.3.1.2.3 Alternative 3A and 3B

These alternatives are similar to Alternatives 2A and 2B except only the northern portion of Closed Area I would become a spawning closure. Because Alternatives 2 and 3 are so similar, significant differences in impacts between Alternatives 2 and 3 are not expected. Therefore, Alternatives 3A and 3B are also expected to have slightly positive impacts on seabed habitats relative to Alternative 1/No Action, which maintains additional area closures, most on a year-round basis. As for Alternative 2, both the direction and magnitude of these impacts is uncertain.

4.3.1.2.4 Alternatives 2 and 3, Option C

This alternative could be selected in addition to either 2A or 2B, and would exempt scallop dredge vessels from spawning closure restrictions. Because these alternatives would have fewer restrictions on fishing locations that could preclude operational efficiency, they would be expected to have slightly greater positive impacts on seabed habitats compared to Alternatives 2A/B and 3A/B. As was the case for Alternatives 2A/2B and 3A/3B, impacts are likely still slightly positive relative to Alternative 1/No Action.

4.3.2 Large mesh groundfish stocks

4.3.2.1 ***Gulf of Maine***

4.3.2.1.1 Alternative 1 (No Action, preferred)

No Action would retain the existing set of seasonal rolling closures for sector and common pool groundfish vessels and the April to June Gulf of Maine Cod Spawning Protection Area for commercial and recreational vessels fishing for groundfish. It would also retain the year-round Western Gulf of Maine Closure Area and the Cashes Ledge Closure Area, assuming one or both of these areas is not removed via selection of an alternative set of habiat management areas. Currently an alternative set of management areas in the central Gulf of Maine is the preferred habitat management alternative for that sub-region, which implies removal of the Cashes Ledge Closure Area.

Although this alternative does not change the purpose of seasonal rolling closures or year round groundfish closed areas, this alternative has incidental benefits from reducing fishing effort on spawning cod and other groundfish. Although the context is different than Alternative 2 below, the impacts on cod and other groundfish spawning and on the stocks are evaluated here.

The existing rolling closures, the Western Gulf of Maine Closure Area, and even to some extent the Cashes Ledge Closure Area have a high degree of overlap with the distribution of large spawning size groundfish hotspots in the Gulf of Maine (Map 90), in both spring and summer when many groundfish, and particularly cod and haddock, are known to spawn. Some winter spawning of cod occurs in the Massachusetts Bay area, where there are state-waters seasonal cod conservation zones. During winter months when cod spawn in the southern part of Massachusetts Bay, the only seasonal closure in Federal waters is an October-December closure (Rolling Closure Area V, thirty minute squares 124 and 125). Various types of fishing vessels are exempted from this rolling closure, and therefore it applies to mostly to common pool groundfish vessels, which account for less than one percent of the total groundfish fishing effort. Sector vessels are not required to comply with this rolling closure, which may in fact promote more intensive fishing during the winter since the sector rolling closures off of Massachusetts are in effect during April and May.

In the winter, the Western Gulf of Maine and Cashes Ledge Closure Areas contained 19 unweighted and 28.5 weighted hotspots[18] (Table 111). (Note that although the Massachusetts state-waters Winter Cod Conservation Zone shown on Map 90 is closed from November 15 through January 31, it was not included in the No Action totals which refer to Federal area closures only.) In the spring, the sector rolling closures, Cashes Ledge, and the Gulf of Maine Cod Spawning Protection Area had 923 unweighted and 2086.8 weighted hotspots. Hotspots in the eastern sliver of the Western Gulf of Maine Closure Area were not included in the total because they contained a negligible amount of large spawner size groundfish hotspots and overlapped with the common pool rolling closure areas. The additional hotspots in the Common Pool Rolling Closures were also not included in the total because they apply to a small fraction of fishing vessels and groundfish fishing effort. The 14 km^2 Gulf of Maine Cod Spawning Protection Area is simply too small for any hotspots at a 100 km^2 grid scale to fit inside.

[18] Hotspots were weighed more heavily for stocks with low biomass relative to the MSY target, stocks that formed sub-populations, and stocks that were known to have resident populations.

Table 111 – Summary of unweighted and weighted large spawner hotspots by Gulf of Maine spawning protection alternative. Seasonal spawning = GOM cod spawning protection area.

	Winter		Spring	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine				
No Action	**19**	**28.5**	**923**	**2086.8**
Seasonal spawning	0	0.0	0	0.0
Sector RC	51	121.2	909	2057.7
Comm Pool RC	102	224.5	1469	3566.7
Year round	19	28.5	111	406.4
Alternative 2	1	9.5	916	2071.8

On one hand, the Alternative 1/No Action areas encompass a broad area where spring groundfish spawning, primarily cod and haddock, occurs. In contrast to smaller areas meant to protect specific spawning components of cod or another species, these large areas are more robust to changes in annual spawning activity caused by environmental variation and climate change. They are also less likely to cause local shifts in fishing effort to nearby areas having unobserved spawning components that are not protected.

Based on the hotspot results, literature based information on (primarily cod) spawning (see Volume 1, Affected Environment), the distribution of developing and ripe cod and haddock, and on the distribution of survey catches of mature sized cod, the existing set of seasonal and year round closed areas in this alternative encompass a reasonably high proportion of groundfish spawning in the Gulf of Maine. However, the areas do not include spawning of resident cod, halibut, and other species in the eastern Gulf of Maine. They also offer little to no protection for winter cod spawning in Federal waters of Massachusetts Bay and the southern part of the western Gulf of Maine. Despite these gaps in groundfish spawning protection, Alternative 1/No Action likely has positive impacts on groundfish productivity because these areas appear to protect a considerable amount of spawning activity in the western Gulf of Maine and potentially improve groundfish productivity.

4.3.2.1.2 Alternatives 2A and 2B

Alternative 2 would retain the existing sector rolling closures as spring spawning closures, which would apply to all commercial fishing vessels capable of catching groundfish (Alternative 2A) and additionally to recreational groundfish vessels (Alternative 2B). Specific gears that do not catch groundfish would be exempt from the closure. Successive and overlapping thirty minute squares from Massachusetts Bay to Penobscot Bay would close for one month each from April to June. The existing Gulf of Maine Cod Spawning Protection Area that is closed from April to June to commercial and recreational fishing vessels that catch groundfish would remain. An additional winter spawning closure would apply in Massachusetts Bay during November 1-January 31 to all commercial and recreational fishing vessels capable of catching groundfish.

Compared to other areas, Massachusetts and Ipswich Bays have a fairly high proportion of developing and ripe cod (Map 92). The timing of the spring surveys has to be considered when interpreting maps showing the number or proportion of fish at each maturity stage, because maturation stages typically have unequal durations. The timing of when ripe and running ripe cod may or may not coincide with the timing of the survey, so a high proportion of developing fish is indicative of where spawning may occur soon, but an absence of developing or ripe fish does not mean that spawning will not occur there. The early spring survey probably misses some cod spawning that occurs in late spring from Ipswich Bay and to the north.

Winter cod spawning is known to occur in the middle and southern portions of Massachusetts Bay, and probably off the outer portion of Cape Cod as well. A new area where fishermen have reported intensive cod spawning off Scituate, Massachusetts is being investigated by Massachusetts Division of Marine Fisheries scientists using acoustic tags. While this area appears to be important for immature cod in the spring (Map 92), the winter trawl surveys have caught few large cod in this area, compared to portions of the Western Gulf of Maine Closure Area and the southern portion of Jeffreys Ledge (Map 93). Nonetheless, a winter spawning closure in this area could complement the existing Massachusetts Bay spawning closure in state waters (Map 93) and potentially other spawning protection areas in state waters that will be identified from this research.

On one hand, small closures that protect well-defined spawning components should be very effective to reduce the impacts on spawning codfish. On the other hand, small closures of relatively short duration (to focus conservation on specific spawning components) carries a higher risk of missing annual spawning events when, for example, environmental events during an abnormal year delay, advance, or cause spawning activity to develop elsewhere. Climate change may also play a role in changing spatial and temporal spawning characteristics. Broad-scale closures, like the ones in this alternative, would also protect less prominent or scientifically unidentified spawning components.

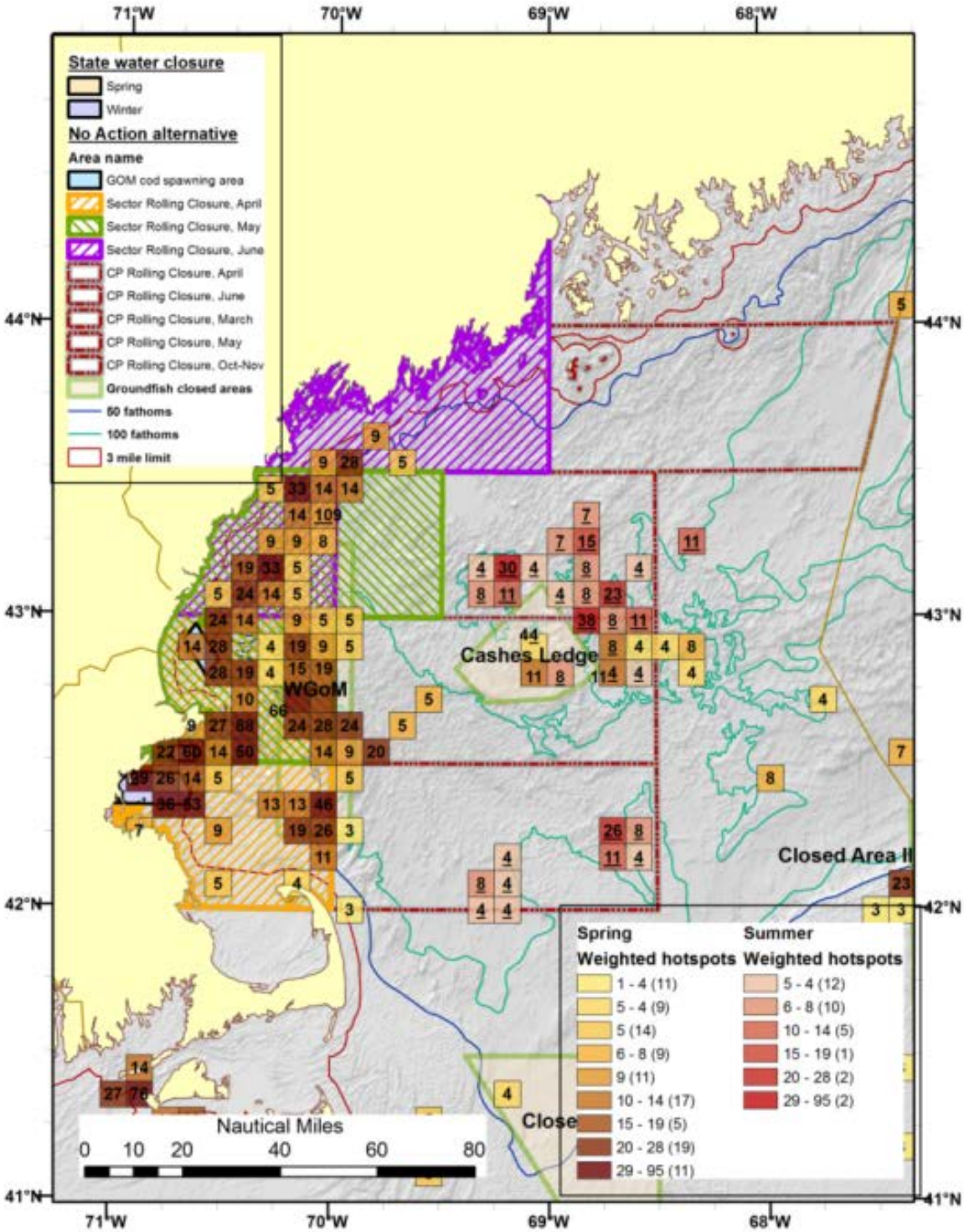
<u>Alternative 2 essentially protects spawning in the same areas and seasons as in Alternative 1 (No Action). Some additional spawning protection may be provided by the Massachusetts Bay cod spawning protection area.</u> Areas included in this alternative had about the same number of spawning hotspots as those for Alternative 1 (Table 111, Map 91).

The only difference between Option A and B is that fishing by recreational vessels that catch groundfish would be prohibited during the April to June rolling closures under Option B. While there is no research that suggests that recreational fishing could interfere with spawning behavior, it could cause spawning fish to disperse or avoid areas with many recreational vessels and it certainly contributes to removals of large spawning fish from the population before they have been able spawn in that year. During the 2012 fishing year, estimates indicate that recreational vessels harvested more Gulf of Maine haddock than commercial groundfish vessels, exceeding their 2012 allocation of the Gulf of Maine haddock annual catch limit.

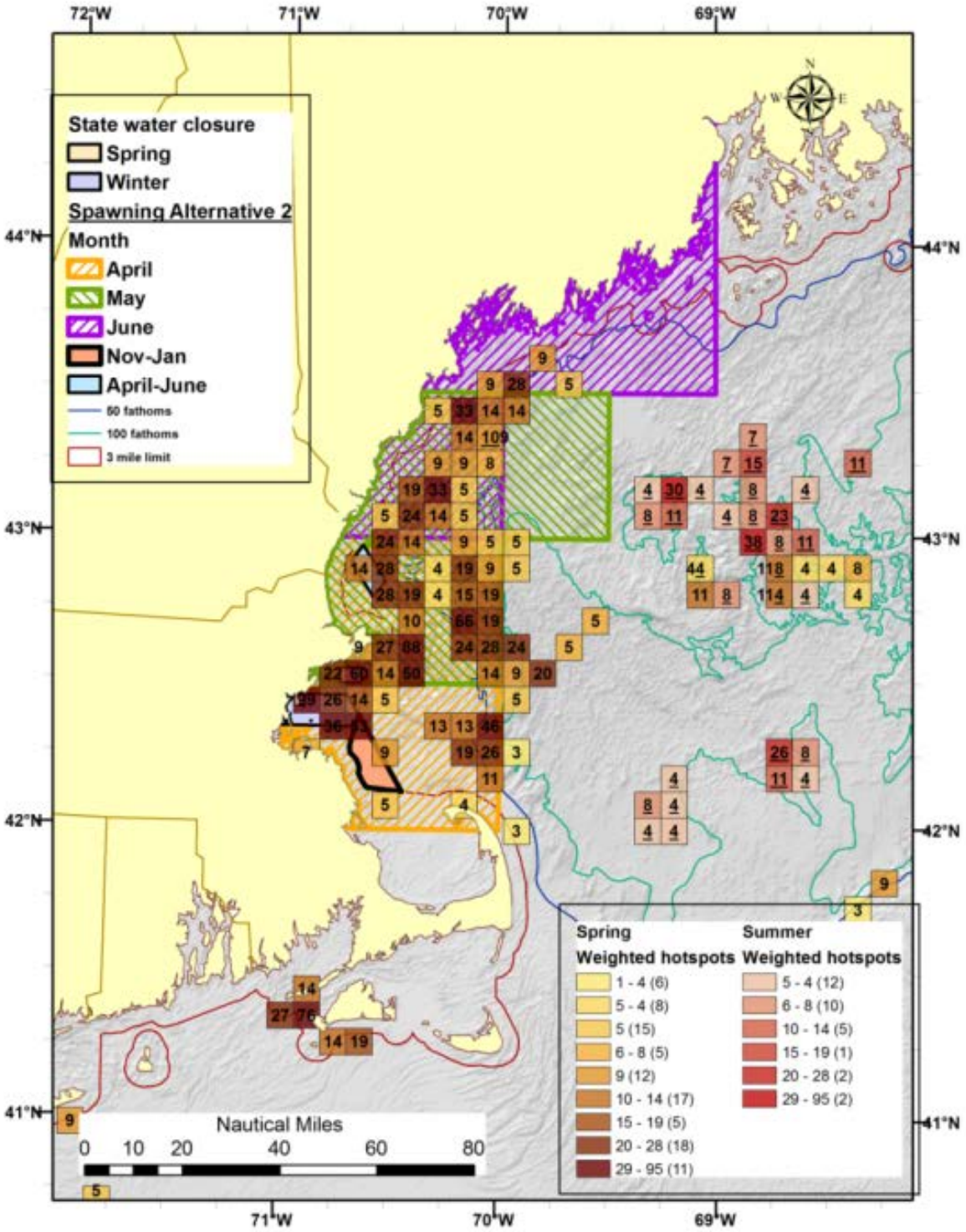
<u>Considering these effects described above, the impact of Alternative 2B on groundfish productivity is expected to be slightly positive compared to Alternative 1/No Action. Because</u>

Option B includes measures that restrict recreational fishing effort on spawning groundfish, Option B would have slightly more benefits to groundfish stocks when compared to Option A.

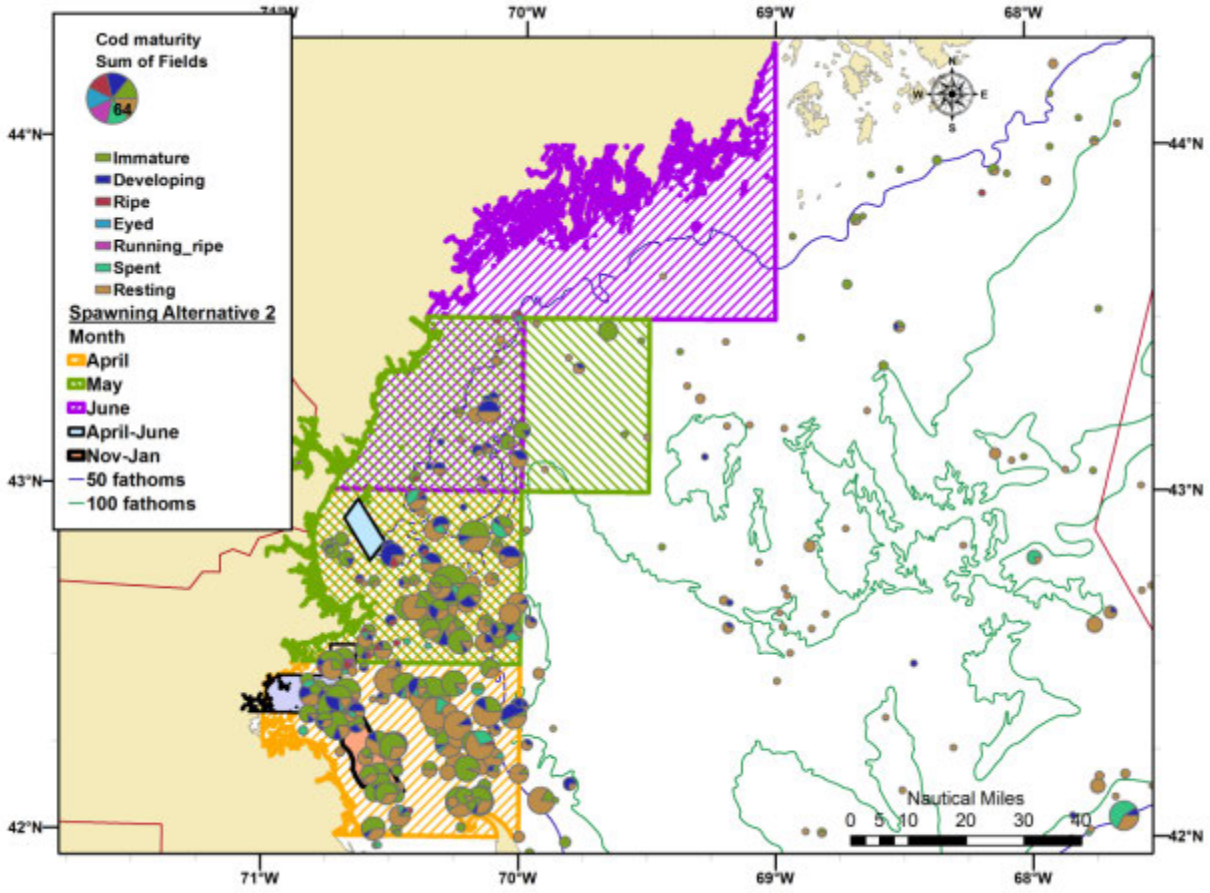
Map 90 – No Action rolling and year round closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the Western Gulf of Maine sub-region, using 2002-2012 spring NMFS, MADMF, ME-NH, and IBS cod survey data.



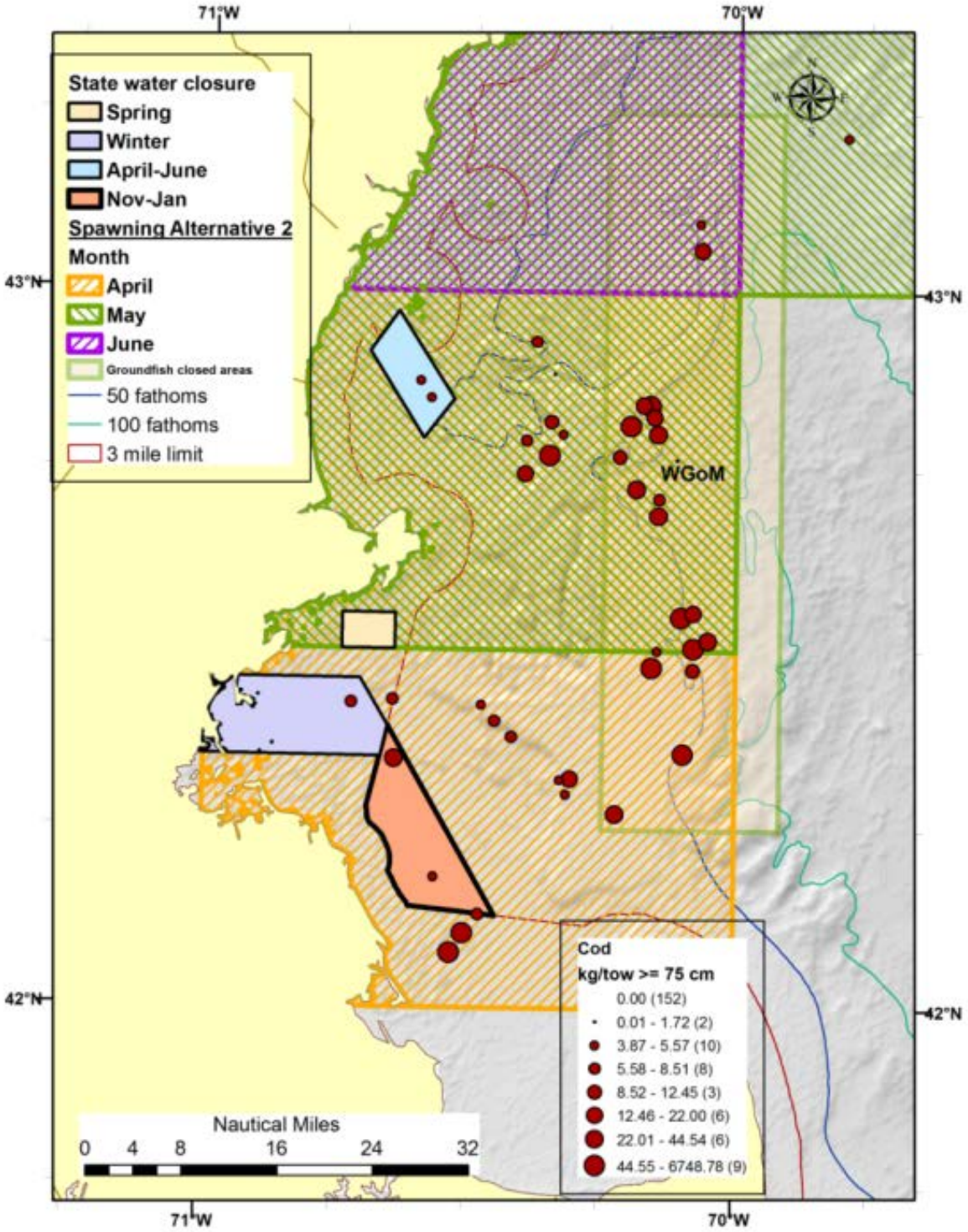
Map 91 – Alternative 2 spawning closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the WGOM sub-region, using 2002-2011 spring NMFS, MADMF, ME-NH, and IBS cod survey data.



Map 92 – Proportion of cod abundance by stage of maturation during NMFS and MADMF spring trawl surveys, 2002-2011.



Map 93 – Distribution of large mature cod during NMFS winter trawl and IBS trawl surveys, 2002-2007.



4.3.2.1.3 Alternative 3 (Preferred)

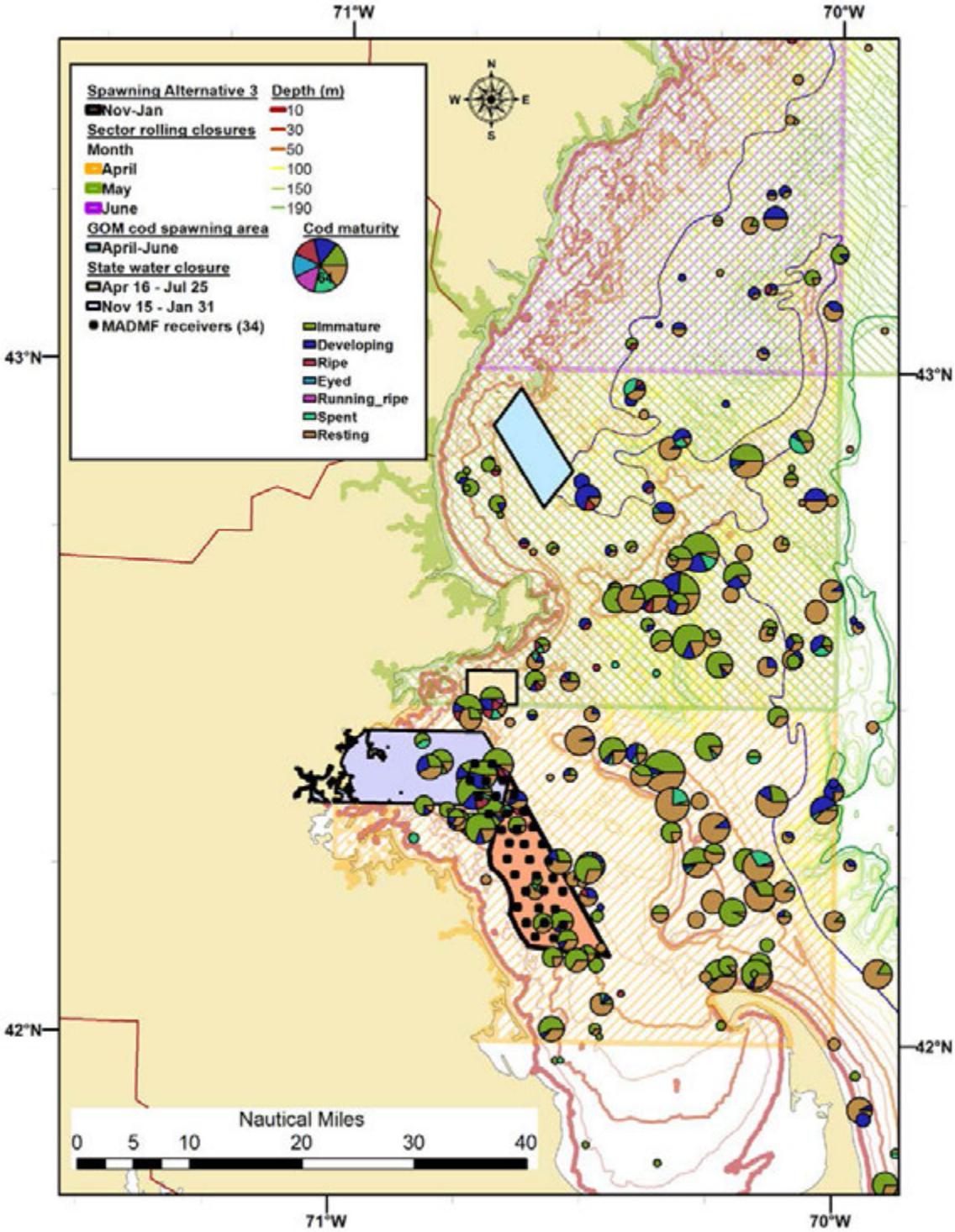
This alternative would designate the Massachusetts Bay Cod Spawning Protection Area between November 1 and January 31. Like the Gulf of Maine Cod Spawning Protection Area, the new spawning area shown in Map 26 (lower right panel) would be closed to all commercial gears capable of catching groundfish and recreational groundfish fishing, primarily to protect spawning cod.

While scant winter survey data support the presence of spawning codfish, fishermen often report the presence of spawning cod in the middle and southern portions of Massachusetts Bay, and probably off the outer portion of Cape Cod as well. A new area where fishermen have reported intensive cod spawning off Scituate, Massachusetts is being investigated by Massachusetts Division of Marine Fisheries (MADMF) scientists using acoustic tags. During winter 2013-2014, MADMF placed 150 acoustic transmitters on large cod and tracked their location and movements with 32 receivers (Micah Dean, MADMF, pers. comm.). The intent of this research was to guide further scientific work, but there was a tendency for cod to remain in the northern portion of the array during the winter study period. It is not known whether this is a persistent feature or changes from year to year.

While this area appears to be important for immature cod in the spring (Map 92), the winter trawl surveys have caught few large cod in this area, compared to portions of the Western Gulf of Maine Closed Area and the southern portion of Jeffreys Ledge (Map 93). Howver, the area has not been well surveyed during the proposed closure months and data from commercial catches rarely has information about spawning condition. The area also does not coincide well with groundfish spawning hotspots (weighted heavily for large spawner cod) in the spring and summer surveys (Map 91). Most of the cod in the area were in immature or resting spawning condition during the spring survey (Map 94), but a notable amount of developing codfish were sampled in the northern portion of the proposed spawning area.

Nonetheless, a winter spawning closure in this area could complement the existing Massachusetts Bay spawning closure in state waters (Map 93) and potentially other spawning protection areas in state waters that may be identified from this research. <u>The proposed spawning winter spawning closure area could have a slightly to highly positive impact on spawning cod</u>, depending on how well the area and season coincide with winter cod spawning activity. <u>It would have a positive cumulative effect when considered in combination</u> with the effects of the Gulf of Maine Cod Spawning area in Ipswich Bay and a continuation of the sector rolling closures in March to June in the western Gulf of Maine (see discussion in the cod section of Volume 1). <u>This measure could have a slight negative impact on other groundfish stocks</u> occupying locations where vessels would fish when displaced from this area.

Map 94 – Location of Massachusetts Bay Cod Spawning Protection Area (orange with black border) compared to the location of acoustic receivers used in 2013-2014 winter cod spawning research by MADMF and to the location of other existing spawning protection areas in the Western Gulf of Maine. The relative number and proportion of cod in 2002-2012 spring surveys by maturation are shown as pie charts at the location of the observation.



4.3.2.2 ***Georges Bank and Southern New England***

4.3.2.2.1 Alternative 1 (No Action)

Alternative 1/No Action would retain the year round groundfish closed areas, Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area. Closed Areas I and II are included in habitat management Alternative 1/No Action for the Georges Bank sub-region, and the Nantucket Lightship Closed Area is part of habitat management Alternative 1/No Action for the Great South Channel/southern New England sub-region, and selection of alternatives to no action could impact the continued existence of these areas. It would also continue the Georges Bank Seasonal Closure Area during May. The latter area is open to fishing to all but a few types of commercial fishing vessels. Vessels that operate under an approved sector operations plan may fish in this seasonal closed area. Recreational fishing vessels targeting groundfish or other species may fish in the Nantucket Lightship Closed Area with a letter of authorization.

Although most groundfish, including cod and haddock, primarily spawn in the spring, groundfish spawning also occurs in other seasons. For example, data from Smolowitz et al. (2012) indicate that yellowtail flounder spawning in Closed Area II occurs during July and August. Although hotspots for large mature groundfish stocks occur in any season to varying extents, the weighted hotspots were given a non-zero multiplier only during the seasons when that stock was known to spawn (Table 112). Non-zero multipliers were assigned to cod, winter flounder, witch flounder, pollock, redfish, halibut, ocean pout, and windowpane flounder during the summer, fall, and winter, varying by factors accounting for stock biomass, subpopulations, and residency. This makes the seasonal weighted hotspots an appropriate metric to evaluate the degree of spawning protection afforded to groundfish stocks by the year-round closures. It is also valid to compare these weighted hotspots with those for Alternatives 2 and 3 in the spring season, when the action alternative spawning closures would apply.

Most of the large spawner hotspots were identified in Closed Area II, totaling 549.8 (97 unweighted) in the spring (Map 95), with some hotspots (22.4) in the fall (Table 112). Closed Area I had a relatively low number of large spawner hotspots in the spring (Map 95) and fall (Map 96), while the Nantucket Lightship Area had 28.1 weighted hotspots in the winter, associated with windowpane flounder.

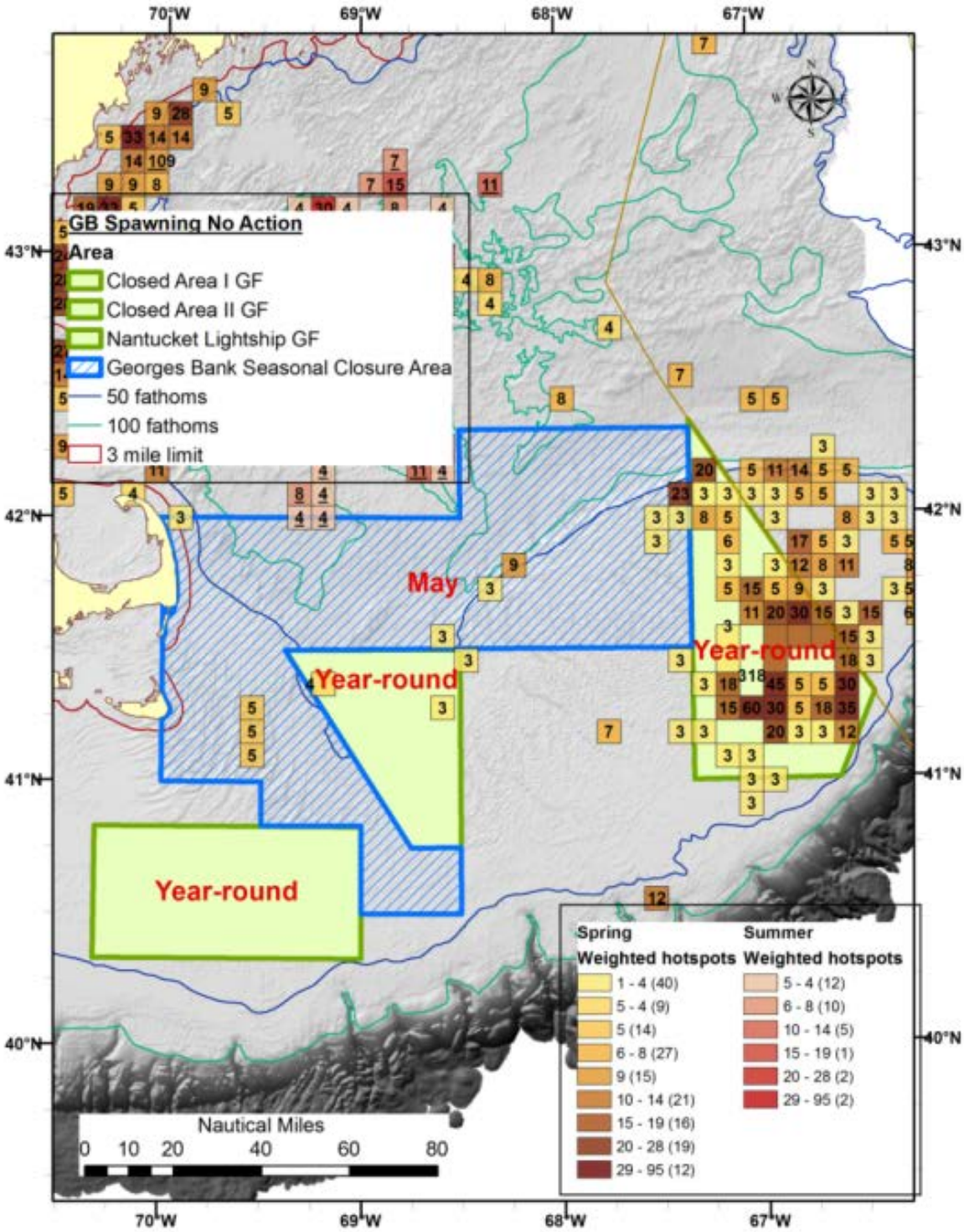
Table 112 – Seasonal summary of unweighted and weighted large spawner hotspots for the No Action alternative.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank/Southern New England								
Groundfish closure	139	618.4	51	7.5	282	209.5	11	43.1
Closed Area I GF	2	6.5	15	0.0	23	15.1	0	0.0
Closed Area II GF	97	549.8	24	0.0	42	22.4	3	0.0
Nantucket Lightship GF	0	0.0	2	0.0	0	0.0	6	28.1
Georges Bank Seasonal Closure Area	40	62.2						

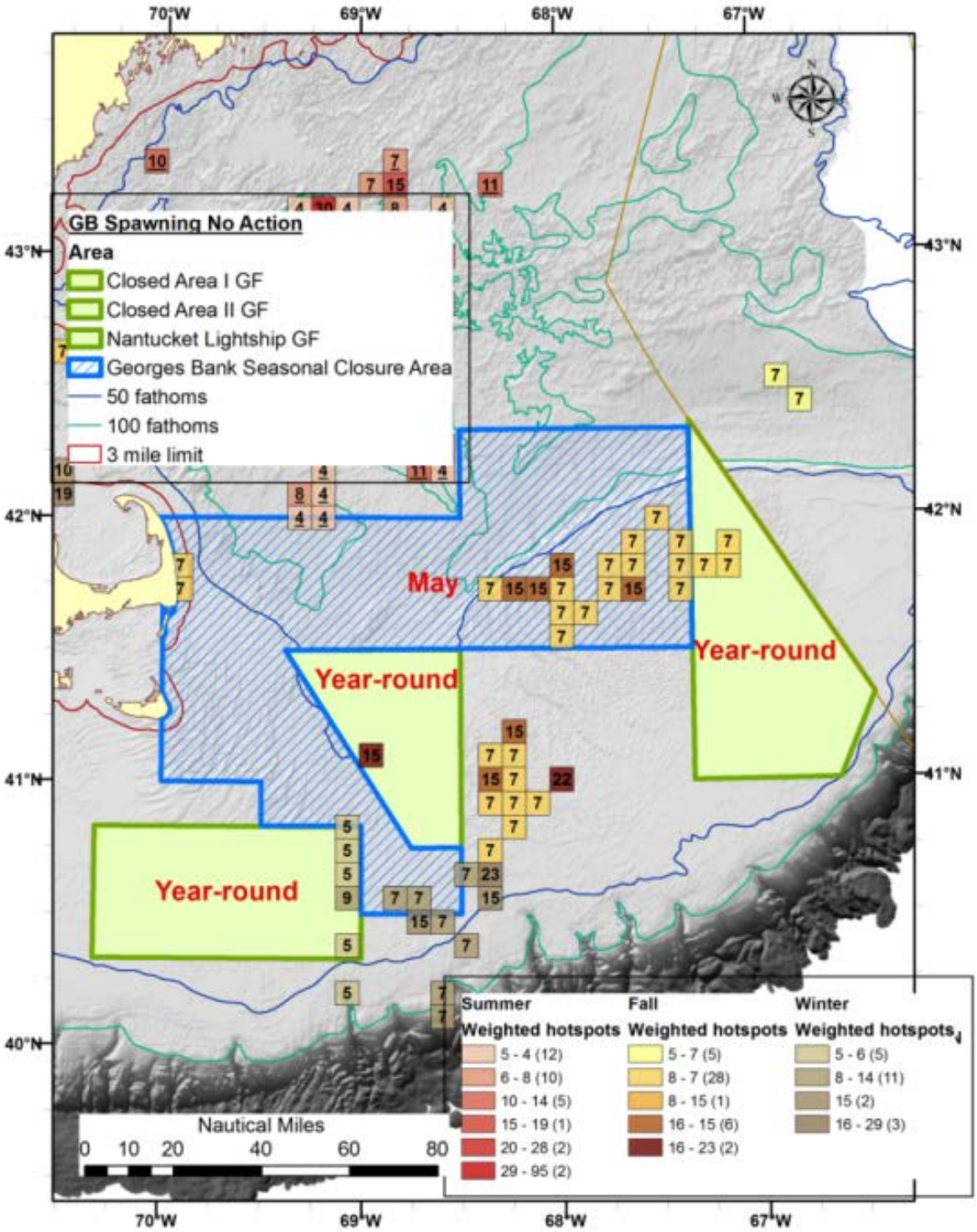
The existing year-round groundfish closed areas provide a relatively high level of spawning protection, except in areas that are open to fishing under specific groundfish and scallop access programs. The scallop access program currently allows scallop dredge fishing in these areas year-round, with the exception of August 15 to November 15 in Closed Area II, which would continue under Alternative 1/No Action. This measure was adopted by the Scallop FMP via Framework Adjustment 24 to increase yield in the scallop fishery given constraints on yellowtail flounder catches required under Groundfish FMP sub-ACL limits, essentially reducing yellowtail flounder bycatch per pound of scallop landings. **It was not adopted as a measure to protect yellowtail flounder spawning**, which according to industry-generated survey data appears to occur during June to early August.

The No Action alternative likely has positive impacts on managed large mesh groundfish because the likely benefits to groundfish productivity are considered to be relatively high, especially for cod, haddock, winter flounder, yellowtail flounder (and probably a considerable number of non-groundfish species).

Map 95 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1/No Action areas.



Map 96 – Distribution of weighted large spawner groundfish hotspots in summer, fall, and winter seasons compared to Alternative 1/No Action areas.



4.3.2.2.2 Alternatives 2A and 2B (2B preferred)

During February 1 to April 15, Alternative 2A would close all of Closed Areas I and II to commercial fishing with gears capable of catching groundfish, including trawls, gillnets, longlines, hook gear, and scallop dredges. Certain exemptions would apply and are described in Section 2.2.1.3. The intent is to reduce impacts on spawning groundfish, particularly cod and haddock.

Most of the spring large spawner groundfish hotspots occur in Closed Area II (Table 113; Map 97), particularly for haddock and yellowtail flounder. A few cod hotspots occur, but most are in Canadian waters. Although there are relatively few hotspots located in Closed Area I, there are large cod and haddock caught there by surveys, particularly in portions overlapping the Great South Channel and in the deeper water in the northern half of Closed Area I (Map 98). Past observations indicate that cod and haddock spawn in this area during the spring, and such spawning activities were the basis for the original Closed Area I (and Closed Area II) designations. During the spring surveys, few developing and ripe cod were caught on Georges Bank, except in the southern part of Closed Area I (Map 99, top). A considerable proportion of haddock were, however, in developing or ripe condition during the spring surveys in most areas of eastern Georges Bank and in the northern two thirds of Closed Area I (Map 99, bottom).

Table 113 – Summary of unweighted and weighted large spawner hotspots during spring, comparing Georges Bank Alternatives 1/No Action, 2, and 3.

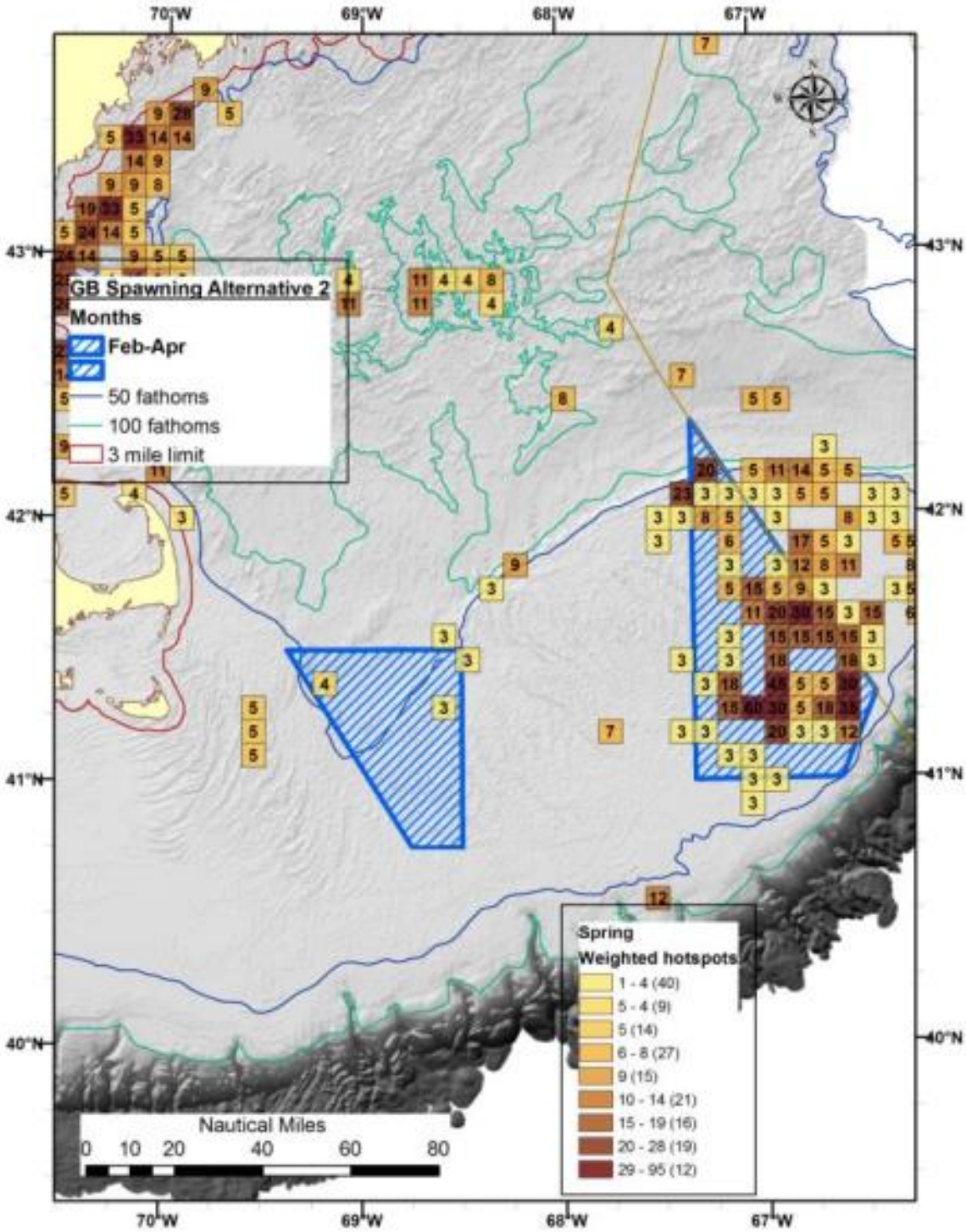
	Spring	
	Total hotspots	Total weighted hotspots
Georges Bank		
No Action	**139**	**618.4**
Seasonal spawning	40	62.2
Year round	99	556.2
Alternative 2	99	556.2
Alternative 3	98	553.5

Using the number of large spawner hotspots as an indicator of groundfish spawning protection, Alternative 2A has slightly positive impacts on groundfish productivity for spring spawners (due partially to the elimination of the scallop access program during Feb to Apr) and large negative impacts on fish that spawn during other seasons. Although larger cod and haddock tend to be able to avoid noisy 15' dredges, much of the concern is disruption of spawning behavior and dispersion of spawning fish, which can reduce spawning efficiency, vs. removals of spawning fish via directed fishing or bycatch (see additional discussion under Option C, below). The lower number of hotspots in the spring (99 for Alternative 2 as compared to 139 for Alternative 1) is due to the elimination of the May Georges Bank seasonal closure area which includes 40 spring hotspots.

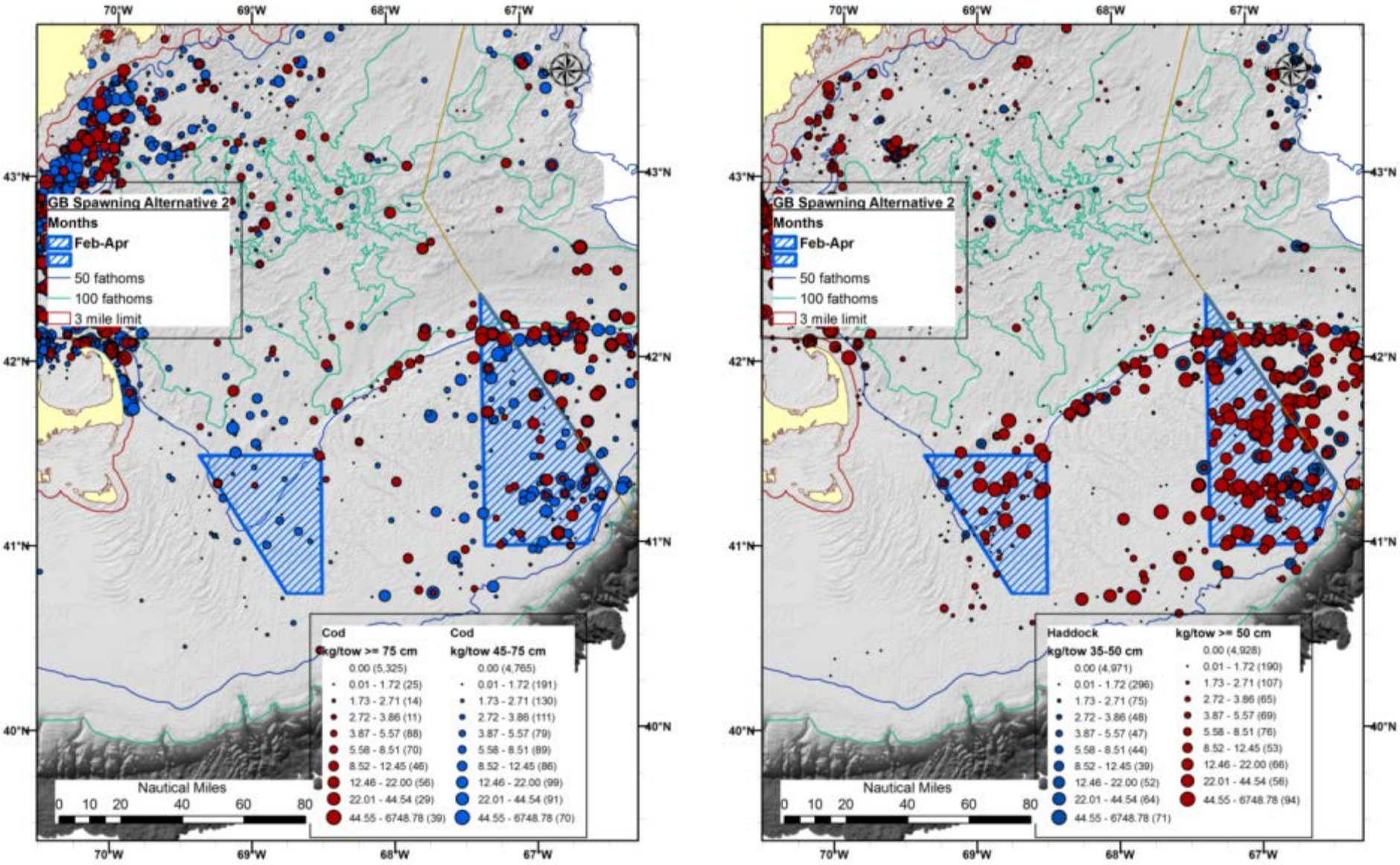
Option B is preferred and differs from Option A only in that it would also prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This proposed measure is closer to current management status, under which recreational fishing vessels are prohibited from targeting groundfish within the boundaries of Closed Areas I and II. This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Areas I and II during the spring when the fish spawn. While a relatively small amount of recreational groundfish fishing effort occurs on Georges Bank during February and April, Alternative 2B provides some slight added protection for spawning cod and haddock, both primary recreational target species, compared to 2A.

Thus compared to Alternative 1/No Action, Alternative 2B has slightly positive impacts on groundfish productivity in the spring season (due partially to the exclusion of scallop access during February to April and prevention of recreational fishing for spawning cod and haddock) and large negative impacts on fish that spawn in other seasons.

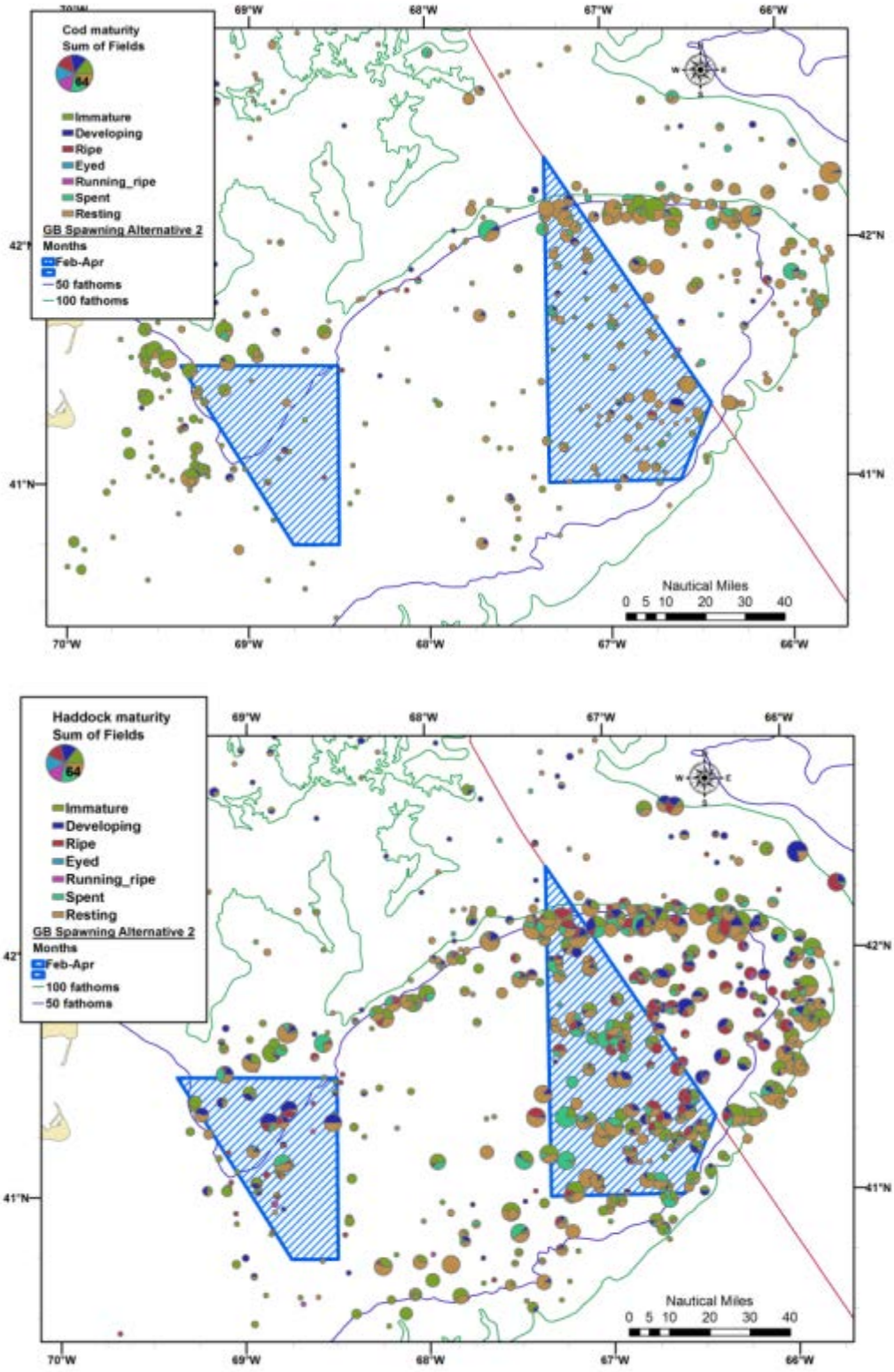
Map 97 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1 areas. Closures to gears capable of catching groundfish would occur from Feb 1 to Apr 15.



Map 98 – Distribution of cod (left) and haddock (right) by small and large mature fish size classes during spring and summer surveys of Georges Bank during 2002-2011.



Map 99 – Distribution of cod (top) and haddock (bottom) by maturity stage during 2002-2011 surveys.



4.3.2.2.3 Alternatives 3A and 3B

Alternative 3 differs from Alternative 2 in that the south and central portion of Closed Area I would not be included as a spawning protection area.However, note that if Closed Area I South is chosen as a dedicated habitat research area (Section 2.3.4), the southern portion of this area would remain closed year round to mobile bottom-tending gears, having a very small positive effect on groundfish productivity through spawning protection.

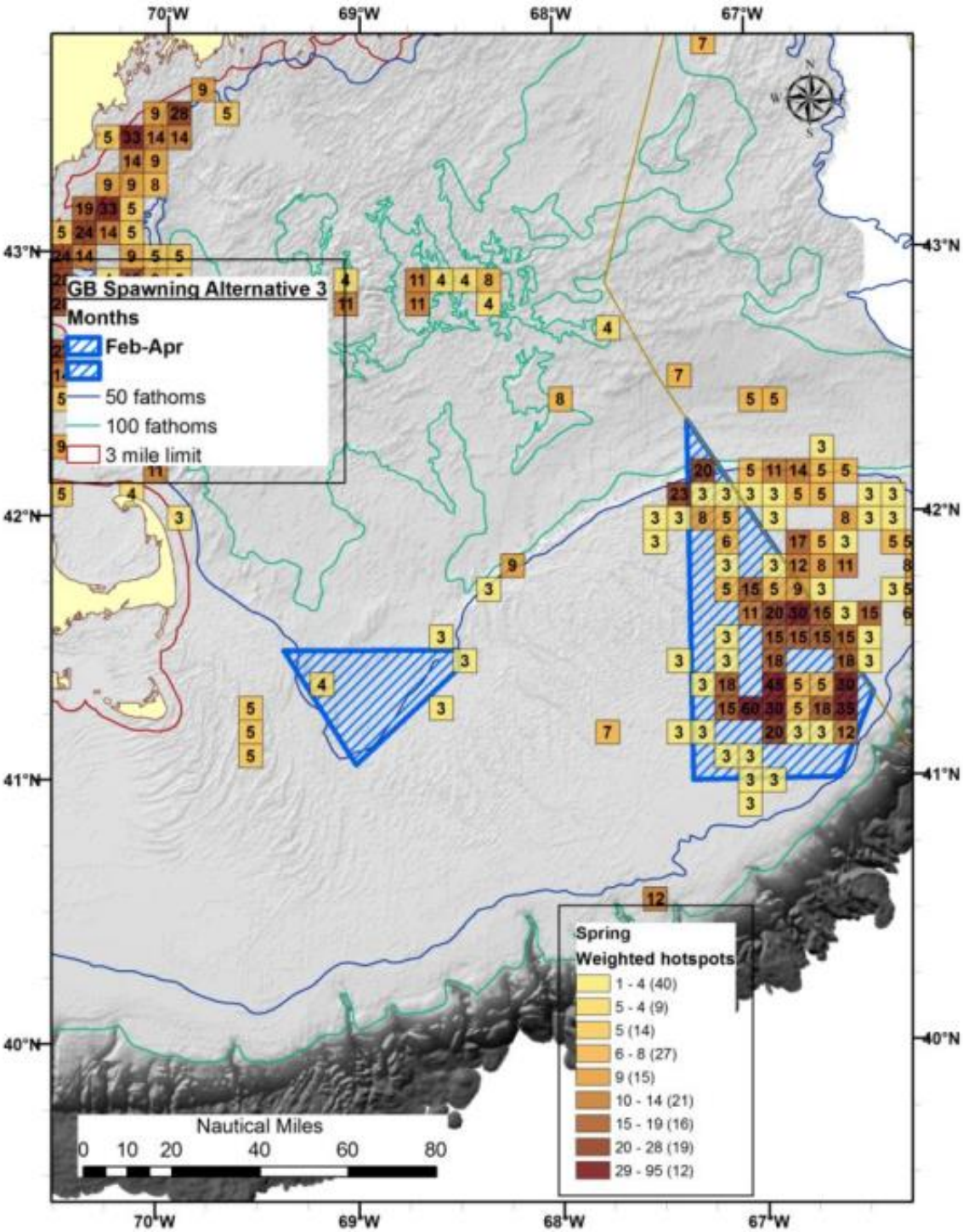
Most of the large spawner hotspots in Closed Areas I and II are included in Alternative 3 (553.5 weighted hotspots vs 618.4 for Alternative 1, Table 113), as there are few large or mature cod and haddock in the south and central portions of Closed Area I during the spring surveys (Map 100). Closed Area I North and all of Closed Area II, have a considerable number of hotspots, large cod and haddock (Map 98), and haddock in developing or ripe condition (Map 99).

Therefore, Alternative 3A has nearly the same impact on groundfish productivity through spawning protection as Alternative 2A, i.e., a slightly positive impacts on spring spawners and negative effects on fish that spawn in other seasons.

Option B differs from Option A only in that it would also prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Area I North and Closed Area II during the spring when the fish spawn. While a relatively small amount of recreational groundfish fishing effort occurs in Closed Area I and II during February and April (see Human and Community impacts section), Alternative 3B provides a small amount of added protection for spawning cod and haddock, both primary recreational target species.

Thus relative to Alternative 1 (No Action), Alternative 3B has slightly positive impacts on groundfish productivity in the spring season (due partially to the elimination of the scallop access program during February to April and prevention of recreational fishing for spawning cod and haddock) and large negative impacts on fish that spawn in other seasons.

Map 100 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 2 areas. Closures to gears capable of catching groundfish would occur from Feb 1 to Apr 15.



4.3.2.2.4 Alternatives 2 and 3, Option C

Option C would exempt scallop dredge vessels from the February 1 to April 15 spawning closures in Closed Areas I and II. Option C could be selected independently of whether the spawning closure allows recreational fishing (Option A) or does not allow recreational fishing (Option B). If Option C is chosen and an exemption was provided, seasonality of scallop fishing in the Georges Bank access areas would still be subject to regulation under the Atlantic Sea Scallop FMP, for example to improve scallop yield or reduce bycatch. Scallop fishing could continued to be prohibited in portions of Closed Areas I and II where habitat management areas restrict the use of dredge gears. Within these areas, scallops are concentrated in the central portion of Closed Area I and the northern and southeastern parts of Closed Area II.

Since catches are capped by an annual catch limit, the purpose of the spawning closures is to enhance spawning success by reducing effects (i.e., removals, disruption, dispersal) on spawning activity. There is no evidence of and common sense belies the supposition that scallop dredges have less of an impact on spawning than do other types of gears targeting groundfish. Although groundfish trawls typically sweep a larger area, scallop dredges are heavier and noisier, kicking up as much (or possibly more) sediment than a standard groundfish trawl.

Although bycatch of round-bodied groundfish such as cod and haddock is low in scallop dredges, their spawning activity may be disturbed by dredge activity. Mature size (Map 98, left panel) and spawning condition (Map 99, upper panel) cod are abundant in spring survey catches in the northern part of Closed Area II, along the Northern Edge, and the southeastern part of Closed Area II. Both areas have high biomasses of fishable scallops. Mature size (Map 98, right panel) and spawning condition (Map 99, lower panel) haddock occur throughout Closed Area II in spring survey catches, particularly along the Northern Edge of Georges Bank and in the central and northern part of Closed Area I. The central portion of Closed Area I often has high biomass of fishable scallops and is an identified access area.

Note that while scallop dredges capture winter and yellowtail flounder at higher rates in Closed Area II, spawning for these species takes place during seasons other than the proposed February 1 to April 15 spawning closure. Large yellowtail flounder are abundant in the southeastern and central portion of Closed Area II during the summer months.

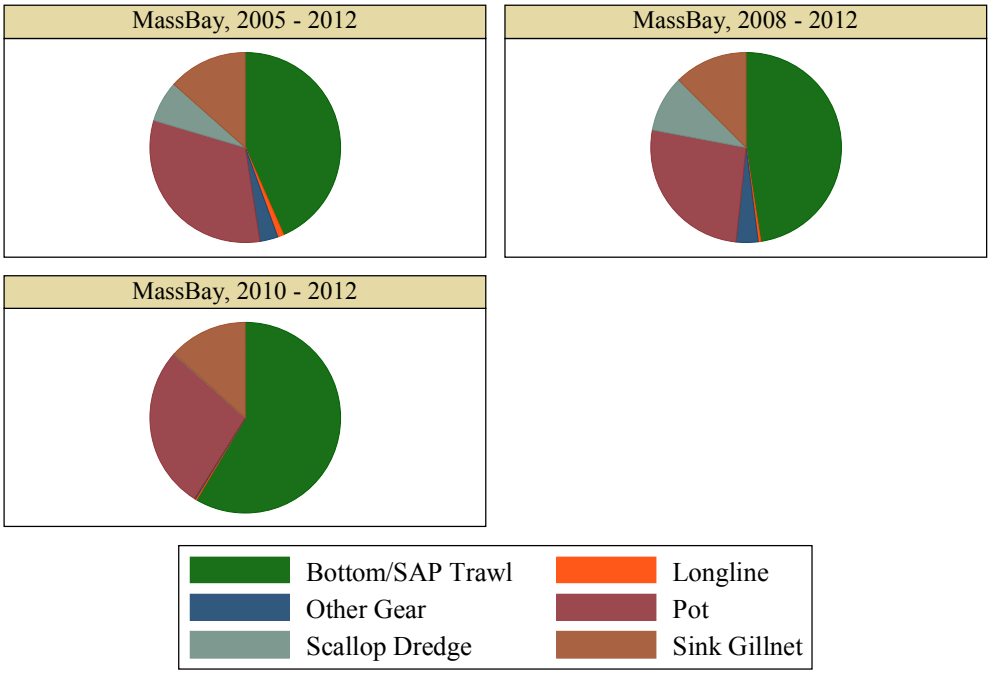
Thus, based on the distribution of cod and haddock in spring survey catches, the prevalence of groundfish spawning hotspots in Closed Area II, and the probable equivalent effects of dredge and trawl gear on spawning, <u>Alternative 2C is likely to have a negative effect on the groundfish resource and productivity compared to Alternative 1 (No Action) because scallop dredge fishing would mitigate the possible benefit of prohibiting groundfish fishing in the closed areas during spawning. Alternative 3C is also likely to have a negative effect on the groundfish resource and productivity compared to Alternative 1 (No Action).</u>

4.3.3 Human communities and the fishery

4.3.3.1 *Gulf of Maine*

Tables and figures related to analysis of the social and economic impacts of the Gulf of Maine spawning management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 40 – Massachusetts Bay Groundfish Spawning Area revenue by gear, as a percentage of the total average revenue Nov. 1 – Jan 31 within each year range given. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 582,110; 2008 – 2012 = $ 680,528; 2010 – 2012 = $ 651,690



Graphs by Area and years

Figure 41 – Average recreational revenue generated within the Massachusetts Bay Spawning Area during Nov. 1 – Jan 31, delineated by whether or not groundfish were caught on a trip.

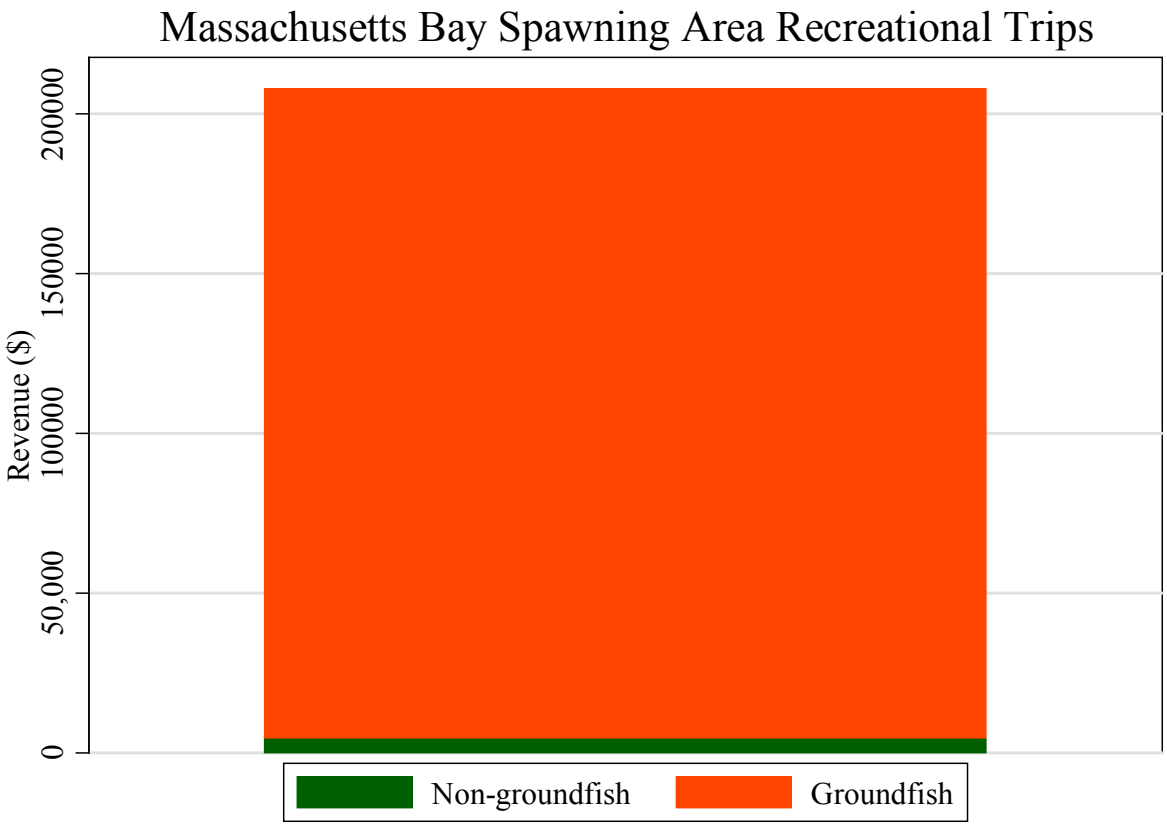


Figure 42 – Recreational revenue estimated to have been generated by trips reported within the GOM Spawning Alternative 2 areas, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the areas. Note: Groups do not necessarily consist of the same individuals across years.

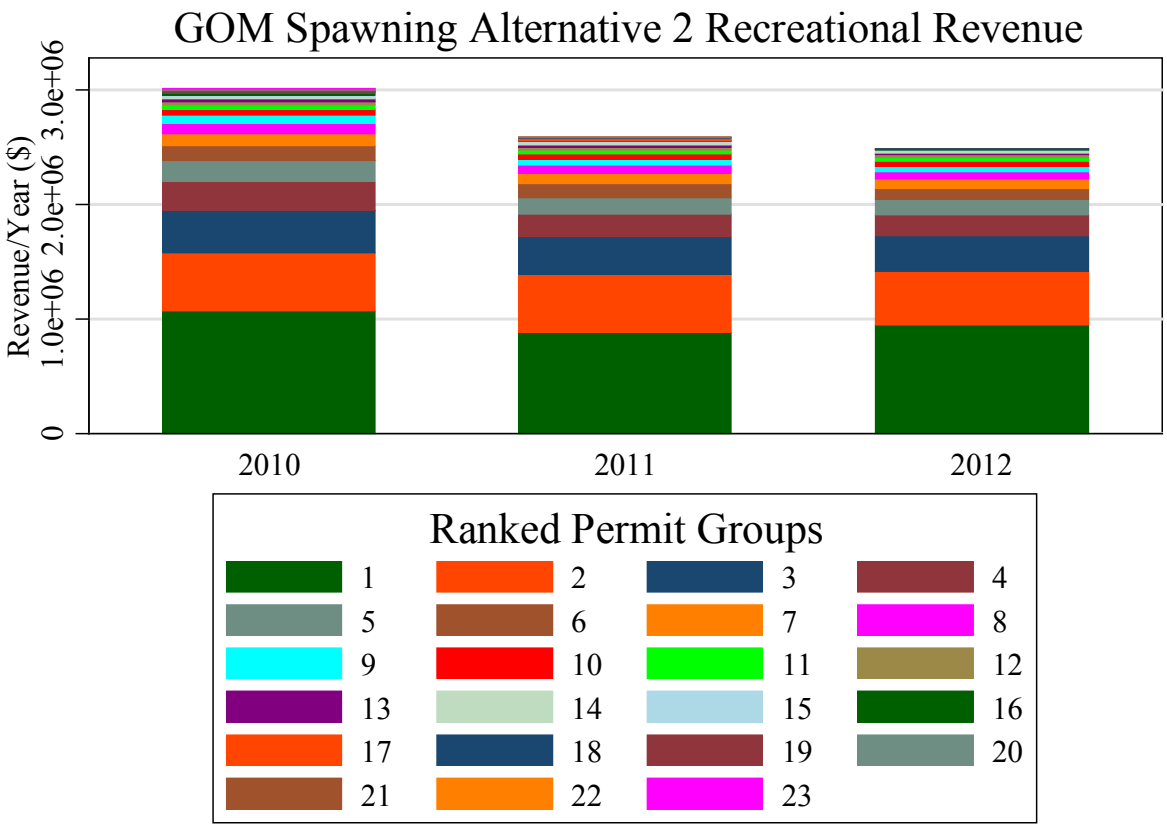


Figure 43 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the areas of GOM Spawning Alternative 2 during the relevant time periods.

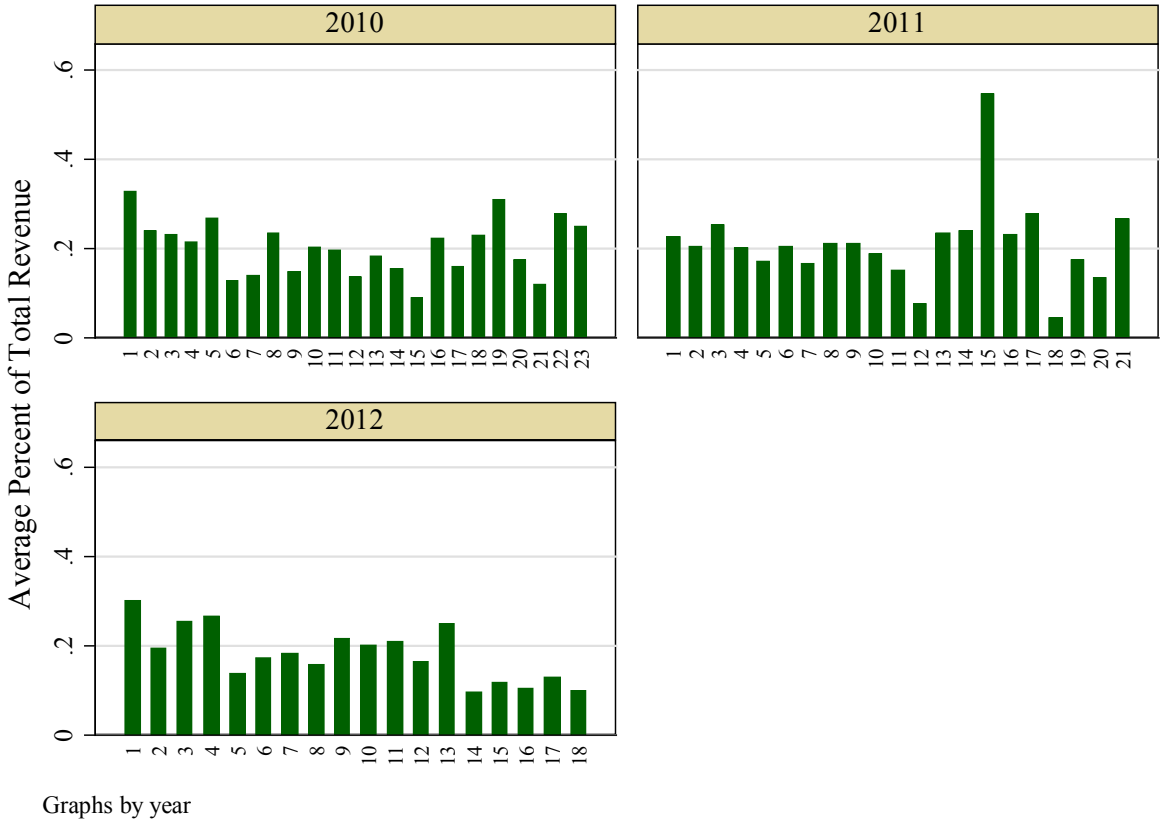


Table 114 – Revenue in currently open portions of the Massachusetts Bay Spawning Area (Alternatives 2 and 3) potentially impacted by the management options during November 1 - January 31. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom/SAP Trawl	MassBay	L/U	36,579	20,799	35,281	99,572	5,023	28	120	2005 - 2012
Bottom/SAP Trawl	MassBay	L/U	52,190	58,534	36,618	99,572	8,846	27	139	2008 - 2012
Bottom/SAP Trawl	MassBay	L/U	60,390	58,534	38,287	99,572	23,065	29	158	2010 - 2012
Bottom/SAP Trawl	MassBay	M	139,095	102,792	81,450	292,076	66,471	37	315	2005 - 2012
Bottom/SAP Trawl	MassBay	M	172,780	169,320	87,767	292,076	73,085	31	314	2008 - 2012
Bottom/SAP Trawl	MassBay	M	207,165	221,715	93,043	292,076	107,705	24	220	2010 - 2012
Bottom/SAP Trawl	MassBay	S	77,127	75,371	38,127	140,730	32,892	34	422	2005 - 2012
Bottom/SAP Trawl	MassBay	S	98,399	76,757	31,485	140,730	74,719	29	377	2008 - 2012
Bottom/SAP Trawl	MassBay	S	113,752	123,767	33,141	140,730	76,757	21	248	2010 - 2012
Longline	MassBay	ALL	5,935	3,912	7,224	23,230	495	14	83	2005 - 2012
Longline	MassBay	ALL	3,286	3,060	2,387	6,653	495	12	62	2008 - 2012
Longline	MassBay	ALL	1,778	1,779	1,282	3,060	495	7	26	2010 - 2012
Scallop Dredge	MassBay	L	33,673	0	95,242	269,386	0	9	2	2005 - 2012
Scallop Dredge	MassBay	L	53,877	0	120,473	269,386	0	9	3	2008 - 2012
Scallop Dredge	MassBay	L	0	0	0	0	0		0	2010 - 2012
Scallop Dredge	MassBay	OTHER	7,089	593	17,885	-	-	4	12	2005 - 2012
Scallop Dredge	MassBay	OTHER	10,845	577	22,639	-	-	4	14	2008 - 2012
Scallop Dredge	MassBay	OTHER	785	577	826	-	-	4	11	2010 - 2012
Sink Gillnet	MassBay	ALL	77,865	71,254	34,722	144,568	41,906	32	503	2005 - 2012
Sink Gillnet	MassBay	ALL	84,808	74,097	43,726	144,568	41,906	32	522	2008 - 2012
Sink Gillnet	MassBay	ALL	86,857	74,097	52,507	144,568	41,906	21	263	2010 - 2012

Table 115 – Recreational fishing revenue associated with the GOM Spawning Alternative 2 areas in the relevant time frames being considered for closure. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
MassBay	2006 - 2012	185,770.82	7.29	998.14	5,703.49	5,029.83	3,839.85
MassBay	2008 - 2012	162,435.41	6.40	872.60	5,601.22	5,029.83	3,641.90
MassBay	2010 - 2012	162,817.46	5.00	874.00	5,956.74	5,681.85	3,489.34
April Rolling	2006 - 2012	1,079,749.20	68.14	7,695.29	2,523.62	1,117.74	2,424.28
April Rolling	2008 - 2012	1,054,411.55	70	7,562	2,411.74	1,117.74	2,297.45
April Rolling	2010 - 2012	966,533.19	66.67	7,005.67	2,334.62	1,117.74	2,208.30
May Rolling	2006 - 2012	1,188,660.21	60.71	10,378.71	2,313.86	1,789.8	1,957.86
May Rolling	2008 - 2012	1,247,564.94	60	10,929.8	2,345.05	1,790.25	1,970.24
May Rolling	2010 - 2012	1,331,199.46	59	11,388.33	2,392.81	1,790.25	2,050.06
June Rolling	2006 - 2012	196,061.85	23.43	1,418.14	1,506.51	894.9	1,180.85
June Rolling	2008 - 2012	188,064.71	22.6	1,380.2	1,536.48	937.75	1,146.55
June Rolling	2010 - 2012	182,662.07	22.33	1,339	1,565.68	1,023	1,124.79

Table 116 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting trips capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area.

State	Community	Port	City
MA		**124**	**99**
	Boston	13	
	Gloucester	70	37
	Manchester		3
	Marshfield	8	3
	New Bedford	19	19
	Plymouth	3	
	Provincetown	4	
	Sandwich	3	
	Scituate	7	7
	Swampscott		3
ME		**3**	**20**
	Portland	3	9
NH		**3**	**4**

Table 117 – Landing port and associated revenues for gear capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area. Ports with less than 3 vessels each were included in the state totals only.

State/port	Total revenue
MA total	565,567.10
BOSTON	82,742.82
GLOUCESTER	147,627.10
MARSHFIELD	7,507.21
NEW BEDFORD	18,206.15
PLYMOUTH	46,495.47
PROVINCETOWN	8,706.05
SANDWICH	919.21
SCITUATE	251,750.30
ME total	1,120.66
PORTLAND	1,008.85
NH total	65.63

Table 118 – Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the GOM Spawning Alternative 2 in the relevant time frames being considered for closure.

Gulf of Maine		Alternative 2	
State	Community	Port	City
MA		**55**	**54**
	Gloucester	9	9
	Marshfield	5	5
	Newburyport	8	8
	Plymouth	4	4
	Rockport	3	3
ME		**11**	**11**
NH		**24**	**25**
	Hampton	5	5
	Hampton Falls	3	3
	Rye	6	6

4.3.3.1.1 Alternative 1 (No Action, preferred)

The No Action Alternative considers the spawning protection impacts of (1) the Western Gulf of Maine Closure Area and the Cashes Ledge Closure Area, (2) the Gulf of Maine Rolling Closures Areas that apply to sector and common pool vessels, and (3) the Gulf of Maine Cod Spawning Protection Area, also known as the Whaleback area.

To the extent that spawning aggregations increase CPUE, the ongoing cost of the rolling closures to fishermen are expected to be substantial. In addition, the close proximity of the rolling closures to shore means that many of the impacted fishermen face additional steaming costs in order to reach areas of the ocean open to fishing. Nevertheless, given the expected impact of Alternative 1/No Action on groundfish habitat and productivity, the expected impact on the fisheries managed is moderately positive.

The social impacts associated with Alternative 1/No Action are expected to be neutral as it would maintain the status quo. There may be some negative impacts on the *Attitudes, Beliefs, and Values* of members of the groundfish fishery related to the lack of flexibility of management as this would maintain current mortality closures, which are seen by some as no longer needed due to output controls in the fishery.

4.3.3.1.2 Alternatives 2A and 2B

Alternatives 2A and 2B would remove the common pool rolling closure areas, while maintaining the sector rolling closures (and applying them to all vessels with gear capable of catching groundfish) and adding a spawning area in Massachusetts Bay during the fall/winter. Option B would extend spawning area restrictions to recreational vessels.

Options A and B are equivalent in their impact on commercial fishing. The gear currently employed within the bounds of the Massachusetts Bay Spawning Protection Area during the proposed November 1 to January 31 closure period is illustrated in Figure 40. Of particular interest for this alternative is the large portion of the revenue generated by bottom/SAP trawls and sink gillnet. Table 114 provides more detail about the fishing revenue being generated by these gears. For bottom/SAP trawls, a mean per-trip revenue of $382 (3.0% of an average trip's revenue) is estimated to fall within the area closure for the > 70 ft vessel category, for vessels between 50 ft and 70 ft the mean per-trip revenue potentially displaced is estimated to be $942 (12.4% of an average trip's revenue), and for vessels < 50 ft it is $459 (16.1% of an average trip's revenue). Vessels between 50 ft and 70 ft represent 54% of the total bottom trawl revenue estimated for the Massachusetts Bay Spawning Protection Area. The area is estimated to produce a per-trip revenue of $330 (14.4% of an average trip's revenue) for vessels fishing with sink gillnets, with a relatively large number of trips estimated to have fished in the area. Less fishing is conducted using longline, which has a mean per-trip impact of $68 (7.6% of an average trip's revenue), and scallop dredges, for which the < 70 ft vessels average per-trip impact is estimated to be $71 (2.3 of an average trip's revenue) and the > 70 ft vessels recently producing no revenue in the area, although historically this was not always true. Overall, the impact represents 0.3% of bottom/SAP trawl, 0.3% of sink gillnet, 0.03% of longline, and 0.00% of scallop average annual revenue generated from relevant statistical areas between 2010 and 2012 (see section 4.5 of Volume 1 for relevant statistical areas and magnitude of total revenue).

The April – June rolling closures in Alternative 2 are a subset of the current common pool rolling closures. Alternative 2 is thus expected to have a slightly net positive impact on common pool vessels in the short run when compared to Alternative 1/No Action, by increasing their flexibility in fishing location choice. Because these rolling closures already apply to sector vessels (i.e., the majority of groundfish vessels), neutral impacts are expected when compared to Alternative 1/No Action.

Additional year-round habitat closures are being considered for both the central and western Gulf of Maine, which could drastically change the overall impact analyses of this alternative for mobile bottom-tending gear vessels. Nevertheless, as written Alternative 2 would have short-term moderately positive benefits to commercial fishermen, as it would provide access to the current Western Gulf of Maine and Cashes Ledge Closure Areas. However, the long-term impacts are expected to be moderately negative, due to the negative impact on groundfish stocks.

When coupled with the preferred habitat alternatives in the western (Alternative 1, Alternative 7A) and central (Alternative 4) Gulf of Maine, the impacts of Alternative 2A are expected to be neutral to slightly positive in the short-term, when compared to Alternative 1/No Action, with a trade-off between additional flexibility of where and when to fish in the central Gulf of Maine, and the negative impact of the Massachusetts Bay Spawning Protection Area on commercial groundfish fishermen. Conversely the long-term impacts are expected to be neutral to slightly negative, again given the trade-off between decreased long-term benefits in the central Gulf of Maine and increases in groundfish productivity due to the Massachusetts Bay Spawning Protection Area. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly positive impacts, and long-term slightly negative impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

Alternative 2B may impact recreational groundfish fishing when compared to Alternative 1/No Action (Table 115). The average annual revenue is consistently high, with a small number of permits consistently active in these areas. The five permits with the highest revenue estimated to fall within the Alternative 2 areas in the relevant months account for 36%, 34%, and 38% of the total revenue estimates in 2010, 2011, and 2012 respectively (Table 115). Figure 40 indicates that the vast majority of the revenue generated within the Massachusetts Bay Spawning Protection Area is generated on trips that land groundfish. The existing Gulf of Maine Cod Spawning Protection (Whaleback) Area is expected to have a neutral impact as compared to Alternative 1/No Action, given that the management regime does not change between the two alternatives.

The following discussion assumes a positive correlation between the percentage of revenue a management action affects, and the costs of compliance for an individual fisherman. For example, an individual having 100% of their total annual revenue displaced by a management action is assumed to have a higher cost of compliance than someone with 10% of their revenue impacted. In reality, the cost of compliance depends on an individual's next best alternative to recreational fishing in these areas during the time periods of interest. However, this next best alternative is likely different for each individual, and cannot be readily assessed with the data in

hand. On average, the percentage of revenue displaced is assumed to be a good proxy for this unknown cost.

Figure 43 indicates what percentage of each rank group's total revenue, including commercial revenue, would be expected to be displaced by Alternative 2. These percentages are relatively stable across time, with no readily apparent trends. At around 20%, they also tend to be relatively large. This suggests that, in the short-term, Alternative 2B will have highly negative impacts to the recreational fishery when compared to Alternative 1/No Action. In the long-term, impacts are also expected to be negative for the recreational fishery when compared to the Alternative 1/No Action, due to the expected impact on groundfish stocks.

The net impact of Alternative 2B is expected to be negative in the long run when compared to Alternative 1/No Action, given the expected impact on groundfish stocks. However, this determination ultimately depends on what habitat management alternatives are selected in central/western Gulf of Maine, and thus the analysis is highly uncertain in terms of a final determination of net effects.

When coupled with the preferred habitat alternatives in the western (Alternative 1, Alternative 7A) and central (Alternative 4) Gulf of Maine, the impacts of Alternative 2B are expected to be neutral to slightly positive in the short-term, when compared to Alternative 1/No Action, with a trade-off between additional flexibility of where and when to fish in the central Gulf of Maine, and the negative impact of the Massachusetts Bay Spawning Protection Area on commercial and recreational groundfish fishermen. Conversely the long-term impacts are expected to be neutral slightly negative, again given the trade-off between decreased long-term benefits in the central Gulf of Maine and increases in groundfish productivity due to the Massachusetts Bay Spawning Protection Area. All impacts are expected to be slightly larger in magnitude than comparable impacts in Alternative 2A. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly positive impacts, and long-term slightly negative impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be slightly negative. There may be some positive impacts associated with the overall reduction in closed areas and the resulting flexibility and access this gives some commercial vessels. There may be some negative impacts particularly to smaller vessels that fish inshore due to the implementation of the Massachusetts Bay Spawning Protection Area. This will particularly impact the communities identified in Table 116. Additionally, Option B will have a negative impact on communities involved in recreational fishing.

4.3.3.1.3 Alternative 3 (Preferred)

Alternative 3 would designate the Massachusetts Bay Spawning protection area. The discussion under Alternative 2 reviews the expected impacts of the Massachusetts Bay spawning closure area for gear capable of catching groundfish.

The impact of Alternative 3 is expected to be slightly negative in the short-term, as the Massachusetts Bay spawning closure area is situated in an important center of groundfish

fishing. However, given the demonstrated impact fishing has on cod spawning behavior (see section dealing with impact of fishing on cod spawning), the status of the cod stock in the Gulf of Maine (see section dealing with cod stock status), and the economic importance of cod to groundfish fishermen in the Gulf of Maine, the long-run impact of Alternative 3 is expected to be slightly positive when compared to the Alternative 1/No Action. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The short term social impacts of Alternative 3 are expected to be slightly negative, particularly for smaller vessels that fish inshore. This will particularly impact the communities identified in Table 116. Many of these communities have high levels of commercial fishing engagement (See the Communities section of Volume 1). The long term social impacts are expected to be moderately positive if increased protection of spawning groundfish in the Massachusetts Bay Spawning Area leads to increased cod populations. There may be some negative impacts on the *Attitudes, Beliefs, and Values* of members of the groundfish fishery related to the lack of flexibility of management as this would maintain current mortality closures, which are seen as no longer needed due to output controls in the fishery.

4.3.3.2 ***Georges Bank and Southern New England***

Tables and figures related to analysis of the social and economic impacts of the Georges Bank spawning management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 44 – Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip occurred within a period that would provide access to these areas under Georges Bank Spawning Alternative 2.

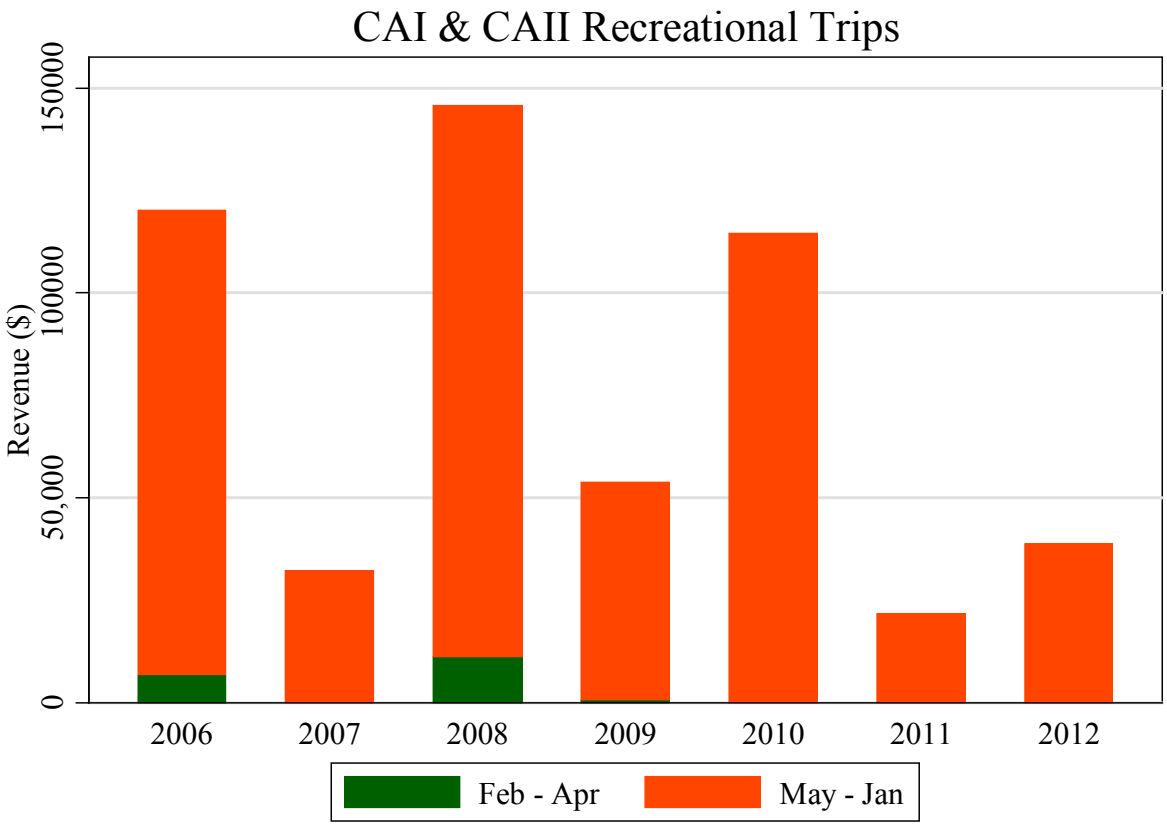


Figure 45 – Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip caught at least one groundfish.

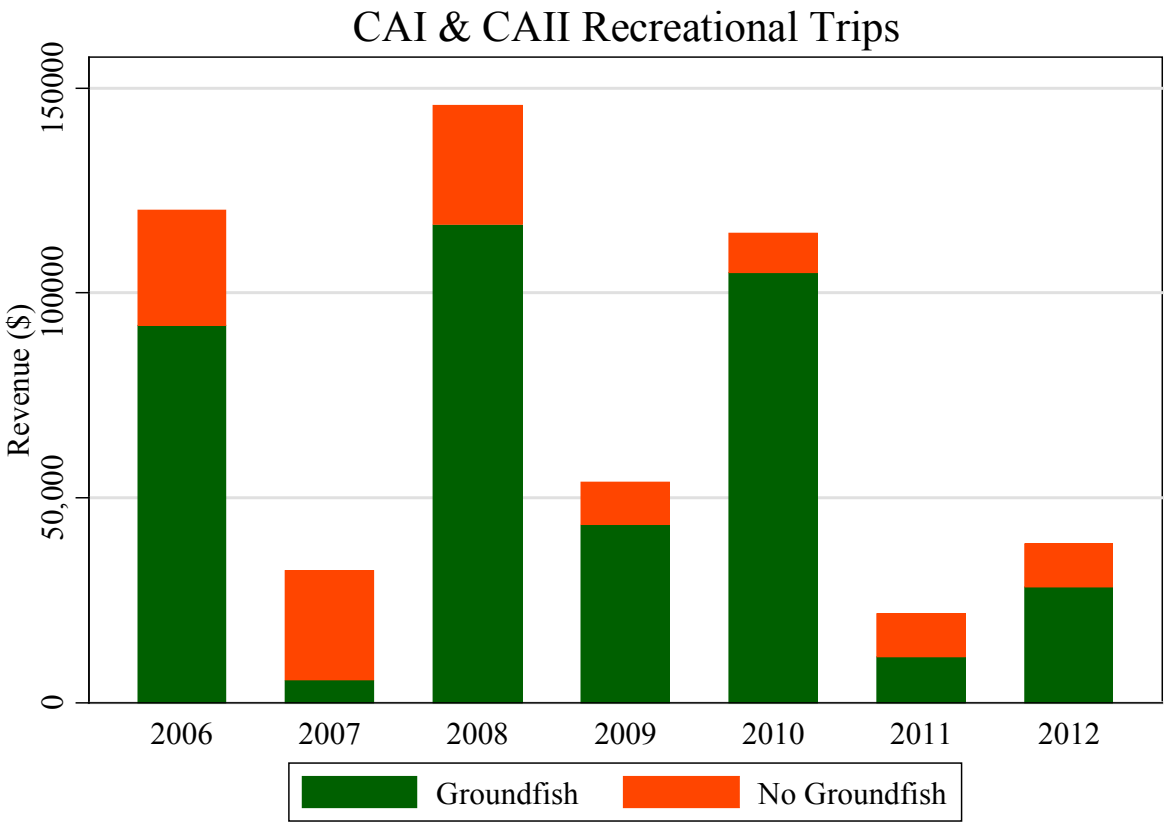


Table 119 – Recreational revenue estimated within a 10 nautical mile buffer of areas within Georges Bank Spawning Alternative 2 currently closed to recreational groundfishing. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, individuals represents the average number of permit holders fishing in the area, and anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate data censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CAIIbuffer	2006 - 2012	-	-	-	-	-	-
CAIIbuffer	2008 - 2012	-	-	-	-	-	-
CAIIbuffer	2010 - 2012	-	-	-	-	-	-
CAIbuffer	2006 - 2012	75,245.64	9.86	409.71	2,002.74	1,117.74	2,394.29
CAIbuffer	2008 - 2012	74,863.38	9.2	406.2	2,354.19	1,117.74	2,604.09
CAIbuffer	2010 - 2012	58,266.78	7.67	320	2,427.78	1,117.74	2,555.87

Table 120 – Total number of Massachusetts permits conducting recreational fishing trips within a 10 nautical mile buffer of Closed Area I (see previous table for revenue estimates). Other states and individual communities could not be identified due to privacy concerns.

Georges Bank		Alternative 2	
State	Community	Port	City
MA		6	5

4.3.3.2.1 Alternative 1 (No Action)

Alternative 1/No Action considers the spawning protections of the existing year round closed areas on Georges Bank and in Southern New England, specifically Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area, as well as the the May Georges Bank Seasonal Closure Area.

Given the expected positive impacts on managed large mesh groundfish through the benefits of current area management to groundfish productivity, there are expected to be positive benefits of Alternative 1/No Action for the groundfish fishery. However, there are substantial costs of taking no action, primarily concentrated in the scallop fishery, which makes the expectation of the overall net impact of Alternative 1/No action negative. If the Closed Area II Habitat Closure Area or a substantial fraction of it is opened by this amendment, and a scallop access area is created in a trailing action, the net impacts would change. Presently, the scallop fishery is exempted from the southern portion of Closed Area II for access area fishing during most of the year, but has not been granted exemptions from the Closed Area II Habitat Closure Area.

The social impacts associated with Alternative 1/No Action are expected to be neutral as it would maintain the status quo. There may be some negative impacts on the *Attitudes, Beliefs, and Values* of members of the groundfish fishery related to the lack of flexibility of management as this would maintain current mortality closures, assuming they are not removed as a result of the habitat management alternatives selected for the Georges Bank and Great South Channel/Southern New England sub-regions. These year-round closures are seen by some as no longer needed due to output controls in the fishery. Given the current vulnerability in the groundfish fishery, impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.3.3.2.2 Alternatives 2A and 2B (2B preferred)

Alternative 2 would retain as spawning closures Closed Area I and Closed Area II during the months of February, March, and the first half of April. Under this alternative, the Nantucket Lightship Groundfish Closed Area and the Georges Bank Seasonal Closures Area would be eliminated.

A general discussion of the benefits of additional access to Closed Area I, Closed Area II, and Nantucket Lightship for the groundfish and recreational fleet can be found in Sections 4.2.3.4.2 and 4.2.3.5.2. Section 4.6.4 details the expected economic impact of Alternative 2 to the scallop fishery.

Options A and B are equivalent for commercial fishermen. Alternative 2 would provide additional access to common pool vessels in all current closures, increasing the flexibility of where and when to fish over Alternative 1/No Action, including access to Closed Areas I and II, the Nantucket Lightship Closed Area, and the May Closure, which is expected to have a positive impact in the short-term. Sector vessels would be provided additional access to Closed Area II, by what amounts to an extension of the Eastern US/Canada Haddock SAP season into January, and providing access to the area between latitudes 41° 30' and 42° 10' May – January within a fishing year. Although there is a current SAP in Closed Area I, it only provides exemptions to demersal longline and tub trawl gear, and even then only to northerly portions of Closed Area I. Alternative 2 would provide additional access for other gear capable of catching groundfish, and extend tub trawl and demersal longline access into the southern regions of Closed Area I during the relevant time periods. The Nantucket Lightship Closed Area would be removed, providing additional flexibility of where and when to fish. The May Closure only applies to common pool vessels not under a Handgear A or Handgear B permit, so positive impacts of increased access would be limited to these vessels. In summary, Alternative 2 is expected to produce slightly positive impacts in the short-term when compared to Alternative 1/No Action, primarily from additional access afforded around Closed Area II, assuming that the scallop fishery is exempted from the area. However, ultimately the full impact of this amendment depends on the cumulative impact of all the alternatives chosen, and thus depends greatly on the habitat alternatives chosen.

Table 117 details the recreational fishing reported within a 10 nautical mile buffer around Closed Areas I and II, for which there is no current demersal groundfish recreational exemption. It is clear that there is a very small number of permit holders currently fishing in these buffer areas. The discussions in Sections 4.2.3.4.1 and 4.2.3.5.1 indicate that only local groundfish effort is likely to be displaced if and when access to Closed Areas I and II would be granted. Under Alternative 2, Option A, some of this effort would be expected to flow into areas currently closed to recreational fishing. Figure 44 indicates that the majority of the revenue generated by trips surrounding Closed Areas I and II occur during periods in which both of these areas would be open to recreational fishing, and Figure 45 indicates that these trips catch groundfish. A neutral to relatively small positive net benefit to the recreational fishery would be expected from providing access to the closures (Alternative 2A), with the majority of the benefit provided by additional access to Closed Area I. Communities associated with these trips in 2012 are all in Massachusetts (Table 120) however due to confidentiality concerns individual communities are not identified.

Table 104 in the habitat section overviews the recreational fishing currently occurring in the Nantucket Lightship closure. The annual averages suggest a very small number of permit holders report fishing within the bounds of the current closure, particularly in recent years. This suggests that Option B would have a neutral impact on recreational fishermen in the short-term, as recreational fishing is currently allowed in Nantucket Lightship. Although any influx of commercial effort could induce gear conflicts, the relatively small amount of recreational effort historically within the bounds of Nantucket Lightship indicate this interaction would likely be insubstantial.

Ultimately the long-run impacts depend to some extent on the final habitat alternatives selected. Regardless, as written the longer run impacts of Alternative 2 are expected to be slightly

positive. The long-run difference between Option A and B are expected to be negligible, given the very small amount of recreational fishing currently reported in and around Closed Area I, Closed Area II, and Nantucket Lightship. The magnitude of these impacts is expected to be slightly smaller than Alternative 3.

The short-term social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be positive. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.3.3.2.3 Alternatives 3A and 3B

Alternative 3 would retain as spawning closures the northern part of Closed Area I and Closed Area II during the months of February, March, and the first half of April. Under this alternative, the Nantucket Lightship Groundfish Closed Area and the Georges Bank Seasonal Closures Area would be eliminated.

A general discussion of the benefits of additional access to Closed Area I, Closed Area II, and Nantucket Lightship for the groundfish and recreational fleet can be found in Sections 4.2.3.4.2 and 4.2.3.5.2. Section 4.6.4 details the expected economic impact of Alternative 2 to the scallop fishery. Alternative 2 above discusses the expected impact of seasonal closures for the entirety of Closed Areas I and II. The fishing effort maps in Volume 1 highlight the clustering of observed and reported effort around the northern edge of Closed Area I, indicating that from the perspective of groundfish the additional access afforded by Alternative 3 likely affords only a marginal increase in benefits when compared to No Action.

Options A and B are equivalent for commercial fishermen. Alternative 3 is expected to produce slightly positive impacts in the short-term when compared to Alternative 1/No Action. The magnitude of this benefit is expected to be slightly larger than Alternative 2, given the additional flexibility in where and when to fish. It should be noted that, when compared to Alternative 1/No Action, long-term economic impacts are expected to be negative for the groundfish fishery given Alternative 3's expected impact on groundfish habitat in particular (see 4.3.2.2.3). The long-term difference between Options A and B are expected to be negligible, given the very small amount of recreational fishing currently reported in and around Closed Areas I and II, and the expectation that the opening of these areas is likely to only displace local effort.

The short-term social impacts of Alternative 3 in comparison to Alternative 1/No Action are expected to be positive. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.3.3.2.4 Alternatives 2 and 3, Option C

Option C would exempt scallop dredge vessels from the February through April spawning closures in Closed Areas I and II. Option C could be selected in conjunction with 2A, 2B, 3A, or

3B. Unless restricted by a habitat closure, scallop fishing could be prosecuted throughout the areas during this window. Within these closures, scallops are concentrated in the central portion of Closed Area I and the northern and southern parts of Closed Area II. Impacts of these alternatives to the scallop fishery are detailed in section 4.6.4.2.2. Option C is expected to induce a slightly positive impact on the scallop dredge fleet, by providing additional flexibility in where and when they can fish. The seasonal closures are not expected to bind the number of trips to either Closed Area I or Closed Area II, but is likely to shift effort within the year.

4.3.4 Protected resources

4.3.4.1 *Gulf of Maine*

Generally, the spawning alternatives prohibit the use of gear capable of catching groundfish, including trawls, gillnets, dredges, and, in some cases, hook and line. Alternative 1/No Action would maintain the current set of "common pool" and "sector" rolling closures, the Gulf of Maine Cod Spawning Protection (Whaleback) Area, and the year-round Western Gulf of Maine and Cashes Ledge Closure Areas. The Western Gulf of Maine and Cashes Ledge Closure Areas are also part of the no action habitat management alternatives in the central and western Gulf of Maine sub-regions.

Alternative 2 would remove the common pool rolling closures and implement the sector rolling closures, which means there would be no rolling closures in March, October, or November, and the April through June closures would be smaller. The new Massachusetts Bay Cod Spawning Protection Area would be closed from November through January. The Gulf of Maine Cod Spawning Protection Area, known as the "Whaleback" area, would continue to be closed from April through June. There are two options under consideration for Alternative 2. Option A would exempt recreational and charter/party fishing from the rolling closure areas, as is currently the case, although recreational groundfish fishing would continue to be prohibited in the Whaleback Area, and would be prohibited in the Massachusetts Bay Cod Spawning Protection Area. Alternative 2 Option B would prohibit recreational groundfishing fishing in all of the spawning protection areas, including the rolling closures.

Alternative 3 would add just the Massachusetts Bay Cod Spawning Protection Area from November through January, but would not change the common pool or sector rolling closures, or the Whaleback Area. The Massachusetts Bay Cod Spawning Protection Area would prohibit the use of commercial and recreational gears capable of catching groundfish, similar to the current restrictions of the Whaleback Area.

Removing the common pool rolling closure areas via Alternative 2A or 2B could lead to a small increase in effort in offshore areas, although the majority (99%) of the groundfish fleet participates in sectors and is already fishing under the action alternative's rolling closures. There is an existing Harbor Porpoise Take Reduction Plan gillnet closure in the portion of the western Gulf of Maine with the highest concentration of porpoises, known as the Massachusetts Bay Management Area (Map 89), as well as seasonal pinger requirements throughout much of the region. As stated above, pingers have a 92 percent success rate at preventing interactions between gillnet gear and porpoises. There may be a slightly negative impact to other protected resources if availability of fishing locations increases; however, the proposed alternatives are not

significant changes from no action. Further, there may be a slightly positive impact to protected resources from the Option 2B alternative that would prohibit recreational fishing in the rolling closure areas by reducing the number of lines in the water during April, May, and June.

The overall impacts of the spawning alternatives on protected resources in the Gulf of Maine are expected to be negligible when compared to the baseline environmental condition.

4.3.4.2 *Georges Bank and Southern New England*

The Georges Bank Spawning Alternatives would result in all (Alternative 2) or part (Alternative 3) of Closed Area I and Closed Area II being closed to gear capable of catching groundfish from February through April 15. Both action alternatives have three options associated with them: (A) exempt recreational and charter/party fishing; (B) prohibit recreational and charter/party fishing; (C) exempt scallop dredges from the spawning closures. As there is relatively little recreational fishing in the vicinity of Closed Areas I and II, the differences between Options A and B would be minimal.

Based on large whale sightings taken from the North Atlantic Right Whale Consortium Database and data obtained through OBIS-SEAMAP (Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations), few large whale sightings have been recorded in this region during December through March. In the spring months, sightings of large whales increase in the vicinity of Closed Area II with highest numbers here appearing to be in May and June. Right whales sightings diminish in the area by August. Humpback and fin whale sightings largely dwindle during the fall. However, it is important to note that these data should be treated as presence-only, and that an absence of sightings does not indicate an absence of animals from the area. Allowing groundfish fishing in Closed Area II outside of February, March, and April may result in increased interaction with large whales.

The impacts would be similar to those discussed above related to the habitat management area alternatives in Georges Bank (Section 4.2.4.4) , when compared to the baseline environmental condition. That is, Alternatives 2 and 3 would have a slightly negative impact on marine mammals relative to Alternative 1/No Action, as the spawning closures do not prevent fishing during times of highest known mammal abundance; and negligible impacts to sea turtles, Atlantic sturgeon, and Atlantic salmon. In addition, vessels would still be subject to the Great South Channel gillnet closure from April through June (Map 88) under the Atlantic Large Whale Take Reduction Plan, which overlaps the northern portion of Closed Area I and would effectively close this area to gillnet gear from February through June. Scallop dredges would continue to be subject to the gear restrictions and requirements that mitigate lethal interactions with sea turtles.

4.4 Alternatives to designate Dedicated Habitat Research Areas

The Dedicated Habitat Research Areas proposed in this amendment (Section 2.3) encompass areas also identified as no action Habitat Closure Areas or candidate Habitat Management Areas. Generally, the fishing restriction measures that would be applied within the DHRAs are similar to those that could be associated with an HMA designation, depending on the HMA option selected. Thus, the following sections may refer back to discussions presented in section

4.1.4.2.1 when discussing the impacts of the DHRA alternatives. Additional discussion presented in this section will focus on any the direct impacts of any additional restrictions associated with a DHRA alternative that were not discussed previously, as well as on the long term benefits that would be associated with the improved understanding gained through research conducted in the DHRAs. Additional discussion of the impacts of these alternatives on non-large mesh groundfish resources, and fishery-specific human impacts, are discussed in section 4.6.

4.4.1 Physical and biological environment

Impacts of DHRA designations on the physical and biological environment will mostly be long term, indirect, positive impacts that stem from an improved understanding of the relationship between habitats and fish survival, growth, and reproduction. This may lead to refined management strategies that promote habitat conservation and stock productivity as it relates to habitat. These positive impacts assume that the DHRAs are used to conduct research that relates to the agenda presented in the introduction to section 2.3; however if they are not, the Alternative 5 sunset provision, if selected by the Council, would trigger removal.

Because the DHRA boundaries are the same as some of the habitat management area boundaries, the figures, tables, and maps in the habitat management area sections of this document (4.2.1) can be referred to for understanding habitat type and vulnerability within each DHRA. Specifically, the Eastern Maine DHRA = Eastern Maine Small HMA, the Stellwagen DHRA = Stellwagen Large HMA, and the Georges Bank DHRA = Closed Area I South Habitat Closure Area. Depending on the habitat management areas selected by the Council, and the fishing restrictions associated with those areas, the fishing restrictions associated with the DHRA designation could be more restrictive. In this case, then the benefits of DHRA designation might be more positive than the benefits associated with the HMA alternative.

Data describing dominant substrate and data support by high versus low energy for each area are provided in Table 121. A summary of diversity indices within each DHRA is provided in Table 122.

Table 121 – Summary of substrate distribution, data quality, and total size of dedicated habitat research areas. Percentages indicate the coverage by area of substrate and data support values are listed in the text.

Area name, type, and region (number of overlapping unstructured grids)	Energy										Data support							Area, km^2
	Low energy					High energy					Low	Moderate			High			
	M	S	G	C	B	M	S	G	C	B	1	2	3	4	5	6	7	
Eastern Maine DHRA (50)	59%		19%	21%								26%	64%	10%				529
Stellwagen DHRA (639)	10%	70%	11%	1%			7%	1%				2%	52%	44%		1%	1%	1185
Georges Bank DHRA (607)		4%				2%	82%	12%				4%	6%	1%	3%	34%	51%	2028

Table 122 – Average diversity indices by DHRA Alternative.

	SPRING				SUMMER				FALL				WINTER			
	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
No Action	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2	20	0.629	0.654	1.660	0	0.000	0.000	0.000	6	0.564	0.603	1.649	2	0.716	0.814	1.952
Alternative 3A	69	0.486	0.539	1.269	13	0.497	0.711	1.544	21	0.498	0.734	1.901	24	0.520	0.551	1.139
Alternative 3B	63	0.496	0.546	1.309	10	0.508	0.697	1.555	19	0.521	0.741	1.951	24	0.501	0.541	1.119
Alternative 3C	59	0.484	0.535	1.261	10	0.508	0.697	1.555	17	0.501	0.729	1.892	23	0.521	0.554	1.143
Alternative 4	14	0.409	0.597	1.393	17	0.334	0.610	1.476	9	0.354	0.437	1.053	1	0.719	0.288	0.830

4.4.1.1 ***Alternative 1 (No Action)***

Currently there are no DHRAs designated. If none of the candidate DHRAs (Alternative 2, 3, and/or 4) are adopted by this amendment, then no action conditions would continue. DHRAs are expected to focus habitat-oriented research activities on particular topics and in particular locations. DHRAs are intended to streamline the permitting process, if the proposed research is in line with the DHRA research objectives. Finally, measures associated with the DHRA designations could afford additional research opportunities that may not be available without DHRA designation. Specifically:

- If the Eastern Maine Small area is not designated as a Habitat Management Area with the Option 1 mobile bottom-tending gear prohibition, the DHRA designation would be the only mechanism for establishing these conditions.
- If the Western Gulf of Maine Groundfish Closure Area is removed, the DHRA designation would be the only mechanism for maintaining no action fishing restrictions on gear capable of catching groundfish and on mobile bottom-tending gear use. The reference area element of this DHRA designation is the only mechanism for creating a no-groundfishing area in the New England region.
- If the Closed Area I South Habitat Closure Area is removed and the Closed Area I groundfish closure is converted to a seasonal spawning area, the DHRA designation in this area would be the only mechanism that would maintain the year-round prohibition on the use of mobile-bottom tending gears.

Thus, depending on the other overlapping management areas selected, and the measures applied within those areas, selecting no action could have indirect negative impacts on seabed habitats and greatly impact both ongoing research and opportunities for future targeted research because the appropriate conditions for conducting research will not be created.

4.4.1.2 ***Alternative 2 (Preferred)***

Designation of the Eastern Maine DHRA is expected to have moderately positive, indirect benefits to seabed habitats via facilitation of research that will improve resource management over the long term.

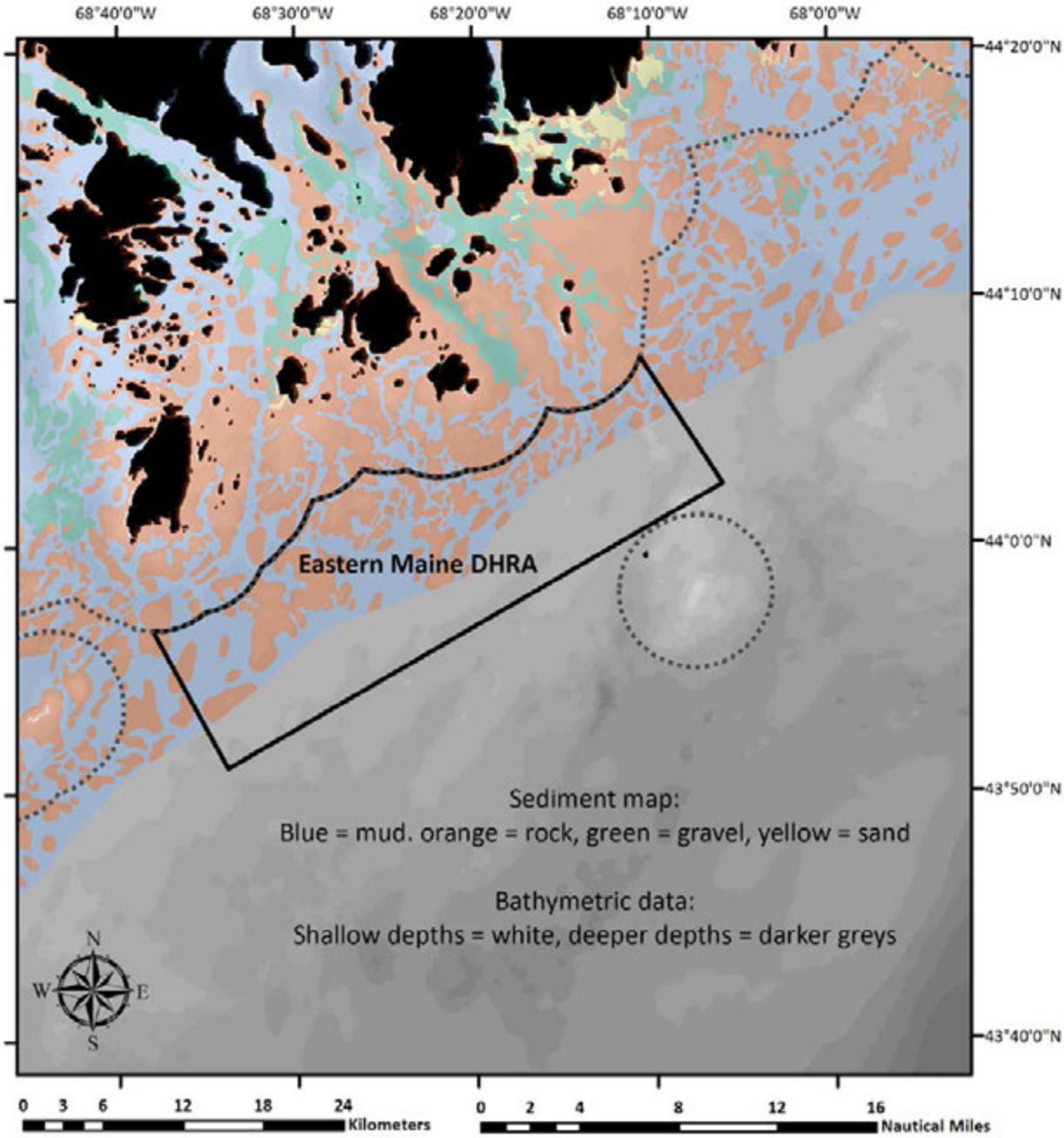
The Eastern Maine DHRA is uniformly low energy, but contains a diversity of sediment types including mud, granule-pebble, and cobble according to the sediment classification developed for the SASI model (Table 121). This sediment classification is moderately well supported as the area has only been sampled with grab-sampling technology vs. visual surveys capable of detecting the largest sediments. A more accurate depiction of bottom type in the area is the Maine Bottom Type data set (Map 101), although these data only cover the inshore portion of the DHRA. The Maine Bottom Type data depict the inshore portions of the DHRA as consisting of bedrock outcrops interspersed with mud. Perhaps ideally the DHRA would include a full range of sediment types, encompassing sand and finer gravels as well as muds and rock, but sand and gravel are generally less commonly found seabed types in the inshore Gulf of Maine (see additional Maine Bottom Type maps in section 4.2.1.1 of Volume 1).

Compared to the other DHRA alternative areas, the Eastern Maine DHRA has relatively high large mesh groundfish diversity index values (Table 122). In the spring, diversity across all species groups (large mesh groundfish, regulated/managed species, and all species) is higher in the Eastern Maine DHRA than in any other DHRA. The Eastern Maine DHRA is not especially well sampled in other seasons, with only six tows in the fall surveys, two tows in the winter surveys, and no tows in the summer shrimp or scallop surveys. The higher large mesh groundfish diversity values are consistent with the potential for the area to serve as a useful research site for examining groundfish recovery in the eastern Maine region. Groundfish recovery is a key study topic in this region, given recent dam removals and expected associated increases in prey availability that are expected to benefit groundfish stocks over the medium to long term.

In terms of baseline data, the area includes longline survey data collected in a sentinel survey conducted during 2010-2013 (most recently summarized in Chen et al.). The broad scale fish surveys covering the region are the Maine/New Hampshire and NMFS bottom trawl surveys, and the longline sentinel survey is intended to complement these data sets. The main purpose of the sentinel survey is to provide indices of abundance and habitat preference information for groundfish species (i.e. cusk, cod, white hake, and Atlantic halibut) in a traditionally important fishing area not well sampled by other monitoring programs. Depth and sediment appear to be key factors determining the catch rates of cod, cusk, white hake, and halibut. Because the survey uses a combination of jigging (inshore of proposed DHRA) and longline sampling, it is able to sample areas that are difficult to survey with bottom trawl gears (i.e. rocky outcrops). The latter two years of the survey were conducted with a stratified random design, and in 2013 jigging was also conducted at many of the longline stations. Survey protocols have become increasingly standardized over time with 2010 and 2011 considered pilot years.

If a DHRA is created in this area in the absence of an overlapping Habitat Management Area, there would be a moderate positive habitat impact.

Map 101 – Sediments and bathymetry in the Eastern Maine DHRA (solid black outline). Dotted line indicates the state/Federal waters boundary at 3 nm and the coastline is depicted in solid black. Source: Barnhardt et al 1998 (sediment) and the Nature Conservancy's Northwest Atlantic Marine Ecoregional assessment (bathymetry).



4.4.1.3 ***Alternatives 3A, 3B, and 3C (3B preferred)***

Designation of the Stellwagen DHRA is expected to have highly positive, indirect benefits to seabed habitats, via facilitation of research that will improve resource management over the long term. The research area is appropriately sited for this purpose, and research in this area would

build on a large number of previous studies. Due to its close proximity to shore, a diversity of habitat types and marine species, and partial overlap with the Stellwagen Bank National Marine Sanctuary, there have been numerous geologic and ecological studies to serve as a baseline for future work. With funding support from the Sanctuary, the U.S. Geological Survey has mapped the area with continuous coverage multibeam acoustics (Valentine et al 2005) and identified boulder ridges using various types of information including topographic and backscatter data, terrain ruggedness index values, and thousands of video and photographic stations (Valentine et al 2005). Some of the boulder ridges are quite large, with the largest tens of meters wide and hundreds of meters long, with a maximum height of 18 m (Valentine et al 2005). The ridges are composed of cobbles and boulders interspersed with voids, and harbor an array of attached organisms as well as various fish species (Valentine et al 2005).

Other studies have focused on the ecology of fishes, their relation to variation in habitat, patterns and variation in biological diversity and the ecological effects of fishing (e.g. Auster et al. 1996, 1998, 2001, 2003a, 2003b; Auster and Lindholm 2005; Grannis 2005, Kropp et al. 2000, Lindholm et al. 2001, 2007, Lindholm and Auster 2003, Nenadovic 2009, Tamsett et al. 2010). In summary, fishes of a diversity of species, including those managed by the Council, exhibit associations with habitat features at multiple spatial scales (i.e., biologic and geologic structural features of the environment from short lived hydroids to long lived sponges as well as textural elements in fine grain mud and sand to boulders, sediment types based on grain size, and regions and seasons defined by temperature and depth). Direct observation demonstrated that in general, the impacts of fishing gear reduce the structural complexity of biologic and geologic habitats and smooth sedimentary bedforms. Removal of habitat features reduce survival of juvenile fishes in laboratory experiments and can have population level effects if such results are scalable to larger areas. Further, these observations suggest the potential for match-mismatch dynamics between short-lived species that function as habitat or principal prey for juvenile fishes in fine-grain sedimentary habitats. While a good deal is known in regards to habitat associations of fish in this area compared to others in the Northeast Shelf Large Marine Ecosystem, actual linkages between habitat attributes and survivorship, growth and productivity of managed species at the scale that management operates remain to be conducted.

Grannis (2005), Nenadovic (2009) and Tamsett et al. (2010) contain detailed results from the Seafloor Habitat Recovery Monitoring Program (SHRMP) that began in 1998 at the time of designation of the Western Gulf of Maine Closure Area. Time series photographic observations of emergent and epifaunal species in mud, sand, gravel and boulder reef habitats, as well as grab samples of infaunal species in fine grain sediments, from inside and outside the closure were collected (infaunal samples 1998-2004, imagery 1998-2010). Overall, species composition was dynamic across years, habitats and fishing treatments (i.e., inside and outside the closure). That is, while community composition was dynamic due to natural variation, the effects of fishing remain clear. While communities inside the closed area are recovering from disturbance due to fishing, the recovery is not progressing as expected from studies conducted elsewhere. Communities to date have not reached a stable “climax” community state, so it is unclear if communities exhibit predictable succession, or are stochastic such that disturbances produce recovery to a new or different state. In regard to fine grained sedimentary habitats, sand infauna appeared to be most resilient to fishing disturbance in contrast to mud infauna, although both mud and sand epifaunal community structure was statistically different between fished and

unfished sites. This project has been (and continues to be) funded by Stellwagen Bank National Marine Sanctuary, which is planning on the project's long-term implementation.

Benthic habitats in this area have also been surveyed with still and video imagery using various ROVs and submersibles from 1984-2010 (NURTEC video archive), the U.S. Geological Survey SEABOSS system, the School for Marine Science and Technology video and still camera pyramid, and the Woods Hole Oceanographic Institution HabCam system (Howland et al. 2006). Coverage from these image sets and associated data sets varies but these can establish baseline conditions across a diverse set of habitats and over time.

The current management regime in the combined Western Gulf of Maine Groundfish and Habitat Closure Areas limits bottom-tending gear as well as fixed gear capable of catching groundfish (i.e., gillnet, longline). Changing the fishing regime in the research area would confound our understanding of this ecological process that is fundamental to our assumptions about recovery used in the SASI model and in a qualitative fashion throughout the EFH management process, which is why this research area is proposed as a closure to mobile bottom-tending gears and commercial gears capable of catching groundfish.

<u>The reference area component specifically will allow research that investigates the ecosystem implications of a no-groundfish-take area. In general, aside from the Ammen Rock HMA which is more restrictive, the most restrictive Habitat Management Area designations proposed in this amendment would prohibit the use of all mobile bottom-tending gear (potentially additional gears capable of catching groundfish in eastern Gulf of Maine Alternative 2), allowing all other forms of fishing. While logical in regards to minimizing adverse effects on EFH, this prohibition alone greatly constrains the utility of DHRA designations in regards to developing knowledge of use in future fishery management decisions.</u>

In addition, there is no opportunity in such a regime to assess and compare impacts of fixed gears with mobile gears under a range of effort and across habitats (or the synergistic effects of different gears in particular habitats) or assess the effects of removal of species that exert effects on seafloor communities in regards to habitat and prey. Fixed gear impacts, and the effects of fish removals, can be significant based on general understanding from current research, at least at small spatial scales (e.g. Steneck et al 2004). Research that parses effects to particular gears, levels of effort and links responses to community state would produce relatively unambiguous results for use in decision-making in regards to habitat conservation for fisheries objectives. Allowing significant removals only by fixed gears and recreational catch would greatly impede work to link habitat condition to productivity of managed species. Despite more than 15 years since the passage of the Magnuson-Stevens Act EFH provisions, we have not significantly improved our knowledge linking the state of seafloor habitats to the productivity of managed species. Existing time series of recovery dynamics in this area are ongoing (after 12 years of continuous monitoring) with no obvious ecological endpoint as yet to understand the dynamics of seafloor habitat recovery in the Gulf of Maine region.

Relative to other locations in the New England region, the Stellwagen DHRA has relatively high diversity indices for large mesh groundfish, and moderate diversity indices for regulated/managed species and all species caught in the surveys (see maps and tables in Volume

1, Section 4.2.3). Values for the DHRA areas only are summarized in Table 122, but the relative diversity of these areas as compared to the range of possible habitat management areas is easier to discern from the table comparing diversity indices across all habitat management areas in Volume 1, Section 4.2.3. This provides a better indication of how species diversity in the DHRA fits within a regional context. The table in Volume 1 indicates that the Stellwagen DHRA (= Large Stellwagen HMA) is at or above the 75th percentile for groundfish diversity in all seasons except the spring. The regulated/managed species diversity indices and the all species diversity indices are at or above the 75th percentile in the summer and fall. Research conducted in the area will have application to a relatively broad array of species given these relatively high diversity indices.

4.4.1.4 *Alternative 4 (Preferred)*

Designation of the Georges Bank DHRA is expected to have moderately positive, indirect benefits to seabed habitats, via facilitation of research that will improve resource management over the long term.

Seabed types in the Georges Bank DHRA are generally high energy, sand- and granule-pebble dominated (Table 121). This area is well-sampled by the video survey so the sediment map developed for the Swept Area Seabed Impact analysis is likely to be an accurate reflection of actual conditions.

Relative to other locations in the New England region, the Georges Bank DHRA has moderate to low diversity indices for large mesh groundfish, regulated/managed species and all species caught in the surveys (see maps and tables in Volume 1, Section 4.2.3). Values for the DHRA areas only are summarized in Table 122, but the relative diversity of these areas as compared to the range of possible habitat management areas is easier to discern from the table comparing diversity indices across all habitat management areas in Volume 1, Section 4.2.3. This provides a better indication of how species diversity in the DHRA fits within a regional context. The table in Volume 1 indicates that the Georges Bank (= Closed Area I North Habitat Closure) is below the 75th percentile for all indices except for large mesh groundfish in the winter survey. This indicates that research conducted in the area will have application to a relatively narrower array of species given these relatively lower diversity indices.

4.4.1.5 *Alternative 5 (Preferred)*

This alternative would implement a sunset provision whereby any DHRA designations implemented by the amendment could be removed administratively after a three year period if specific conditions are not met. To the extent that the possibility of administrative removal encourages earlier and/or more active investment in the research areas, it could lead indirectly to positive impacts on seabed habitats. If the sunset provisions are used to remove a DHRA, this could result in a relaxing of fishing restrictions in the area, which might have negative impacts on seabed habitats. **Importantly, however, if the Council wishes to actively conserve seabed habitats within one of these three areas, they should not use the DHRA designation solely as an indirect approach to implement conservation measures.**

4.4.2 Large mesh groundfish stocks

The discussion below focuses on the expected impacts of Dedicated Habitat Research Area measures on the 19 large-mesh groundfish stocks. Fishing gear restrictions in the DHRAs would affect groundfish habitat and potentially groundfish productivity. Since many of these areas also overlap proposed habitat management areas with impacts as discussed in Section 4.2.2, only the potential incremental effects of special measures for the DHRAs are discussed below. These impacts could arise from the following measures that could apply in the DHRAs beyond what is proposed for the corresponding habitat management areas:

- Prohibitions on additional gears, such as longlines, gillnets, and recreational gears (Alternative 3), and
- DHRA removal if no research is underway (Alternative 5).

A major focus of the research agenda identified for the DHRAs is to assess some of the assumptions and processes applied in the Swept Area Seabed Impact model, i.e. to what extent specific fishing gears impact habitat (gear impacts), how quickly does habitat recover (habitat recovery), the effects of natural disturbance on various types of habitat, and measurement of how habitat changes and recovery impact fish productivity. Research on these topics is expected to have moderately positive, indirect impacts on groundfish resources, because better science is expected to translate into better, more effective management.

The preferred DHRA alternatives include Alternatives 2, 3B, 4, and 5, which would implement a Small Eastern Maine DHRA, a Stellwagen DHRA with the northern recreational closure reference area/reference area 2, a Georges Bank DHRA (southern portion of Closed Area I), and a three year evaluation and sunset period for DHRA designation, respectively. Especially when considered in combination, the preferred alternative provides a contrast in areas and proposes research areas of sufficient size that habitat research conducted in these areas is likely to have a strong positive impact on the ability to productively conserve age 0/1 juvenile groundfish habitat, and potentially improving the groundfish resource.

4.4.2.1 *Alternative 1 (No Action)*

The effects of Alternative 1/No Action are difficult to evaluate distinctly from potential Habitat Management Area impacts discussed in Section 4.2.2. Depending on the habitat management alternatives selected, management conditions appropriate to conducting habitat research may already apply in these areas, such that DHRA designation would not be necessary for creating appropriate conditions for doing habitat-related research.

If the current habitat closures remain in place and new habitat management areas are not adopted, the current impacts on groundfish productivity could continue, possibly with better data if additional monitoring measures are adopted (see description of Monitoring Measures in Section 2.4). However, no newly closed areas would be created to study the initial and sequential recovery of habitat types. If alternative habitat management areas replace current habitat closure areas, the effects of gear impacts in the newly opened habitat closures and groundfish habitat recovery in newly closed habitat management areas could be studied. Whether action or no action habitat management alternatives are selected, the effects of habitat condition and closed

area management on groundfish productivity could be studied given additional monitoring (see Section 2.4). However, it may be more difficult to conduct comparable research in adjacent and similar habitat types and oceanographic conditions.

While possibly not as beneficial as one or more of the DHRA alternatives, the impact of not deliberately designating DHRAs (i.e. No Action) on groundfish habitat and productivity may only be slightly negative.

Tables summarizing groundfish hotspots in each of the DHRAs are provided below and are referenced in the discussions of individual alternatives.

Table 123 – Total number of unweighted and weighted age 0/1 groundfish hotspots by season and DHRA alternative.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
No Action	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
Alternative 2	41	0	0	0	110	229.8	0	0
Alternative 3	24	112.9	6	6.8	17	123.5	1	6.7
Alternative 3A	2	25.1	0	0	2	12.5	0	0
Alternative 3B	0	0	0	0	3	37.6	0	0
Alternative 4	0	0	0	0	0	0	0	0

Table 124 – Total number of age 0/1 groundfish hotspots by species and DHRA alternative.

	Acadian redfish	American plaice	Cod	Haddock	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Grand Total
Alternative 2	34	0	0	0	0	0	62	36	13	3	3	151
Spring	0	0	0	0	0	0	37	0	0	3	1	41
Summer	0	0	0	0	0	0	0	0	0	0	0	0
Fall	34	0	0	0	0	0	25	36	13	0	2	110
Winter	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	23	4	7	1	0	6	5	1	0	1	0	48
Spring	13	0	2	0	0	5	3	1	0	0	0	24
Summer	1	4	0	0	0	1	0	0	0	0	0	6
Fall	9	0	5	0	0	0	2	0	0	1	0	17
Winter	0	0	0	1	0	0	0	0	0	0	0	1
Alternative 3A	0	0	3	0	0	0	0	0	0	1	0	4
Spring	0	0	2	0	0	0	0	0	0	0	0	2
Summer	0	0	0	0	0	0	0	0	0	0	0	0
Fall	0	0	1	0	0	0	0	0	0	1	0	2
Winter	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3B	0	0	3	0	0	0	0	0	0	0	0	3
Spring	0	0	0	0	0	0	0	0	0	0	0	0
Summer	0	0	0	0	0	0	0	0	0	0	0	0
Fall	0	0	3	0	0	0	0	0	0	0	0	3
Winter	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 4	0	0	0	0	0	0	0	0	0	0	0	0
Spring	0	0	0	0	0	0	0	0	0	0	0	0
Summer	0	0	0	0	0	0	0	0	0	0	0	0
Fall	0	0	0	0	0	0	0	0	0	0	0	0
Winter	0	0	0	0	0	0	0	0	0	0	0	0

4.4.2.2 ***Alternative 2 (Preferred)***

This alternative would close the Eastern Maine DHRA to vessels using mobile bottom-tending gear, the same as Eastern Maine HMA Alternative 3, Option 1 (Section 2.1.1.3). The impacts of this alternative on groundfish habitat and productivity are summarized in Section 4.2.2.3.2. The majority of groundfish hotspots across large and small mesh species are for silver hake, white hake, redfish, and windowpane flounder. Weighted hotspots from groundfish observed in the fall surveys (Table 123, Map 38 in HMA section) arise from redfish, windowpane flounder, winter flounder, and witch flounder (Map 59).

It is thought that the effects of habitat management in this area will be synergistic with the effects of dam removal and restoration projects on the Penobscot River. These projects are expected to allow recovery of diadromous prey which could improve groundfish productivity. The interaction between better quality groundfish habitat and improvements in prey availability could be very important.

Setting aside this area for dedicated habitat research, particularly on those projects focusing on groundfish productivity changes, would be beneficial and have positive impacts on groundfish resources compared to Alternative 1/No Action. The impacts on groundfish habitat would be the same as Alternative 1/No Action if the Eastern Maine Small habitat management area already prohibits the use of mobile bottom-tending gear (Option 1), but positive if no habitat management area is designated or if the restrictions in that area are ground cable modifications only (Option 3 or 4). These impacts could be very positive and important for groundfish stocks in Eastern Maine and related fisheries in neighboring communities, in particular.

4.4.2.3 ***Alternatives 3A, 3B, and 3C (3B preferred)***

This alternative would close a Stellwagen DHRA and maintain the existing restrictions associated with the combined Western Gulf of Maine Closure Area and Habitat Closure Area, i.e. closure to mobile bottom-tending gears and other gears that catch groundfish including sink gillnets and demersal longlines. In addition, if Alternative 3A or 3B is selected, a reference sub-area would also be closed to recreational and party/charter groundfish fishing. The Stellwagen DHRA has the same boundaries as the Stellwagen Large area included in western Gulf of Maine habitat Alternatives 3 and 6 described in Section 2.1.3. The impacts on groundfish habitat and productivity by habitat Alternatives 3 and 6 are evaluated in Sections 4.2.2.5.2 and 4.2.2.5.5, respectively.

Map 102 shows the relationship between the weighted age 0/1 groundfish hotspots and the Stellwagen DHRA (purple outline). More survey catch data for cod and haddock age 0/1 and age 2+ sublegal cod and haddock are shown in Map 103 to Map 106.

Compared to Alternative 1 (No Action) which would have no specific habitat research areas, but would have either existing habitat closures or new habitat management areas, Alternative 3 would provide considerable opportunity to test habitat model assumptions and refine future management. This alternative therefore would have moderately to highly positive impacts overall, and also relative to Alternative 1/No Action.

Measures applied to DHRAs may be more restrictive than habitat management area measures which could prohibit or place restrictions on mobile bottom-tending gears. Although gillnets, longlines, and recreational fishing gears are estimated to have fewer impacts on coarse and hard substrates that are vulnerable to fishing damage, they would otherwise be able to capture groundfish in these areas which have benefited from habitat improvement. The higher amounts of juvenile groundfish may either be caught and discarded in the area, be caught at legal size and landed, or (if no or less groundfish fishing occurs in a DHRA) may continue to survive and grow to older age. As a result of the added restrictions, more of the fish would contribute to stock productivity and biomass rebuilding for a longer time until they become vulnerable to fishing elsewhere. Therefore to the extent that the DHRA and/or reference area overlaps the age 0/1 groundfish weighted hotspots (as a measure of groundfish habitat location) and/or distributions of juvenile cod and haddock, this alternative would likely have moderately positive impacts on groundfish habitat and productivity.

Proposed Reference Areas (Alternatives 3A and 3B)

Indirectly, it is likely that the incorporation of potential habitat research, including the effects of groundfish removals from all fisheries, into the management process would produce long term positive impacts on the groundfish resource through more informed and better management practices. These DHRA areas appear to be ideally suited for comparative research with control and experimental designs, although due to the areas' small size the effects on overall stock productivity may be difficult to detect.

Although some localized direct effects on resident populations of groundfish (to the extent that they occur) and on ecosystem function might be realized, these effects as well as population level effects are going to be very difficult to detect. Fishing within the area and in adjacent areas (including potential increased fishing in the Western Gulf of Maine Habitat Closure by vessels using groundfish gillnets, fishing around the border of a closed area, fishing with lobster traps and other gears that catch a small amount of groundfish, and illegal fishing by a few) could potentially overwhelm a detectable signal from reduced groundfish mortality in a 55 nm^2 area.

Although there are more age 0/1 groundfish hotspots inshore of the Stellwagen DHRA (Table 123; Map 102), some groundfish hotspots occur in the proposed area. Although offshore of most of the small juvenile cod and groundfish, the reference areas are closer to the hotspot concentrations of groundfish associated with coarse and hard substrates. Selective research with separate control and experimental areas could explore the association between age 0/1 groundfish hotspots and habitat types. There are few differences between the two reference areas with respect to hotspots (Map 102), sub-legal cod abundance (Map 103), and sub-legal haddock abundance (Map 104).

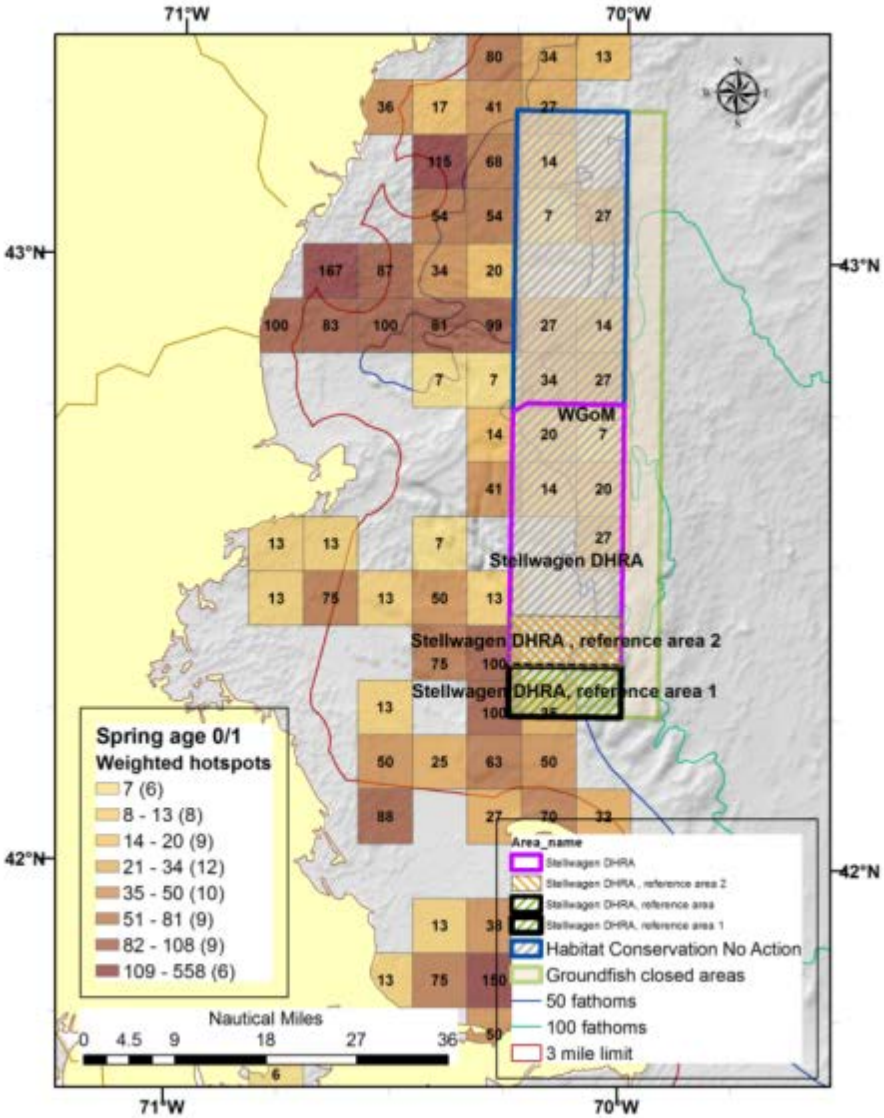
Moreover, such research may address the habitat use by different cohorts of sublegal cod and possibly other groundfish. Many of the smaller age 0/1-sized cod are typically well inshore of the larger sublegal cod in both the spring and fall surveys (Map 103). To a lesser extent, the same is true for juvenile haddock (Map 104). The inshore half of the proposed reference areas appears to contain a higher biomass of legal size cod in both the spring and fall (Map 105), although similar to the amounts of legal size cod found elsewhere in the Stellwagen DHRA (and elsewhere

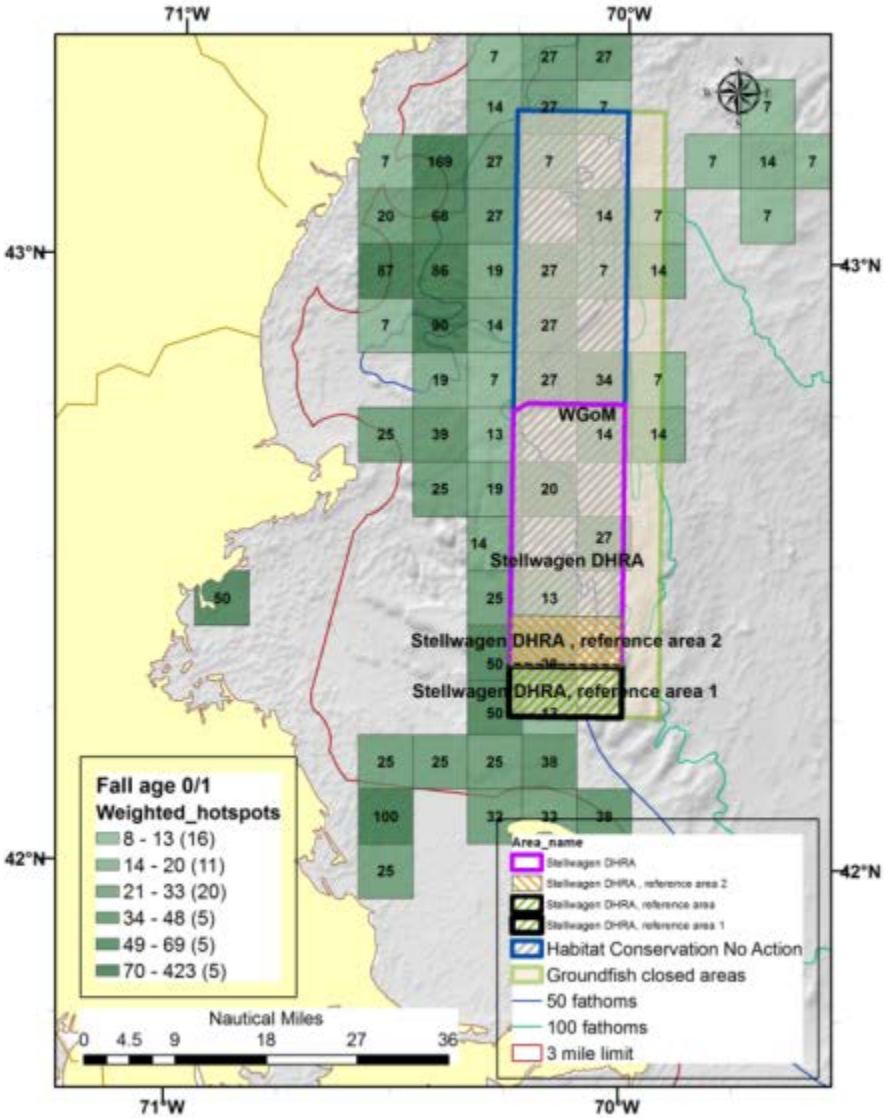
inshore of the Western Gulf of Maine Closure Area). Legal size haddock do not appear to be quite as concentrated on the inshore half of the proposed reference areas (Map 106), but do occur within both.

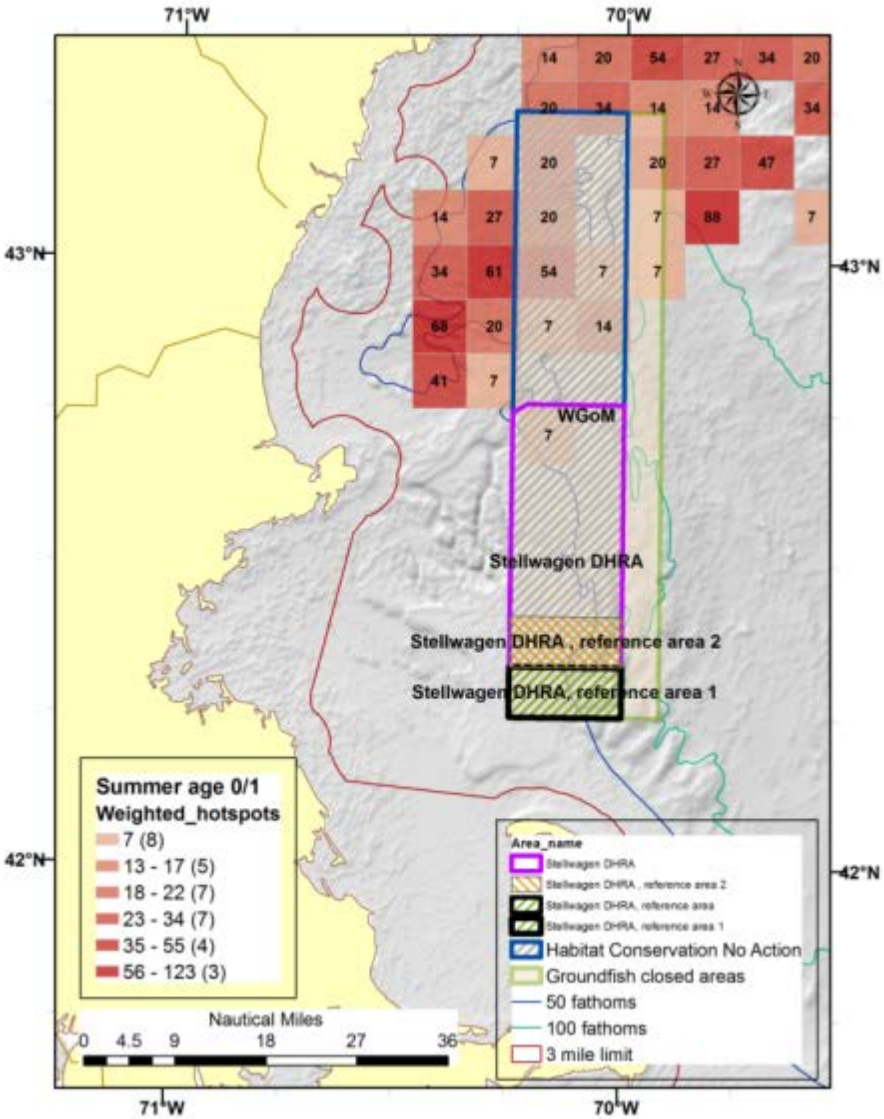
Differences in legal-size cod and haddock survey catches during 2002-2012 are not readily apparent. The area is currently closed to commercial groundfish fishing, but is open to recreational fishing by private anglers and commercial party and charter boats. Map 107 shows the spatial and seasonal (by month) distribution of VTR-reported cod catch per angler on commercial party and charter boats. The data indicate that cod catches are distributed fairly widely through the center of both reference areas. Cod catches in the Reference Area 2 (northern) are a bit more widespread than in Reference Area 1 (southern). If the influence of cod mortality on groundfish habitat and on ecosystem effects is more important, than Reference Area 2 may have a greater probability of producing detectible differences than Reference Area 1.

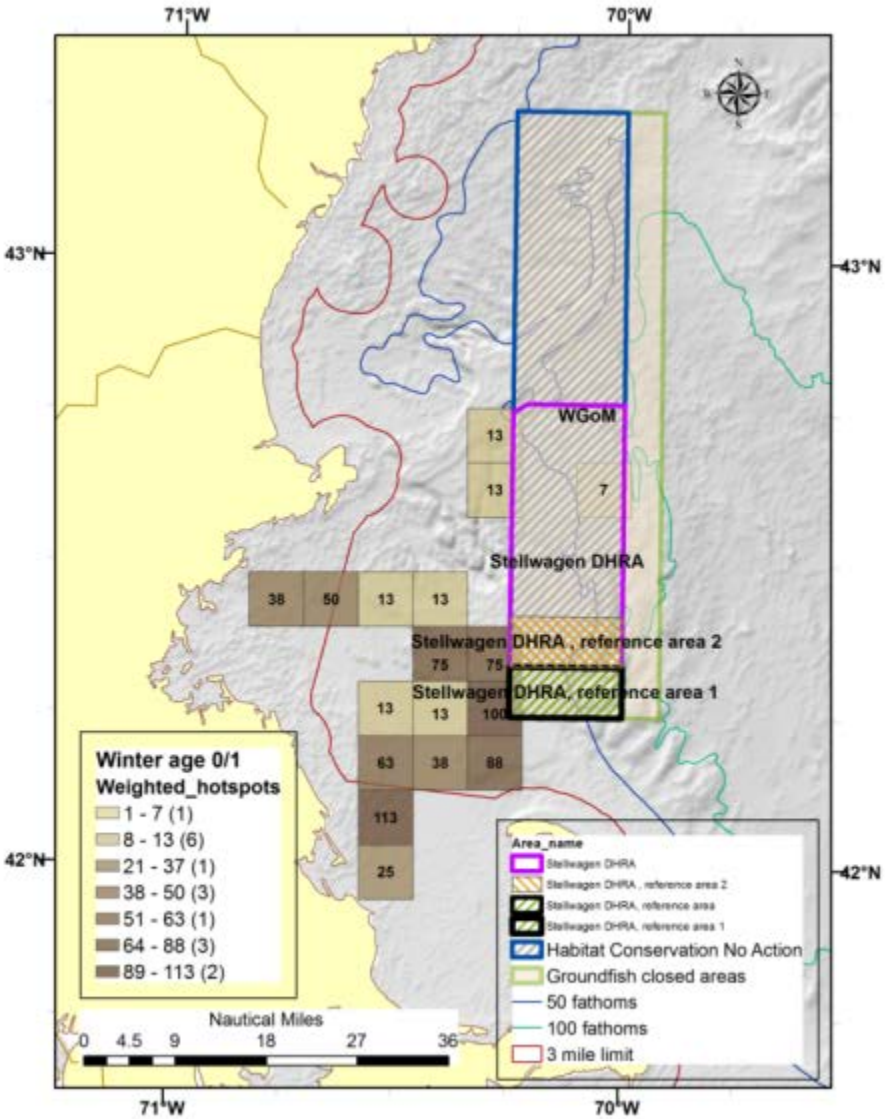
Cautious interpretation of these VTR-reported commercial party and charter boat data should be exercised, however, because many fishermen report one (average) fishing location per trip and do not represent the full range of a trip's fishing activity, much less specifically the locations where cod (or another species) were caught.

Map 102 – DHRA Alternatives 3 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data (continued on next page).

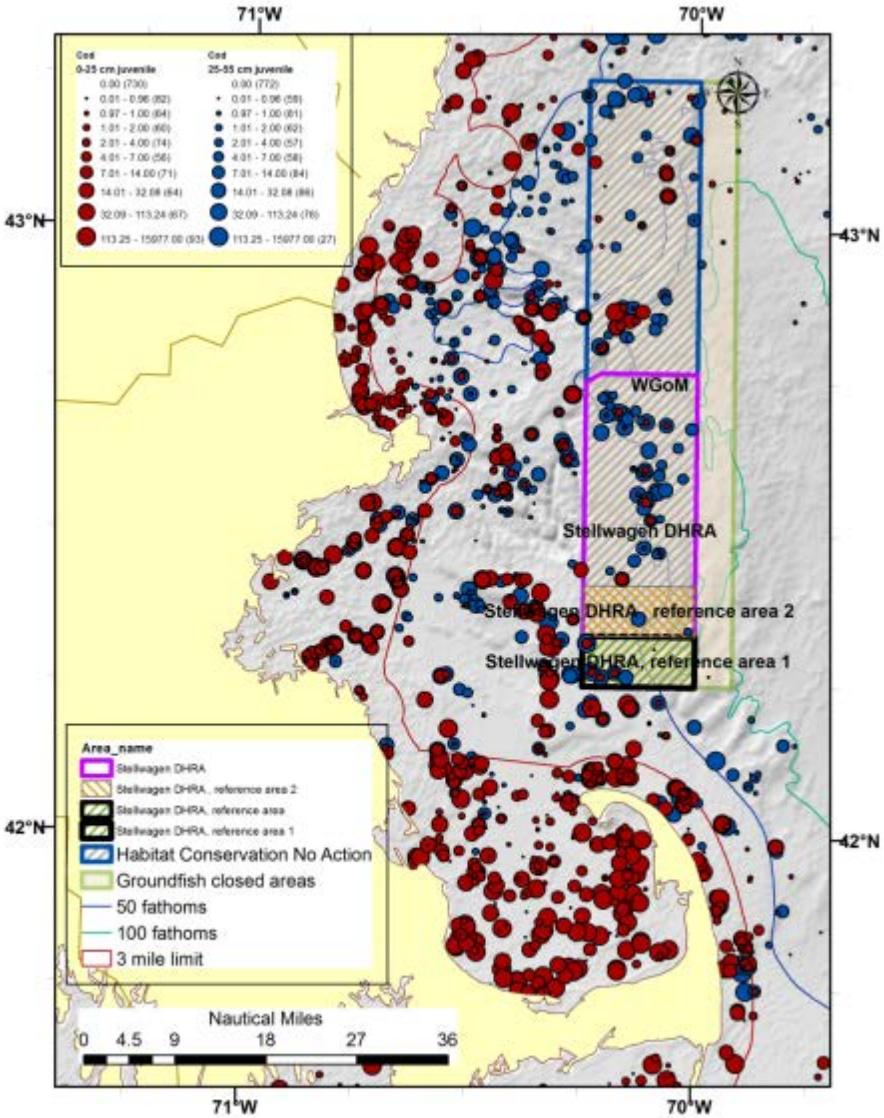


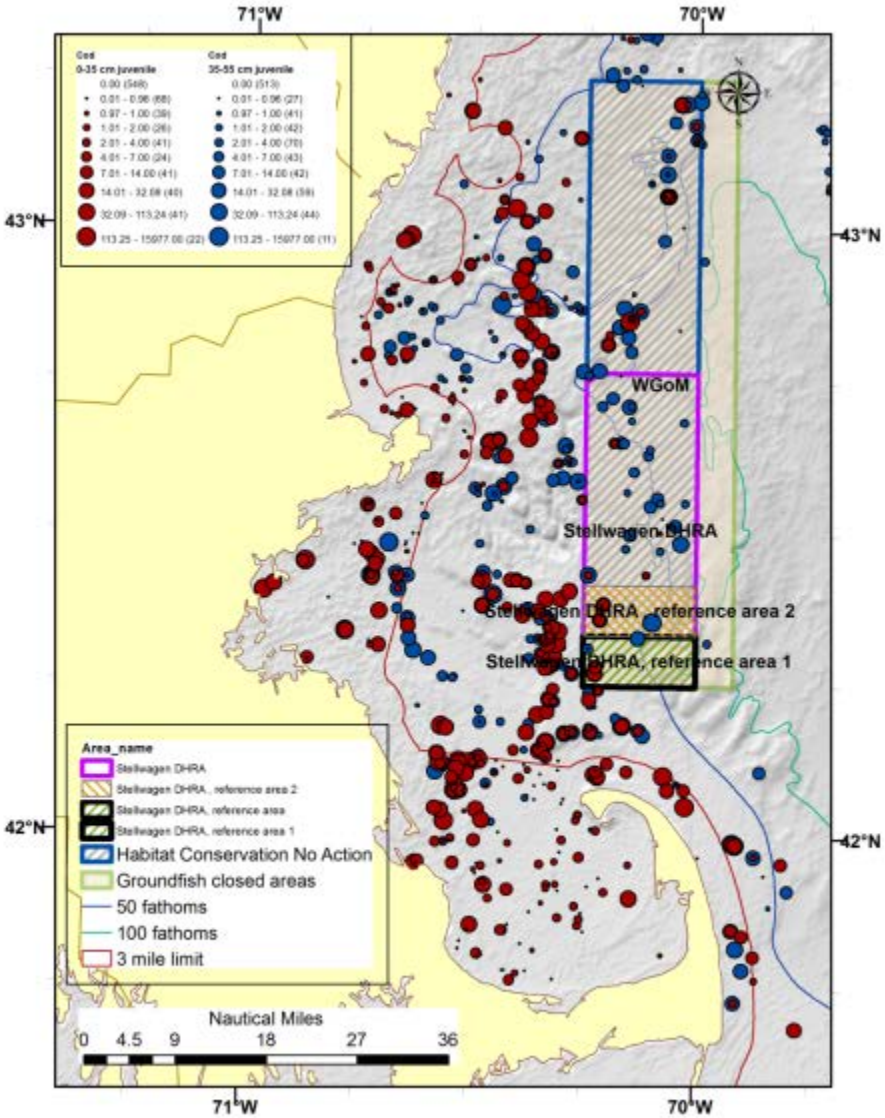



71°W
70°W
43°N
42°N
WGoM
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area 1
Summer age 0/1
Weighted_hotspots
7 (8)
13 - 17 (5)
18 - 22 (7)
23 - 34 (7)
35 - 55 (4)
56 - 123 (3)
Area_name
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area
Stellwagen DHRA, reference area 1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 4.5 9 18 27 36

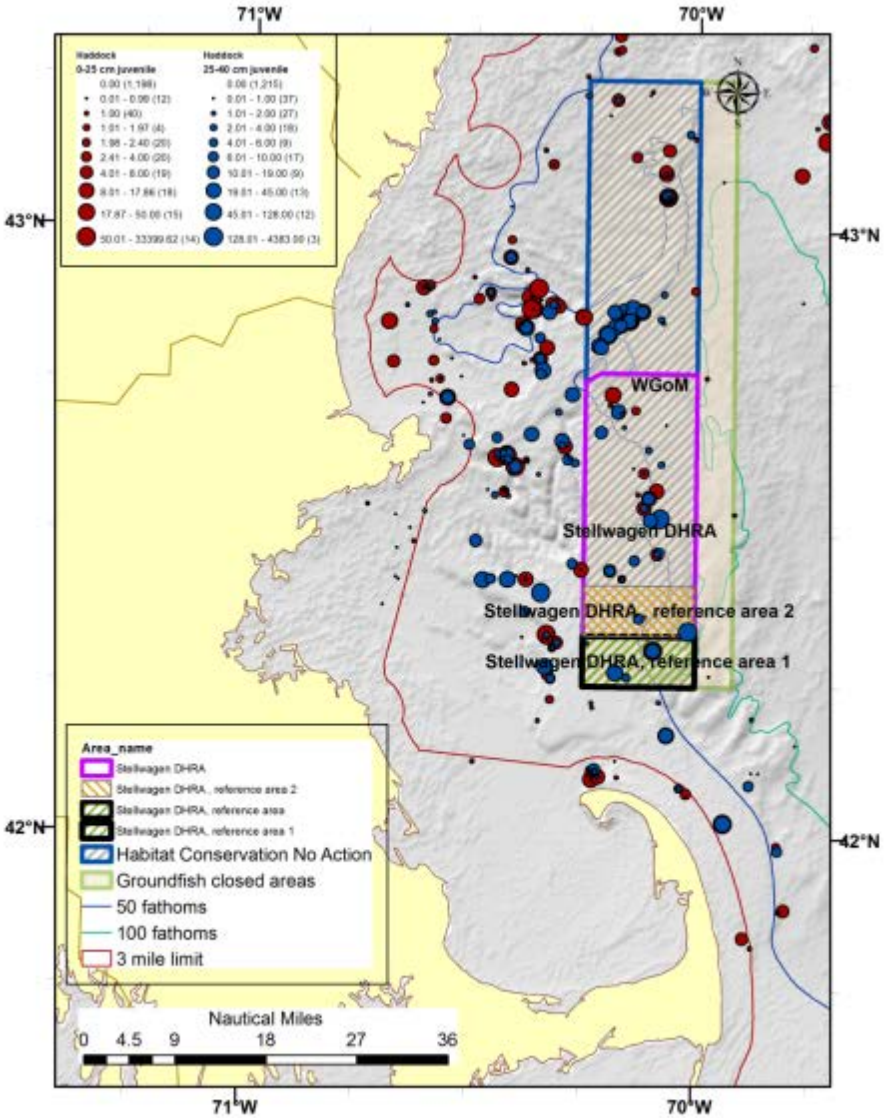

71°W
70°W
43°N
42°N
WGoM
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area 1
Winter age 0/1
Weighted_hotspots
1 - 7 (1)
8 - 13 (6)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Area_name
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area
Stellwagen DHRA, reference area 1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 4.5 9 18 27 36

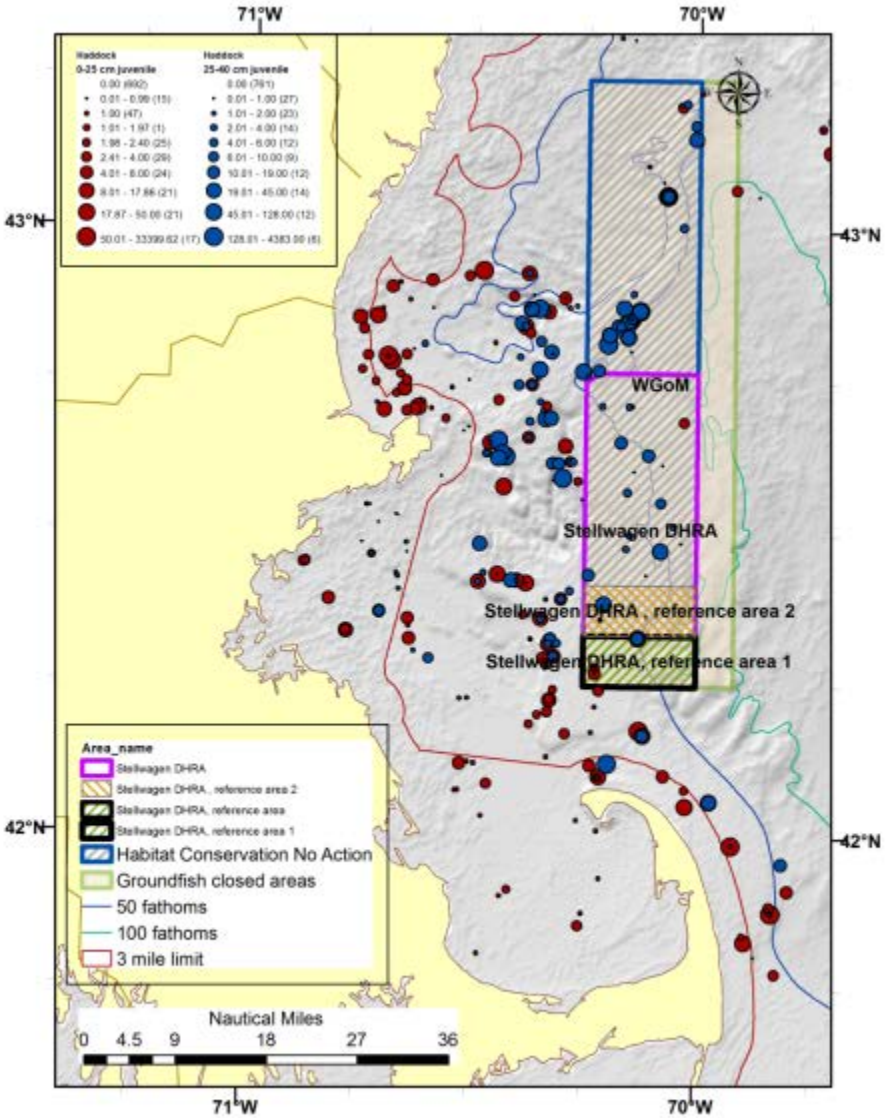
Map 103 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data (continued on next page).



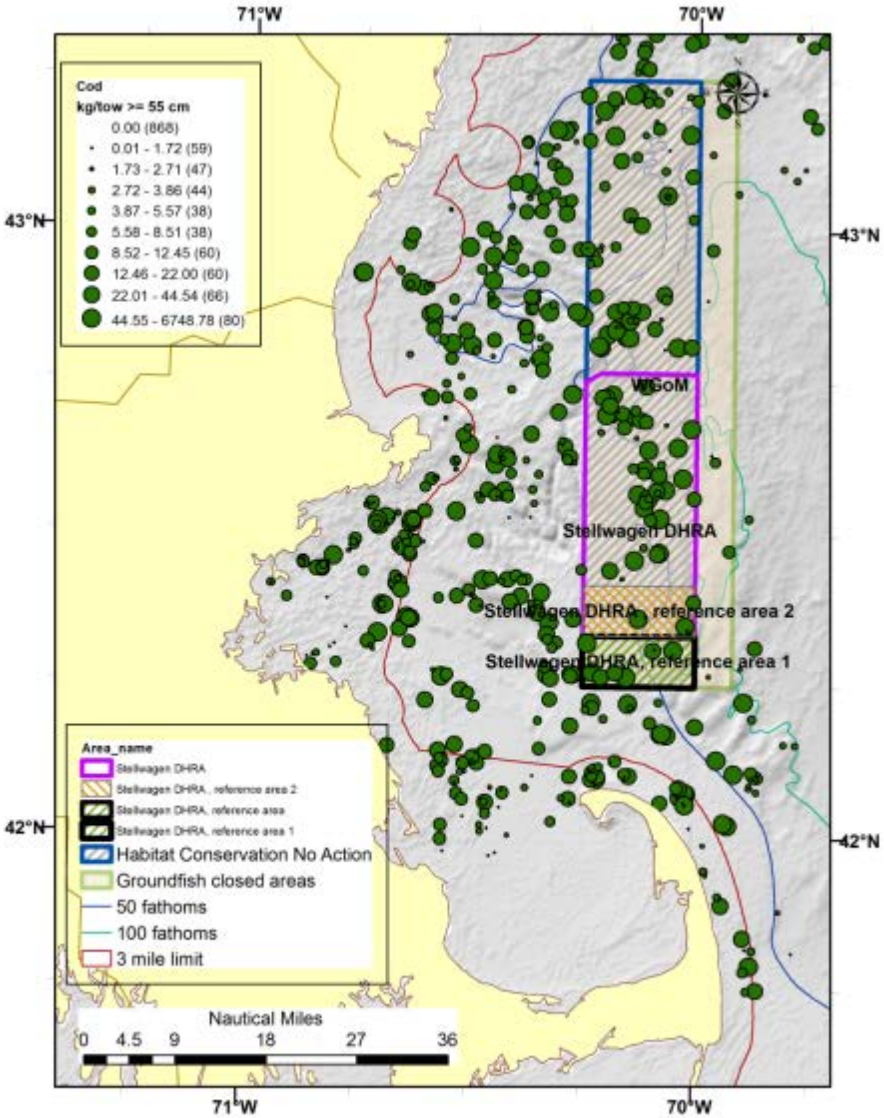


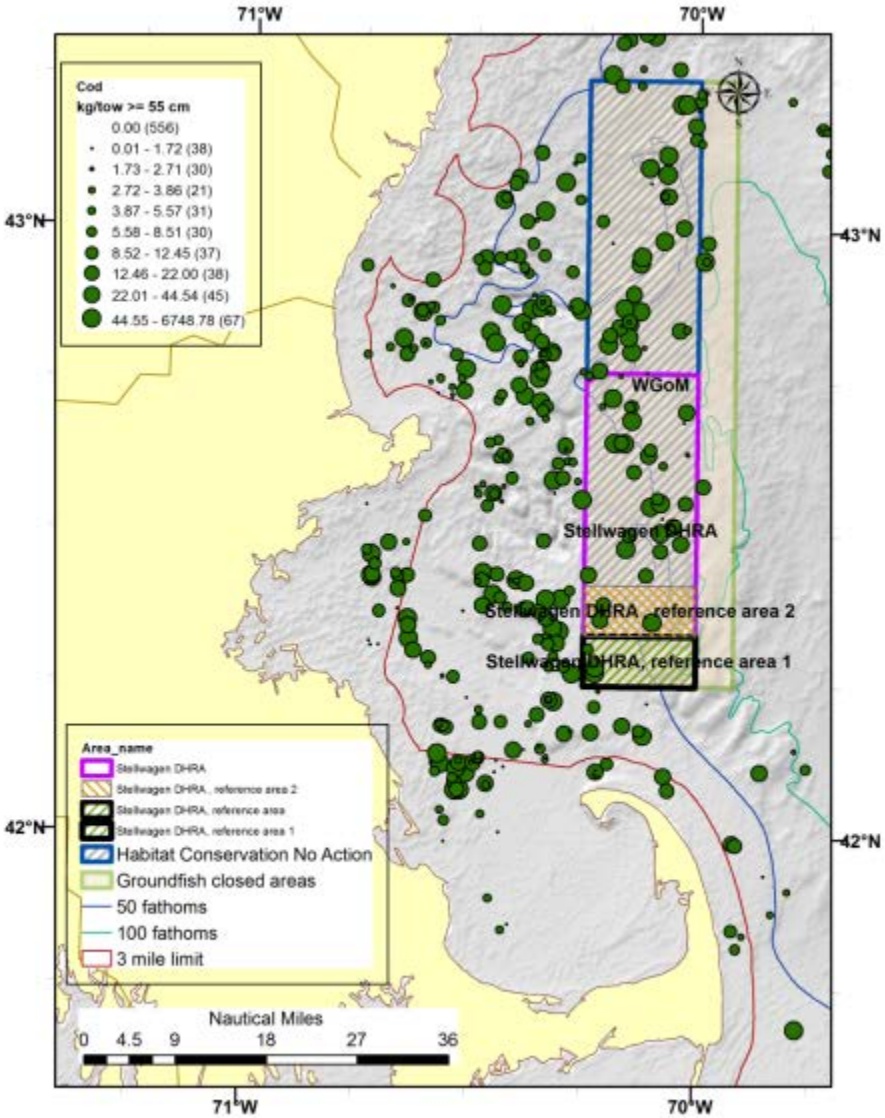
Map 104 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



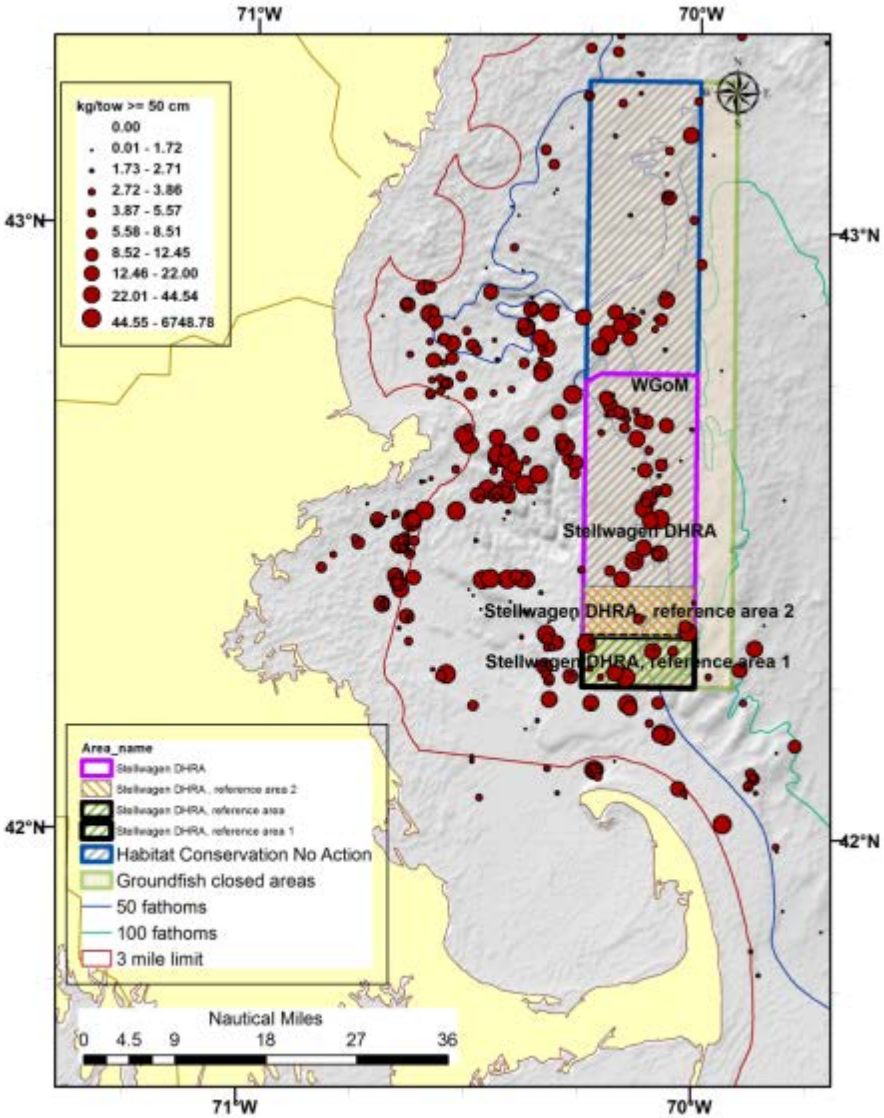


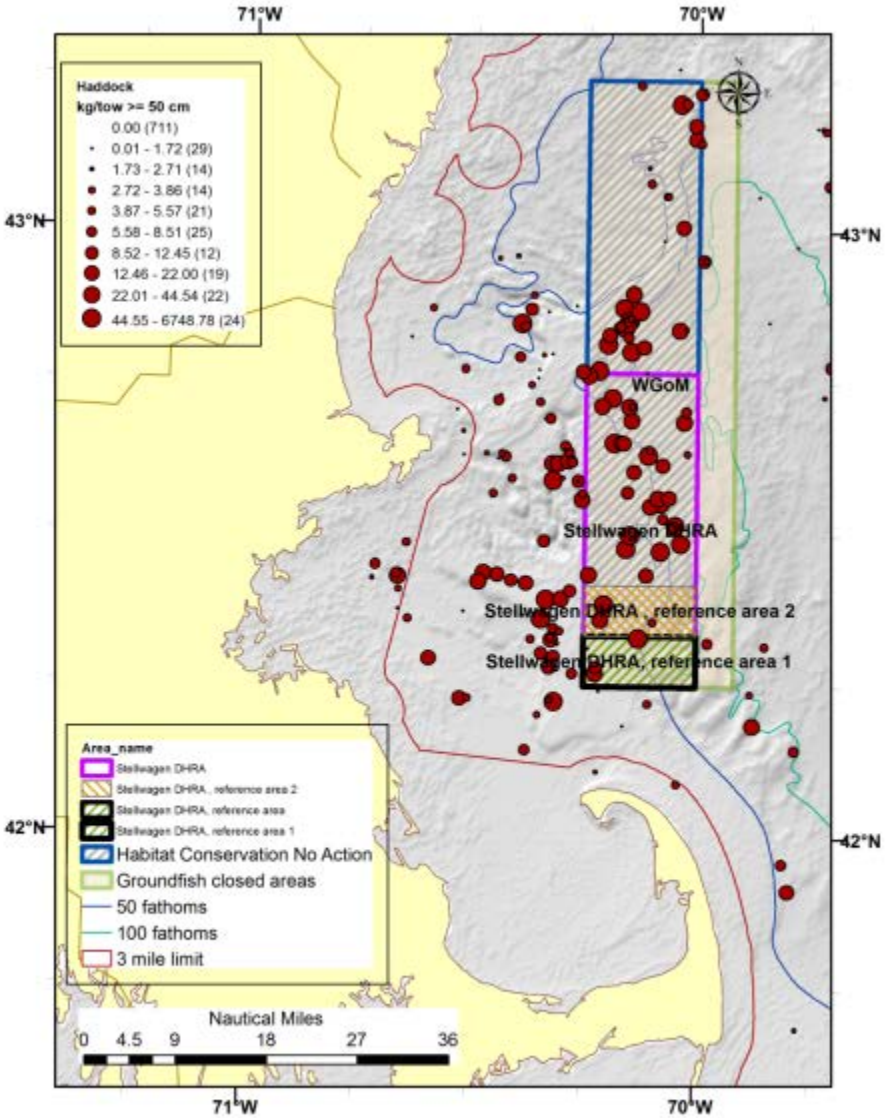
Map 105 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal cod weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



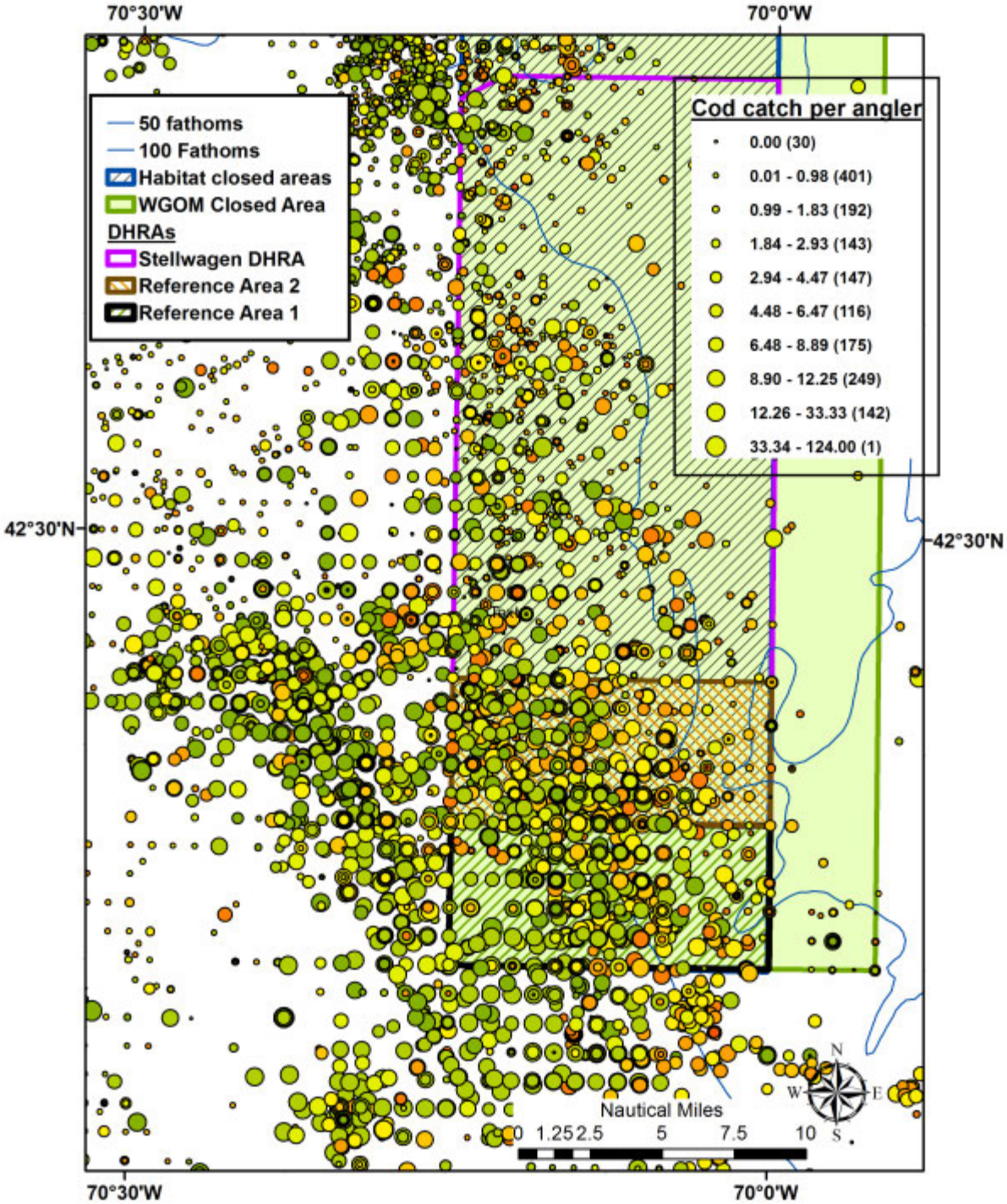


Map 106 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal haddock weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.





Map 107 – VTR-reported cod catch per angler for commercial party and charter boats in the proposed Stellwagen Bank Dedicated Habitat Research Area and Reference Areas, 2008-2012. Catches are color coded by month, Jan (dark green) to August (yellow) to December (red). Each point represents a reported trip.



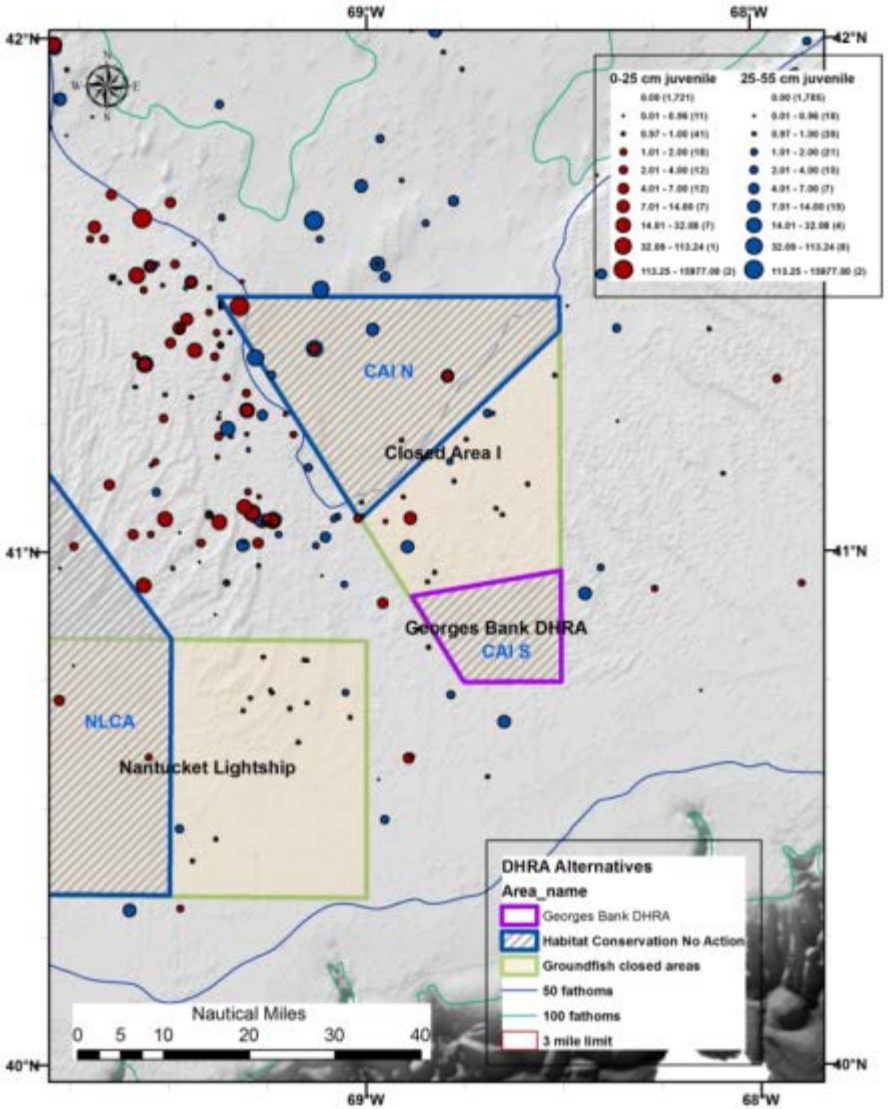
4.4.2.4 ***Alternative 4 (Preferred)***

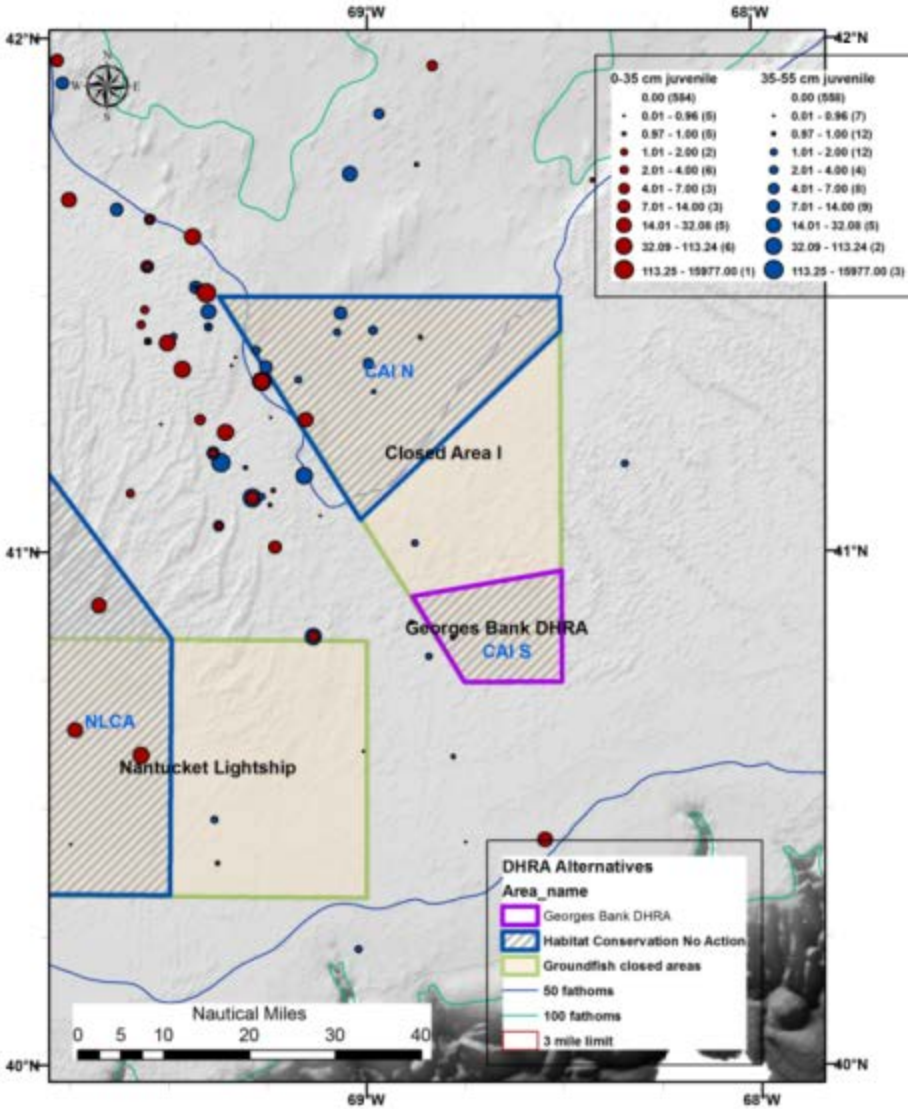
This alternative would establish a Georges Bank DHRA in the southern portion of Closed Area I and is the only DHRA alternative that overlaps a portion of one of the existing year round closed areas on Georges Bank. This area has been closed year-round to commercial gears capable of catching groundfish since a Secretarial action taken in late 1994 and to all mobile bottom-tending gear since 2004 (Amendment 13). Unlike some other Georges Bank closed areas, fishing has not been allowed here as part of a special access program or a scallop access area. The Georges Bank DHRA does not overlap with any of the newly proposed habitat management areas in Section 2.1.4. The DHRA designation would maintain the mobile bottom-tending gear restrictions but other gears capable of catching groundfish could be allowed seasonally if Georges Bank Spawning Alternatives 2 or 3 are selected.

However, this area had no age 0/1 groundfish hotspots (Table 123) which suggests that any positive impact on groundfish habitat and productivity may be low. Looking more broadly at all levels of survey catch of cod and haddock for both age 0/1 and sublegal fish, this DHRA does not appear to be well suited to evaluate the effects of fishing (or not fishing) on groundfish habitat and productivity. Age 0/1 and large sub-legal cod (Map 108) and haddock (Map 109) are less abundant in this area than in other portions of Closed Area I or in the open fishing areas of the nearby Great South Channel.

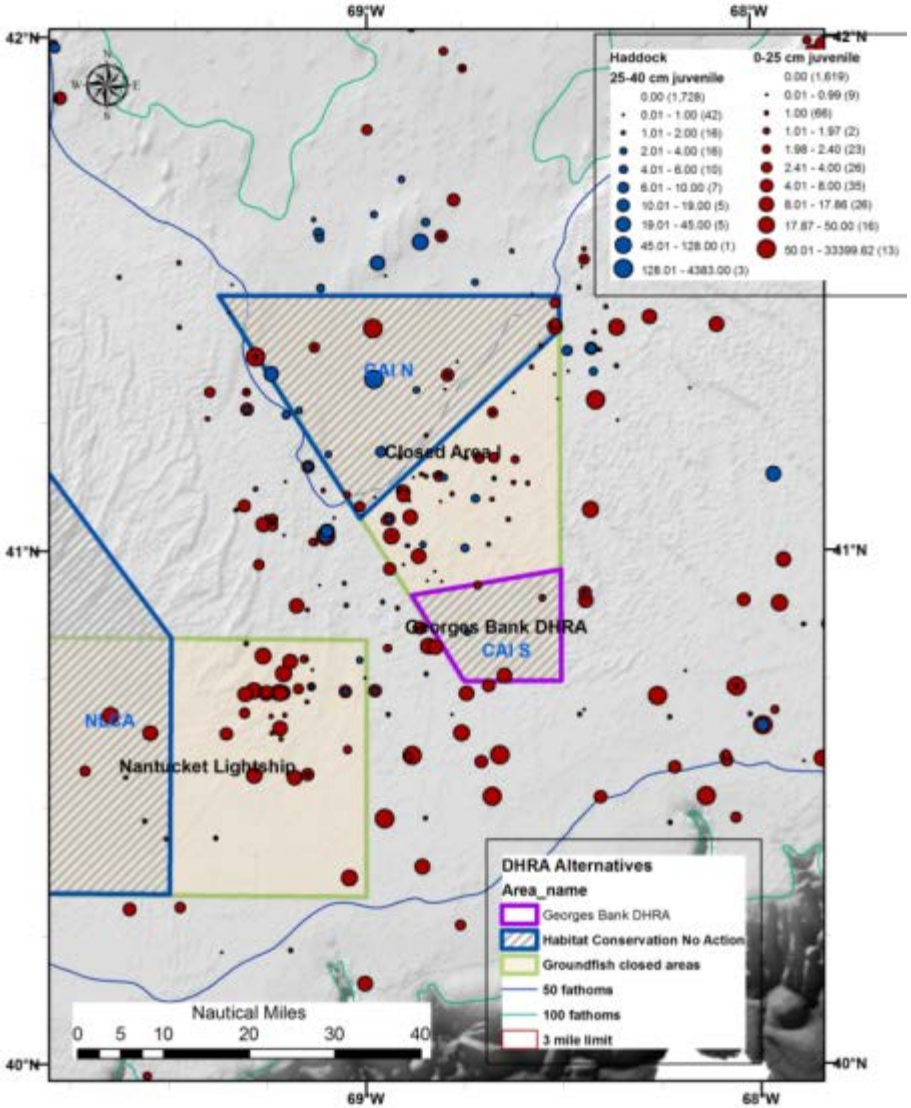
<u>Relative to Alternative 1 (No Action), the impacts on groundfish habitat and productivity are slightly positive, but potential benefits for the groundfish resource are lower than those expected from Alternatives 2 and 3.</u>

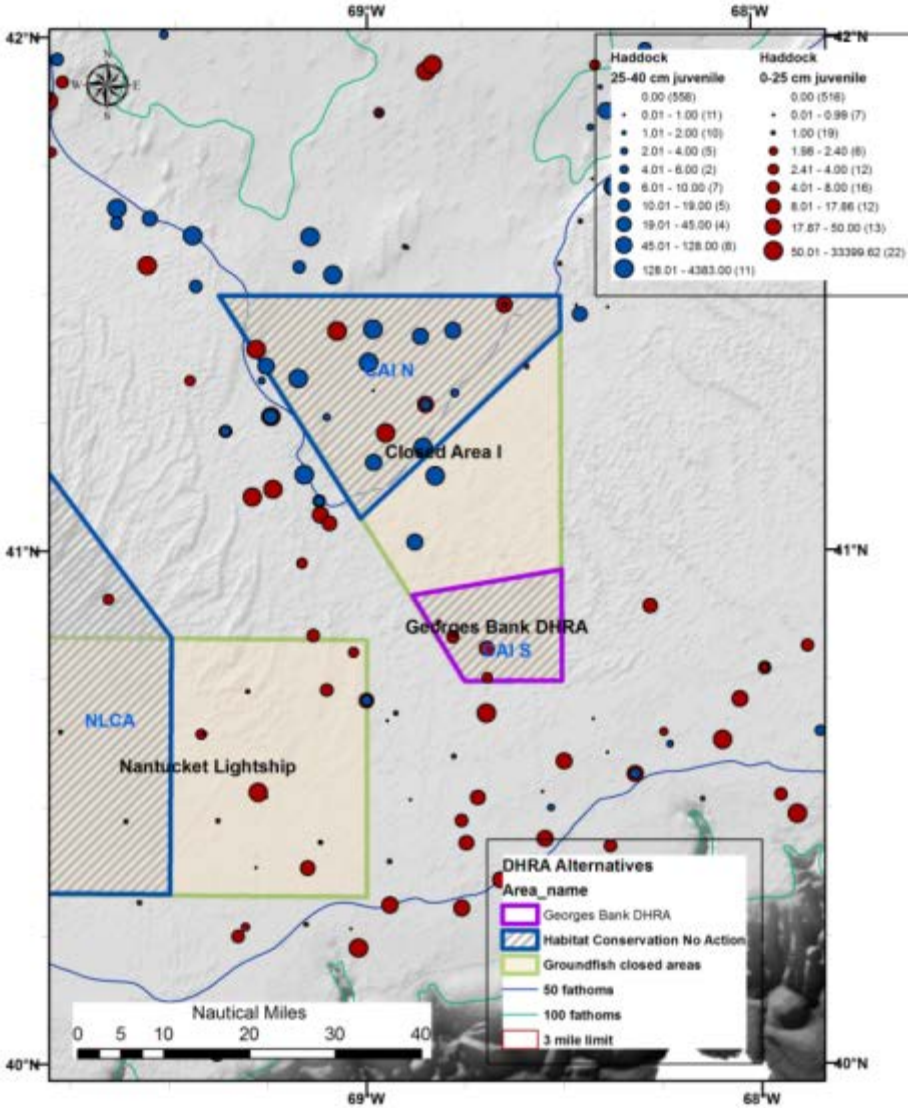
Map 108 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS survey data.





Map 109 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS survey data.





4.4.2.5 ***Alternative 5 (Preferred)***

This alternative would implement a sunset provision whereby any DHRA designations implemented by the amendment could be removed administratively after a three year period if specific conditions are not met.

This alternative would only have direct impacts on groundfish habitat or productivity if the fishing restrictions associated with the DHRA designation improve protection of groundfish stocks on top of positive impacts associated with habitat or spawning management area restrictions, which presumably would remain in place longer than three years. In the Stellwagen DHRA, resuming fishing with sink gillnets, longlines, and recreational gears could reverse any gains in productivity that had been achieved through the DHRA, although in the Eastern Maine and Georges Bank areas, fixed gears capable of catching groundfish would be allowed under DHRA management. More importantly, long term monitoring of how groundfish habitat is affected by fishing and how recovered/recovering habitat translates into productivity improvements could be compromised.

Relative to Alternatives 2, 3, and 4 with an unrestricted implementation timeframe, Alternative 5 has a moderately negative impact, but relative to Alternative 1 (No Action), it has a moderately positive impact because there would be at least a three-year opportunity to conduct groundfish habitat research.

4.4.3 Human communities and the fishery

Many of the general social impacts of the alternatives to designate Dedicated Habitat Research Areas are similar to those discussed earlier regarding the impacts of habitat and spawning management alternatives. Although the purpose of these actions differ (protecting habitat and researching the effects of fishing across habitats respectively) the effects on communities of closing and opening areas to different types of fishing are similar.

Additional social impacts associated with the DHRA alternatives include impacts on *Attitudes, Beliefs, and Values*. Fishermen generally have an inherently different view of the ocean and its fisheries than the views held by ocean/fisheries scientists. Closing access to fishing areas in the name of science and research, which many fishermen consider flawed, could create further mistrust in management. Alternatively, many fishermen feel that scientists know little about the effect of closed areas and gear modifications on habitat and groundfish. Conducting research to better understand these effects may improve the perceptions of spatial management in the future, having positive impacts on the formation of *Attitudes, Beliefs, and Values* about management.

The specific impacts of each alternative will be discussed in the following sections. These are very uncertain and will depend upon the other spatial management alternatives selected.

4.4.3.1 ***Alternative 1 (No action)***

Currently there are no DHRAs designated in the region. Under Alternative 1/No Action, this would continue and DHRAs would not be designated as part of this amendment. The impact of Alternative 1/No Action ultimately depends on the habitat management alternatives selected.

DHRA Alternative 1/No Action is expected to have a neutral to slightly negative impact on fisheries management, as the DHRAs themselves are designed to provide a streamlined process by which scientists can develop the knowledge needed by managers to more effectively and efficiently manage the habitat impacts of fishing.

The social impacts of Alternative 1 are expected to be neutral. There may be positive impacts on the formation of *Attitudes, Beliefs, and Values* about management if new research is conducted to better understand the effect of closed areas and gear modification on habitat and juvenile groundfish, however some of this research could be undertaken in currently closed areas without implementing any DHRAs. Additional types of research work may be facilitated by implementing DHRAs, e.g. mobile gear research in habitat management areas, and this type of research would not generally be possible without the DHRA designation, although there is not an ability to restrict "scientific research on scientific research vessels".

4.4.3.2 ***Alternative 2 (Preferred)***

Alternative 2 would designate a Dedicated Habitat Research Area in the eastern Gulf of Maine. Gear exclusions, and thus economic impacts, of DHRA Alternative 2 are equivalent to the impacts identified for the Small Eastern Maine HMA in the Eastern GOM Alternative 3. The exclusions would primarily impact shrimp/bottom trawl fishermen, although the revenue estimates, though not insignificant, suggest that the area encompassed by the Eastern Maine DHRA is not a major center of fishing even for these gears.

In comparison to Alternative 1/No Action, short-term impacts are expected to be slightly negative given the above, with long-term slightly positive benefits expected from improved resource management. The magnitude of the long run benefits ultimately depends on the quality and quantity of scientific research being generated from the DHRA. Given the large body of knowledge already accumulated on the area encompassed by Alternative 3 (and detailed in Section 4.4.1.3), and the historical exclusion of mobile bottom-tending gears from the existing Western Gulf of Maine and Closed Area I habitat closures, the magnitude of the positive benefits generated by Alternative 2 are expected to be smaller than Alternatives 3 and 4. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be slightly positive. While there may be slightly negative impacts in the short-term particularly to communities in Maine from closing access to this inshore area, the potential benefits of researching this area given current dam removal and restoration projects on the Penobscot River are expected to have moderately positive social impacts in the long-term if there is a better understanding of the interaction between better quality groundfish habitat and improvements in prey availability.

4.4.3.3 ***Alternatives 3A, 3B, and 3C (3B preferred)***

Alternative 3 would designate the Stellwagen DHRA with a reference area along the southern border (Option A), a reference area shifted five nautical miles north (Option B), or no reference area (Option C).

The reference areas (Options A and B) would exclude recreational groundfish fishing. The analysis below focuses on charter and party vessels for which spatial data at the trip level are available (i.e. Vessel Trip Report data). Although it is highly likely that private vessels will be impacted by the reference area options that exclude recreational groundfish fishing, there is no data that allows us to gauge the magnitude of this impact either quantitatively or qualitatively.

Option A excludes recreational groundfish fishing from the southern DHRA reference area. Figure 46 summarizes the number of trips in this southern reference area, grouped by whether groundfish were caught on the trip or not. The majority of trips reported to have occurred within the southern reference area land at least one groundfish, which suggests that almost all trips occurring within the reference area would be affected to some extent by this alternative.

Figure 47 presents the total revenue estimated to have been generated from trips within the southern reference area, delineated by a ranked grouping of 5 permit blocks. The graph indicates that the 5 permits with the highest revenue estimated to fall within the southern reference area account for 63% of the total revenue estimates in 2011 and 2012. The revenue in 2010 seems to have been only slightly more diffuse, with 51% of the revenue share generated by the top 5 permits.

Figure 48 indicates the average percentage of each ranked group's total revenue, including commercial revenue, that the recreational revenue within the southern reference area represents. Group 1 generates the highest annual revenue within the reference area, and the percent of total revenue that this fishing represents remains relatively constant 2010 – 2012, between 20-30% of total revenue each year. When 2012 is compared to 2010, there are fewer groups in 2012, and for the groups with the smallest revenue the percentage of total revenue coming from the reference area is lower.

Table 125 presents a longer-term summary of trips falling within the southern reference area. The statistics indicate that a slightly higher number of permit holders are currently using the reference area when compared to the longer-run averages, with an annual average consistently less than 40 permits. However, most of the other statistics are lower in the last three years when compared to longer run averages. In general, there does not seem to be a recent substantial increase in dependence on the reference area from historical patterns.

<u>Taken together, the data suggest that the southern reference area is used intensively, and consistently, by a relatively small number of charter and party permit holders. The recreational revenue generated from the trips in southern reference area catching groundfish is a substantial portion of these individual's total fishing income, and thus the exclusion of these individuals from the reference area is likely to have a highly negative impact for these individuals, when compared to no action, or to a designation of the research area without the reference area (Option C).</u>

Table 128 identifies the communities associated with recreational trips in 2012. These are all associated with Massachusetts, however it should be noted that both Gloucester and

Newburyport have a high level of engagement in recreational fishing and are likely to be more affected by these impacts.

Other fisheries are not impacted by the DHRA Alternative 3 Option A, when compared to Alternative 1/No Action. However, given that habitat Alternatives 2 – 7 in the western Gulf of Maine could change area management in that sub-region, the designation of the DHRA could have a broad range of economic impacts depending on the final habitat alternative chosen. A sense of these impacts, and their magnitude, can be gleaned from the economic impacts discussion of western Gulf of Maine habitat Alternative 6, with the caveat that commercial non-mobile bottom tending gear capable of catching groundfish would also be excluded from the DHRA.

In the long-term, benefits are expected to accrue to all groundfish fisheries through more informed, and ostensibly better, management decisions. Option A is thus expected to generate a slightly positive benefit when compared to no action, with concentrated costs accruing to a small number of recreational fishermen in the short-term, and diffuse positive benefits in the form of improved groundfish management in the long-term. The benefits are expected to be larger than Option B, given the higher revenue estimates presented in Table 126 and Figure 50 and Figure 51 for the Option B reference area. However, substantial uncertainty exists regarding both the benefits and costs of these options, as they ultimately depend on the quality and quantity of scientific research being generated from the DHRA and the ability of fishermen to change their fishing practices/location. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The social impacts of Alternative 3 Option A in comparison to Alternative 1/No Action are expected to be positive. However there may be negative impacts related to the recreational fishery which is heavily reliant on this area. This will particularly impact communities on the South Shore of Massachusetts Bay and Cape Cod (Table 128).

Figure 46 – The total number of recreational trips (party and charter) reported within the southern reference area, grouped by whether at least one groundfish was caught on the trip. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012.

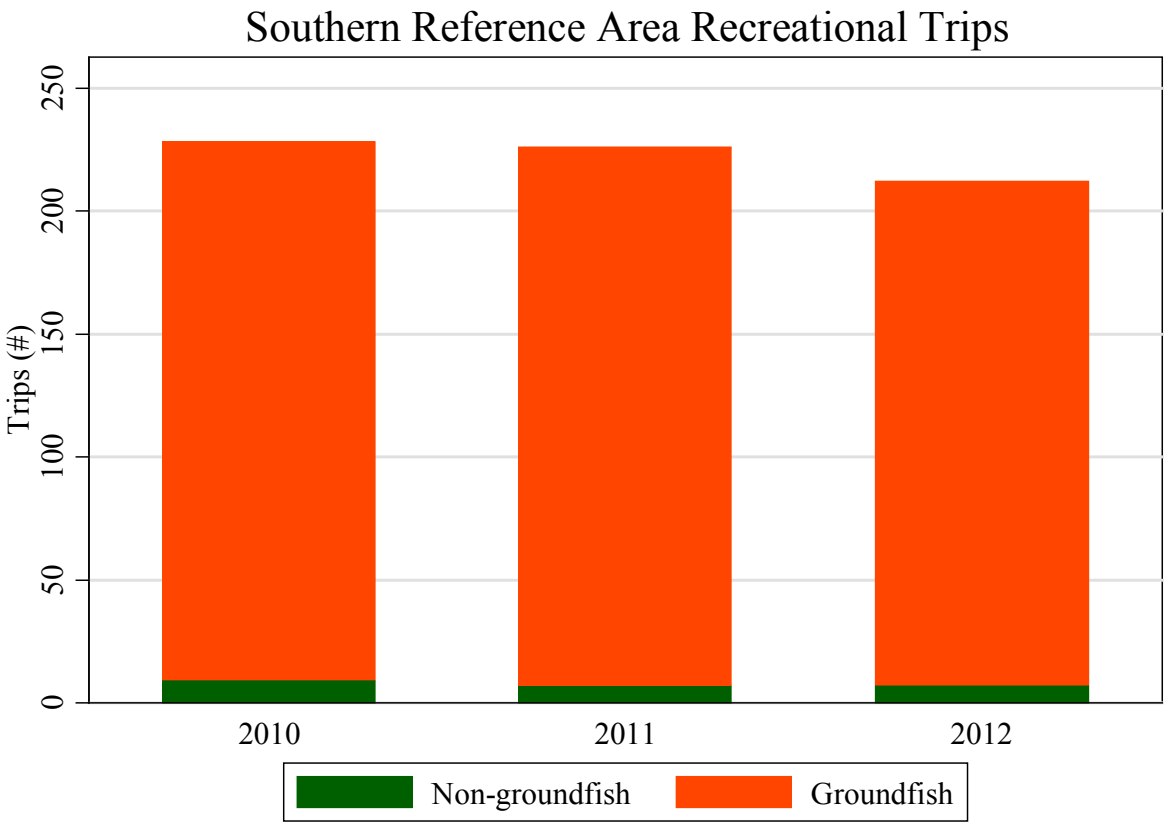


Figure 47 – Recreational revenue estimated to have been generated by trips reported within the southern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012.

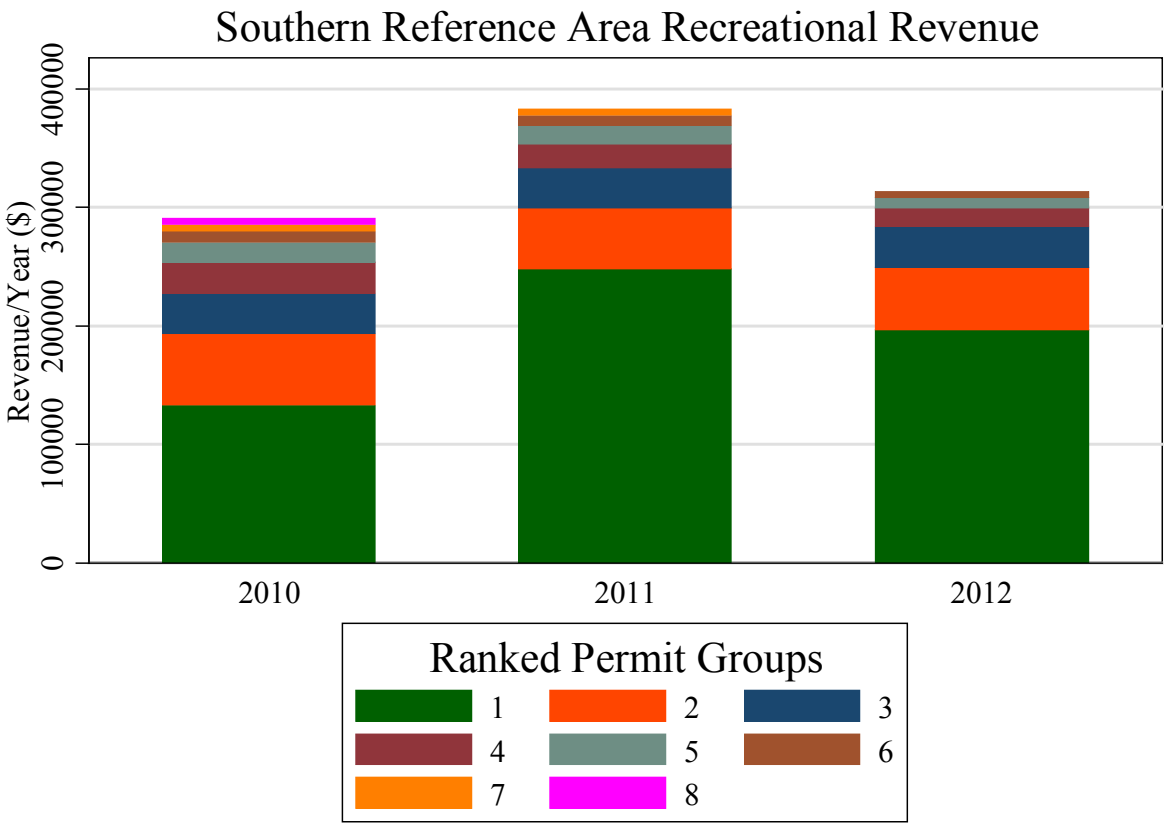


Figure 48 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the southern reference area. Total number of permits is 32 in 2010, 36 in 2011, and 42 in 2012.

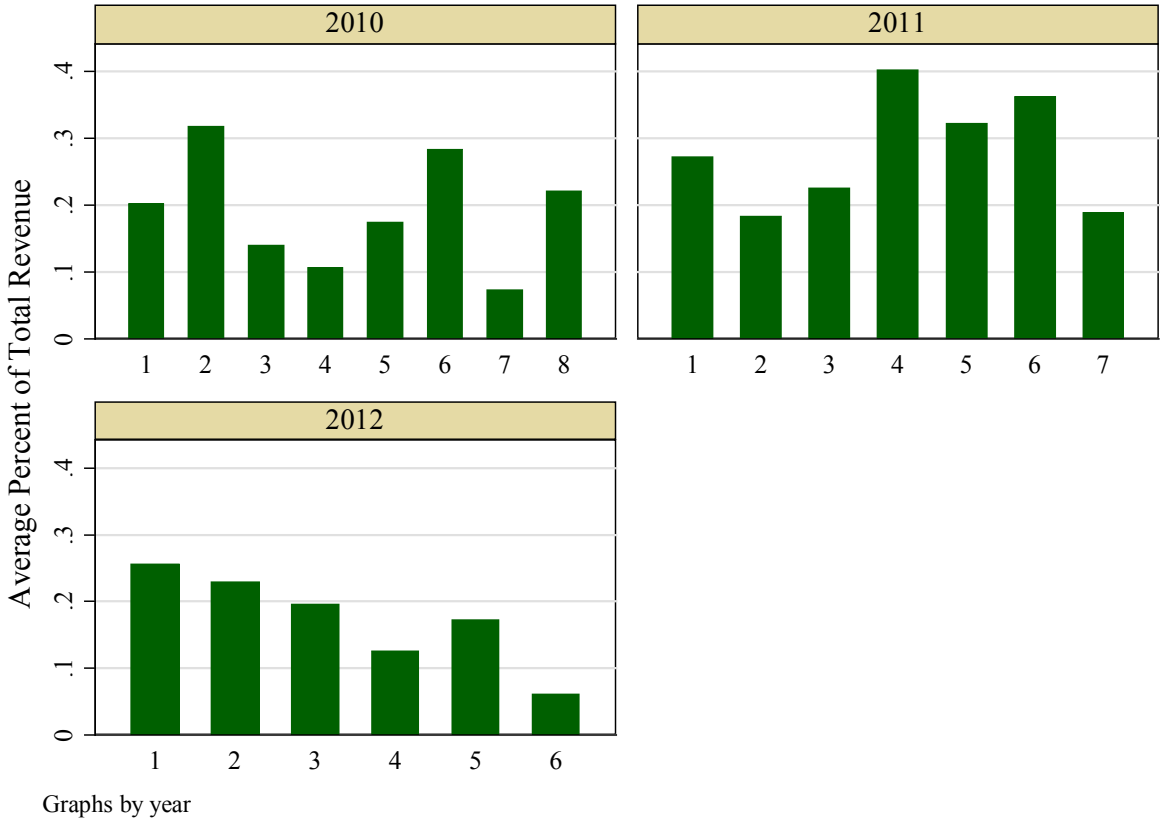


Table 125 – Recreational fishing revenue currently associated with the Southern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate information censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Southern Reference	2006 - 2012	387,262.61	34.14	2,094.43	1,742.18	1,117.74	2,215.63
Southern Reference	2008 - 2012	349,076.66	35.00	1,887.40	1,578.10	1,117.74	1,895.38
Southern Reference	2010 - 2012	328,839.68	36.67	1,768.00	1,481.26	1,117.74	1,737.60

Option B excludes recreational groundfish fishing from the northern DHRA reference area. Figure 49 shows the total number of charter and party boat trips in the northern reference area,

grouped by whether or not at least a single groundfish was caught on the trip. The vast majority of trips reported to fall within the northern reference area catch groundfish.

Figure 50 presents the total revenue estimated to have been generated from trips within the northern reference area, delineated by a ranked grouping of 5 permit blocks. It indicates that the 5 permits with the highest revenue estimated to fall within the northern reference area account for 63%, 62%, and 51% of the total revenue estimates in 2012, 2011, and 2010 respectively. This is a very similar pattern to the estimates for the southern reference area, although the total revenues in 2012 are roughly $125,000 higher in the northern area.

Figure 51 graphs the average percentage of each ranked group's total revenue, including commercial revenue, that the recreational revenue within the northern reference area represents. The importance of the northern reference area seems to be increasing for individuals fishing in this area, as defined by the percentage of total revenue generated. This seeming trend is in contrast to the southern reference area in which the percentages were relatively constant across 2010 – 2012.

Table 126 details the longer-term trends in trips within the northern reference area. Although the number of permit holders is lower than the number fishing within the southern reference area, the other statistics are consistently higher for the northern, when compared to the southern, reference area.

When compared to Alternative 1/No Action or Option C, Option B is expected to generate a highly negative impact for the charter and party boats fishing within these waters. Although the VTR data are unlikely to classify trips inside versus outside these small reference areas with any precision, they should accurately represent general trends of intensity. Thus, although some of the trips reporting latitude/longitude within the northern reference area likely expended effort in the southern reference area and vice versa, the relative magnitude should indicate which of the areas is more heavily fished. In all indicators, save the number of permit holders, the northern reference area looks to be more intensively fished when compared to the southern reference area. The magnitude of the negative impact of Option B on recreational fishermen is thus expected to be larger than Option A.

Other fisheries are not impacted by the DHRA Alternative 3 Option B, when compared to no action. However, given that habitat Alternatives 2 – 7 in the western Gulf of Maine could change area management in that sub-region, the designation of the DHRA could have a broad range of economic impacts depending on the final habitat alternative chosen. As noted above, sense of these impacts can be gleaned from the economic impacts discussion of western Gulf of Maine habitat Alternative 6.

In the long-term, benefits are expected to accrue to all groundfish fisheries through more informed, and ostensibly better, management decisions. Option B is thus expected to generate a net positive benefit when compared to no action, with additional concentrated costs accruing to a small number of recreational fishermen in the short term, and diffuse positive benefits in the form of improved groundfish management in the long term. The net benefits are expected to be smaller than option A and C, given the higher revenue estimates within the northern reference

area and the expected difficulty of identifying the impact of fish removal on such a small scale (see section 4.4.1.3 for expected habitat impacts and 4.4.2.2 for expected impacts on groundfish). Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The social impacts of Alternative 3 option B in comparison to Alternative 1/No Action are expected to be positive. However there may be negative impacts related to the recreational fishery which is heavily reliant on this area. This will particularly impact communities on the South Shore of Massachusetts Bay and Cape Cod (Table 128).

However, substantial uncertainty exists regarding both the benefits and costs of these options, as they ultimately depend on the quality and quantity of scientific research being generated from the DHRA and the ability of fishermen to change their fishing practices/location.

Option C would not restrict recreational groundfishing and is thus expected to have similar impacts to Alternative 1/No Action in terms of the party and charter recreational groundfishing industry. Table 127 summarizes recreational revenue for the entire Stellwagen DHRA area, including both reference areas and the portion of the DHRA outside the reference areas. Given the expected difficulties in identifying the effect of removals on such a small area (see section 4.4.1.3 for expected habitat impacts and 4.4.2.2 for expected impacts on groundfish), the magnitude of benefits derived from Option C is expected to be larger than Options A and B.

Figure 49 – The total number of recreational trips (party and charter) reported within the northern reference area, grouped by whether at least one groundfish was caught on the trip

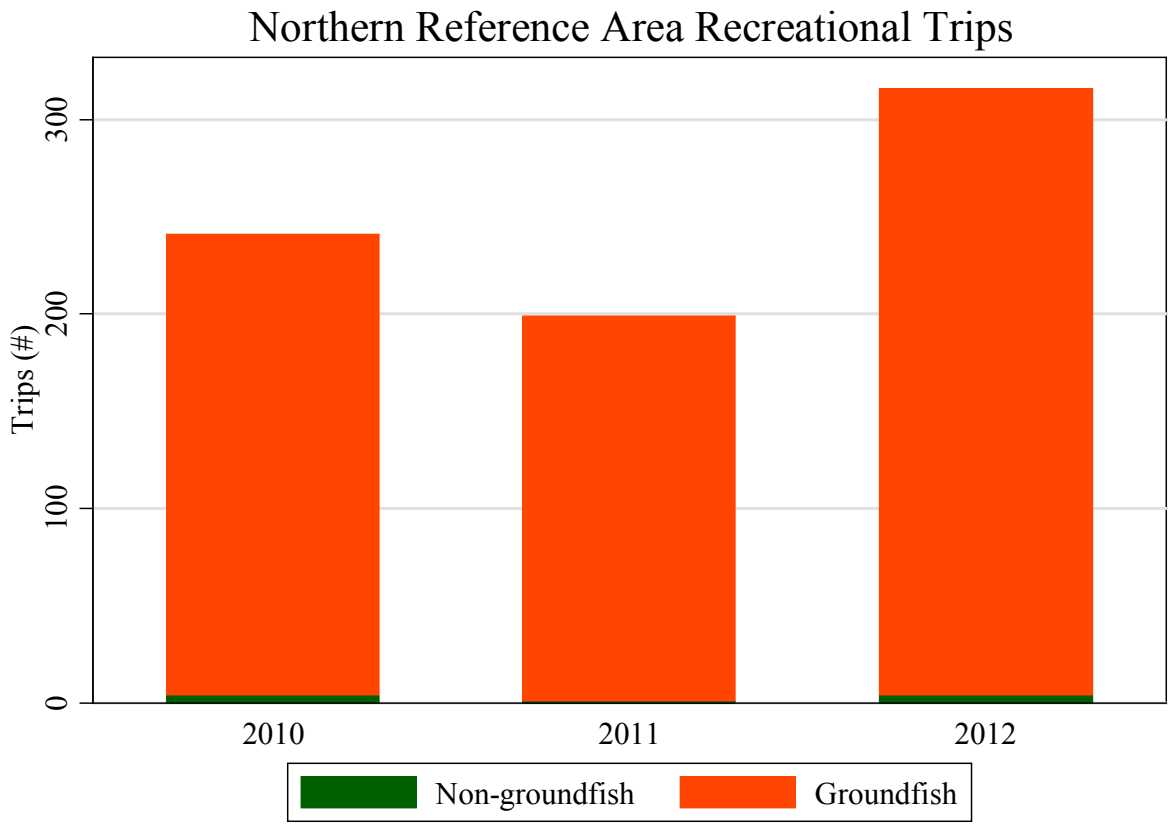


Figure 50 – Recreational revenue estimated to have been generated by trips reported within the northern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years

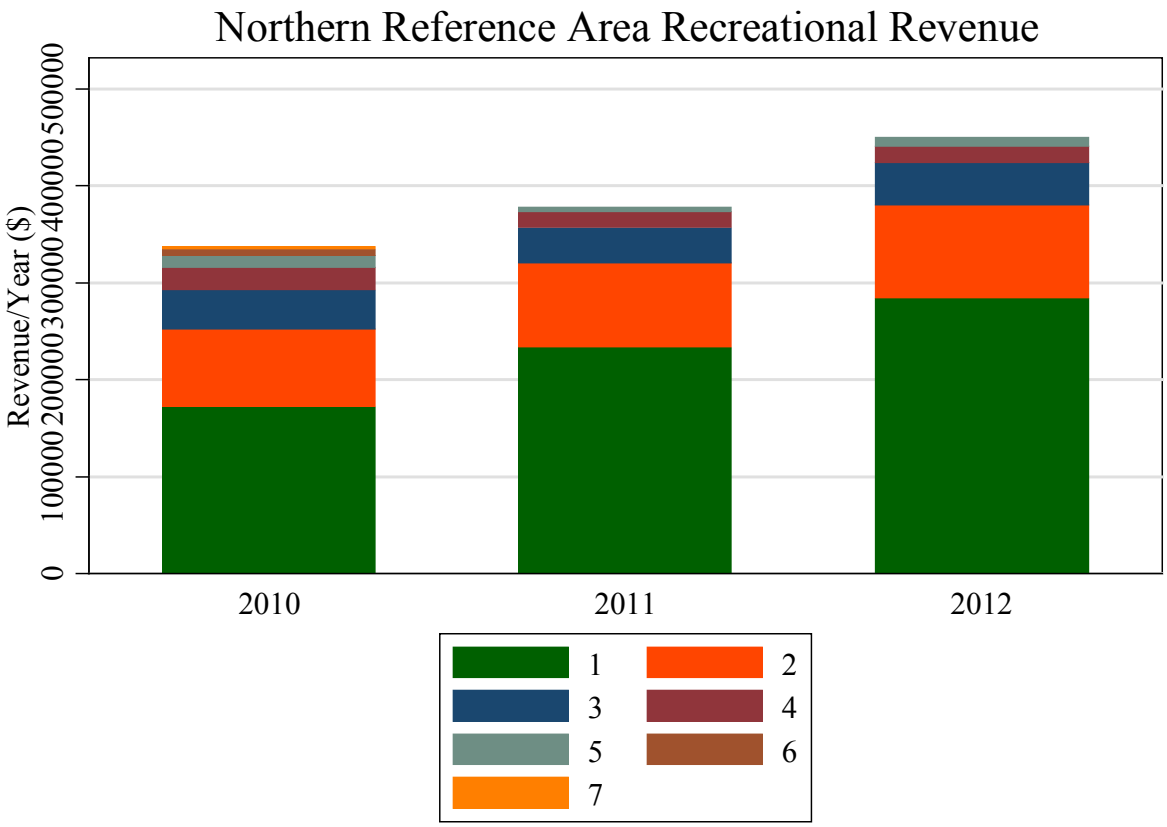


Figure 51 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the northern reference area

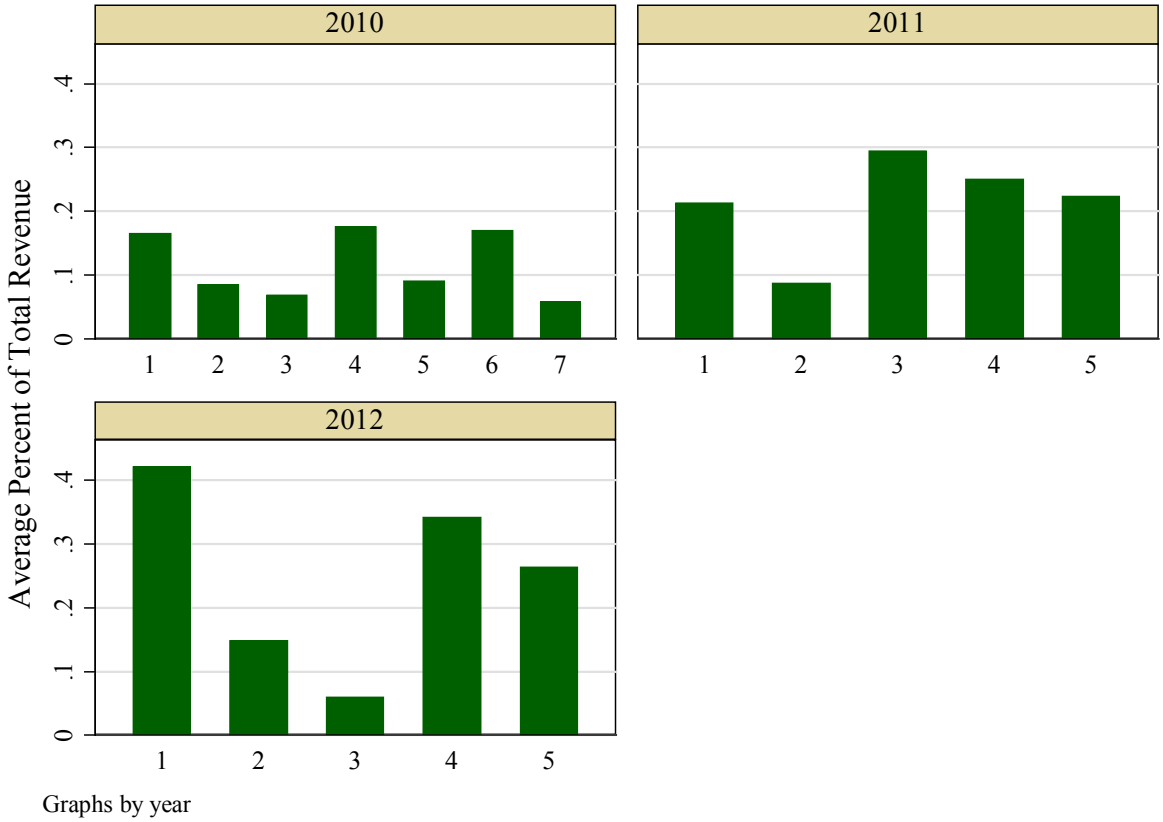


Table 126 – Recreational fishing revenue currently associated with the Northern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Northern Reference	2006 - 2012	556,480.9	30.71	3,003.00	2,077.53	1,117.74	2,665.28
Northern Reference	2008 - 2012	382,553.7	28.80	2,060.00	1,606.02	1,117.74	1,948.86
Northern Reference	2010 - 2012	388,290.5	29.00	2,084.33	1,540.84	1,117.74	1,874.70

Table 127 – Recreational fishing revenue currently associated with the entire Stellwagen DHRA. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Indiv.	Anglers	Mean Revenue	Median Revenue	SD Revenue
Stellwagen DHRA	2006 - 2012	2,101,074	72.86	12,070.71	2,466.05	1,117.74	2702.337
Stellwagen DHRA	2008 - 2012	1,785,023	70.6	10,352	2,252.11	1,117.74	2429.294
Stellwagen DHRA	2010 - 2012	1,767,647	71.67	10,052.33	2,213.25	1,117.74	2443.019

Table 128 – Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the Northern and Southern Reference Areas.

Stellwagen		Option A (Southern)		Option B (Northern)	
State	Community	Port	City	Port	City
MA		30	29	27	26
	Gloucester	7	3	6	3
	Marshfield	16	6	13	6
	Newburyport				
	Plymouth		3		3
	Scituate			3	

Table 129 – Sum of 2012 party/charter recreational fishing revenue associated with the Northern and Southern Reference Areas. Ports with less than 3 vessels each were included in the state totals only.

Alternative		Option A (Southern)	Option B (Northern)
State	Port	Value	Value
MA	**Total**	**312,408.30**	**449,890.40**
	GLOUCESTER	37,444.29	107,116.80
	MARSHFIELD	177,161.80	250,001.20
	SCITUATE		7,824.18

4.4.3.4 *Alternative 4 (Preferred)*

Alternative 4 would designate a Dedicated Habitat Research Area on Georges Bank. Alternative 4 has a neutral impact on commercial fisheries when compared to the Alternative 1/No Action, as it is fully encompassed by the southern portion of the Closed Area I habitat/groundfish closure, an area currently closed to both gear capable of catching groundfish and mobile bottom-tending gears, and outside of the hook and line SAP exemption area. However, the full economic

impact of this alternative ultimately depends on the final alternatives selected for habitat and spawning. Fishing effort distribution maps in Volume 1 of this EIS indicate that the majority of observed effort surrounding Closed Area I does not abut the boundaries of the Georges Bank DHRA. This suggests that the negative impact of Alternative 4 on fisheries employing mobile bottom-tending gear is expected to be relatively small, regardless of the final alternative chosen. There is some scallop dredge effort reported along the boundary of the Georges Bank DHRA. However, the scallop PDT's assessment indicates that the DHRA does not host a substantial concentration of scallop biomass (~0.1% of scallop LT yield), and thus this impact is again expected to be relatively small, and the adjacent fishing effort is within the access area just to the north of the DHRA. Although some recreational effort has been reported within a 10 nautical mile buffer of Closed Area I (see Table 97 in the habitat alternatives section), the relative number of trips in the vicinity of Closed Area I suggest only neutral to slightly negative impacts of this alternative on recreational fishing. Generally, the distance from shore precludes most recreational fishing from the area encompassed by Alternative 4.

Long-term impacts are expected to be slightly positive, when compared to Alternative 1/No Action, given the expected improvement in management stemming from improved scientific knowledge of species under Federal management. The positive benefits are expected to be larger than Alternative 2, given the historical exclusion of mobile bottom-tending gear from Closed Area I, but smaller than Alternative 3 given the substantial knowledge of the western Gulf of Maine closure already amassed (see Section 4.4.1.3). However, substantial uncertainty exists regarding both the benefits and costs of these options, and the trade-off ultimately depends on the quality and quantity of scientific research being generated from the DHRA. Although discounting plays a role in whether the net benefits are ultimately positive or negative, the sort-term slightly negative impacts, and long-term slightly positive impacts make clear that the net benefits are likely to be relatively marginal/negligible regardless of their ultimate sign.

The social impacts of Alternative 4 in comparison to Alternative 1/No Action are expected to be positive. Because the Georges Bank DHRA is in a currently closed area the social impacts are expected to be minor. There may be a small positive impact on the *Attitudes, Beliefs, and Values* regarding management flexibility because no new areas will be closed to fishing activities for this research to occur.

4.4.3.5 ***Alternative 5 (Preferred)***

Alternative 5 is an administrative action allowing removal of the DHRA designation for an area if no research has been initiated within three years of implementation. There is a neutral impact when compared to Alternative 1/No Action, as Alternative 5 is superfluous unless at least one of Alternatives 2 – 4 is also selected. However, this sunset provision helps decrease the uncertainty regarding the benefit/cost trade-off of Alternatives 2-4, as the cost of these other alternatives will cease if and when the positive benefits expected from increased scientific knowledge fail to materialize. Thus, Alternative 5 is expected to have slightly positive impacts when coupled with at least one of the Alternatives 2-4.

The social impacts of Alternative 5 in comparison to the no action alternative are expected to be positive. The creation of a sunset provision will ensure that if DHRAs are not providing a

research benefit they will be open to fishing activities. This will have a positive impact on the *Attitudes, Beliefs, and Values* regarding management flexibility.

4.4.4 Protected Resources

Assessment of the impacts to protected resources from the implementation of dedicated habitat research areas is complicated by the overlapping nature of the DHRA, habitat, and spawning alternatives. Because the DHRAs are not aimed at increasing research related to marine mammal stocks or their interactions with fishing gear, no research-related benefits are expected to result from implementation of one or more DHRAs. Thus, any impacts relate to shifts in fishing effort by gear type that result from the DHRA designation, in conjunction with any overlapping habitat management area or spawning management area designations.

4.4.4.1 *Alternative 1 (No Action)*

Alternative 1/No Action would not implement any dedicated habitat research areas. No changes to current fishing practices, beyond what would be expected from modifying the habitat management areas, as described above, would be implemented. As a result, the impacts on protected resources would be neutral when compared to the baseline environmental condition.

4.4.4.2 *Alternative 2 (Preferred)*

Implementing a DHRA in the small Eastern Maine area would result in mobile gear being restricted in that habitat management area, either for the short-term, or indefinitely. There is relatively little mobile gear activity in this region. As a result, there is not expected to be a significant change in the location of fishing effort. Therefore, the impacts on protected resources would likely be negligible when compared to the baseline environmental condition.

4.4.4.3 *Alternatives 3A, 3B, and 3C (3B preferred)*

The Stellwagen Bank DHRA would maintain the existing restrictions on mobile and fixed gear within the southern portion of the existing Western Gulf of Maine Closure Area. In addition, recreational or charter/party fishing might be prohibited in the small reference area in either the southern-most portion of the DHRA (Option A), or an area of equal size, just to the north (Option B). Option C would implement the DHRA without the reference area component. There may be some concentration of recreational gear outside of the reference area, which may have some negative impacts on large whales, but the reference area is relatively small in size. Overall, however, the impacts from implementing the DHRA in this region would be negligible when compared to the baseline environmental condition.

4.4.4.4 *Alternative 4 (Preferred)*

The impacts from establishing a DHRA in the southern portion of the existing Closed Area I would be negligible when compared to the baseline environmental condition. As described previously, there are some interactions with large whales around Closed Area I, however, those are primarily in the northern area, which would not be affected by this alternative. Neither the Atlantic Large Whale nor the Harbor Porpoise Take Reduction Plans' management areas overlap with the proposed dedicated habitat research area; indicating that additional protections for those

protected species beyond what are established in those management plans are not warranted in that region.

4.4.4.5 ***Alternative 5 (Preferred)***

The implementation of the sunset provision would likely have a negligible impact, when compared to the baseline environmental condition, on protected resources because the overall impact of implementing any of the dedicated habitat research areas is minimal to non-existent.

4.5 Framework adjustments and monitoring

The follow sections discuss the impacts of the two framework adjustment and monitoring alternatives on all valued ecosystem components.

4.5.1 Alternative 1 (No Action)

Alternative 1/No Action would use existing ad hoc framework adjustment procedures scattered across five FMPs, each having a different set of specification on measures that may be adjusted. While the Council could initiate at any time one or more framework adjustment actions to evaluate the performance of habitat management and spawning protection areas, there would be no certainty about when such an action would be initiated. Also it would be unclear what information would be needed, how it would be evaluated, or how it would affect future management decisions.

Because it is not an ideal process for a coordinated review of management area performance, this alternative has indirect, moderately negative impacts on all managed species, including the large-mesh groundfish species for which some of the habitat management and all of the spawning management alternatives were designed. Alternative 1/No Action would also have moderately negative impacts on the physical and biological environment, including EFH and HAPCs, as coordinated review and improved data collection under Alternative 2 would best allow for the evaluation of tradeoffs between habitat protection, fish conservation, and economic and social issues. The resulting impacts are indirect, since the framework and monitoring alternatives are administrative in nature and intended to contribute to the overall efficiency of fisheries management.

Given that Alternative 1/No Action leads to uncertainty and management inefficiency, the indirect economic impact of this alternative is expected to be moderately negative. Social impacts associated with framework adjustments and monitoring are expected to be minor. The social impacts associated with Alternative 1 are expected to be negative as there would be no systematic process developed to review the effectiveness of spatial management measures. This may have moderately negative impacts on the *Attitudes and Beliefs* about management.

Alternative 1/No Action is expected to have neutral impacts on protected resources, when compared to the baseline environmental condition, as fishery management measures are generally not designed with protected resource conservation in mind, although impacts of fishery management actions on protected resources are analyzed as part of the NEPA process, and positive benefits for protected resources may occur incidental to fishery management benefits.

Protected resources management actions are developed via different management structures than fishery management actions.

4.5.2 Alternative 2 – Planned, strategic framework adjustment and monitoring (Preferred)

This alternative would establish a habitat management and spawning protection review and adjustment procedure that would have the following three elements. More specific details about how this strategic framework adjustment process and monitoring program are given in Section 2.4.2.

- Specify additional spatial management measures as frameworkable in various Council FMPs,
- Develop a regular, strategic process to review the effectiveness of spatial management measures, and
- Define a series of research priorities related to the review and development of spatial management measures.

This new process would have several advantages over the existing ad hoc framework adjustment mechanism (Alternative 1/No Action). First, it would set up an expectation that after an appropriate period of time, the performance of habitat and spawning areas would be re-evaluated and adjustments would be made. It would also establish a consistent set of measures that could be adjusted by framework action in each FMP, making the process clearer. Third, and possibly most important, it would establish an understandable and more comprehensive performance monitoring program that researchers can use to address management priorities and more successfully seek funding for their related research.

Although a comprehensive spatial management performance review would take longer, during the first few years after implementation of this amendment the Council may learn new information to make mid-term adjustments as needed, while waiting for long enough to collect sufficient performance data to make more comprehensive changes and adjustments. This could include a better understanding of the linkage between habitat quality and stock or ecosystem productivity, enabling better general management of our fisheries.

As with Alternative 1/No Action, the impacts from this primarily administrative alternative are likely to be indirect. Therefore, compared to Alternative 1/No Action, the impact from this alternative is likely to be moderately, indirectly positive on habitat and fishery productivity in the short term as preliminary information is gathered and analyzed, allowing for some mid-term ad hoc adjustments and better informed fisheries management decisions in general. In the long term, this alternative is likely to have highly positive, indirect impacts on both habitat and fishery productivity as better and more efficient conservations measures are identified and become effective. Because the many of the measures are directly focused on changes to the large-mesh groundfish fishery, the impacts to the other managed species, their EFH, and the human communities involved in those fisheries are likely to be slightly positive for those stocks whose life histories and preferred habitats are similar to large-mesh groundfish, and neutral for those species whose life histories and preferred habitats are unaffected by the habitat management alternatives implemented through this amendment.

The economic impacts of Alternative 2 are expected to be moderately, indirectly positive when compared to Alternative 1/No Action, both in the short and long run, due to increased management efficiency and positive benefits to groundfish stocks. The social impacts of Alternative 2 in comparison to Alternative 1/No Action are expected to be positive. There may be positive impacts on the *Attitudes and Beliefs* about management if there is a systematic process developed to review the effectiveness of spatial management measures.

As above, impacts on protected resources are expected to be neutral when compared to the baseline environmental condition.

4.6 Impacts of all spatial management alternatives on non-large mesh groundfish stocks and fisheries

The focus of the managed species impacts analysis in sections 4.2, 4.3, and 4.4 is large mesh groundfish stocks. Particular focus was placed on these stocks when developing many of the habitat management alternatives and also when developing the spawning management alternatives. In addition, the existing year-round groundfish closed areas were implemented within the Northeast Multispecies Fishery Management Plan to reduce mortality and other impacts on groundfish stocks. Impacts on other managed resources are described in the sections that follow.

While the economic and social impacts analyses in sections 4.2, 4.3, and 4.4 encompass all gear types and fisheries operating in and around the proposed management areas, the sections below provide additional discussion on the fisheries prosecuting resources other than large-mesh groundfish. The purpose of the sections below is to incorporate additional fishery-specific analyses in a single and relatively concise section of the DEIS. Readers interested in impacts on a particular fishery are encouraged to review the sections below as well as the economic and social impacts analyses in sections 4.2, 4.3, and 4.4. The analyses cannot directly address impacts that other management actions may have on an individual fishery. Concurrent management actions may mitigate or exacerbate impacts of these alternatives, e.g. specifications may be set at levels that reduce the ability of a fishery to achieve its total allowable catch.

4.6.1 Small mesh multispecies: silver and red hake

4.6.1.1 *Biological impacts*

Juvenile red and silver hake, the target species in the small-mesh multispecies fishery, are not known to associate with coarse and hard substrates, which are more vulnerable to adverse impacts from mobile bottom tending fishing gear. Habitat Management Area (described in Section 2.1) and Dedicated Habitat Research Area (described in Section 2.3) measures could restrict or prohibit mobile bottom tending gear fishing, including small-mesh trawls used to target red and silver hake[19]. No Dedicated Habitat Research Areas overlap with existing small-mesh exemption areas. Spawning area alternatives could also restrict trawling during specific

[19] Small-mesh multispecies trawls are also used to target offshore hake, but the proposed Habitat Management and Dedicated Habitat Research Areas do not overlap the distribution of offshore hake.

seasons, but these seasons and areas do not overlap with the existing small mesh-exemption areas.

In habitat management areas that overlap concentrations of small juvenile red and silver hake (Map 110 to Map 112), the mobile bottom-tending gear restrictions could reduce fishing mortality on young fish, improve selectivity, and increase yield-per-recruit. Small-mesh trawls do not, however, retain many age 0/1 red and silver hake, which are less than 20 cm[20] (Figure 52 and Figure 53, respectively), so only a limited reduction in catch and discards of age 0/1 red and silver hake would be expected from a reduction in fishing where there are large concentrations of age 0/1 red and silver hake.

Note that the distribution of offshore hake, the other small-mesh species, has limited, if any, overlap with the proposed management areas, so impacts to this species are expected to be neutral.

4.6.1.1.1 Gulf of Maine Habitat Management and Dedicated Habitat Research Area Alternatives

During the spring and fall trawl surveys, the major concentrations of age 0/1 silver hake hotspots overlap with the Bigelow Bight, Toothaker Ridge, and Eastern Maine HMAs (Map 110 and Map 112). Age 0/1 silver hake appear to be concentrated in deeper water according to the summer shrimp trawl and scallop dredge survey data (Map 111), which have a limited geographical range. No hotspots that overlap with the proposed HMAs were detected in winter trawl surveys.

During the fall, age 0/1 red hake hotspots appear to have a similar geographical distribution as silver hake (Map 112), with significant overlap with the Bigelow Bight, Toothaker Ridge, and Eastern Maine HMAs. During the spring and summer surveys (Map 110 and Map 111), hotspots appear to be concentrated in deeper waters and do not have significant overlaps with any of the HMAs. No hotspots that overlap with the proposed Habitat Management and Dedicated Habitat Research Areas were detected in winter trawl surveys.

<u>Biological impacts on red and silver hake, targets of the small-mesh multispecies fishery, appear to be minimal, but slightly positive, particularly for alternatives that include the Bigelow Bight, Toothaker Ridge, and Eastern Maine HMAs. Alternatives that do not include these proposed HMAs and or the Eastern Maine DHRA would have a neutral or slightly negative impact because incidental catch of juvenile red and silver hake will continue to occur in fisheries overlapping these hotspots.</u>

4.6.1.1.2 Georges Bank and Southern New England habitat management and Dedicated Habitat Research Area alternatives

Georges Bank and Great South Channel Habitat Management and Dedicated Habitat Research Area alternatives do not overlap with age 0/1 red and silver hake hotspot distribution to any appreciable degree (Map 110 to Map 112). <u>Thus biological impacts of these alternatives on red and silver hake appear to be neutral.</u>

[20] During 2002-2012 spring trawl surveys, all age 0 and 90% of age 1 fish were less than 20 cm.

Figure 52 – Length frequency distribution of kept and discarded red hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls.

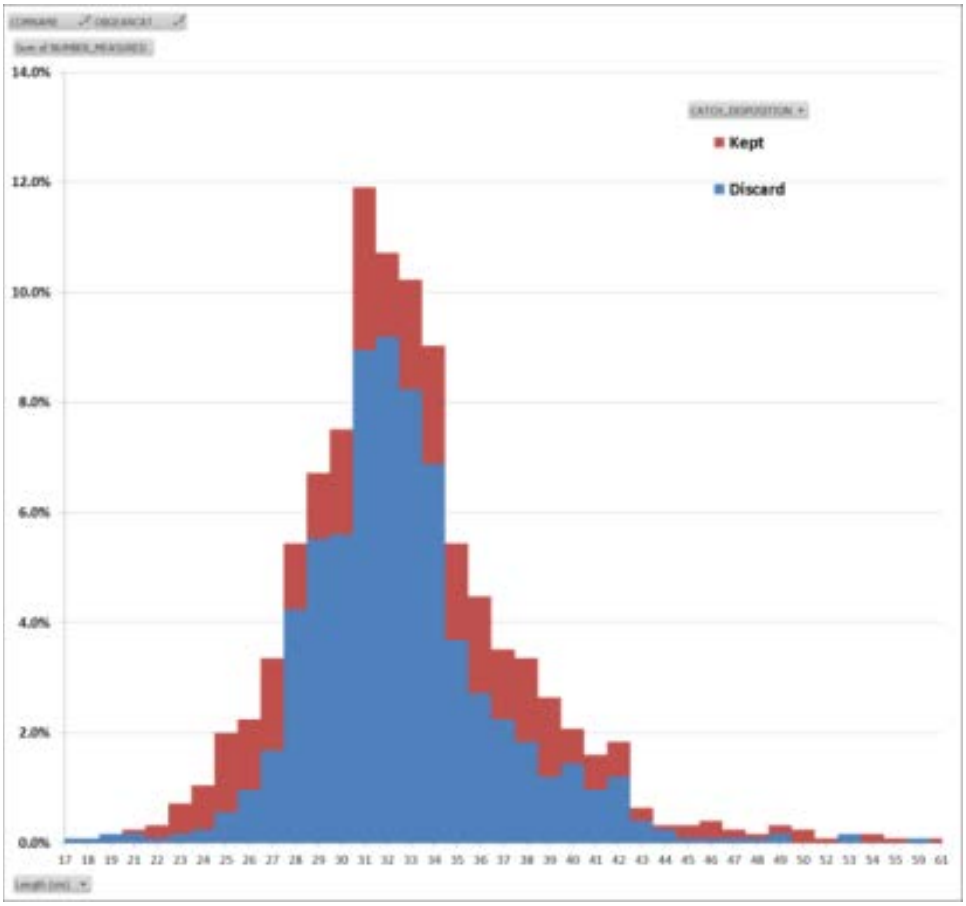
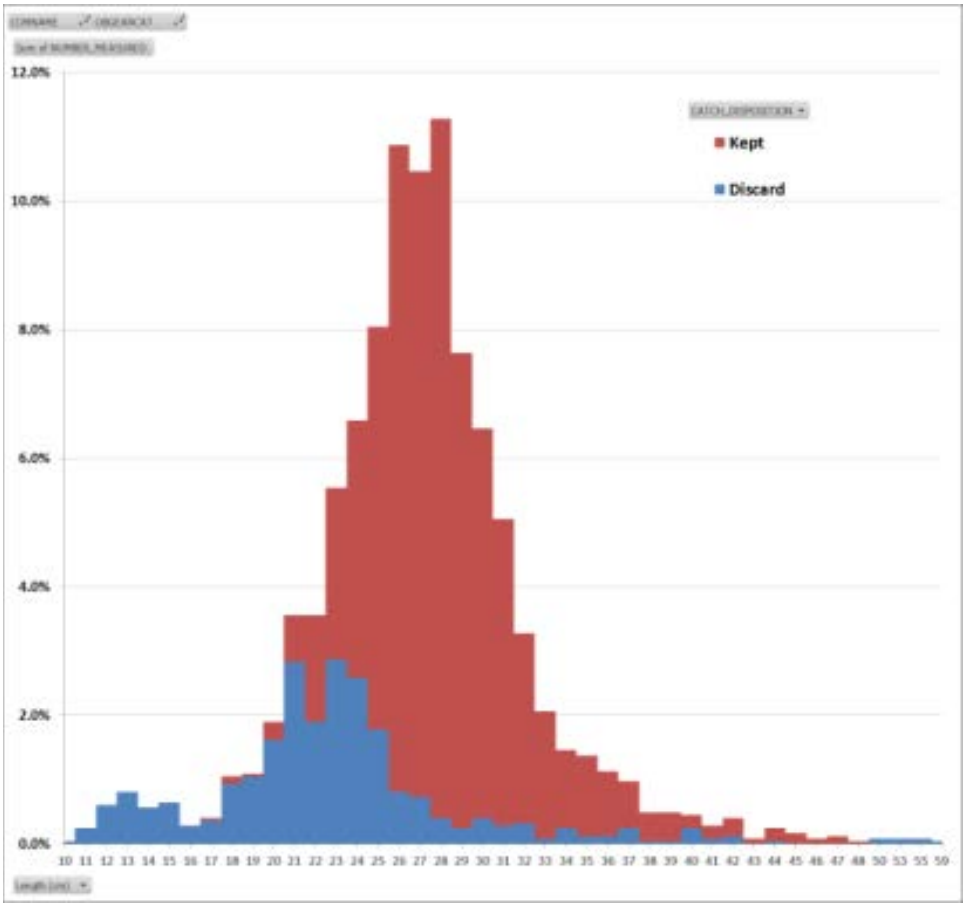
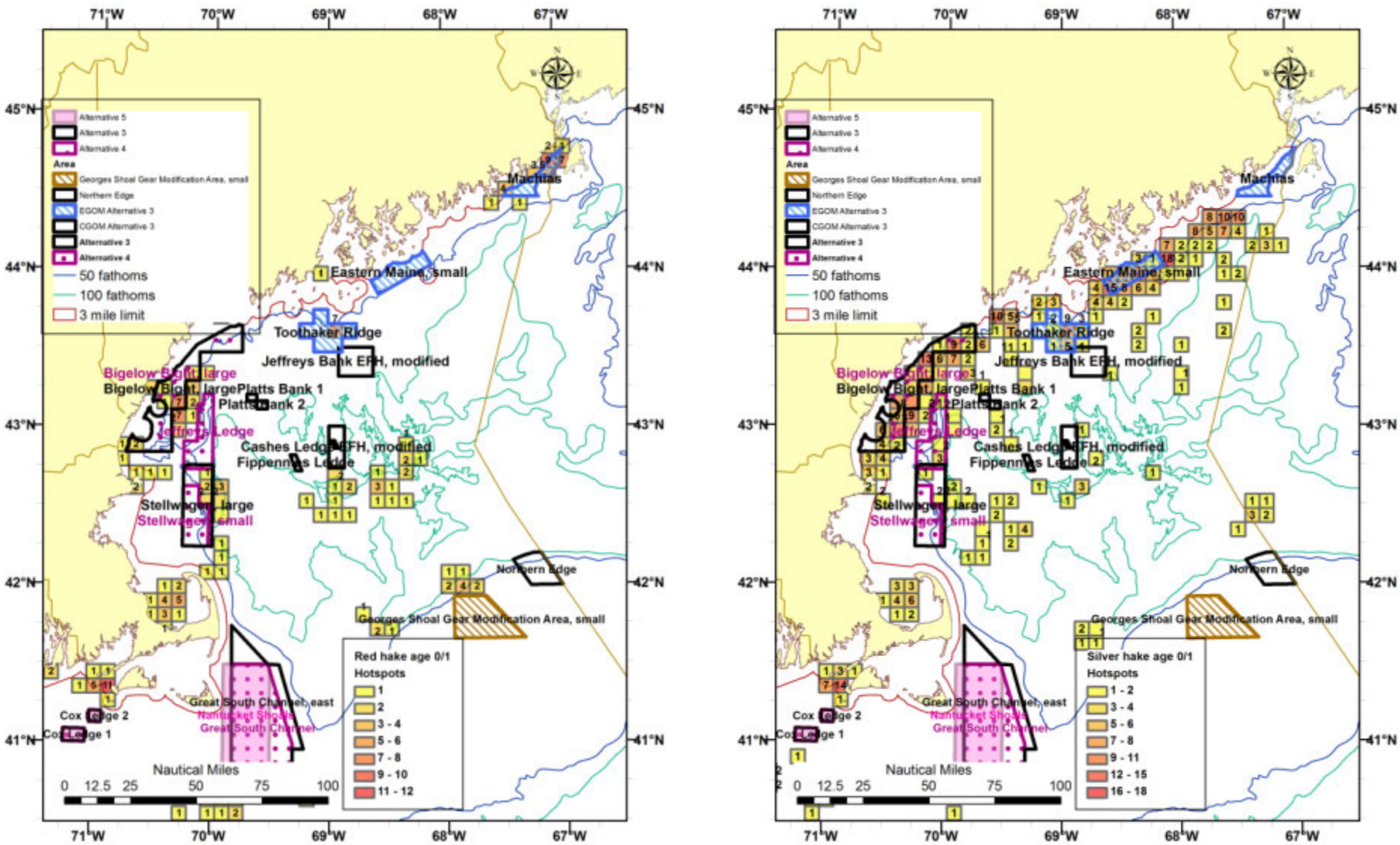


Figure 53 – Length frequency distribution of kept and discarded silver hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls.



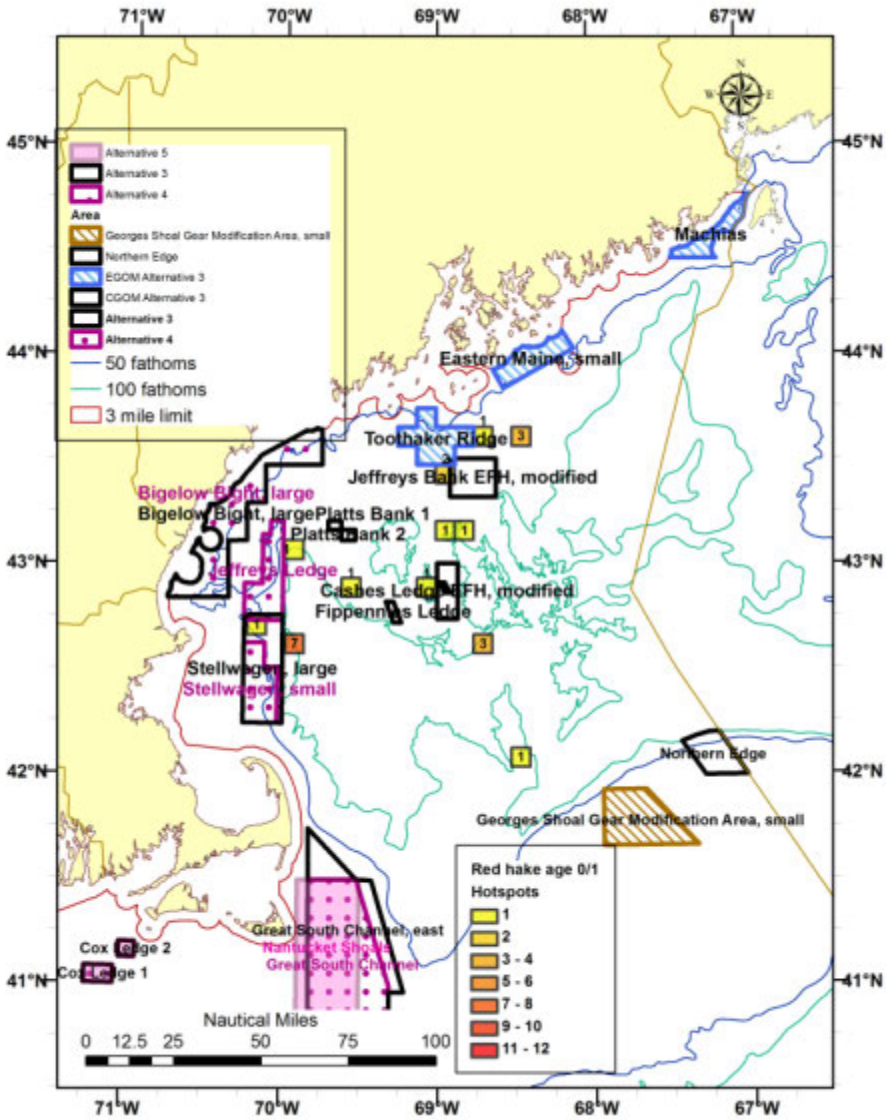
Map 110 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 spring trawl surveys.

Red hake **Silver hake**

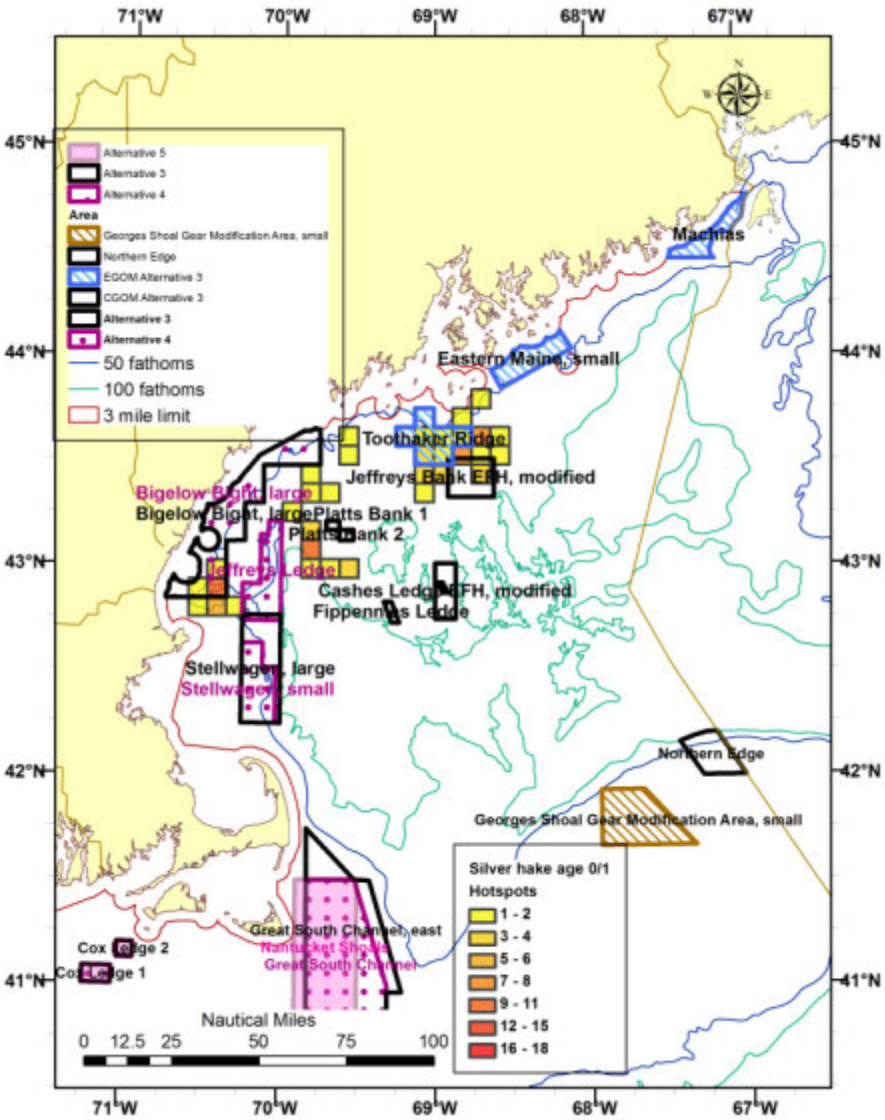


Map 111 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 summer shrimp trawl and scallop dredge surveys.

Red hake

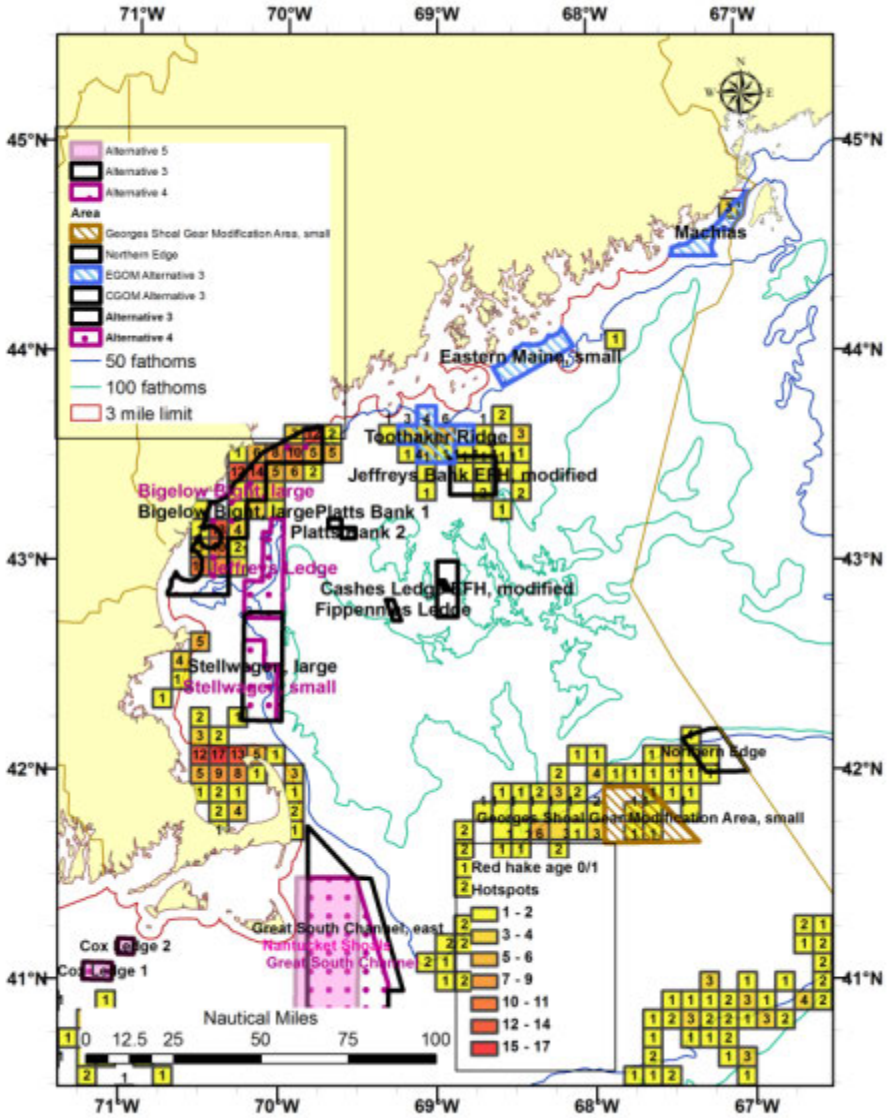


Silver hake

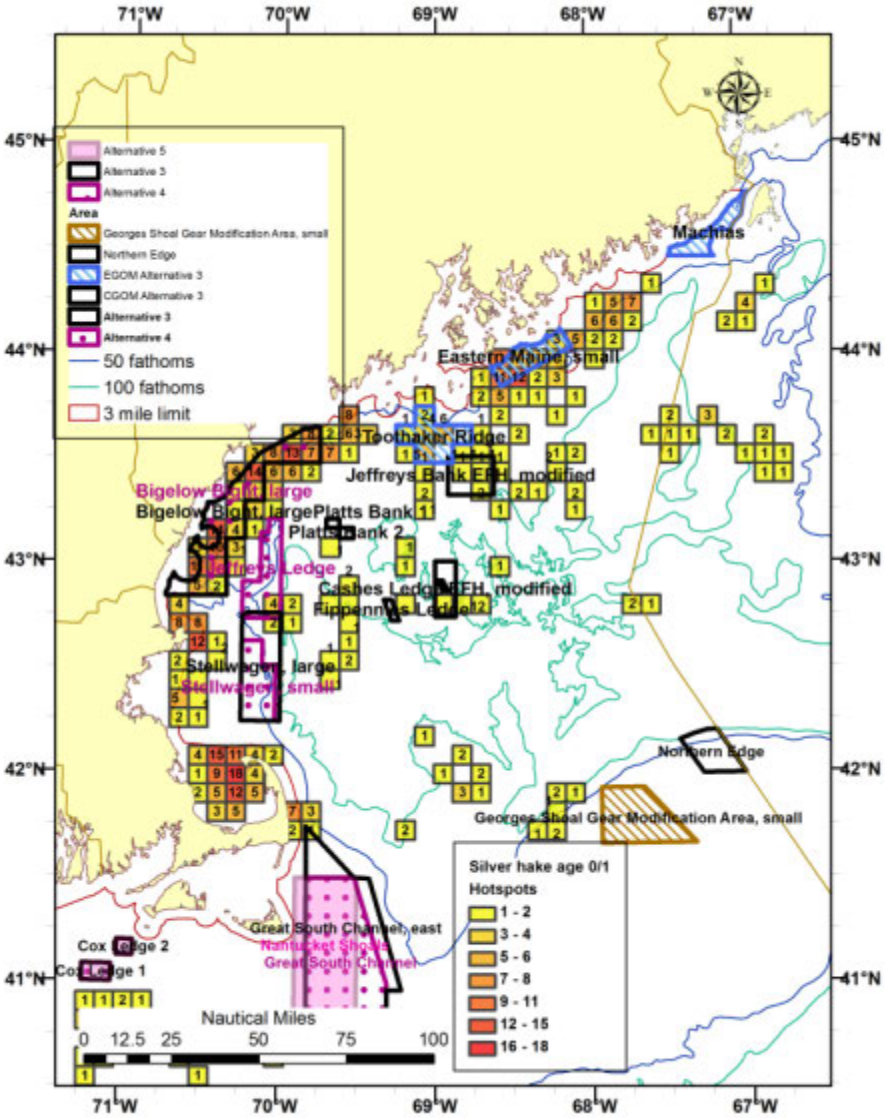


Map 112 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 fall trawl surveys.

Red hake



Silver hake



4.6.1.1.3 Spawning management alternatives

It is not known whether and how fishing affects red and silver hake spawning, or precisely where or when this spawning activity takes place. In general, the effects of the proposed spawning protection areas on red and silver hake are uncertain.

For silver hake, spawning occurs on Georges Bank beginning in May, and spawning begins in the Gulf of Maine during June. Peak spawning for the northern stock (Georges Bank and Gulf of Maine areas) occurs during July and August. Alternative 1/No Action for both the Gulf of Maine and Georges Bank includes areas where groundfish catches are regulated year-round, which would include these late spring and summer months, but the action alternatives only include late winter/spring spawning closures. Spawning Alternatives 2 and 3 on Georges Bank likely miss the temporal window associated with silver hake spawning as they would be in effect February 1-April 15. In the Gulf of Maine, only the northernmost of the Gulf of Maine rolling closures in Gulf of Maine Spawning Alternatives 1 and 2 are in effect during June. Since it is not clear whether or not fishing activity actually affects spawning activity in silver hake, the removal of year-round closures via the action alternatives (Alternative 2 in the Gulf of Maine and Alternatives 2 and 3 on Georges Bank) may or may not constitute a negative impact on the silver hake resource.

For red hake, major spawning areas are believed to occur on southwestern Georges Bank and on the continental shelf off southern New England, with spawning beginning during May or June in the New England region. The only spawning management area in this general location is theNantucket Lightship Closed Area which is part of George Bank Spawning Alternative 1/No Action, but maps of red hake larger than 35 cm place biomass offshore of the closure. Therefore, neither the no action nor alternative spawning areas on Georges Bank are likely to provide many benefits in terms of red hake spawning, such that the impacts of the alternatives on the red hake stock are likely neutral. Biomass maps indicate that adult red hake occur in higher abundance in the inshore Gulf of Maine and along the northern margin of Georges Bank. Given that major spawning aggregations are not known to occur in these locations, is is unclear whether either the no action or alternative spawning management areas in the Gulf of Maine would benefit the red hake resource. Northern red hake is the only small-mesh stock that is experiencing overfishing, so any negative impacts on this stock would be of greatest concern. Removal of the year-round Western Gulf of Maine Closure Area would eliminate restrictions on gears capable of catching groundfish in an area where adult red hake occur, but whether or not this constitutes a negative impact on the stock is unclear, given that fishing impacts on spawning activity are unknown.

4.6.1.2 ***Fishery impacts***

Fishing with small-mesh trawls to target red and silver hake in the Northern Management Area (grey-shaded area in Map 113 to Map 116) is restricted compared to other fisheries, limited to well-defined exemption areas and seasons. Fishing in exemption areas that have a high amount of overlap with proposed Habitat Management Areas will of course be highly impacted by alternatives that include those specific areas, if mobile bottom-tending gears are prohibited. These impacts may be quite local and acute for vessels that cannot fish in remote exemption areas.

All of the Habitat Management Area and Dedicated Habitat Research Area alternatives will have the potential to shift fishing effort, between areas and between fisheries, particularly for the small-mesh multispecies fishery which does not currently have any limited access restrictions and could experience an increase in effort. Specifically, vessels that use mobile bottom tending gear to target other species may find it more attractive to target small-mesh multispecies in the exempted areas. While catches and mortality are limited by annual catch limits, such effort shifts into the small-mesh multispecies fishery, if they occur, could have negative impacts on existing fishery participants, particularly for northern red hake, where catch exceeded the annual catch limit in both fishing year 2012 and 2013.

Most of the proposed Habitat Management Area alternatives include options that limit or restrict mobile bottom-tending gear within their boundaries. It is more straightforward to assess the impacts in areas where mobile bottom-tending gear would be prohibited (with or without an exemption for hydraulic clam dredges). For the proposed gear modifications to restrict ground cable length (Options 3 and 4) or require cookies on the ground cable (Option 3), it is more difficult to assess probable impacts, since the proposed gear modifications have not been tested in fisheries targeting red and silver hake with small-mesh trawls (they have only been the subject of pilot testing in the large-mesh multispecies fishery). If the modification is incompatible with the fishery, then the impact would be the same as a total prohibition on mobile bottom-tending gear. If the modification can be accommodated, there would be a small negative impact from the cost of the new fishing gear plus any loss in gear efficiency to catch the target species.

Since the small-mesh exemption areas were configured to accommodate the existing year-round groundfish closed areas and do not overlap with the existing EFH closures, Alternative 1/No Action is expected to have a neutral impact on the small-mesh fishery. The no habitat management alternative for any sub-region (typically Alternative 2) does not propose any habitat management areas, and therefore would have no overlap with the small-mesh exemption areas, leading to a neutral impact on the fishery. The absence of habitat management areas in a particular sub-region may however open new opportunities for small-mesh exemption areas. As a result, this alternative could have a small positive impact on the fishery.

4.6.1.2.1 Eastern and Central Gulf of Maine habitat management and Dedicated Habitat Research Area alternatives

Platts Bank and other central and eastern Gulf of Maine proposed Habitat Management Areas do not overlap with either the Small-Mesh Area II or the Gulf of Maine Raised Footrope Area (Map 113). None of the Habitat Management Areas proposed for the central and eastern Gulf of Maine overlap with the small-mesh fishery exemption areas. Thus, all central and eastern Gulf of Maine Habitat Management Area and Dedicated Habitat Research Area Alternatives are likely to have a neutral impact on the small-mesh multispecies fishery.

4.6.1.2.2 Western Gulf of Maine habitat management and Dedicated Habitat Research Area alternatives

In particular, the Large Bigelow Bight Habitat Management Area proposed in western Gulf of Maine Alternatives 3 and 4 has a substantial amount of overlap with the Small-Mesh Area I and the Gulf of Maine Raised Footrope Trawl Area (Map 113 and Map 114). Western Gulf of Maine

Alternative 5 includes a Bigelow Bight Small Habitat Management Area which has a substantial (but not complete) overlap with the Small-Mesh Area I (Map 115). Western Gulf of Maine Alternative 6 has no overlap with the existing small-mesh multispecies exemption areas (Map 116).

Thus, Alternatives 3 and 4 are expected to have the most negative impact on the small-mesh multispecies fishery, locally acute for vessels that fish in Small-Mesh Area I and the Gulf of Maine Raised Footrope Area, but overall a moderate negative impact on vessels that are able to fish in other small-mesh exemption areas. Alternative 5 is likely to have a low negative impact, but this impact may be acute for vessels that fish in the Small-Mesh Area I fishery. Alternative 6 is expected to have neutral impact on the small-mesh multispecies fishery.

4.6.1.2.3 Georges Bank habitat management and Dedicated Habitat Research Area alternatives

Alternative 3 proposes no Habitat Management Areas that overlap with any of the small-mesh exemption areas (Map 113). Alternative 4 has a proposed gear modification area that may affect vessels fishing in the Cultivator Shoals Area small-mesh fishery (Map 114). It is not possible to determine the amount of impacts this area would have on the small-mesh fishery, except that most fishing in the Cultivator Shoals Area does not overlap with this proposed restricted gear area in Alternative 4.

Alternative 5 proposes a larger gear modification than Alternative 4 (Map 114) and it has a much greater and meaningful overlap with the Cultivator Shoals Area small-mesh fishery (Map 115), although the majority of fishing occurs along the boundary with and to the northeast of Closed Area I. Like Alternative 3, it is not possible to determine the amount of impacts this area would have on the small-mesh fishery. The proposed Georges Shoal 1 Mobile Bottom-Tending Gear area has only a negligible overlap with the Cultivator Shoals Area. Alternatives 6A and 6B propose a habitat management area that is a moderate westward expansion of the existing Closed Area II Habitat Closure, in statistical area 561. According to 2008-2012 observer and vessel trip report data, no small-mesh fishing targeting whiting occurs in this area.

Although Alternative 7 proposes a Georges Shoal 2 Mobile Bottom-Tending Gear area, half of which is in the Cultivator Shoals Small Mesh Exemption Area (that allows fishing for whiting and squid during June 15 to October 31), no observed or reported small-mesh fishing targeting whiting occurred in this area since 2008 (Map 117). Alternative 8 proposes the Northern Georges Mobile Bottom-Tending Gear HMA, which does not extend as far to the west and into the Cultivator Shoals Area, but it includes more of the deeper slope on the northern edge of Georges Bank, where some whiting fishing occurs (Map 117). Whiting fishing within the Northern Georges Mobile Bottom-Tending Gear HMA is however a relatively small proportion of observed hauls and reported trips since 2008 within the Cultivator Shoals Area.

Thus, Alternative 8 will have a low negative impact on the fishery. Trips targeting whiting in the proposed habitat management areas could relocate to adjacent areas while the Cultivator Shoals Area is open. Alternatives 4, 5, and 7 will also have a low negative impact, and Alternatives 3, 6A, and 6B will have a neutral impact.

If the proposed gear modifications are compatible with gears currently used to target small-mesh multispecies, then the Georges Bank alternatives that apply reductions in ground cable length or require elevating disks will have a neutral impact on the fishery. Otherwise the gear modification areas would have the same impacts as would mobile bottom-tending gear closures, depending on the degree of overlap with the fishery.

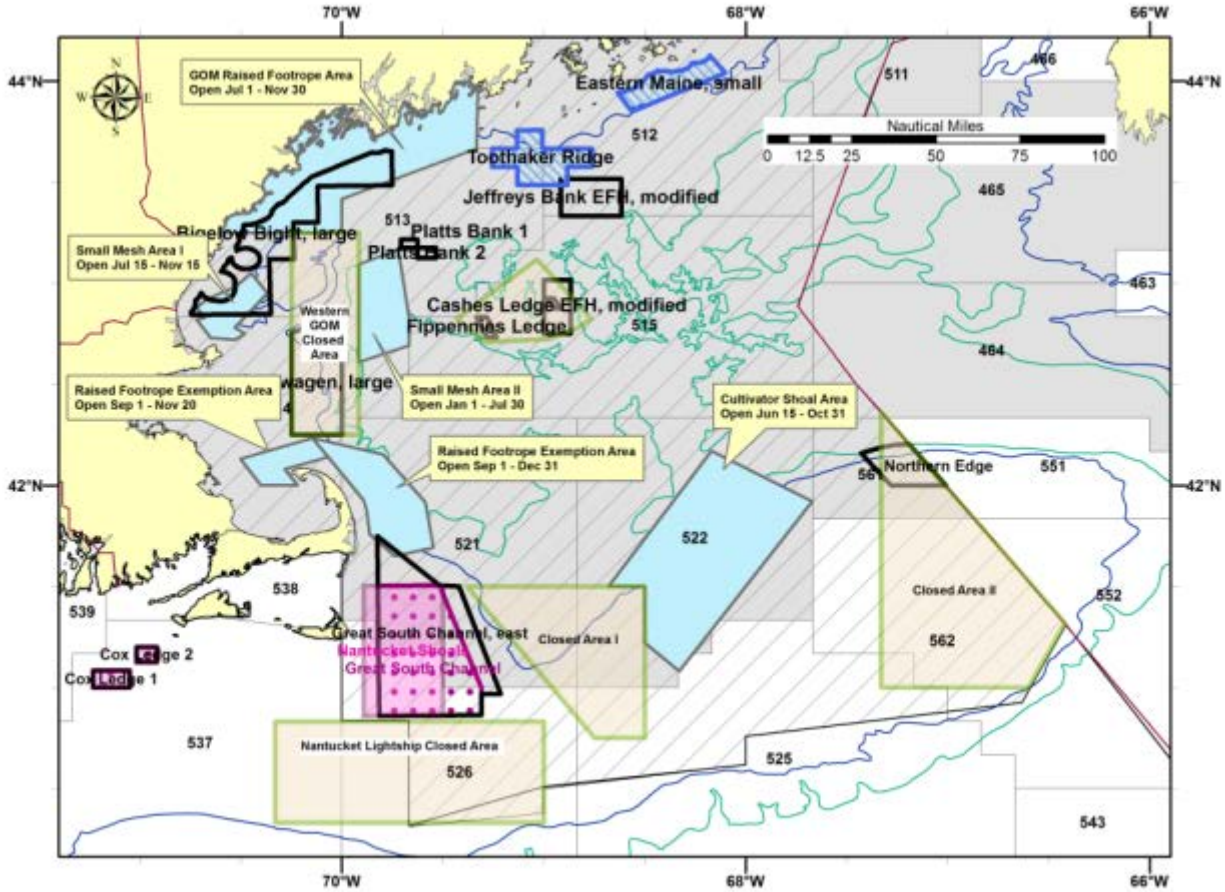
4.6.1.2.4 Great South Channel/Southern New England habitat management alternatives

None of the Great South Channel alternatives overlap with the small-mesh multispecies raised footrope exemption areas and they are all north of the Southern New England/Mid-Atlantic Exemption Areas. Thus other than the potential effort shifts discussed above, all of the Great South Channel Habitat Management Area and Dedicated Habitat Research Area alternatives are likely to have negligible impacts on the small-mesh multispecies fishery.

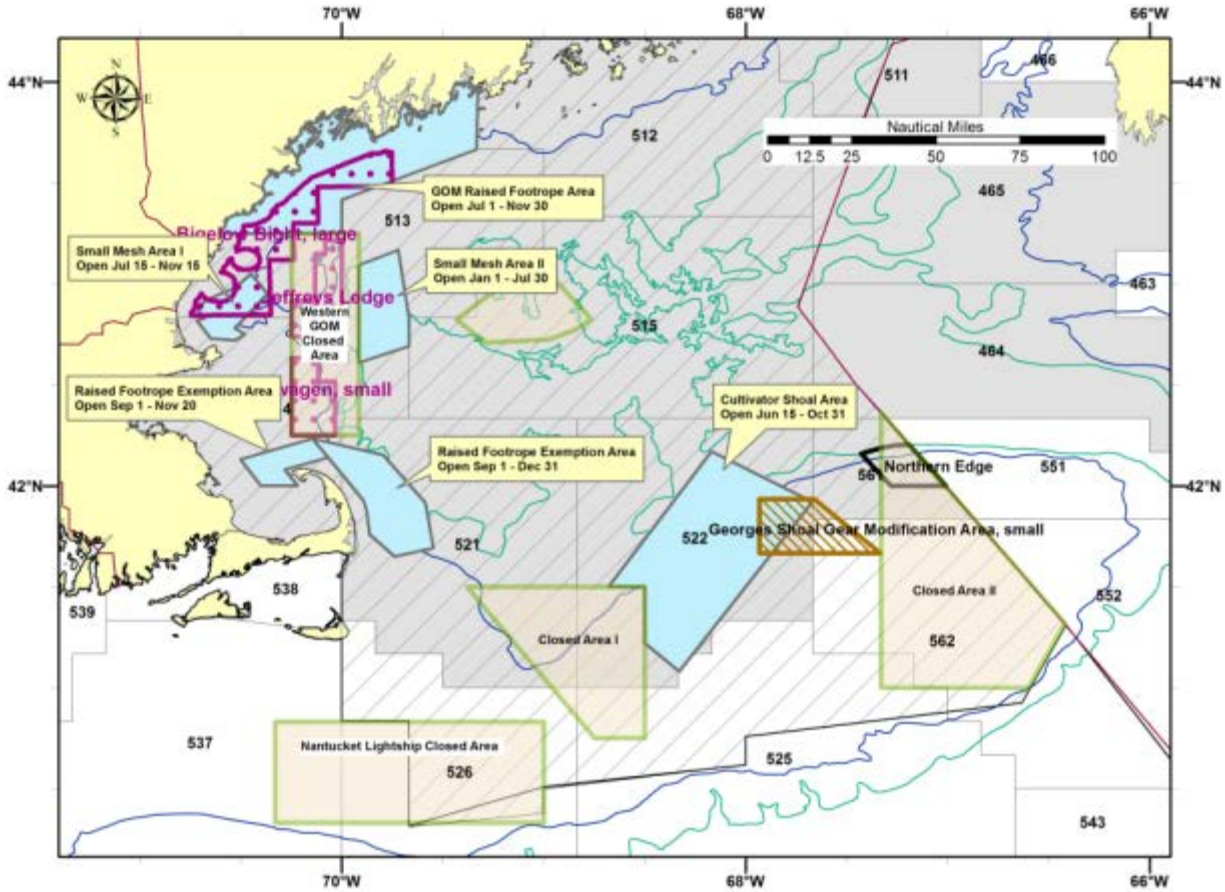
4.6.1.2.5 Spawning management alternatives

The proposed seasons when specific areas would be closed to gears capable to catching groundfish do not conflict with the open fishing seasons for the small-mesh exemption areas. Thus, the Spawning Management Area alternatives are unlikely to have any impact on the small-mesh multispecies fishery.

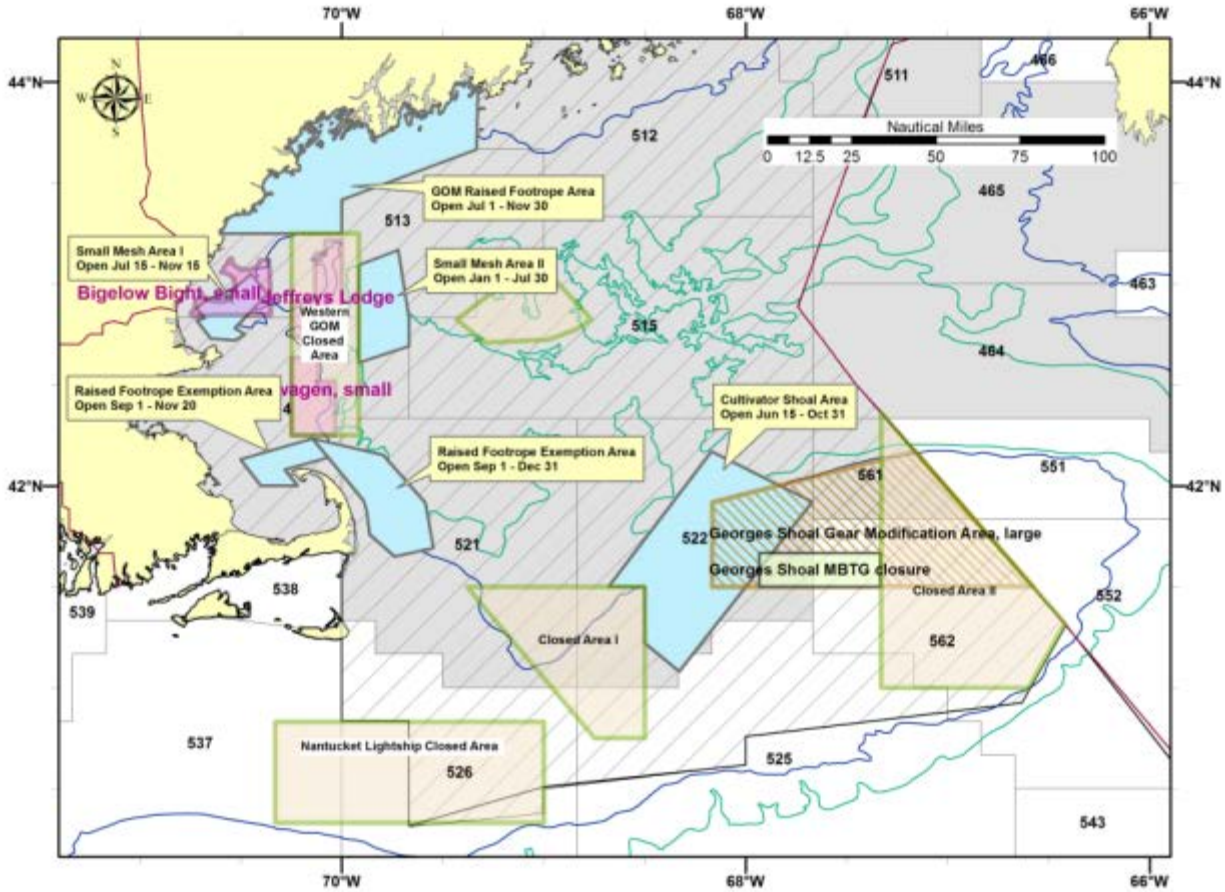
Map 113 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 3 in WGOM, CGOM, EGOM, and GB sub-regions, and Alternatives 3-5 in the GSC sub-region. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



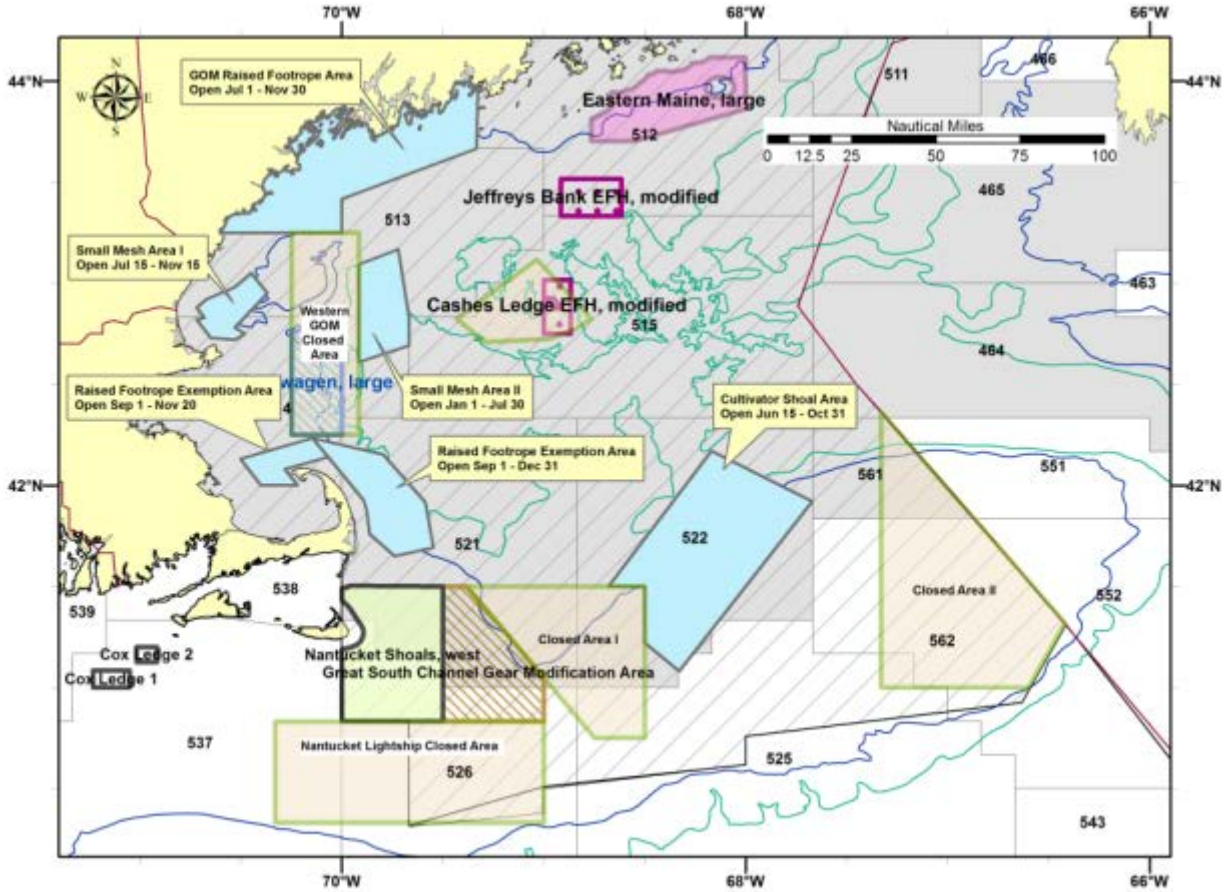
Map 114 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 4 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



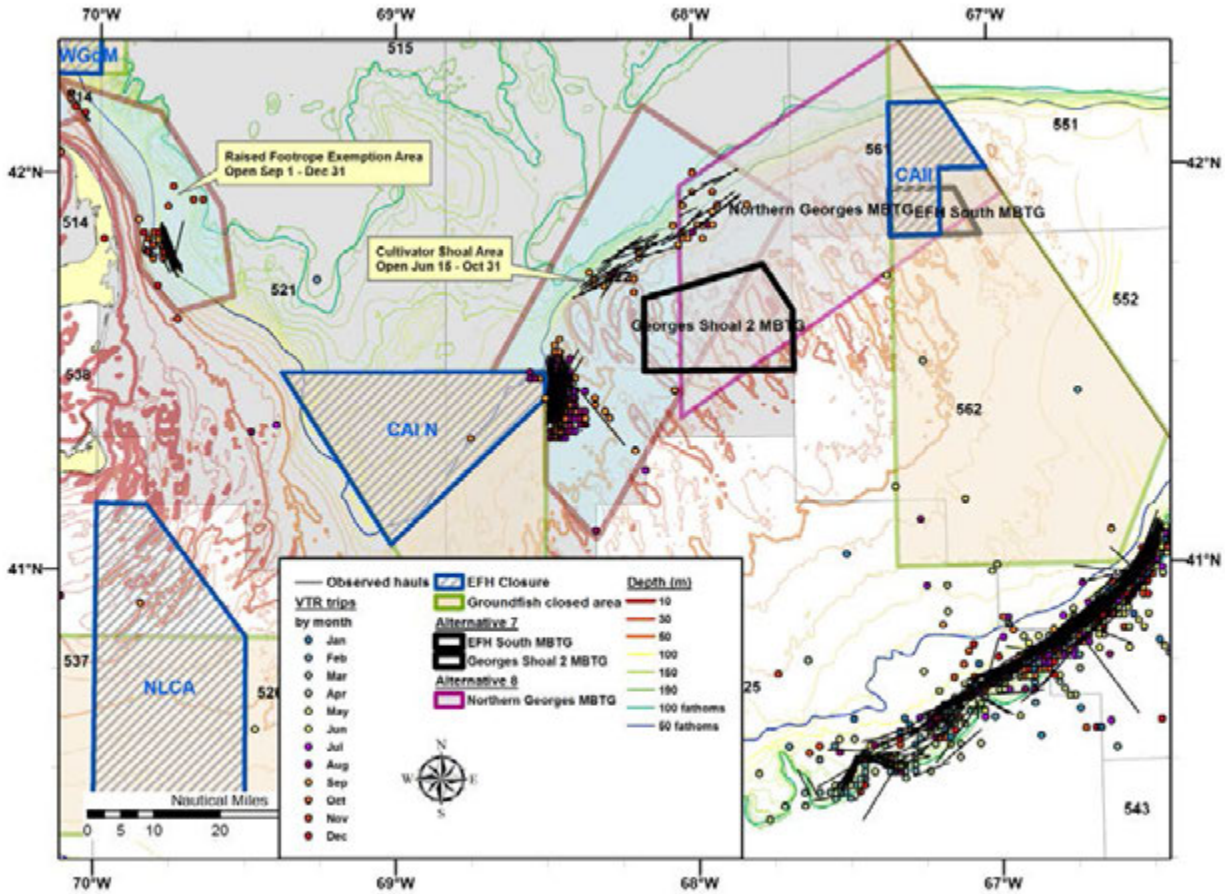
Map 115 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 5 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



Map 116 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 6 in WGOM, GB, and GSC sub-regions, with EGOM Alternative 2 and CGOM Alternative 4. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



Map 117 – Location of the Cultivator Shoals Small-mesh Exemption Area (open to fishing during June 15-Oct 31; blue shading with brown border) compared to the placement of the Georges Shoal 2 MBTG (Alternative 7; black border) and Northern Georges MTBG (Alternative 8; grey shading with purple border) areas. Observed trawl locations are represented by black lines, while fishing locations on vessel trip reports are represented by dots color coded by the month of landing, both data sets from 2008-2012.



4.6.2 Monkfish

This section evaluates the potential effects on the monkfish resource and fishery based on current resource distribution and fishing patterns.

The monkfish fishery is managed jointly by the New England and Mid-Atlantic Fishery Management Councils in two management units, a Northern Management Area in the Gulf of Maine, the Great South Channel, and most of Georges Bank, and a Southern Management Area covering the southwest part of Georges Bank, Southern New England, and Mid-Atlantic waters.

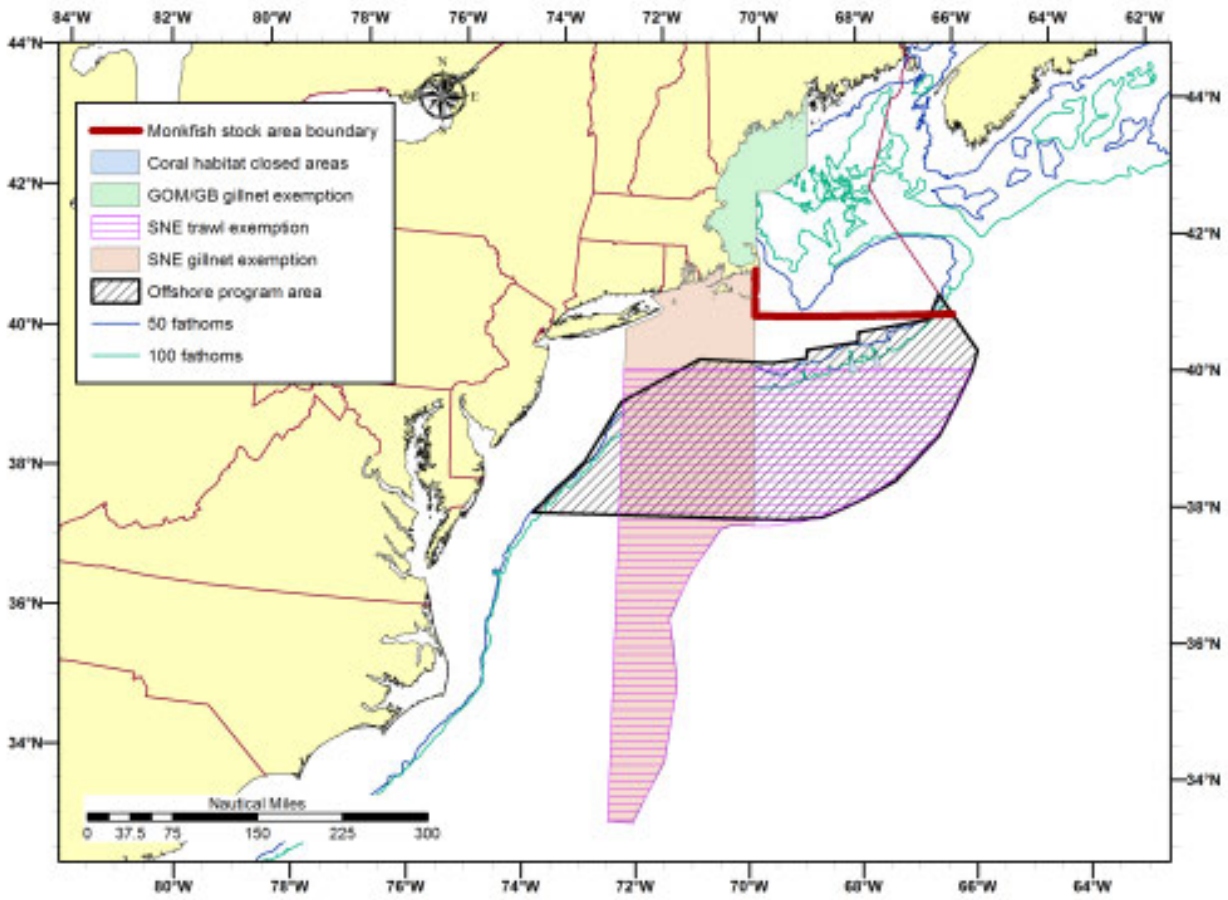
Use of mobile gear (trawls and dredges) to target and catch monkfish may be directly affected by the proposed habitat alternatives in this amendment. Vessels in the fishery also frequently use sink gillnets to target and catch monkfish which may be indirectly affected by the habitat alternatives and would be directly affected by the spawning alternatives.

The monkfish fishery is regulated in two distinct management areas, the Northern (NFMA) and Southern Fishery Management (SFMA) Areas (separated by the heavy read line shown in Map 118). The fishery is primarily managed through the issuance of limited access permits, as well as days-at-sea (DAS) allocations, landing limits, and gear restrictions that differ in each fishery management area. Monkfish DAS allocations and landing limits are reconsidered every few years to achieve the FMP mortality goals. Limited access monkfish vessels having a limited access groundfish permit are also required to comply with applicable Multispecies DAS and sector provisions. Mesh size regulations for trawls and gillnets are set to prevent the fishery from targeting small monkfish and catching groundfish when not on a Multispecies DAS. As a measure to reduce habitat impacts, regulations promulgated under Monkfish Amendment 2 require trawl vessels in the SFMA to use nets with roller gear with a diameter no larger than 6-inches[21]. Monkfish vessels fishing in the Inshore Roller Gear Restricted Area in the western Gulf of Mane, which may be modified by alternatives in this amendment (Section 2.1.3.7), may use roller gear with a diameter no larger than 12-inches.

Monkfish vessels may not fish with trawls or gillnets in the existing year round groundfish closed areas (Western Gulf of Maine, Cashes Ledge, Closed Area I, Closed Area II, and the Nantucket Lightship Area; shaded areas shown in Map 119). Vessels using mobile bottom-tending gear (e.g. trawls and dredges) also may not fish in the habitat closure areas (WGOM, Cashes Ledge, Jeffreys Bank, CAII, CAIN and CAIS, and NLCA; hatched areas with blue borders shown in Map 119). There are also two habitat protection areas Lydonia and Oceanographer canyons off the southern edge of Georges Bank that are closed to all monkfish fishing vessels.

[21] See Section 4.1.8.1 in Monkfish Amendment 2, http://www.nefmc.org/monk/planamen/final_planamen2.html)

Map 118 – Monkfish management areas including the boundary between the Northern and Southern (Monkfish) Fishery Management Areas (separated by thick red line).



In addition to the regulations described above, there are four special management areas that apply to vessels with monkfish limited access permits. Using trawls and gears with a minimum mesh size and during specific times to reduce the capture of regulated large-mesh groundfish, vessels may target and retain monkfish without being on a Multispecies DAS.

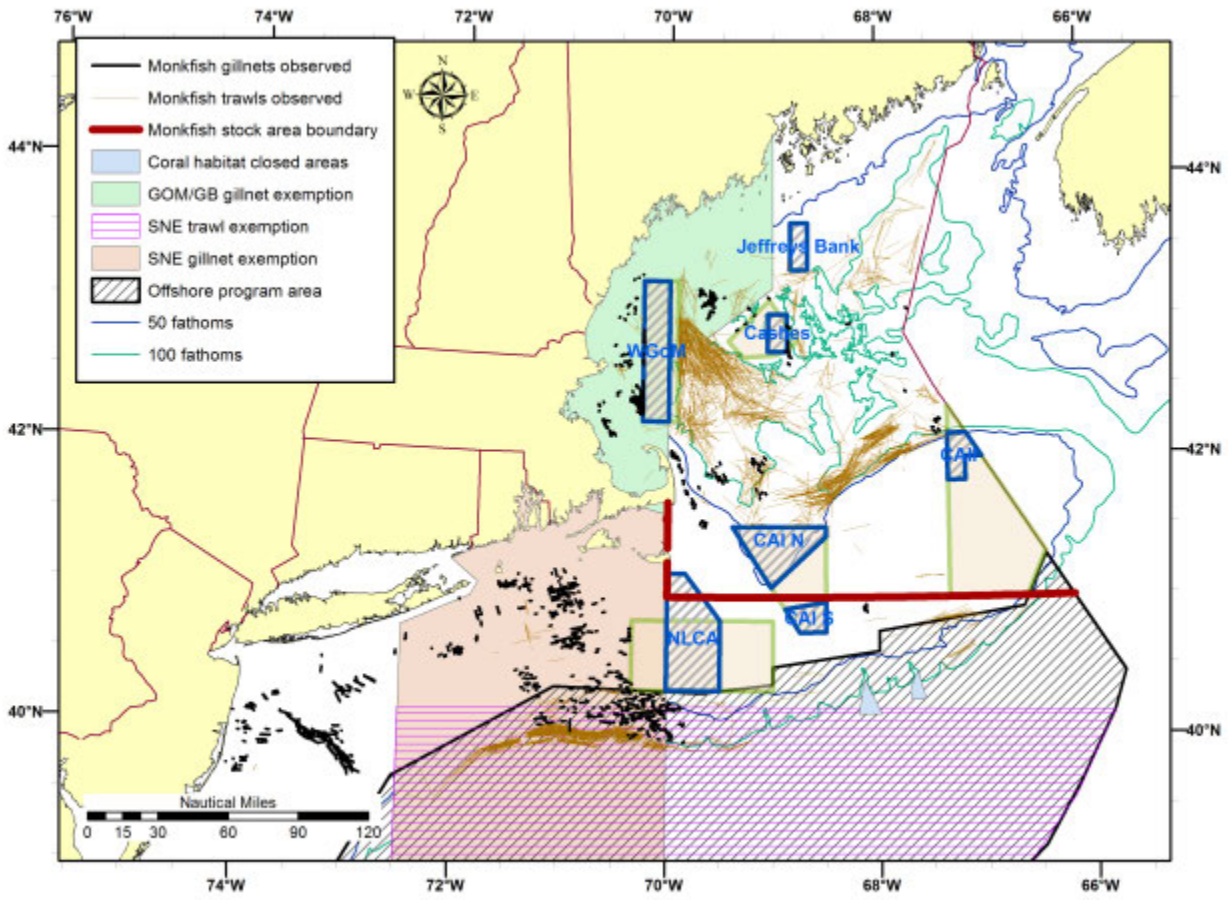
In the western Gulf of Maine there is a "Gulf of Maine/Georges Bank Dogfish and Monkfish Gillnet Fishery Exemption Area" (light green shaded area in Map 119). From July 1 to September 14, vessels using gillnets with a minimum mesh size of 10-inches may target monkfish and dogfish without being on a Multispecies DAS [§648.80(a)(13)]. Overlapping this exemption, vessels may use gillnets with a minimum mesh size of 6.5-inches, but may retain monkfish up to 10% of the total weight of fish onboard [§648.80(a)(14)].

A "Southern New England Monkfish and Skate Trawl Exemption Area" allows vessels to target monkfish without being on a Multispecies DAS year round, provided the vessel is using a trawl with a minimum mesh of 10-inches square or 12-inches diamond. This area is shown in Map 119 with the pink horizontal hatching. This area overlaps the edge of the continental shelf edge and deeper waters of the U.S. EEZ.

A "Southern New England Monkfish and Skate Gillnet Exemption Area" allows vessels targeting monkfish with gillnets to fish year round without being on a Multispecies DAS, provided the gillnet has a minimum mesh size of 10-inches. This area is shaded light orange in Map 119 and extends from the three-mile limit between Eastern Long Island to Cape Cod, south to the offshore boundary of the U.S. EEZ.

Lastly, vessels with a Category F monkfish permit may fish in the "Monkfish Offshore Program Area", which extends along the edge of the continental shelf south to 38º04' N latitude (shown with a diagonal black hatching in Map 119). Vessels fishing in this area with a Category F permit may fish with a higher monkfish possession limit in exchange for a reduction in their monkfish DAS allocation.

Map 119 – Distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish. No Action EFH Closures (blue outline) and year round Groundfish Closed Areas (tan background with green borders) are shown with Monkfish Fishery Exemption Areas.



4.6.2.1 ***Biological impacts***

Although monkfish are widely distributed throughout the US EEZ from shallow to deep water (Map 120) and occur on a variety of bottom substrates, they generally prefer softer sediments in deeper water rather than the harder substrate (and more vulnerable seabed structure) addressed by this amendment (see Section 4.4 of Framework Adjustment 7 to the Monkfish FMP for more details about monkfish EFH; see also Section 4.1.81 from Monkfish Amendment 2[22]). Fishing for monkfish with mobile bottom-tending gear (i.e. trawls) is, therefore, less likely to be affected by the proposed alternatives than fishing for other species that inhabit harder substrates.

Conversely, gillnets capture monkfish better when the fish are migrating, often for spawning. Gillnet fishing activity tends to occur in shallower areas throughout the Gulf of Maine, Southern New England, and the Mid-Atlantic. In some areas, such as around Cox Ledge and Jeffreys Ledge, the observed fishing effort also seems to focus on areas surrounding structured habitats, rather than occurring over the structures themselves.

4.6.2.1.1 Gulf of Maine habitat, spawning, and research area management alternatives

Although some shifts in fishing effort to deeper water with soft bottoms and/or to using gillnets to target monkfish in Habitat Management Areas might increase fishing for monkfish, the fishery in recent years has not harvested its annual catch limit. This may be as a result of the requirement for vessels in both areas to use a monkfish DAS when exceeding the applicable incidental limit. DAS usage has remained relatively stable between fishing years 2009 and 2012 (Monkfish Framework Adjustment 8 – NEFMC, 2014). Therefore, modest increases in fishing effort to target monkfish in deep water or with gillnets is unlikely to risk exceeding the ACL and thereby harm the resource. Thus, impacts on the monkfish resource from the habitat, spawning, or research area alternatives in the three Gulf of Maine sub-regions are expected to be neutral. The Monkfish FMP utilizes annual catch targets to account for management uncertainty. Amendment 5 established accountability measures in both management areas for this fishery, which were designed to prevent overfishing. If the accountability measure is triggered, the annual catch target, in the year following the overage, would be reduced on a pound-for-pound basis. Days at sea and trip limits would also be adjusted to ensure the revised annual catch target was not exceeded.

4.6.2.1.2 Georges Bank habitat, spawning, and research alternatives

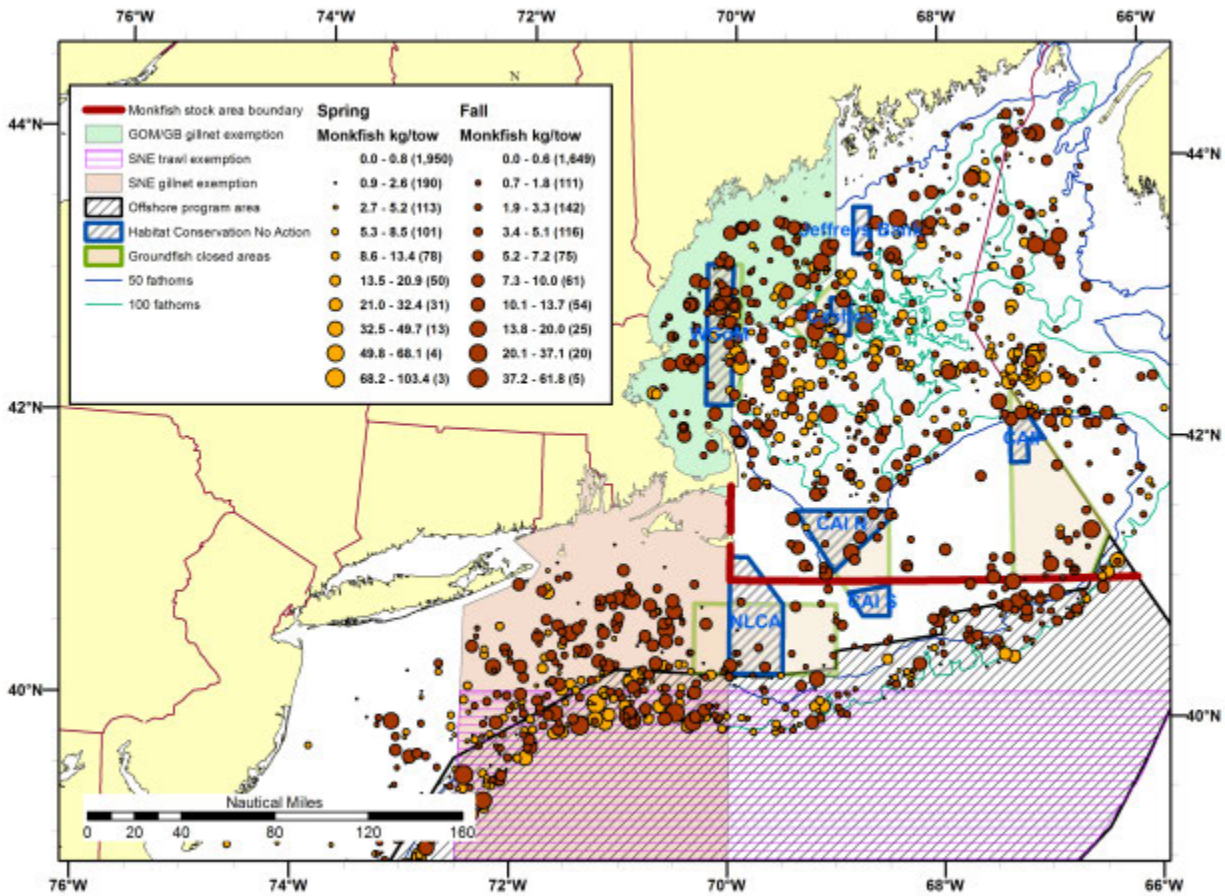
Impacts on the monkfish resource is likely to be neutral to slightly negative, since the fishery does not currently harvest the monkfish annual catch limits but some vessels targeting groundfish may shift fishing effort into areas where monkfish are more prevalent. Generally, a low proportion of monkfish biomass occurs in the areas proposed as Habitat Management Areas in the Georges Bank sub-region (Map 124).

[22] "The primary sediment type in areas where directed monkfish trawling occurs is mud, in both northern and southern areas, although during migration periods monkfish are caught in sandy and more complex bottom types."

4.6.2.1.3 Great South Channel/Southern New England habitat management alternatives

Impacts of the proposed Habitat Management Area alternatives on the monkfish resource are likely to be neutral to slightly positive. There appears to be some amount of fishable monkfish biomass within the proposed Great South Channel Gear Modification Area (Map 126). It is unknown whether there are concentrations of monkfish in the relatively unsampled Nantucket Lightship Shoals region that is included in some of the Habitat Management Area alternatives. Nonetheless, these areas might be fished more heavily by vessels using gillnets to target monkfish if trawling in the area were more restricted by the Habitat Management Area alternatives. Fishing this area with gillnets may be challenging due to heavy currents and high bottom relief.

Map 120 – 2002-2012 spring (orange circles) and fall (red circles) biomass distribution with habitat closures, year-round groundfish closures and monkfish exemption areas shown. Source: NMFS trawl survey data.



4.6.2.2 ***Fishery impacts***

4.6.2.2.1 Gulf of Maine habitat, spawning, and research area management alternatives

Generally the Habitat Management Area alternatives are expected to have a highly positive impact on the monkfish fishery, potentially opening up new areas to fishing using trawls and gillnets which are now closed primarily as year round groundfish closed areas. The Dedicated Habitat Research Area alternatives in the Gulf of Maine overlap with the proposed Habitat Management Areas, so any additional impacts on the monkfish fishery from the Dedicated Habitat Research Area alternatives are unlikely to occur. Since the proposed spawning management alternatives in the Gulf of Maine already exist as rolling closure areas and are closed to all gears capable of catching groundfish (including trawls and gillnets used to target monkfish), the proposed Spawning Management Areas are expected to have a neutral impact on the monkfish fishery.

During 2012 in the Gulf of Maine, 87.5% of monkfish landings on trips targeting monkfish used trawls. The majority of monkfish fishery landings from trips in the NFMA since 1994 also used trawls (Figure 54). Most of the observed trawl fishing activity targeting monkfish since 2008 occurred in deeper water, east of the Western Gulf of Maine Closure Area and off the northern edge of Georges Bank (Map 119). A smaller amount of observed trawl fishing for monkfish also occurred in the deeper basins of the Gulf of Maine. There appears to be very little overlap between observed monkfish trawl fishing activity and the proposed alternatives in the western, eastern, or central Gulf of Maine (Map 121).

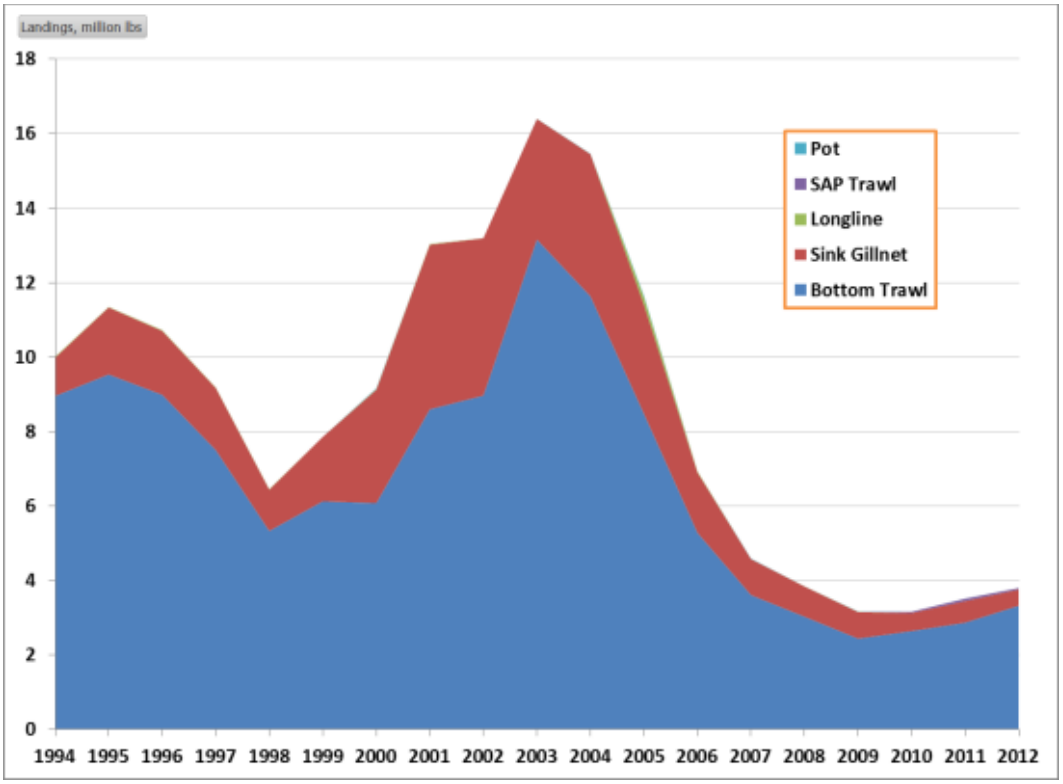
Observed gillnet fishing for monkfish, on the other hand, appear to be concentrated in shallower areas, often surrounding areas with a greater amount of bottom structure. Eight percent of landings on trips targeting monkfish in the Gulf of Maine used sink gillnet gear in 2012, a proportion that declined slowly since 1994 (Figure 54). Observed sets were notable west of the Western Gulf of Maine Closure Area, in the "Gulf of Maine/Georges Bank Monkfish Gillnet Exemption Area" and around Platts Bank, northeast of the Western Gulf of Maine Closure Area (Map 122). Another concentration of monkfish gillnet fishing effort occurred east of Cape Cod, Massachusetts, and north of Closed Area I. A small amount of observed monkfish gillnet fishing effort occurred northwest of Closed Area II, just north of Georges Bank in deeper water.

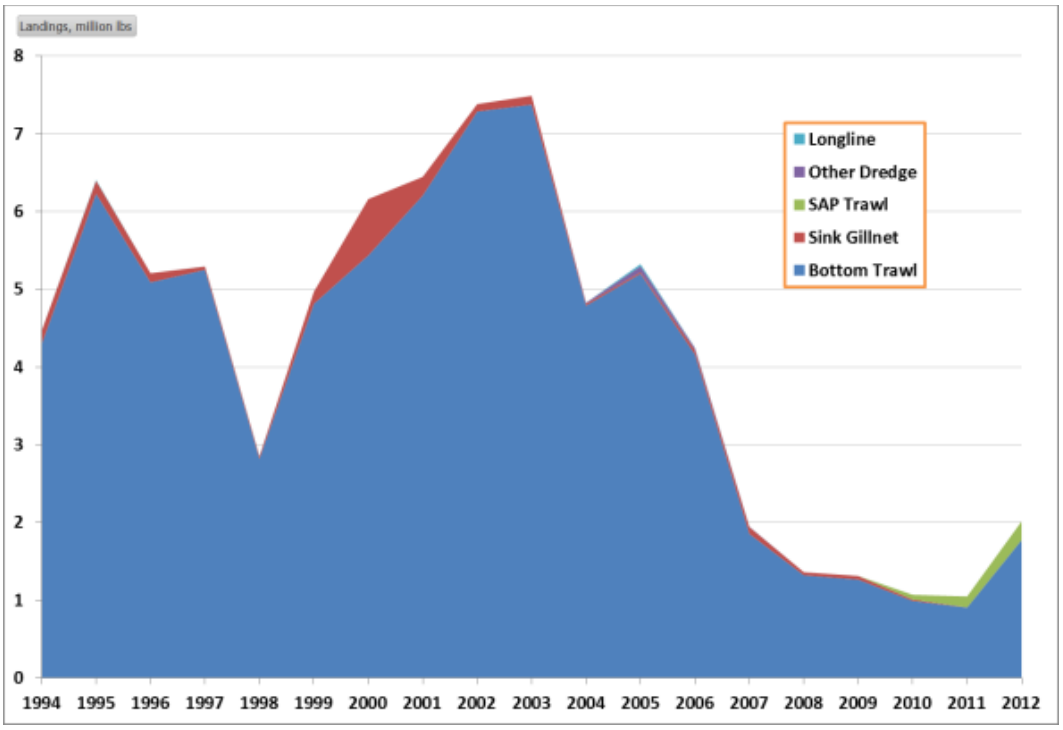
Since trawl fishing to target monkfish occurs along the eastern boundary of the Western Gulf of Maine Closure Area, it is likely that trawl fishing effort may disperse westward, potentially to the eastern boundary of the proposed Habitat Management Areas. Otherwise, direct effects on trawl fishing are unlikely. Indirectly, a reduction in the availability to trawl in harder substrate areas may shift some effort into the deeper basins of the Gulf of Maine and increase targeting of monkfish on available DAS.

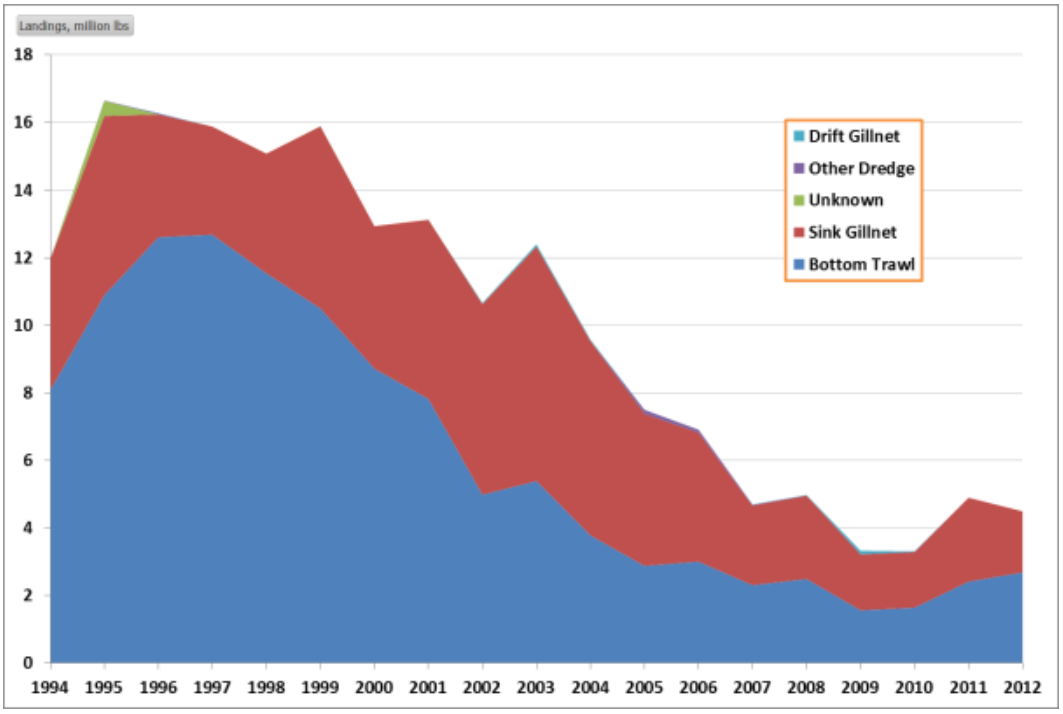
Lifting the restriction on fishing with gillnets in the Western Gulf of Maine Closure Area, while restricting fishing with mobile bottom-tending gear in the proposed habitat areas is likely to make more areas available to fishing for monkfish with gillnets, particularly on or around Jeffreys Ledge, Tillies Bank, and Stellwagen Bank. This area is also within the "Gulf of Maine/Georges Bank Monkfish Gillnet Exemption Area". Gillnet fishing for monkfish here is very likely to expand into the western Gulf of Maine, benefiting the fishery, but possibly causing

other problems such as gear conflict. Monkfish fishing with gillnets already occurs around the proposed Platts Bank Habitat Management Area (Map 119) and does not appear likely to change in distribution to fish the shallower portions of this area, even if it were closed to fishing by mobile bottom-tending gear.

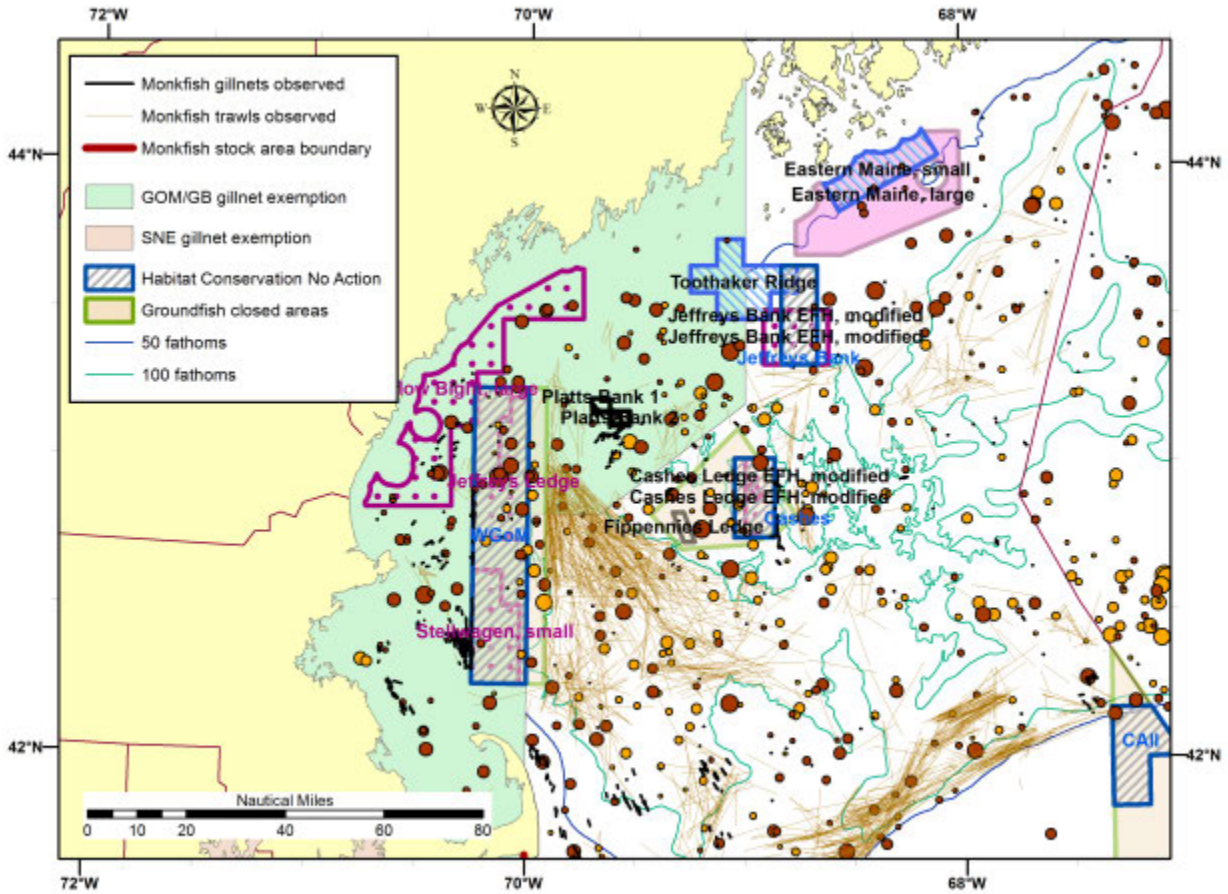
Figure 54 – Monkfish landings (million lbs.) by the top five gears by region, 1994-2012 (continued on next page). Source: NMFS CFDBS data. Upper panel – GOM, SAs 464, 465, 511-515. Middle panel – GB, SAs 522, 525, 542, 543, 561, and 562. Lower panel – SNE, SAs 521, 526-541.



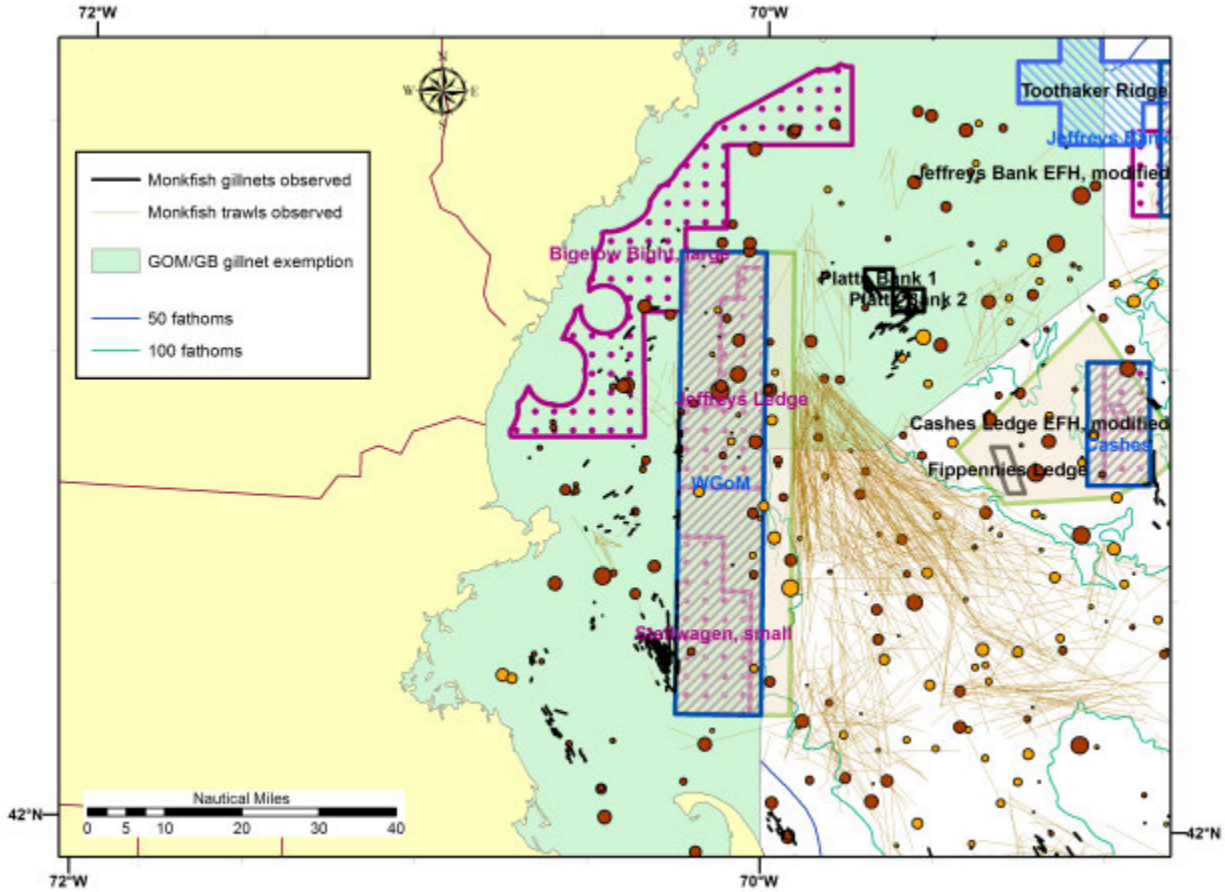

Landings, million lbs
8
7
6
5
4
3
2
1
0
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Longline
Other Dredge
SAP Trawl
Sink Gillnet
Bottom Trawl


Landings, million lbs
18
16
14
12
10
8
6
4
2
0
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Drift Gillnet
Other Dredge
Unknown
Sink Gillnet
Bottom Trawl

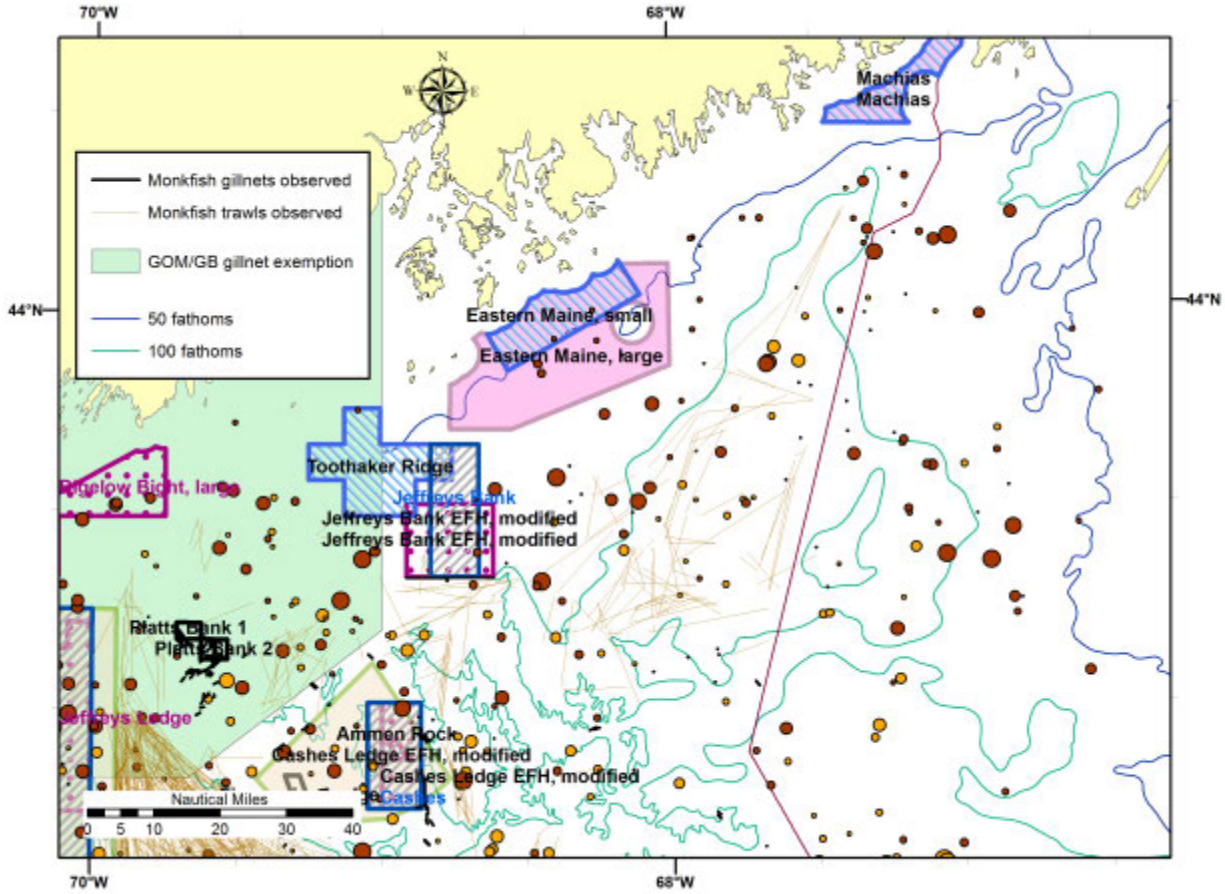
Map 121 – Relationship between proposed Habitat Management Areas and No Action areas in the GOM. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM (Groundfish) Closed Area, as well as Alternatives 2, 3, and 4 in the Central and Eastern GOM. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Map 122 – Relationship between proposed Habitat Management Areas and No Action areas in the Western Gulf of Maine. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM Groundfish Closed Area. Proposed and HMAs in the Central GOM are also shown. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Map 123 – Relationship between proposed Habitat Management Areas and No Action areas in Central and Eastern Gulf of Maine. Shown are proposed Habitat Management Areas associated with Alternatives 2, 3, and 4. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NEFSC trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



4.6.2.2.2 Georges Bank habitat, spawning, and research alternatives

Due largely to additional access to areas where monkfish occur in the southern half of Closed Area II (currently a year round groundfish closed area with some fishing allowed under groundfish and scallop special access programs) and the northern portion of Closed Area I (currently both a habitat and groundfish closed area), <u>the various habitat management action alternatives are likely to have a moderately positive impact on the monkfish fishery.</u> More areas that have monkfish would become open to fishing with trawls and gillnets, while the proposed habitat management area alternatives do not appear to have as much monkfish biomass.

<u>Closure of Closed Areas I and II from February 1 to April 15 is unlikely to significantly affect access to monkfish that occur in these areas. The proposed Dedicated Habitat Research Area in</u>

Closed Area I South appears to have relatively low monkfish biomass, and its closure is therefore unlikely to affect the monkfish fishery.

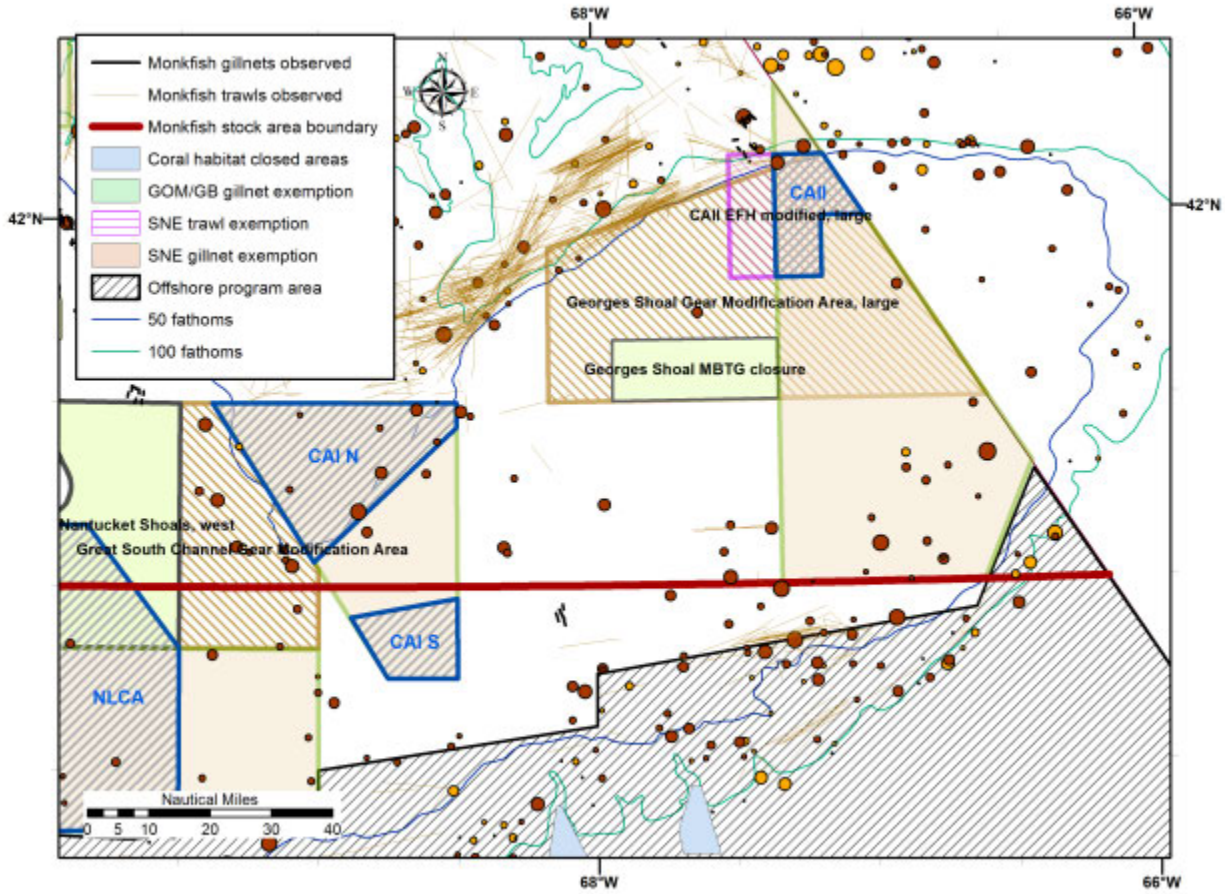
Nearly all of the observed monkfish fishing on Georges Bank is conducted with trawls, but there are a few observed gillnet trips on Georges Bank (Map 124). During 2012, 99.9% of monkfish landings on trips targeting monkfish came from vessels using trawls (Figure 54)[23]. Most of the observed monkfish trawl fishing effort occurs along the northern edge of Georges Bank, in deeper water off the edge of the bank. Some of this effort partially overlaps and coincides with the 'Northern Georges Gear Modification Area' (Alternative 5) and the 'EFH Modified 1 and 2 areas' (Alternatives 6A and 6B), but it appears that this fishing effort could shift into a little deeper water to the north, or into Closed Area I North, mitigating the negative effects of these alternatives.

Alternative 7 habitat management areas have no overlap with observed monkfish trawl and gillnet fishing. Thus the impact of Alternative 7 on the monkfish fishery is neutral. Alternative 8 has more conflict with the monkfish trawl fishery than any other Georges Bank sub-region alternative. Specifically, the Alternative 8 Northern Georges Mobile Bottom Tending Gear HMA extends north into deeper waters along the slope, where monkfish trawling often takes place. Vessels that would usually use trawls to target monkfish in this area would probably fish further southwest, closer to Closed Area I, or in deeper waters where other monkfish trawling has been observed. This potential effort shift may reduce monkfish catch per hour fished or otherwise increase fishing costs. Thus, the impact of Alternative 8 on the monkfish fishery is slightly negative.

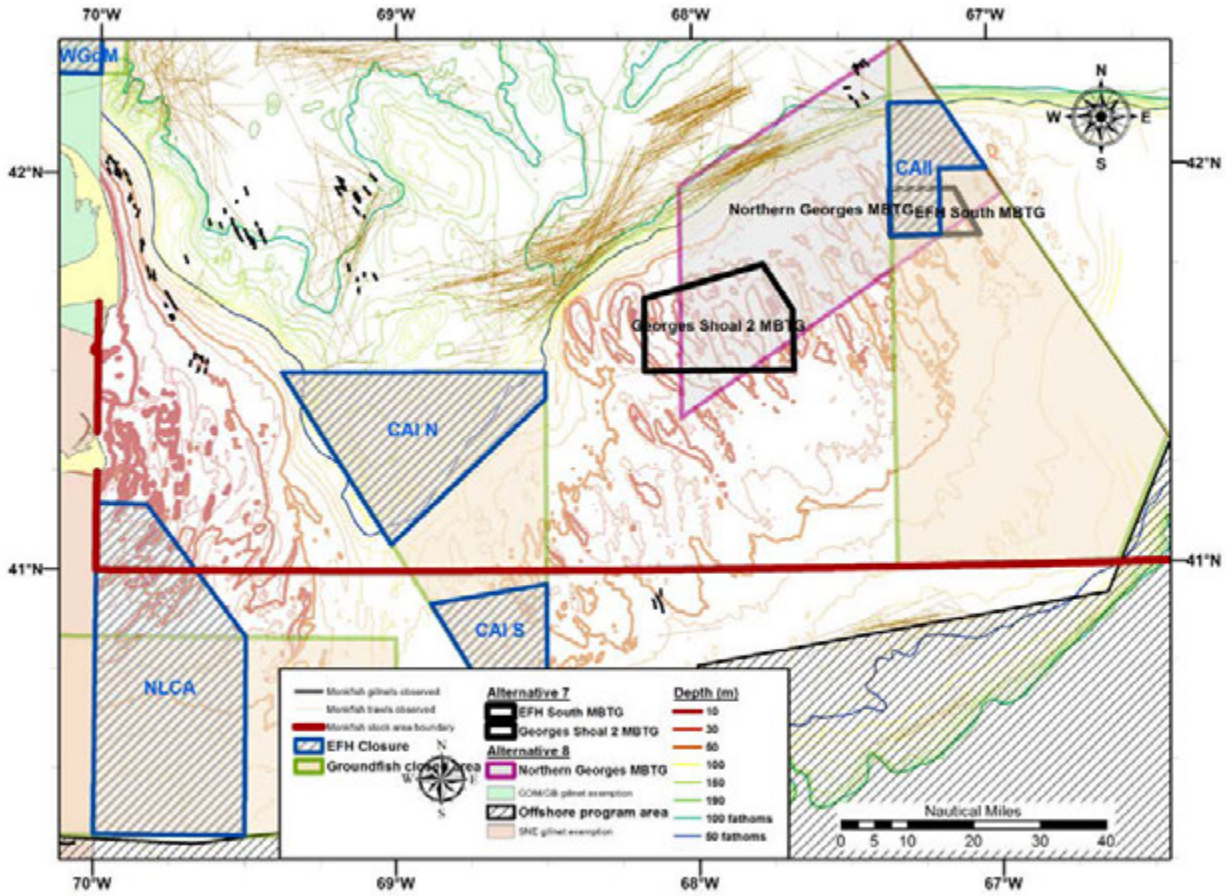
Based on the distribution of monkfish biomass from survey tows, trawl fishing along the northern edge of Georges Bank may also expand southwest into the northern portion of what is now Closed Area I (Map 124). This area is currently closed to groundfish fishing (year round closed area) and to mobile bottom-tending gear fishing (habitat closure). In any of the proposed alternatives, this area would re-open to fishing using either type of gear (trawls, gillnets, and dredges), except for February-April when the area would potentially be closed to gears capable of catching groundfish during spawning closures.

[23] 11.9% of monkfish were from vessels in SAP fisheries using Ruhle or separator trawls.

Map 124 – Relationship between proposed Habitat Management Areas and No Action areas on Georges Bank. Shown are proposed HMAs associated with Alternatives 5 and 6.1. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Map 125 – Relationship between proposed Habitat Management Areas and No Action areas on Georges Bank. Shown are proposed HMAs associated with Alternatives 7 (Georges Shoal 2 MBTG and EFH South MBTG; black border) and 8 (Northern Georges MBTG; grey shading and purple border). These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow.



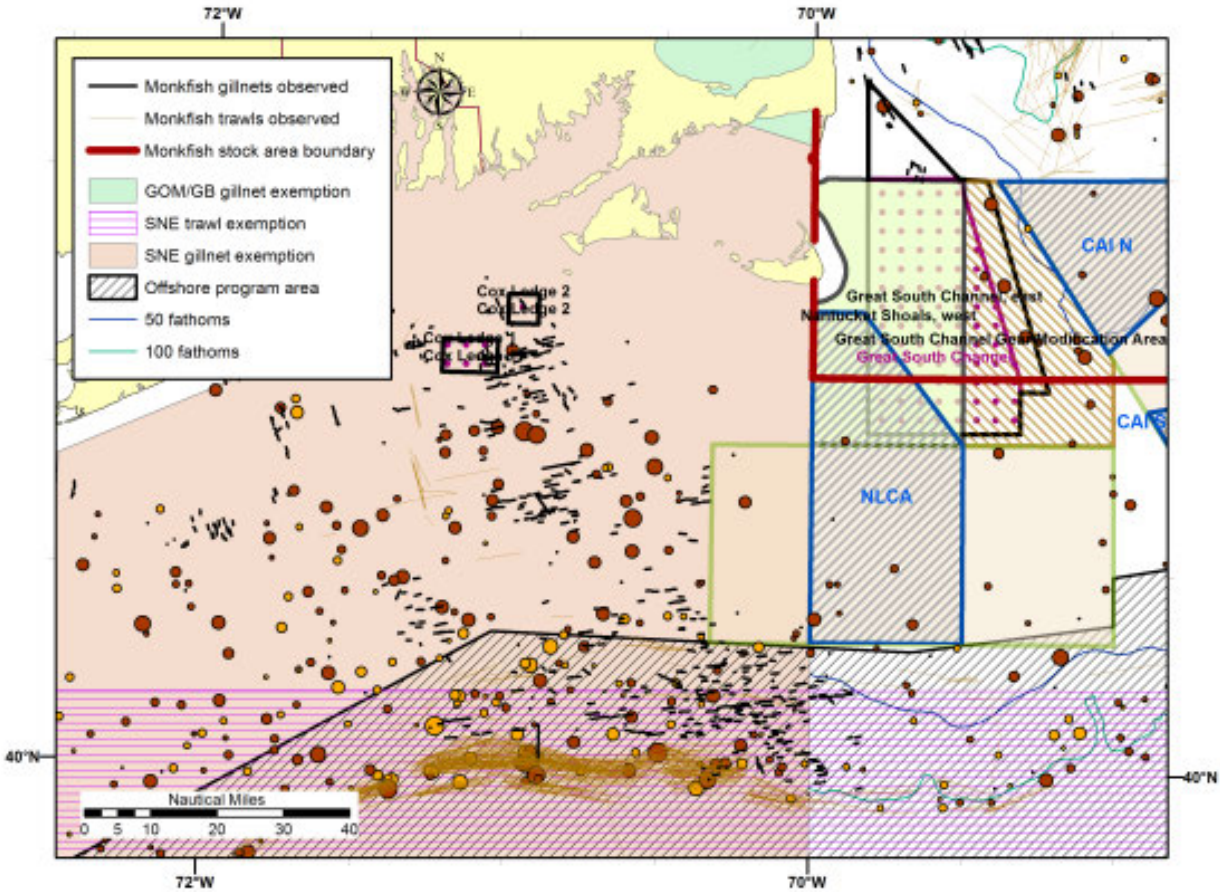
4.6.2.2.3 Great South Channel/Southern New England habitat management alternatives

<u>Impacts of the proposed alternatives on the monkfish fishery appears to be neutral to slightly positive due to the low amount of overlap between the proposed Habitat Management Areas and the little bit of additional fishing area available to monkfish gillnet vessels in the southern and western portion of the Nantucket Lightship Closed Area (Map 126).</u>

Inshore gillnetting for monkfish is conducted more frequently in the southern New England region than in the Gulf of Maine or on Georges Bank. Vessels using trawls typically target monkfish along the continental shelf edge, next to canyons and in deeper water than vessels fish with gillnets. Still, 59.7% of monkfish landings in 2012 were from vessels using trawls and 40.3% were from vessels using gillnets (Figure 54).

Except for the Cox Ledge areas, there is very little overlap between observed fishing activity and the proposed HMA alternatives (Map 126). Gillnet fishing activity around the two Cox Ledge areas has been observed, but this effort appears to primarily fall outside of the proposed areas and may have little effect on fishing activity. Gillnets would be allowed in the Cox Ledge HMA.

Map 126 – Relationship between proposed Habitat Management Areas and No Action areas in SNE. Shown are proposed HMAs associated with Alternatives 3, 4, and 6. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



4.6.3 Skates

4.6.3.1 *Biological impacts*

Clearnose and rosette skate are generally distributed south of the no action and alternative habitat, spawning, and research management areas (see maps for each species in the Affected Environment (Volume 1) and EFH alternatives sections (Volume 2)) and constitute a small fraction of landings in the skate fishery, so none of the spatial management alternatives are expected to have a notable impact on these stocks. Rosette skate are caught off the shelf edge and

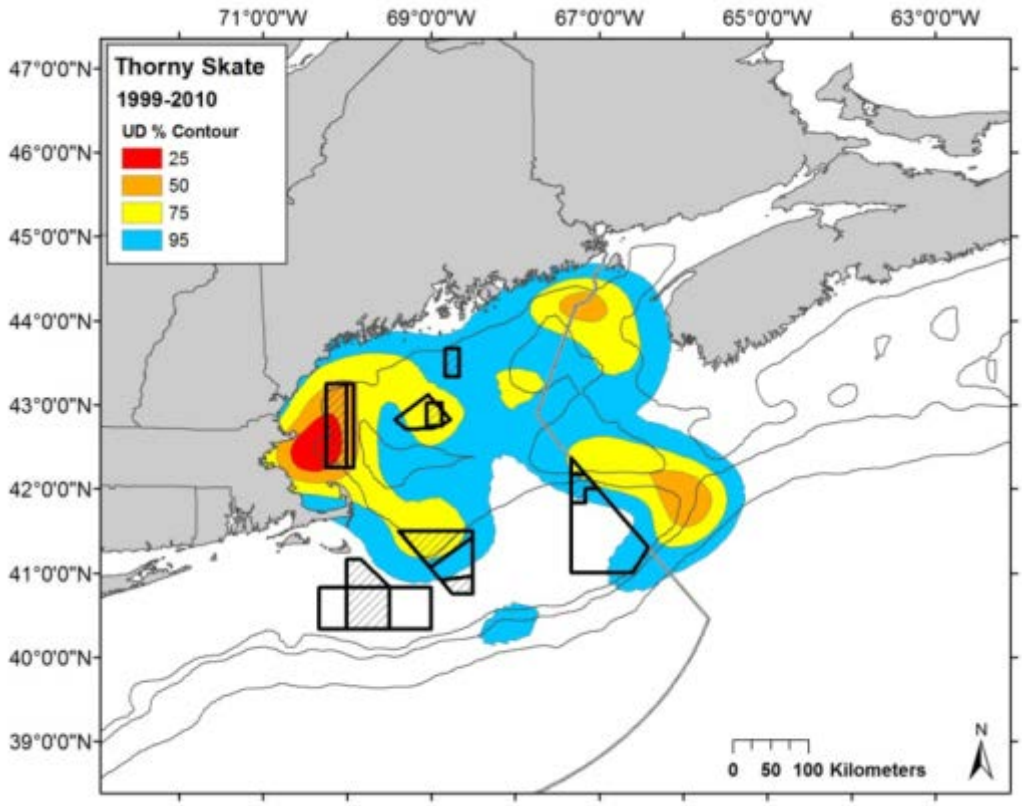
therefore do not intersect with any of the proposed management areas in this amendment. Some clearnose skates may be migrating into Southern New England waters during the summertime, but it is doubtful that many are found as far north as the Great South Channel, although there may be some undocumented intersection with the Cox Ledge area.

4.6.3.1.1 Habitat management alternatives

Habitat management areas in the Gulf of Maine overlap with the distribution of thorny and smooth skates, so changes in the boundaries of habitat management areas or the fishing restriction measures within these areas could impact these stocks. Smooth skate is not overfished and not subject to overfishing not occurring but is in a rebuilding plan, and thorny is overfished with overfishing occurring. Due to their status, impacts on thorny skate are of greater concern. Thorny skate have a somewhat shallower and more inshore distribution as compared to smooth skate, and greater overlap with the various habitat management areas, which tend to occur in shallower waters and do not generally overlap with deeper mud basins.

In the last decade especially, thorny skate have become concentrated in the western Gulf of Maine, both inside and outside of the Western Gulf of Maine Closure Area (Map 127). Increases in either trawl or gillnet effort within the area of highest thorny skate abundance could lead to negative impacts on thorny skate. Increased trawl effort in areas where thorny skate occur in large numbers could result from removal of the existing habitat and groundfish closed areas, although this would be mitigated if new HMAs are designated as mobile gear closures nearby, for example the Bigelow Bight, Stellwagen, or Jeffreys Ledge HMAs in Alternatives 3-6. However, no year-round habitat management areas are proposed south of Cape Ann and west of the current Western Gulf of Maine Habitat Closure, overlapping with the areas of highest density in the figure below. Increases in gillnet effort could result from removal of the groundfish closure, because with no management areas (Western Gulf of Maine Alternative 2) or only habitat management areas that restrict mobile bottom-tending gears (Western Gulf of Maine Alternatives 3-6), the use of gillnets and other fixed gears would be permitted, apart from any spawning closures or protected resource-related management measures that restrict this gear.

Map 127 – Fixed kernel utilization distribution (UD) of positive thorny skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



Thorny skate have a zero possession limit, so presumably increases in effort in areas where they are more abundant would not lead to directed fishing on the stock, but they are caught incidentally in various gears (Table 130). Because reporting at the species level is incomplete, these discard values are estimates based on fishing location and discarded to kept catch ratios on observed trips. The overall skate complex Total Allowable Landings (TAL) is a combined value that is primarily based on a moving survey biomass index across the seven skate species. The TAL is set below the annual catch limit at a level that equals the annual catch target (75% of ACL) minus discards, minus state landings. Different species contribute different fractions of the TAL depending on their current stock size. For reference, thorny skate contribute 229 mt to the skate complex TAL under the specifications proposed for fishing year 2014 (Skate Framework Adjustment 2, May 21, 2014; 79 FR 29154). In total, the thorny skate bycatch estimates are of similar magnitude (estimated discards for otter trawl, gillnet and scallop dredge in 2012 was 409 mt). Because it is a skate complex TAL, catch and landings are not managed directly according to an individual species' TAL contribution. <u>However, with current bycatch of thorny skate estimated to be above the fraction they contribute to the TAL, additional bycatch of the species as a result of alternatives proposed in this amendment is of concern, as it could compromise rebuilding of the stock</u>. <u>Fixed gear discards are lower than mobile gear discards, so alternatives that increase the potential for fixed gear use in areas of high thorny skate abundance (i.e. Alternatives 3-6 as mobile bottom tending gear closures) would have smaller negative impacts than those that increase mobile bottom-tending gear use in areas of high thorny skate abundance</u>

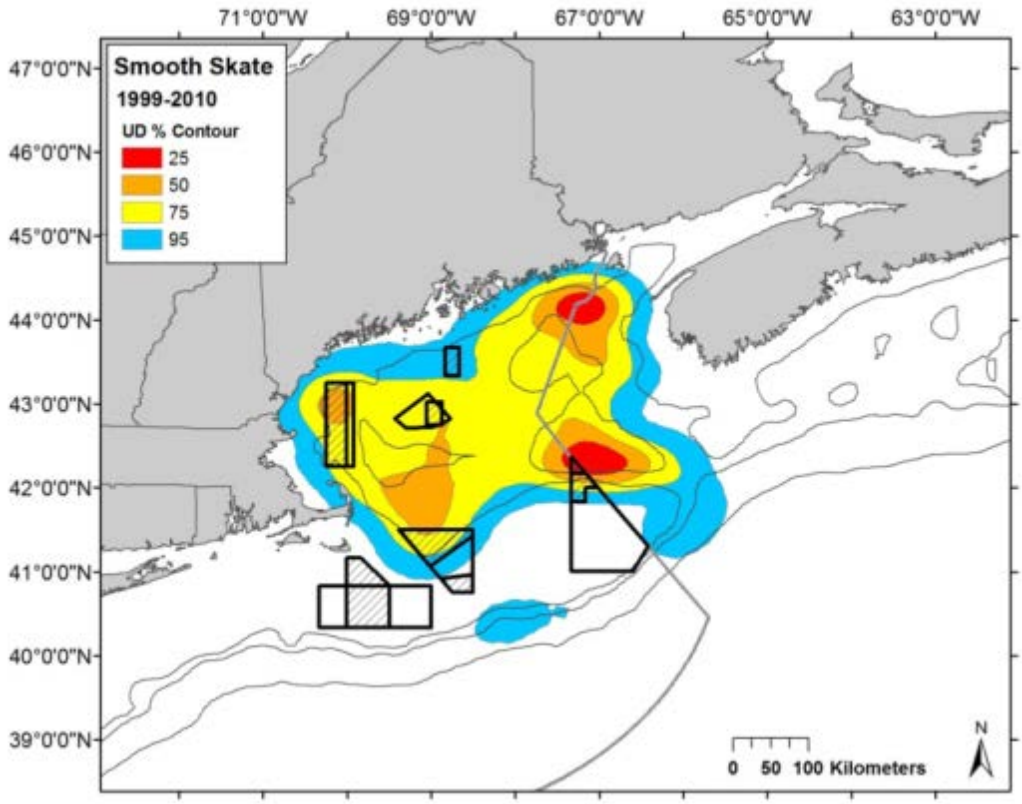
(Alternative 2, Alternatives 3-6 as gear modification areas). Currently, the specifications process assumes a 23% discard mortality rate of otter trawl-caught thorny skates, but this may be an underestimate. A higher discard mortality rate would mean that increased catches of thorny skate result in a higher fishing mortality rate on the stock. The assumed discard rate in fixed gear (e.g. gillnets) is 50%, but this is based on limited data.

Table 130 – Estimated total discards of thorny skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	3	1	90	31	125
2009	8	1	179	18	206
2010	6	3	268	22	299
2011	4	1	149	22	176
2012	8	2	326	73	409

Smooth skate have a somewhat different distribution than thorny skate, with the highest concentrations of survey catch north of Jordan Basin and in Georges Basin (Map 128). Moderate concentrations of catch (50% contour on the kernel utilization plots) are found on Jeffreys Ledge and between Wilkinson Basin and Closed Area I.

Map 128 – Fixed kernel utilization distribution (UD) of positive smooth skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



Impacts of habitat management alternatives on smooth skate are somewhat less concerning than for thorny skate, as the status of the stock is better relative to biological reference points, but it is still below the target. Like thorny skate, smooth skate have a zero possession limit, so presumably increases in effort in areas where they are more abundant would not lead to directed fishing on the stock, but they are caught incidentally in various gears (Table 131). For reference, smooth skate contribute 644 mt to the skate complex Total Allowable Landings (TAL) under the alternative specifications currently under development. In total, these bycatch estimates are of similar magnitude.

Otter trawls and scallop dredges make the greatest contribution to estimated smooth skate discards, so alternatives that increase use of these gears in areas of high smooth skate abundance could have a negative impact on the stock. This could be the case if year-round mobile gear restrictions are eliminated on Jeffreys Ledge (Alternative 2, 3, or 6), or if gear modification are the preferred management option for Alternatives 4 or 5, which include the Jeffreys Ledge HMA. The assumed discard mortality rate for smooth skate in otter trawls is 60%, but 50% for all other gear types.

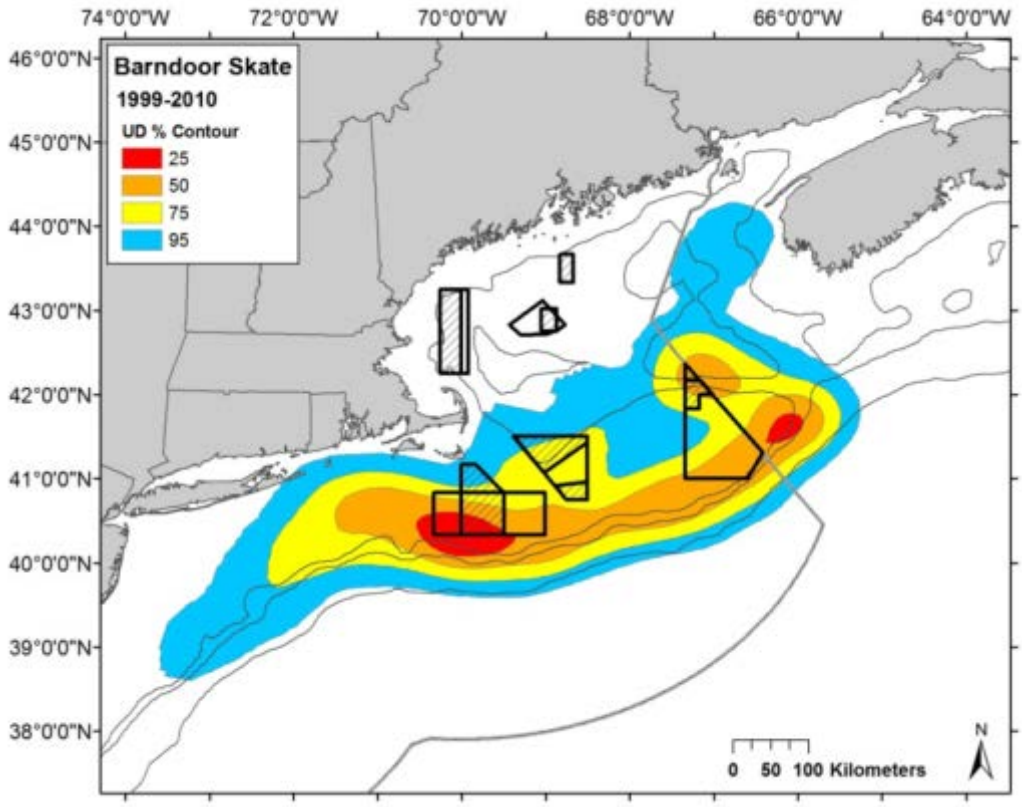
Table 131 – Estimated total discards of smooth skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	18	4	591	250	863
2009	23	3	591	48	665
2010	15	15	577	52	659
2011	25	11	637	128	801
2012	20	3	596	172	791

Habitat management alternatives on Georges Bank and in Southern New England overlap with winter, little, and barndoor skate distributions. Both winter and little skate are currently very abundant, although overfishing is occurring on winter skate as of 2012, based on the percent change in three year moving average survey indices for the species. It is not known whether these species are resident in closed areas, such that the historic presence of closures may have contributed to their currently high biomass. Both species are very widely distributed over the bank, such that any combination of management areas will overlap their distribution. Altogether, it is unlikely that changing habitat management areas in Georges Bank and Southern New England will have a negative impact on winter skate or little skate. Trip limits and overall total allowable landings limits for the wing and bait fisheries will likely control overall mortality on these stocks, regardless of changes in spatial management, although it should be noted that the approach to developing trip limits and total allowable landings limits could change in the future. Furthermore, recent studies of discard mortality rates (Mandelman et al. 2013) indicate that these rates are lower than previously believed.

Barndoor skate occur in all of the current closed areas, but are most abundant along the margin of the bank, including the southwestern part of the Nantucket Lightship Closed Area and Closed Area II (Map 129). Barndoor skate abundance is increasing, and although it has not yet reached the biomass target, barndoor skate is not overfished and overfishing is not occurring. Retention of barndoor is still prohibited, and additional conservation of the stock may be helpful as it continues to rebuild. Based on its distribution, alternatives that reopen the southern part of Closed Area II and the Nantucket Lightship Closed Area would probably have the greatest effect on discards of barndoor skate.

Map 129 – Fixed kernel utilization distribution (UD) of positive barndoor skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



Like thorny and smooth skates, because barndoor skate have a zero possession limit, it is assumed that increases in effort in areas where they are more abundant would not lead to directed fishing effort on the stock. However, they are caught incidentally in various gears so fishing does contribute to mortality (Table 132). The highest discard rates are in the otter trawl and sink gillnet fisheries, and at least some of the effort in those fisheries is directed on skates. If barndoor abundance continues to increase and retention is allowed at some point in the future, these discards would likely be converted to landings, at least in the wing fishery which targets larger animals. For reference, barndoor skate contribute 3,221 mt to the skate complex Total Allowable Landings (TAL) under the proposed 2014 specifications.

Table 132 – Estimated total discards of barndoor skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	742	39	3258	290	4329
2009	188	29	1492	335	2044
2010	764	121	2544	303	3732
2011	1660	36	4370	570	6636
2012	965	9	3413	503	4890

Table 133 summarizes the potential impacts of the various habitat management alternatives on each of the skate stocks, with the exception of rosette and clearnose which do not overlap the current or alternative management areas.

Table 133 – Summary of the impacts of habitat management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate.

<table>
<tr><th>Sub-region</th><th>Alt</th><th>Thorny</th><th>Smooth</th><th>Little</th><th>Winter</th><th>Barndoor</th></tr>
<tr><td rowspan="2">EGOM</td><td>1</td><td colspan="2">Neutral</td><td colspan="3" rowspan="13">Few to no impacts – based on survey data, these three species have very limited distributions in the GOM</td></tr>
<tr><td>2</td><td colspan="2" rowspan="2">Neutral to slightly positive – some overlap between species and management areas such that elimination of MBTG fishing would benefit the stock</td></tr>
<tr><td>3</td></tr>
<tr><td rowspan="3">CGOM</td><td>1</td><td colspan="2">Slightly positive</td></tr>
<tr><td>2</td><td colspan="2" rowspan="2">Slightly negative</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td colspan="2">Slightly negative</td></tr>
<tr><td rowspan="5">WGOM</td><td>1</td><td>Positive</td><td>Slightly positive</td></tr>
<tr><td>2</td><td>Negative</td><td>Neutral to slightly negative</td></tr>
<tr><td>3</td><td>Slightly negative – removal of management areas on Jeffreys Ledge could cause increased fishing on the stock. Bigelow Bight area would provide some conservation benefits.</td><td rowspan="3">Neutral to slightly negative – less so than Alt 2</td></tr>
<tr><td>4</td><td rowspan="2">Neutral – similar protection compared to current management area, although fixed gear</td></tr>
<tr><td>5</td></tr>
</table>

<table>
<tr><th>Sub-region</th><th>Alt</th><th>Thorny</th><th>Smooth</th><th>Little</th><th>Winter</th><th>Barndoor</th></tr>
<tr><td rowspan="4"></td><td></td><td>fishing would be allowed throughout areas</td><td rowspan="2"></td><td colspan="3" rowspan="2"></td></tr>
<tr><td>6</td><td>Slightly negative – removal of management areas on Jeffreys Ledge could cause increased fishing on the stock</td></tr>
<tr><td>7a and 7b</td><td colspan="5">Uncertain, probably neutral</td></tr>
<tr><td>8</td><td colspan="5">The shrimp trawl exemption area would have slightly negative to neutral impacts on thorny and smooth skate in combination with Alternative 1, and neutral impacts on other stocks. The alternative could increase shrimp trawl effort in the exemption area, but large amounts of fishing in the exemption area are unlikely.</td></tr>
<tr><td rowspan="9">GB</td><td>1</td><td>Slightly positive – limited distribution of these species in northern parts of existing CAI and CAII which would be retained under no action</td><td colspan="2" rowspan="8">Neutral – species are abundant and found throughout sub-regions, and fishing mortality is controlled via other means</td><td colspan="2">Neutral to slightly positive</td></tr>
<tr><td>2</td><td colspan="2" rowspan="7">Slightly negative – limited distribution of these species in northern parts of existing CAI and CAII which would be eliminated under these alternatives</td><td colspan="2" rowspan="7">Slightly negative – increases in fishing could increase bycatch in southern part of CAII; however stock not overfished</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td rowspan="6">GSC-SNE</td><td>1</td><td colspan="2" rowspan="6">None – very limited distributions of these species in these areas</td><td colspan="2" rowspan="6">Neutral – highest abundance areas along southern margin of GB, not in this sub-region</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
</table>

4.6.3.1.2 Spawning management alternatives

Contingent on decisions made about the year-round groundfish closures under the habitat management alternatives, the spawning management alternatives would maintain existing year round and seasonal closures (No Action), modify these areas (Gulf of Maine Alternative 2, GB Alternatives 2 and 3), or create a new area (Gulf of Maine Alternative 3).

Specifically, Gulf of Maine Alternative 2 would remove the Western Gulf of Maine and Cashes Ledge year round closures, as well as the common pool rolling closures. Depending on the habitat management alternatives selected for these areas, changes to the Western Gulf of Maine closure could negatively impact thorny skate, and to a lesser extent, smooth skate. Portions of these areas would still be closed to many gears capable of catching groundfish on a seasonal

basis (April-June, depending on the area). Gulf of Maine Alternative 3 would designate a new spawning area in Massachusetts Bay during November through January. This could have slight positive impacts, especially for thorny skates, if effort is reduced in that season, as their distribution overlaps the area, but it would have neutral impacts if effort simply shifts elsewhere in the inshore western Gulf of Maine. Georges Bank Alternative 2 would remove the Nantucket Lightship Closure, and make Closed Areas I and II seasonal in the spring. This could increase discards of barndoor skate, and thereby cause negative impacts on the stock relative to no action.

Table 134 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted).

<table>
<tr><th>Region</th><th>Alt</th><th>Thorny</th><th>Smooth</th><th>Little</th><th>Winter</th><th>Barndoor</th></tr>
<tr><td rowspan="3">GOM</td><td>1</td><td>Positive</td><td>Neutral to slightly positive</td><td colspan="3" rowspan="3">None – very limited distributions of these species in these areas</td></tr>
<tr><td>2A and 2B</td><td>Negative</td><td>Neutral to slightly negative</td></tr>
<tr><td>3</td><td colspan="2">Neutral to slightly positive</td></tr>
<tr><td rowspan="4">GB</td><td>1</td><td colspan="2" rowspan="2">Slightly positive – limited distribution of these species in northern parts of existing CAI and CAII which would be retained under no action</td><td colspan="2" rowspan="4">Neutral – species are abundant and found throughout sub-regions, and fishing mortality is controlled via other means</td><td>Positive – NLCA and southern part of CAII may limit bycatch on the stock, although there are access programs currently in place in CAII</td></tr>
<tr><td>2A, 2B, 2C</td><td colspan="2" rowspan="2">Slightly negative – limited distribution of these species in northern parts of existing CAI and CAII which would be made seasonal under action alternatives</td><td rowspan="2">Slightly negative – CAII would only be in place 3 months of the year; however stock not overfished; NLCA would be removed.</td></tr>
<tr><td>3A, 3B, 3C</td></tr>
</table>

4.6.3.1.3 Dedicated Habitat Research Area alternatives

Although they may have costs and benefits due to associated restrictions on fishing, these types of impacts of Dedicated Habitat Research Areas are considered in analysis of their corresponding Habitat Management Areas. Therefore, DHRA impacts are relative to any additional fishing restrictions that might provide enhanced conservation, and to the expected benefits of completing research projects.

Table 135 – Summary of the impacts of research alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3.

<table>
<tr><th>Alt</th><th>Thorny</th><th>Smooth</th><th>Little</th><th>Winter</th><th>Barndoor</th></tr>
<tr><td>1 – No DHRA</td><td colspan="5">Neutral – no research areas designated, but these locations may be managed for habitat or spawning purposes</td></tr>
<tr><td>2 – E Maine</td><td colspan="2">Slightly positive – limited overlap between stocks and this DHRA such that research is likely to generate only limited information about skates in this area.</td><td colspan="3">None – stocks do not occur in DHRA</td></tr>
<tr><td>3A, 3B, 3C – Stellwagen</td><td>Positive – thorny skates are abundant in this area, such that research should provide information to help better manage the skate resource.</td><td>Slight positive – lesser overlap with distribution of smooth skates.</td><td colspan="3">None – limited overlap between stocks and this DHRA</td></tr>
<tr><td>4 – Georges Bank</td><td colspan="2">None – no overlap between stocks and this DHRA</td><td colspan="2">Positive – species are common in this area and research could provide information to help better manage the skate resource.</td><td>Neutral to slightly positive– DHRA is not an area of high abundance for barndoor skate</td></tr>
<tr><td>5 – Sunset provision</td><td colspan="5">Neutral. This alternative is designed to remove a DHRA if it is not being used, and a DHRA that is not in use will not be producing positive benefits in terms of increased information.</td></tr>
</table>

4.6.3.1.4 Framework and monitoring alternatives

No action measures would be expected to have neutral impacts on the skate resource. Under Alternative 2, enhanced data collection and timely review and strategic decision making on spatial management issues could have indirect, slightly positive impacts on the skate resource.

4.6.3.2 ***Fishery impacts***

4.6.3.2.1 Habitat management alternatives

Skates are caught on both directed and incidental trips in the multispecies, monkfish, and to a much lesser extent, scallop fisheries, in trawl, sink gillnet, and scallop dredge gear. The habitat management alternatives generally restrict mobile bottom-tending gears, so there would be no restrictions on directed or incidental catch of skates using gillnets except where such catches are already prohibited under no action (i.e. in the current year-round groundfish closed areas). Statistical areas 521 and 537 have the highest catches of skates in gillnets, and some of this effort likely occurs within the proposed Cox Ledge and Great South Channel HMAs. Restrictions on mobile gears in these areas could potentially increase opportunities for gillnetting, although currently gillnet fishing occurs in conjunction with mobile gear fishing as these are open areas.

The greatest concentration of skate trawl effort is in statistical area 539 south of Rhode Island, but there are relatively high levels of skate trawl effort in areas 537, which includes Cox Ledge,

and 522 and 561, which contain the various Northern Edge, Georges Shoal, and Closed Area II HMAs (Georges Bank Alternatives 1, 3, 4, 5, and 6). Restrictions on trawling in these areas could negatively impact the skate fishery. However, reopening the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II groundfish and habitat closures could provide increased fishing opportunities for the skate fishery (GB Alternatives 2-6 and Great South Channel / Southern New England Alternatives 2-6). Although it is difficult to predict future effort distributions, winter and little skate occur throughout these areas and observed haul locations indicate that trawling for skates occurs along the boundaries of the areas. However, because these two stocks are so widely distributed throughout the Georges Bank and Southern New England region, many skates are still available to the fishery even in the presence of area closures.

With the exception of some gillnet activity in statistical area 514, skate landings from the Gulf of Maine are generally fairly limited. Therefore, changes to habitat management areas in the Gulf of Maine would likely have only minimal impacts on the skate fishery, except to the extent that negative biological impacts on thorny skate, and to a much lesser extent, smooth skate, affect the fishery in the long run.

Table 136 – Summary of the impacts of habitat management alternatives on the skate fishery. No impacts are expected on rosette skate or clearnose skate.

Sub-region	Alt	Fishery impacts
EGOM	1	None. There is no fishing using trawls in this sub-region.
	2	
	3	
CGOM	1	Neutral to slightly negative. There are small amounts of skates landed with trawl gear in statistical area 515 overlapping Cashes Ledge, so the no action management areas may limit skate fishing somewhat.
	2	Slightly positive. This alternative would remove current management areas and allow skate fishing throughout the region with trawl and gillnet gears, but since there are zero possession limits on smooth and thorny skates, such benefits are likely to be limited.
	3	Neutral to slightly positive; uncertain. This alternative would adjust current management areas, remove the Cashes Ledge groundfish closure, and would add a management area on Platts Bank. It is unclear how this would affect fishing opportunities for skates.
	4	Neutral to slightly positive; uncertain. This alternative would adjust current management areas and remove the Cashes Ledge groundfish closure. It is unclear how this would affect fishing opportunities for skates.
WGOM	1	Neutral. Little and winter skate do not occur in any abundance inside the WGOM or Cashes Ledge closed areas, so impacts of these areas on the skate fishery are probably minor.
	2	Neutral. Providing access to current closures is unlikely to benefit the skate fishery given the distribution of little and winter skates.
	3	Neutral. The various updated closures in these alternatives are unlikely to impact the the skate fishery given the distribution of little and winter skates.
	4	
	5	
	6	
	7a and 7b	Neutral. Adjustments to gear measures are unlikely to impact the skate fishery since there is limited trawl fishing for skates in this region to begin with. Also, the 12-inch roller gear restriction already applies to Multispecies vessels, which probably contribute most of the skate landings in this location.
	8	Neutral. Providing shrimp fishery access to current closures will not benefit the skate fishery.
GB	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to CAI and CAII, but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions may not in fact be very limiting to the fishery.
	3	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to Northern Edge area only. Impacts depend on measure selected for northern edge area; a gear restriction would still allow trawl use.
	4	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to

Sub-region	Alt	Fishery impacts
		Northern Edge area and smaller Georges Shoal Gear Modification Area. Impacts depend on measure selected for northern edge area; a gear restriction would still allow trawl use.
	5	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to the Northern Georges GMA and Georges Shoal MBTG area. Trawling with restricted gear would be allowed throughout, except within the Georges Shoal 1 MBTG area, which contains a relatively small fraction of the overall revenue shown for the entire Northern Georges GMA.
	6A and 6B	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to new areas. Some fishing effort likely to be displaced by the modified area (either Option A or Option B).
	7	Overall neutral – probably positive impacts associated with reducing coverage of habitat and groundfish closure areas, but the trawl fishery overlaps with the Georges Shoal 2 MBTG HMA in this alternative which would displace effort and could have negative impacts.
	8	Negative to slightly negative impacts – probably some positive impacts associated with reducing coverage of habitat and groundfish closure areas, but the trawl fishery overlaps significantly with the large Northern Georges HMA in this alternative which could have negative impacts.
GSC-SNE	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to NLCA, but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions may not in fact be very limiting to the fishery.
	3	Neutral – these alternatives would remove the NLCA habitat and groundfish areas and create new areas further north and on Cox Ledge. In statistical area 526, observer hauls are concentrated in the south along the edge of the bank. Some trawl effort might be displaced in Area 521, but most of the skate landings in this area are from gillnets, which would not be restricted under these alternatives.
	4	
	5	
	6	

4.6.3.2.2 Spawning management alternatives

In general, the action alternatives will increase access to fishing grounds and make some year-round areas seasonal. This should provide slightly positive impacts to the fishery, although given the ubiquitous distribution of little and winter skate, the No Action closed areas may not be especially limiting to the fishery.

Table 137 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted).

Region	Alt	Fishery impacts
GOM	1	Neutral to slightly negative. There are small amounts of skates landed with trawl gear in statistical area 515 overlapping Cashes Ledge, so the no action management areas may limit skate fishing somewhat.
	2A and 2B	Neutral to slightly positive. This alternative would remove the current WGOM and Cashes Ledge groundfish management areas and allow skate fishing with trawl and gillnet gears, but since there are zero possession limits on smooth and thorny skates, such benefits are likely to be limited.
	3	Neutral
GB	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to CAI, CAII, and NLCA but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2A and 2B	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions may not in fact be very limiting to the fishery.
	3A and 3B	

4.6.3.2.3 Dedicated Habitat Research Area alternatives

As noted above, DRHA impacts are relative to the expected benefits of completing research projects.

Table 138 – Summary of the impacts of research alternatives on the skate fishery. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3.

Alt	Fishery impacts
1 – No DHRA	Neutral – no DHRAs specifically designated, although there may be management measures in these locations because they have overlapping habitat or spawning management designations.
2 – E Maine	None – there do not appear to be any significant skates or skate landings in this area such that research would provide a benefit to this fishery.
3A, 3B, 3C – Stellwagen	Positive – there are thorny and smooth skate in this area and research on fish and their ecosystem interactions could help in development of management strategies to rebuild these stocks, especially thorny skate.
4 – Georges Bank	Slightly positive – little, winter, and barndoor skate occur in this area, and and research on fish and their ecosystem interactions could help in development of management strategies. This is less critical for these stocks as their status is better than for thorny skate.
5 – Sunset provision	Neutral – if beneficial research is not being conducted, areas would sunset.

4.6.3.2.4 Framework and monitoring alternatives

The skate fishery is closely tied to the multispecies fishery, so adjustments to management areas, especially those focused on groundfish, could indirectly affect skate fishing opportunities. Improved data collection and a more explicit process for developing management adjustments would indirectly benefit the skate fishery to the extent that they participate in the management process and benefit from better management that results from improved data collection.

4.6.4 Atlantic sea scallop

These sections describe potential impacts of the alternatives on the scallop resource and fishery.

4.6.4.1 ***Biological impacts***

4.6.4.1.1 Habitat management alternatives

4.6.4.1.1.1 Eastern, central, and western Gulf of Maine sub-regions

The potential biological impacts of the Habitat Management Area alternatives in the three Gulf of Maine sub-regions were evaluated using survey and fishery distribution information. Fewer data on scallop distribution are available in these sub-regions as the bulk of the scallop resource is concentrated further south. The federal scallop survey and assessment model do not include the Gulf of Maine, and there is relatively limited resource there relative to Georges Bank and areas further south. The state of Maine has conducted scallop dredge surveys of portions of the federal NGOM management area that are open to fishing which indicate relatively low scallop biomass levels. A 2009 video survey (Stokesbury et al. 2010) examined offshore bank and ledge features and found scallops on Jeffreys, Fippennies, and Cashes Ledge, as well as on Platts Bank, but not on Jeffreys Bank. Overall, scallop abundance in the Gulf of Maine is temporally and spatially sporadic.

In general, the Gulf of Maine habitat management alternatives are expected to have neutral impacts on the scallop resource relative to No Action. In the central Gulf of Maine sub-region, action alternatives could remove area closures on Fippennies Ledge (Central Gulf of Maine Alternatives 2 and 4), and Cashes Ledge (Central Gulf of Maine Alternative 2). Both areas contain sea scallops (Stokesbury et al 2010) that could be subject to fishing pressure if the areas reopen. Impacts to the resource as a whole would not be expected, but there could be local effects on these populations of scallops. Similarly, in the western Gulf of Maine sub-region, Alternatives 2, 3, and 6 could remove area closures on Jeffreys Ledge, an area which also contains sea scallops (Stokesbury et al 2010). Again, local population effects could result, but impacts to the resource as a whole would not be anticipated since there is a possession limit of 200 pounds for all Limited Access General Category vessels as well as an overall hard quota of 70,000 pounds for the entire Northern Gulf of Maine. The Northern Gulf of Maine quota should effectively limit catches in the region, as larger limited access vessels would only fish in the Gulf of Maine if catch rates were much higher than present levels. This is because DAS are very limited and catch rates are much higher in other areas.

Of note are increases in scallop catches under the Northern Gulf of Maine quota during 2013 to approximately 40,000 lb. Although catches remained below the 70,000 lb limit, survey data suggest that a limit of 58,000 lb may be more consistent with current resource abundance. However, the surveys conducted in federal portions of the NGOM did not include areas closed to the fishery, including current habitat closure areas. If those areas were included in the survey the estimate of biomass would likely have been higher.

4.6.4.1.1.2 Georges Bank and Great South Channel/Southern New England sub-regions

The management areas in the Georges Bank and Great South Channel/Southern New England sub-regions have been surveyed annually by the Northeast Fisheries Science Center since 1979. For most years the survey has been a lined survey dredge, and in more recent years a towed video survey has been added to the federal scallop survey. In addition, since 2003 the University of Massachusetts Dartmouth School for Marine Science and Technology has completed a broadscale video survey of the entire resource area in all years except 2013. Finally, more fine-scale investigations of scallop abundance, distribution, and size frequency are completed in current or potential rotational management areas using video survey, HabCam, and paired commercial/scientific dredge surveys. Given these various sources of data, the distribution and abundance of the scallop resource in these management areas is considered to be well known. Scallop distribution maps are provided in the fishery impacts section below.

Because sea scallops are a sedentary species, changing the location of habitat management areas in these sub-regions will influence the fraction of the scallop resource available to the fishery and therefore would influence scallop specifications including rotational management allocations. Despite possible changes in available fishing locations, annual catch limits will remain constrained by fishing mortality targets. Furthermore, an explicit objective of the rotational management program is to optimize yield by harvesting an area when most of the animals are at a size that is expected to be at or around their maximum yield per individual.

Because the rotational management program is so critical to optimization of yield in the scallop fishery, the Council agreed that areas with significant scallop biomass that are currently off-

limits to the scallop fishery should not automatically reopen when this amendment takes effect. Rather, a trailing scallop action should evaluate whether scallop access area boundaries need to be adjusted or if new access areas should be created, and then specifications for the fishery overall would be set in the context of these potential adjustments. Therefore the direct impacts on the scallop resource in newly opened areas will be more fully considered in a future action that specifies the level of effort that may be allowed. For example, these impacts could range from no impact (if an area remains closed) to higher impacts if an area reverts to an open area under the scallop management plan and vessels use days at sea to fish in that area.

Given fishing mortality constraints and the fact that specifications will be reconsidered in their entirety after the habitat amendment takes effect, generally neutral impacts on the scallop resource are anticipated to result from the Georges Bank and Great South Channel/Southern New England habitat management alternatives. While Alternative 2 would open all habitat closure areas to potential access to the scallop fishery, this action would keep the areas closed to the scallop fishery until access could be considered in a more holistic way, taking the entirety of scallop fishery specifications into account.

In the fishery impacts section, the Scallop Area Management Simulator (SAMS) model is used to evaluate various area management scenarios. This model is used to evaluate annual specifications for the fishery. If the existing habitat closed areas are removed via this amendment, the SAMS model would not simply maintain open area effort as it has been, and add effort into newly opened areas at an uncontrolled level. The FMP would still constrain the overall limit at 0.28; the current fishing mortality rate associated with the Annual Catch Target, or the fishing mortality rate that has a 25% chance of exceeding than Annual Catch Limit. Since the overall catch for the fishery would still need to be within these limits, open area DAS would need to be reduced to keep overall F under 0.28. Thus, some of the trends in the SAMS simulation results, especially the first few years, are an artifact of F_{TARGET} limits used in the Scallop FMP. However, since those limits are how specifications are set in the scallop fishery, these results are more realistic than if effort simply adjusted based on available resource, without consideration for spatial and overall limits. Overall, regardless of whether habitat closure areas are removed in this action or not, the fishery specifications are still controlled by an overall limit on F from all areas, currently set at 0.28. That will not change as a result of this action, so if more areas are open to the fishery that are not currently open, effort levels will be lower in some areas to account for new fishing mortality that used to be zero in the habitat closure areas.

In addition to the direct impacts on the scallop resource from habitat closure areas, the Scallop Plan Development Team also discussed whether long term area closures have impacts on recruitment and larval production patters on Georges Bank. There has been ample research around the globe on the subject of whether area closures benefit fisheries from spillover of larvae (e.g. Gell and Roberts, 2003). However, the PDT discussed that Georges Bank is a mixed larval pool and scallop recruitment on Georges Bank is cyclical. A recent article published by a member of the Scallop PDT (Hart et al. 2013), concluded that there is no evidence that recruitment of sea scallops increased outside of closed areas from 1994-2006, despite large increases in biomass within the closures. Hart and Rago (2006) found that biomass in Georges Bank closed areas was 25 times higher in 2005 than in 1994 when the areas were closed. However, mean recruitment on Georges Bank did not significantly increase over that same time

period. Almost ten years have passed since this dataset was put together. The stock is currently undergoing a benchmark assessment (SARC59) and recruitment on Georges Bank has improved recently. However, it is still unclear whether the more recent increase in recruitment on GB is due to closures, effort reductions, or random fluctuations, or some combination of these. Therefore it is possible that area closures are having a positive impact on recruitment, but it has yet to be proven.

The Scallop Plan Development Team discussed that there are signals that recruitment patterns on Georges Bank are more likely driven primarily by natural cycles, and not by closed areas. There has also been extensive research about correlations between mass spawning events and environmental variables such as temperature increases or phytoplankton blooms. Bonardelli et al. (1996) studied the correlation of spawning and temperature for *Placopecten magellanicus* and found strong correlation with either a sharp temperature increase or strong temperature fluctuations. Another study in the Gulf of St. Lawrence, Canada concluded that phytoplankton blooms appear to be associated with spawning events (Arsenault and Himmelman, 1998).

Because cycles in recruitment have been observed before areas were closed on Georges Bank, and similar cycles have continued after closures, the Scallop Plan Development Team does not believe that changes to habitat closures on Georges Bank would have a large impact on recruitment. The sense is that Georges Bank is a mixed pool and the larvae production in that area is rather saturated. Overall, there is little evidence that area closures significantly improve scallop recruitment on Georges Bank. In other areas, including the Mid-Atlantic, that is not the case because that sub-region is not a mixed larval pool. In conclusion, closed areas may help prevent overfishing as part of an overall management system, but there does not seem to be strong evidence that they directly increase scallop recruitment success on Georges Bank.

4.6.4.1.2 Spawning management alternatives

As with the Gulf of Maine habitat management alternatives, the areas included in the Gulf of Maine spawning management alternatives have little overlap with the scallop resource. Alternative 2, would remove the Western Gulf of Maine and Cashes Ledge groundfish closures, which could allow fishing on scallops living within those areas, unless prevented by one of the habitat management alternatives. Locally, removing these two groundfish closures could impact scallop populations, but the effects on the resource as a whole would not be expected because this is not an area with major concentrations of scallop biomass and there are measures in place to control overall effort. The hard TAC for the NGOM management area may be more likely to be reached if areas are opened that have harvestable scallops, but the TAC would help prevent excess fishing levels since all vessels with a federal scallop permit would be prohibited to fish in the entire NGOM management area if the TAC is reached.

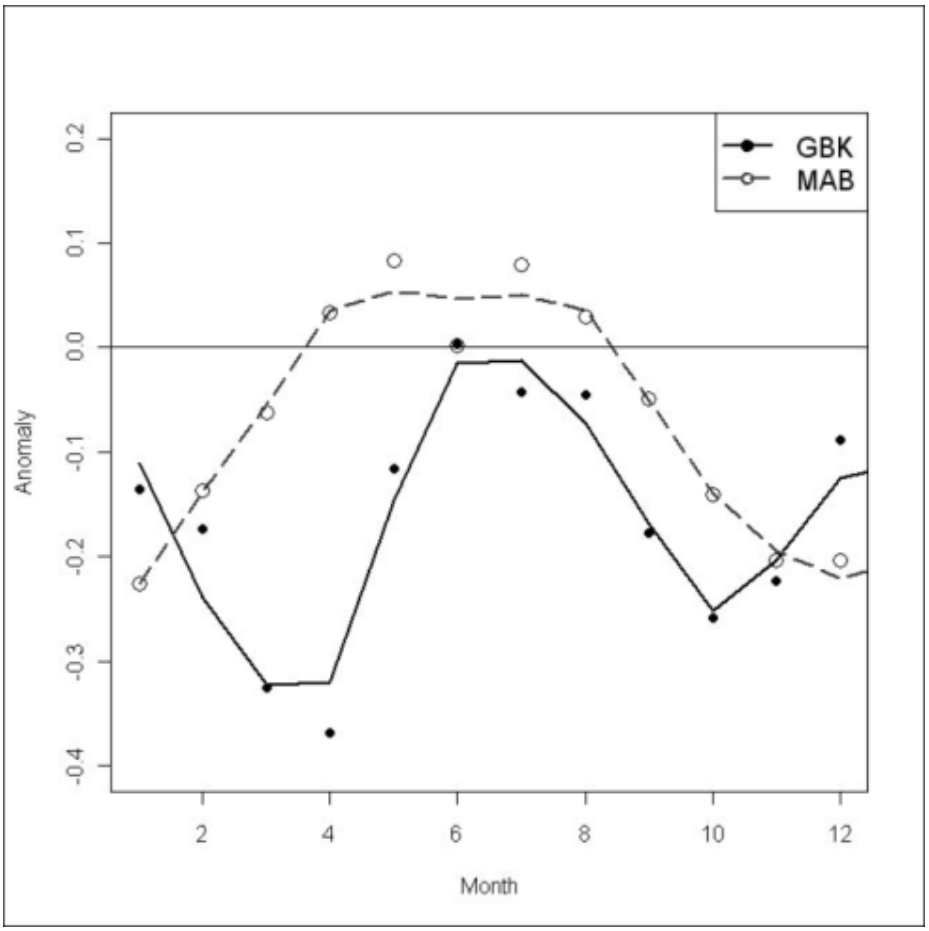
In the Georges Bank and Southern New England region, the action alternatives (Alternatives 2 and 3) would eliminate the Nantucket Lightship Groundfish Closure Area and make Closed Areas I and II seasonal, closed February 1 through April 15. The primary source of information used to assess the potential biological impacts to the scallop resource of a seasonal closure to improve groundfish spawning protection is seasonal changes in scallop meat weights. Over the course of a year, the scallop meat weights increase and decrease based on spawning and other factors. If a seasonal closure is during a time of year when meat weights are higher there could

be negative impacts on the resource, but if the seasonal closure is when meat weights are lower there could be positive impacts.

Hennen and Hart summarized monthly shell height/meat weight data from observed trips, and modeled meat weight by month and region (Georges Bank or the Mid-Atlantic Bight). Those estimates were compared to the month with the highest average meat weights on Georges Bank, June, to calculate a monthly meat weight anomaly (Figure 55). Smaller anomalies indicate months during which yields would be higher (positive resource impacts), and a negative anomalies indicate months of relatively lower yield (negative resource impacts). On Georges Bank, May through September and December/January have smaller anomalies, and February through April and October/November have larger anomalies.

Specifically, the month with the highest meat weights on Georges Bank is typically June, and the lowest is October. The average meat weights are about 20% greater in June than in October. There seems to be a bimodal pattern on Georges Bank for meat weights, with peaks in December and June, and lower meat weights in April and October (Hennen and Hart, 2012). One source of uncertainty with these data is that the number of observed trips is very low on Georges Bank for the months under consideration for the spawning closure (February-April). Most fishing activity on Georges Bank during those months is in the Great South Channel, not Closed Areas I and II. The access areas on Georges Bank were closed from February 1-June14 for most of the years in this data set. Therefore, there are fewer data for these months as compared to the months with higher fishing levels and when Closed Areas I and II were open (June 15-January 31).

Figure 55 – Scallop shell height: meat weight anomaly for GB and MA (Hennen and Hart, 2012)



In addition, a Research Set-Aside project (Coonamessett Farm Foundation bycatch survey) has been evaluating the seasonal changes in bycatch rates in the scallop fishery in both Closed Area I and II for over two years. Shell height/meat weight samples were collected during monthly cruises. Data have been collected during most months since March 2011. In the first year of this study (2011) about 3,000 scallops were measured, and when all available data are combined for March 2011 through September 2013 almost 9,000 scallops have been measured to date. The meat weight model includes the following fixed effects: shell height, area (Eastern Georges Bank, Western Georges Bank), month, and an interaction between month and area. Non-parametric smoothers were used to display annual and inter-annual trends in the relationship for the two areas analyzed and interpolate across any missing months.

Figure 56 and Figure 57 display trends for the two areas together as well as each area separately with the proposed temporal closures specific to each resource area. Results graphically depict the relative position of temporal closures with respect to observed patterns in meat weight maxima and minima. Overall, it seems that Closed Area I has higher meat weights than Closed Area II, at least for the first year of the study. This could be related to depth differences between the stations since scallops have different growth rates at different depths. But for these analyses depth was not considered separately. In general, the spawning closure season of February 1-April 15 seems to overlap when scallops on Georges Bank are ascending to their max weight in June/July.

It is important to keep in mind that this data set is only 2.5 years long. The spring cycle of scallop growth does vary from year to year based on a variety of factors, so the monthly meat weight variation may not match up precisely with the observer data analyses in Figure 55, which is from a larger area (all of Georges Bank) and longer time series.

Figure 56 – Model generated estimate of meat weights for scallops larger than 125mm for Eastern and Western GB (based on scallops measured in CFF bycatch survey)

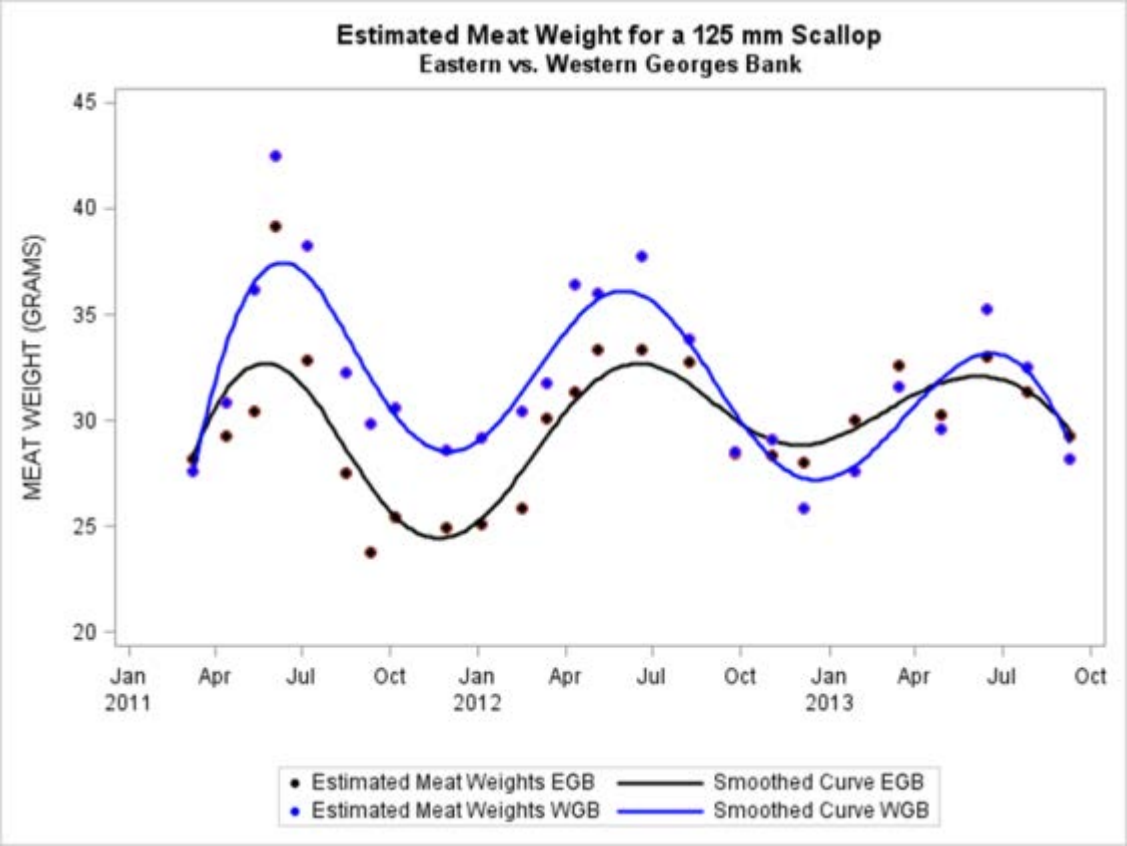
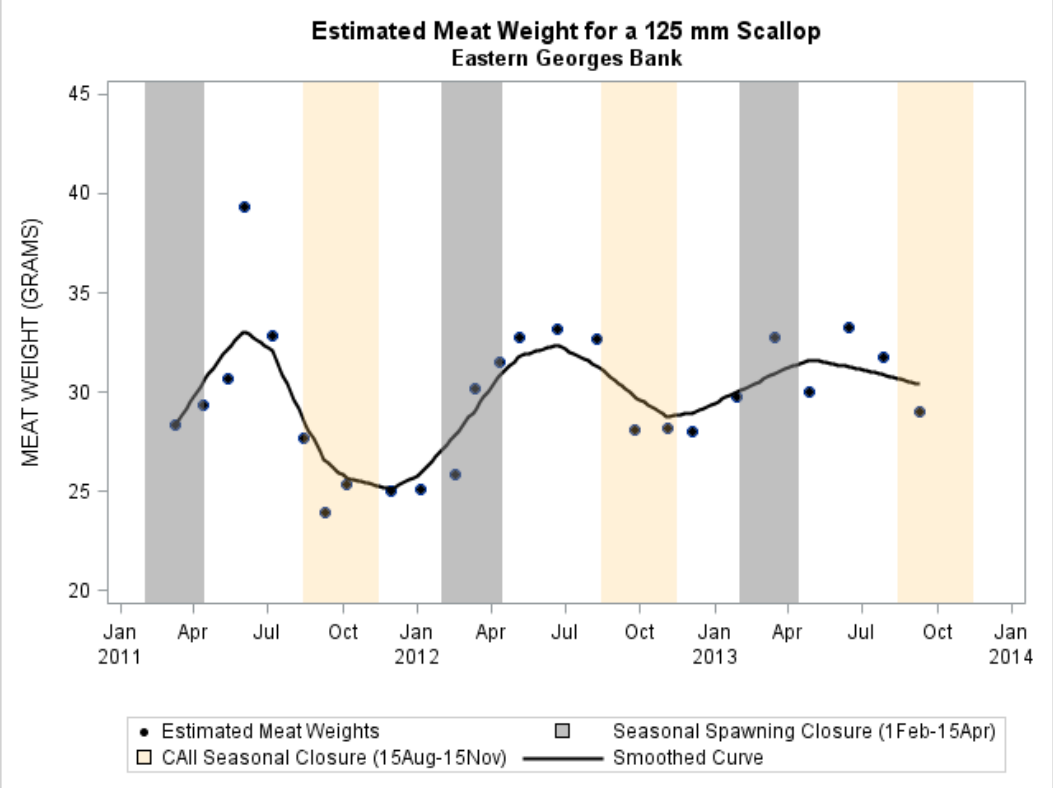
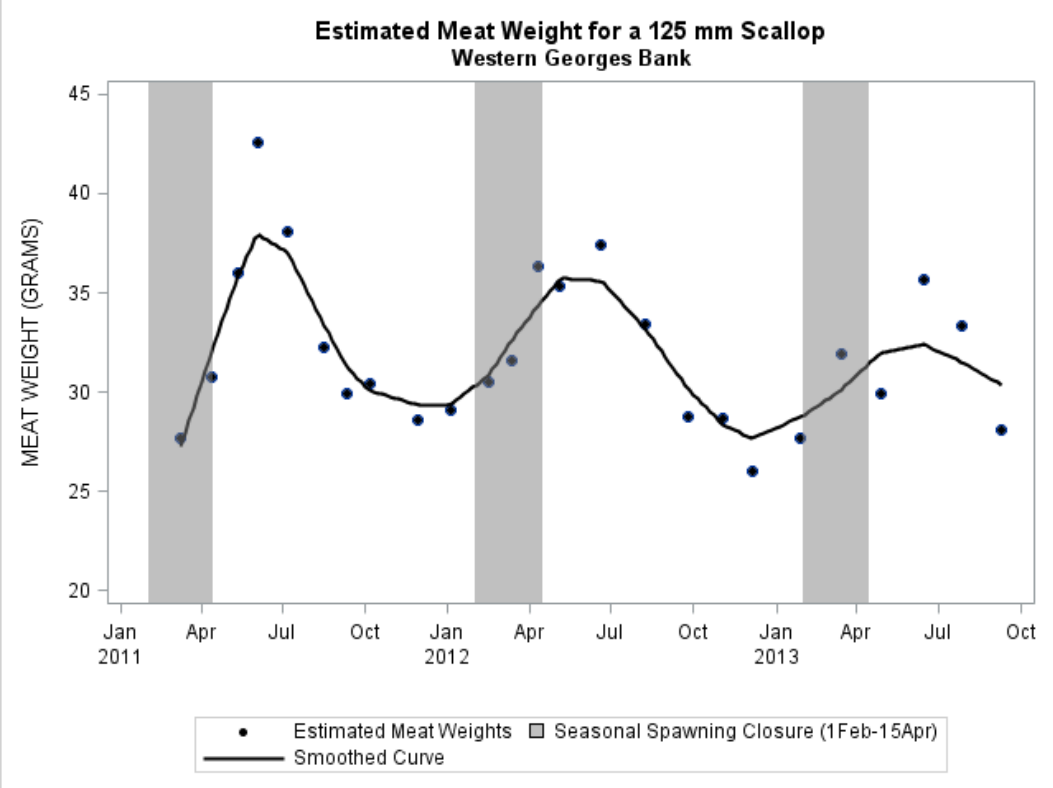


Figure 57 – Model generated estimates of meat weights for scallops larger than 125mm for Eastern (top) and Western GB (bottom) with potential seasonal closures included. Grey is spawning closure under consideration and yellow is in effect already for CAII to reduce yellowtail bycatch.





In general, the overall impacts of seasonal closures are difficult to assess because vessels shift effort differently as a result of a seasonal closure. The closed season will dictate when fishing will not occur in that area, but it could impact fishing patterns in other areas, i.e. open area fishing. Therefore, while a seasonal closure could benefit the scallop resource in that particular area, it could cause effort patterns in other areas to change by season, impacting overall scallop mortality. In this region, there are three options for managing the spawning closures. Options A and B would include restrictions on scallop dredge gear, while Option C would exempt scallop dredge gears from spawning closures. Option C could be selected in addition to either A or B. The impacts described below assume Option C is not selected.

Because there is a possession limit (maximum number of pounds per trip) for access area trips, the greater the meat weight per animal, the fewer scallops will be harvested. This reduces fishing time compared to fishing when scallop meats weights are lower. Fishing during times of higher meat weights translates into less potential bycatch and lower scallop fishing mortality compared to months with lower scallop meat weights in the fall and winter. Because the season under consideration, February-April 15, includes several months with lower scallop meat weights, Georges Bank Spawning Alternatives 2 and 3 may have moderately positive impacts on the scallop resource and fishery in those areas. In particular, the months of February and March are lower meat weight months, so preventing scallop effort in access areas during these months would potentially shift effort to months with higher meat weights. April is not as clear; meat weights are approaching higher levels in April based on the RSA monthly bycatch data. Note that Georges Bank Spawning Alternative 3 only includes the northern part of Closed Area I, so fishing in the southern part of the area would be unrestricted during those months. Therefore, fewer positive impacts would be expected from Alternative 3 than Alternative 2. However, overall there is very little scallop biomass in the southern part of Closed Area I, so any potential positive impact from restricting access in lower meat weight months would have very little overall effect in that area since scallop fishing levels would likely be minimal to start with.

4.6.4.2 ***Fishery impacts***

4.6.4.2.1 Habitat management alternatives

4.6.4.2.1.1 Eastern, central, and western Gulf of Maine sub-regions

The scallop resource in the Gulf of Maine varies widely with sporadic booms and busts. The qualification period adopted under Scallop Amendment 11 for the limited access general category IFQ fishery did not overlap with a period of high scallop abundance in the GOM (FY2000-2004). Therefore, a separate limited entry program was adopted in Amendment 11 with a longer qualification period and no landings history requirement, but more conservative fishing measures including lower possession limits and more restrictive gear requirements. The LAGC Northern Gulf of Maine (NGOM) permit was established and about 125 permits were issued in 2010.

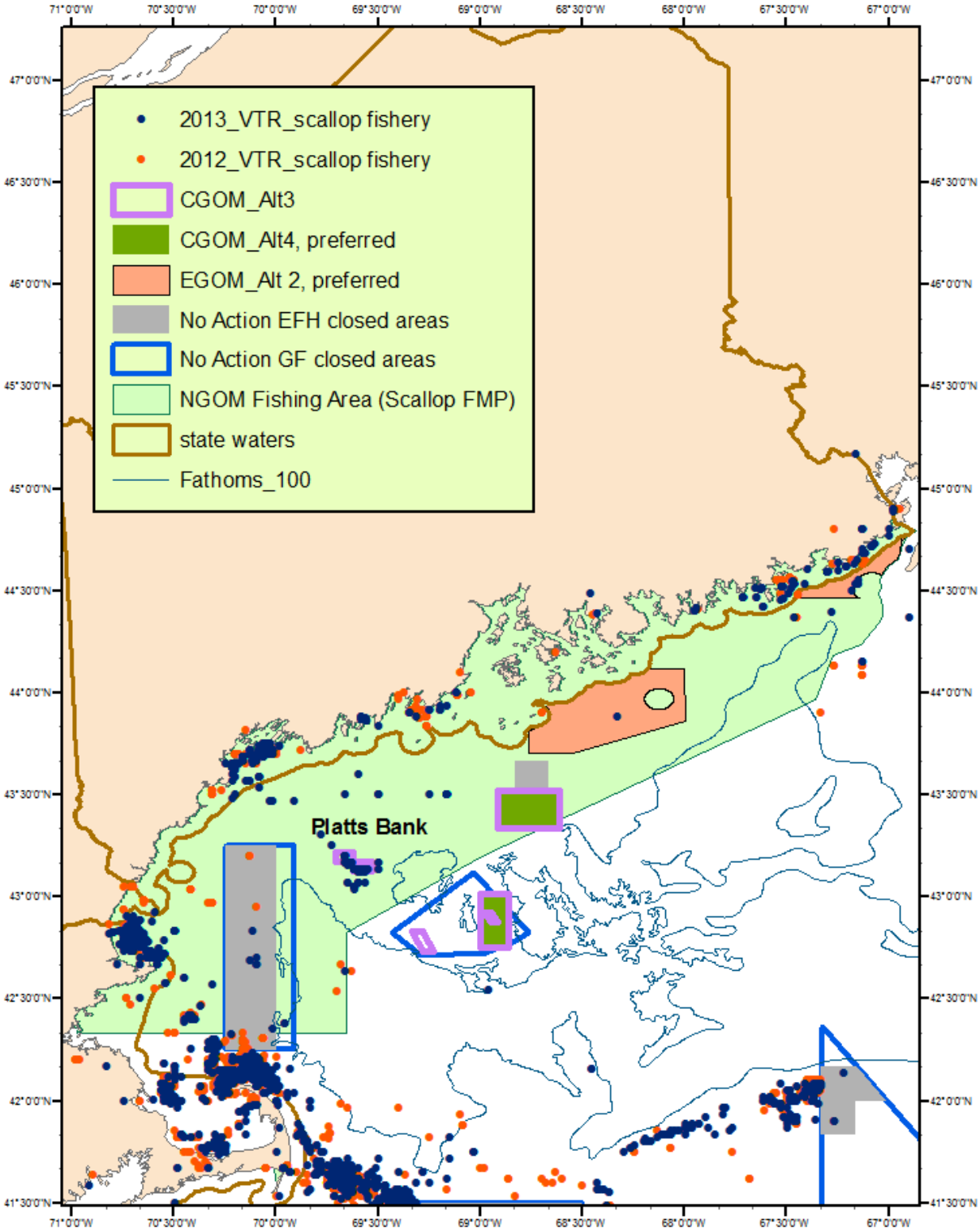
Only a fraction of these permits are active, under 15 vessels, and until more recently total NGOM catches were below 10,000 pounds most years, or 10-15% of the total TAC of 70,000 pounds (Table 1).

Table 139 – Summary of NGOM scallop catch

Year	NGOM landings	% of TAC (70,000 lbs.)
2010	11,539	16.5%
2011	7,946	11.4%
2012	7,733	11.0%
2013	40,663	58.1%
2014 to date (Mar1-Aug7)	26,462	37.8%

In general, the Gulf of Maine habitat management alternatives are expected to have slightly negative to slightly positive impacts on the limited access general category scallop fishery relative to No Action, depending on the alternatives selected. Opening areas that have been closed since 1998 or 2000 will likely have beneficial impacts on the scallop fishery, at least in the short term. Specifically, Central Gulf of Maine Alternative 2 would open Cashes and Fippennies Ledge, Central Gulf of Maine Alternative 4 would open Fippennies Ledge, and Western Gulf of Maine Alternatives 2, 3, and 6 would reopen Jeffreys Ledge. There are some exploitable scallops within portions of these areas, and some level of effort would be expected. Conversely, Central Gulf of Maine Alternative 3 would close an area that is currently open to scallop fishing (Platts Bank). This may have some negative impacts on the fishery. Fishing levels have been relatively low in that area, but effort has increased in 2013 (see section 4.2.3.2 and Map 130). Potential negative impacts of closing that area could be somewhat neutralized if other areas reopen to the scallop fishery. As noted above, limited access scallop effort levels are very low in the Gulf of Maine, so impacts on that segment of the scallop fishery are expected to be neutral.

Map 130 – Gulf of Maine scallop fishing locations during 2012 and 2013 based on vessel trip reports, with potential habitat management area boundaries



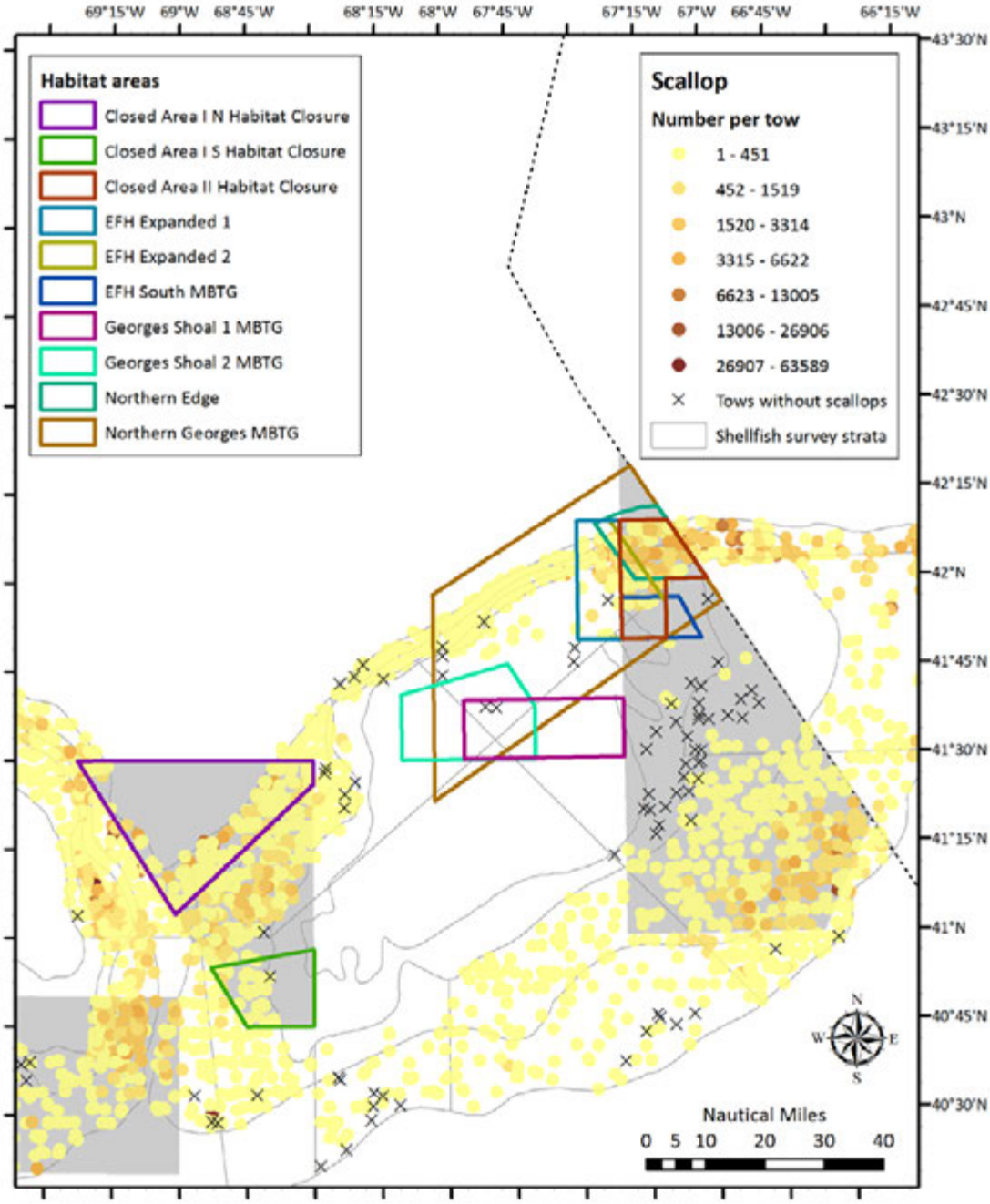
4.6.4.2.1.2 Georges Bank and Great South Channel/Southern New England sub-regions

The potential impacts of Habitat Management Area alternatives in the Georges Bank and Great South Channel/Southern New England sub-regions on the scallop fishery were assessed using the results of the long term and short term potential yield analysis, as well as the results from the SAMS model projections. The former provides a more direct way to evaluate the current and long term scallop yield estimates in various areas, and the latter assesses how modifications to closed areas would fit in with the scallop management program overall in terms of fishery catches. Specifically, the scallop area rotation program provides access to the fishery based on spatially averaged fishing mortality rates that vary depending on whether an area is open or closed, or open and closed sporadically as a scallop access area. The analysis provided in the SAMS model section provides a general analysis of the range of alternatives under consideration: current habitat closure areas, no habitat closure areas, and one example of modified habitat closure areas.

4.6.4.2.1.2.1 Long and short term yield estimates

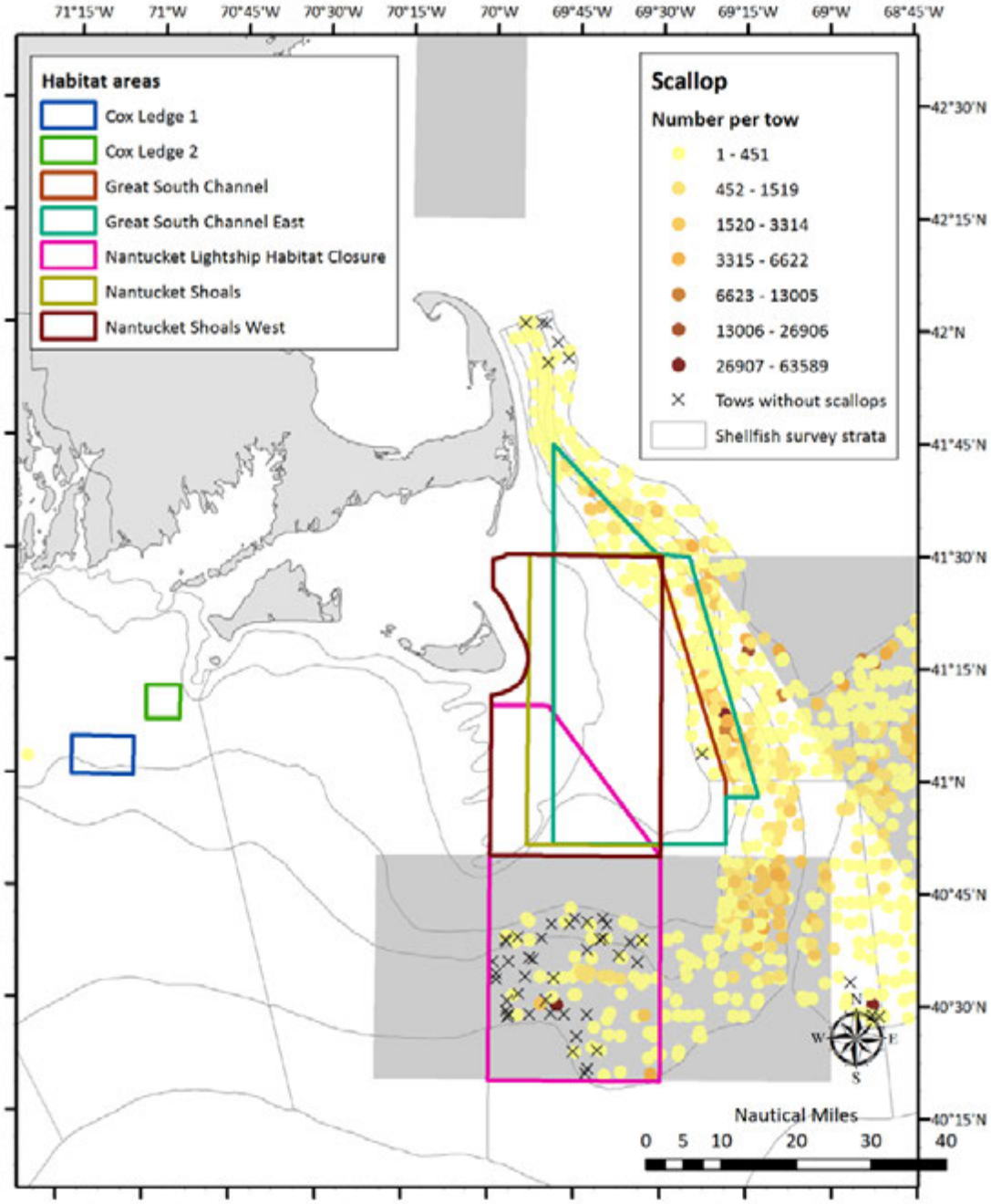
The long term yield per Habitat Management Area was calculated by multiplying the recruitment in each area by the maximum yield per recruit. A stratified mean was calculated since yield per recruit varies in each strata because of depth. First, the area (in nm^2) of each habitat alternative was calculated, as well as the area within each NEFSC shellfish survey strata. This was done so that a stratified mean could be calculated for each Habitat Management Area since yield varies by depth and because all shellfish strata are not sampled equally over time. Map 131 shows the NEFSC shellfish survey strata and catch per tow in and around habitat management alternatives on the Northern Edge of Georges Bank, and Map 132 shows the Great South Channel. Colored circles indicate the total number of scallops per tow from all survey years combined (1966-2013).

Map 131 – NEFSC shellfish survey strata with EFH areas under consideration (Georges Bank) with scallop numbers from scallop dredge survey years 2002-2012.



Key: Northern Edge (Alternatives 3 and 4); Georges Shoal 1 MBTG (Alternative 5); EFH Expanded 1 (Alternative 6a); EFH Expanded 2 (Alternative 6B); Georges Shoal 2 MBTG (part of Alternative 7); EFH South MBTG (other part of Alternative 7); and Northern Georges MBTG (Alternative 8)

Map 132 – NEFSC shellfish survey strata with EFH areas under consideration (GSC/SNE) with scallop numbers from all scallop dredge survey years (1966-2013)



Key: Great South Channel (Alternative 4); Great South Channel East (Alternative 3); Nantucket Lightship Habitat Closure (No Action); Nantucket Shoals (Alternative 5); and Nantucket Shoals West (Alternative 6)

Table 140 summarizes the long-term and short-term yield potential per area. The long-term yield values vary since the recruitment data is very variable, and one or two years with very high recruitment heavily influence the mean. The mean estimate is always higher and can be viewed as an upper bound, while the median is a more conservative estimate. For reference, the MSY

estimate in the assessment is based on a trimmed mean (removing outliers). This trimmed mean can be viewed as compromise between a mean and median, and is not based on the stock recruit curve. Therefore, the estimates may be considered somewhat conservative. The estimated long-term yield from the entire scallop resource in all open and closed areas on Georges Bank and the Mid-Atlantic combined is about 25,000 mt per year; this value is roughly similar whether the mean, median or trimmed mean estimates are used. Differences between mean and median yield estimates are more evident for smaller areas, including the management areas in this amendment, because there are fewer survey tows in these areas such that outliers have a greater influence on the results. The short-term yield is calculated by applying the Fmsy fishing mortality rate (currently 0.38) to the exploitable, or larger scallops in a particular area based on 2013 survey results.

Table 140 – Long-term and short-term yield potential from current EFH closed areas and several new areas under consideration.

Sub-region	Area	Status	Long-term yield (mean)	Long-term yield (median)	Biomass 2013	Short-term yield
GB	CAII North (all area north of scallop access area within CAII closure	Current	1,254	536	8,630	2,589
GB	CAI-N Habitat Closure (Alt 1)	Current	601	42	4,841	1,452
GB	CAI-S Habitat Closure (Alt 1)	Current	29	11	1,658	497
GB	Northern Edge HMA (Alts 3 and 4)	Proposed	1,214	502	7,433	2,230
GB	EFH Extended 1 (Alt 6A)	Proposed	1,858	800	11,519	3,456
GB	EFH Extended 2 (Alt 6B)	Proposed	825	324	4,493	1,348
GB	Georges Shoal 2 MBTG HMA (Alt 7)	Proposed	2	0	3	1
GB	EFH South MBTG HMA (Alt 7)	Proposed	23	10	440	139
GB	Northern Georges MBTG HMA (Alt 8)	Proposed	2,829	1,211	16,448	5,200
GSC-SNE	Nantucket Lightship Habitat Closure (Alt 1)	Current	552	3	93	28
GSC-SNE	Great South Channel East HMA (Alt 3)	Proposed	4,034	1,101	4,460	1,338
GSC-SNE	Great South Channel HMA (Alt 4)	Proposed	313	64	100	30

In the Georges Bank sub-region, the areas under consideration vary greatly in terms of long-term mean and median yield estimates. The Northern Georges Bank MBTG HMA (Alternative 8) has

the highest estimate: about 2,800 mt (using the mean) and about 1,200 mt (using the median). The extended version of the Closed Area II Habitat Closure (Alternative 6A) has the next highest long-term yield potential (1,800 mt using mean recruitment and 800 mt using median recruitment), followed by the Northern Edge HMA (Alternatives 3 and 4) with about 1,200 mt (mean) and 500 mt (median).

Any alternative that contains some or all of the current EFH closed area (CAII North) has the highest estimates of short-term yield since that area has been closed to fishing for many years and scallops in that area are relatively large in size. For example, Alternative 8 includes all of the current habitat closure area, as well as most of the northern flank of GB; therefore, the short-term yield is estimated to be over 5,000 mt. The total biomass in that area is over 16,000 mt, but the portion of that biomass that could potentially be allocated to the scallop fishery is about 5,000 mt. Similar to long-term yield estimates, Alternative 6A has the second highest estimate of short-term yield as well (about 3,500 mt) followed by Alternatives 3 and 4 at 2,200 mt. Alternative 6B also has relatively high estimate of short-term yield since it includes much of the current EFH closed area, but not as much as Alternative 6A.

In a scallop rotational fishery context, 2,500 mt long-term mean yield is equivalent to about one 18,000 pound trip per vessel, or about 6 million pounds overall. Therefore, an area like the Northern Edge HMA (Alternatives 3 and 4) has an estimated long-term yield mean of about 1,200 mt, so on average if that area was open to the fishery and managed rotationally, it would provide about one trip for half the fishery every year, or one trip for the entire fishery every other year. Closed Area I North has only 601 mt long-term yield potential, and Closed Area I South does not have much yield potential at all. When the three existing habitat closures on Georges Bank are combined, the long-term yield potential is about 1,884 mt. Therefore, about 7% of the total potential long-term yield for the entire scallop resource is within the current habitat closed areas, using the mean long-term yield estimates. The median combined estimate is closer to 600 mt.

The Northern Edge HMA area (Alternatives 3 and 4) has similar long term yield potential (1,214 mt) as the No Action Closed Area II north area (1,254 mt). The majority of the yield potential in the Northern Edge HMA comes from a very small "triangle" just east of the western boundary of Closed Area II, and not from the deeper waters along the northern part of the new area. The western part of the Northern Edge HMA which is currently open to the scallop fishery likely has higher long-term yield potential than the southern part of the No Action Closed Area II Habitat Closure area that would potentially open if the No Action habitat closure is eliminated. Specifically, in terms of long-term yield potential, the additional area closed in the Northern Edge HMA is more productive than the area that would open in the southern part of the Closed Area II Habitat Closure on the northern edge. <u>Therefore, the potential impacts of the Northern Edge HMA (Alternatives 3 and 4) on the scallop fishery would likely be slightly negative but similar to No Action/Alternative 1.</u>

The long term yield potential of the EFH Extended 1 HMA (Alternative 6A) is about 50% greater than the existing area or the Northern Edge HMA. Opening a buffer zone along the EEZ (Alternative 6B) reduces the area's size and lowers the long term yield potential. <u>Thus Alternative 6A is expected to have negative impacts on the fishery relative to No Action due to</u>

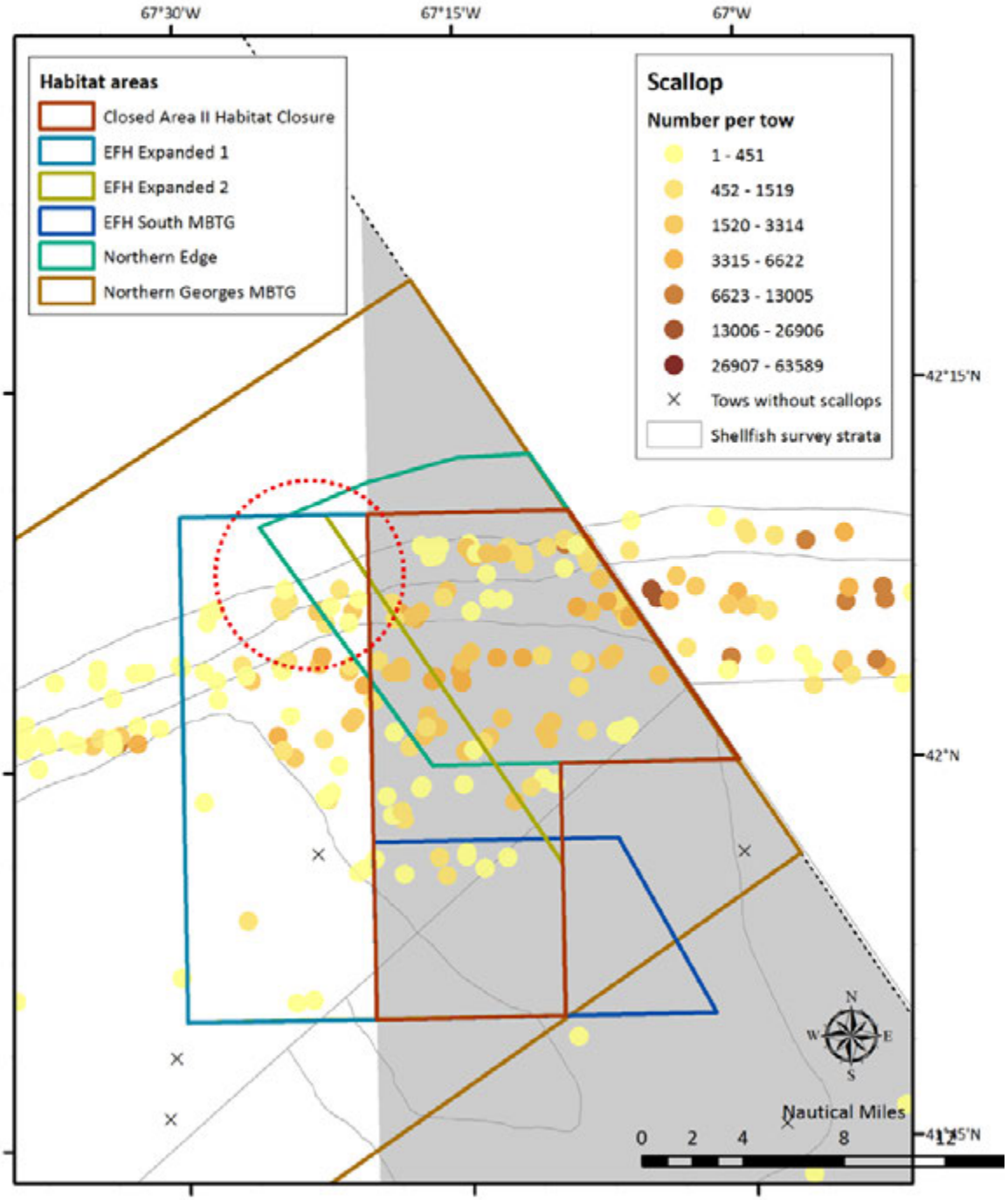
reduced access to high abundance scallop areas, and Alternative 6B is expected to have slightly positive impacts relative to No Action since the estimates of both long-term and short-term yield are lower for Alternative 6A compared to No Action.

Alternative 7 includes two areas, the EFH South Mobile Bottom-Tending Gear HMA and the Georges Shoal 2 Mobile Bottom-Tending Gear HMA. Both areas have very low long term yield potential and therefore implementing these areas in combination as mobile-bottom tending gear closures would have highly positive impacts on the fishery relative to Alternative 1/No Action and relative to all other alternatives, with the exception of Alternative 2 (no habitat closures). Neutral impacts are expected relative to Alternative 2.

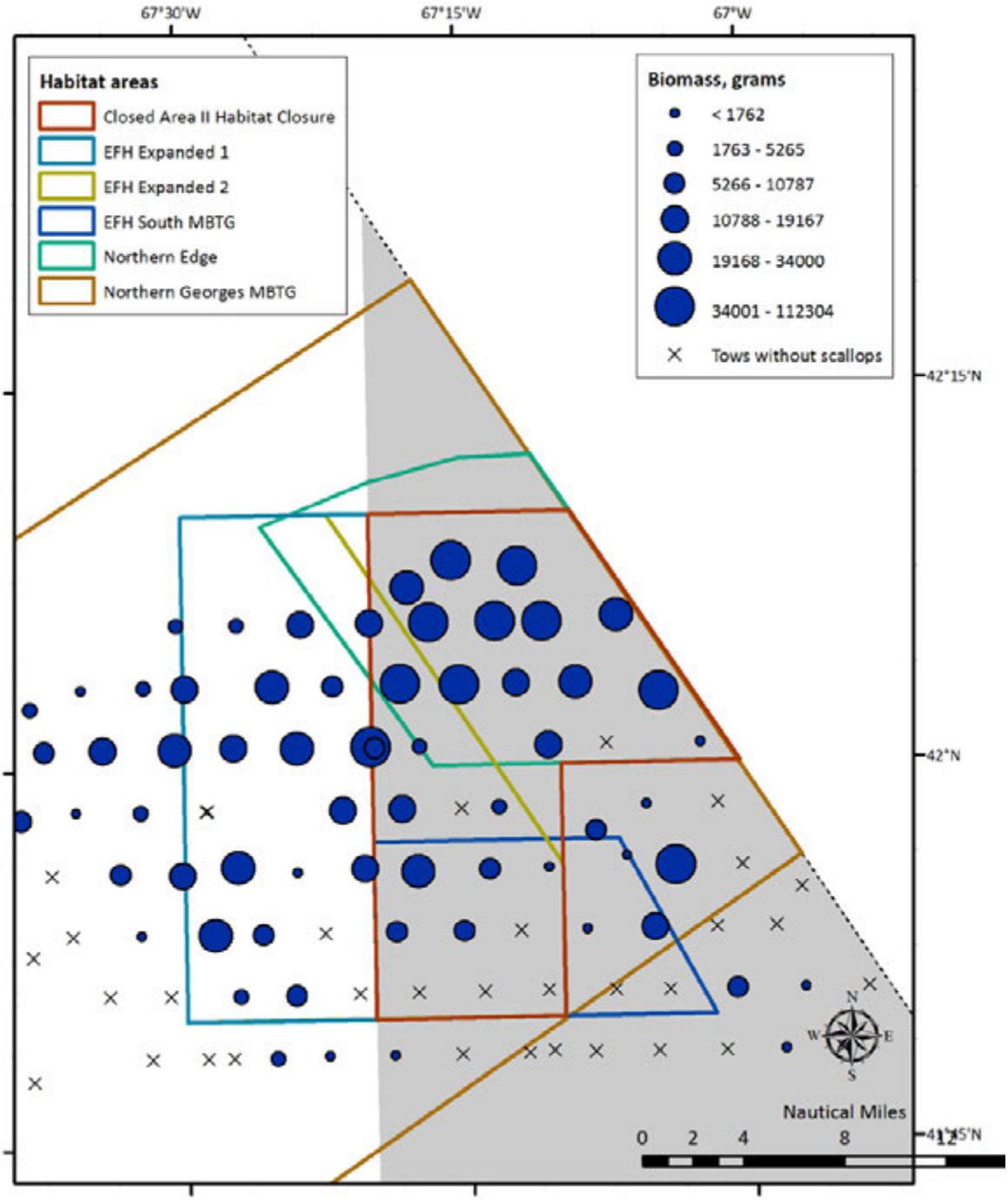
Alternative 8 includes a single larger area, the Northern Georges Mobile Bottom-Tending Gear HMA. This area encompasses significant long term yield potential and therefore Alternative 8 would have highly negative impacts on the scallop fishery. The total long term mean yield estimate for the entire resource is 25,000 mt; Alternative 8 has a mean estimate of about 2,800 mt or 11% of the total long-term yield. The three No Action habitat closure areas combined have a mean estimate of about 1,900 mt, or 7% of the total long-term yield. Therefore, compared to Alternative 1/No Action, Alternative 8 would have higher negative impacts on the scallop fishery, and since it has the highest estimate of long-term yield, it is expected to have more negative impacts on the scallop fishery compared to the other areas under consideration.

The limited access general category fishery does not currently fish in these offshore areas; therefore closing them may not have direct impacts on that segment of the fishery. However, the LAGC IFQ is based on 5.5% of the total estimated catch for the fishery overall. Therefore, if more areas are closed to scallop fishing the total available catch may be lower. Thus, closing areas with higher long-term potential could have indirect negative impacts on the LAGC IFQ fishery through reductions in the overall allocation for that fishery.

Map 133 – Scallop (number/tow) from NEFSC scallop dredge surveys (all years) with EFH areas on the northern edge of Georges Bank. There is substantial long term yield potential west of the existing habitat closure (indicated by a red circle). This area would close under the new Northern Edge HMA (Alternative 3 or 4), the EFH Expanded 1 and 2 HMAs (Alternatives 6A/6B), or under the Northern Georges MBTG HMA (Alternative 8).



Map 134 – Total scallop biomass (2013 VIMS dredge survey data) relative to Alternative 1, 3/4, 6A, 6B, 7, and 8 Habitat Management Areas.



The three areas in the Great South Channel, Nantucket Lightship Habitat Closed Area (Alternative 1), Great South Channel East (Alternative 3), and Great South Channel (Alternative 4), have very different results in terms of LT and ST yield potential. The No Action Nantucket Lightship Habitat Closed Area area has relatively low long-term yield potential, 552 mt based on

the mean and 3 mt based on the median estimate (Table 140). This large difference suggests that the yield potential from this area is dominated by a few years with high levels of observed recruitment, and most years with relatively low levels of recruitment. The Great South Channel HMA has even less, 313 mt based on the mean and 64 based on the median.

In contrast, the Great South Channel East HMA is a very productive scallop yield area. The long-term and short-term yield potential from this area is very high. Even though the boundary only extends slightly farther east than the Great South Channel area, it includes scallop survey strata 50 which is very productive. The estimated potential yield from this area is over 4,000 mt based on the mean. That is 16% of the 25,000 mt total potential yield for the entire scallop fishery. The percentage of total yield is lower, under 5%, using the median long-term yield estimate instead (1,101 mt), but both are substantial. Furthermore, this area is roughly 2-3+ times as productive as the Northern Edge HMA, depending on whether the long-term median or long-term mean is compared. The other Channel areas (Nantucket Shoals and Nantucket Shoals east) have not been evaluated for long-term and short-term impacts the same way. However, since they are shallower that the Great South Channel alternative, the impacts on the scallop resource and fishery are expected to be lower than the Great South Channel HMA alternative.

In summary, for both the Georges Bank and Great South Channel -Southern New England sub-regions combined, about 10% of the total long-term yield for the scallop fishery is estimated to be within the No Action EFH closed areas, (2,500 mt/25,000 mt). If all No Action EFH areas are eliminated in this action the overall yield available to the scallop fishery could increase by about that amount. If the No Action Closed Area II Habitat Closed Area is replaced with the Northern Edge HMA in this action, similar impacts overall would be expected since the estimates of LT yield for the areas are very similar. About 5% of the total estimated long-term yield is within both areas (1,200 mt/25,000 mt), based on median estimates of long-term yield.

All of the HMAs under consideration in the Great South Channel are currently open to the scallop fishery. If the Great South Channel HMA is closed, about 1% of the total long-term yield would no longer be available to the fishery (313 mt / 25,000 mt). On the other extreme, Great South Channel East HMA contains about 16% of the total long-term yield for the fishery. Overall, closing areas with relatively low scallop biomass could have neutral to potentially moderate positive impacts on the scallop resource and fishery by helping to prevent overfishing if some level of scallop biomass is protected from fishing pressure. However, if a substantial amount of total scallop biomass is closed, potentially moderate negative impacts on the fishery are expected since total landings would be reduced, and fishing pressure may be higher in other areas with lower scallop catch rates.

4.6.4.2.1.2.2 Model projected biomass and catch

The SAMS (Scallop Area Management Simulator) model has been used to project scallop biomass and catch to aid management decisions since 1999. SAMS is a size-structured model that forecasts scallop populations in a number of areas. In this version of the model, the Scallop Plan Development Team modified the boundaries of the typical areas to include a handful of the alternatives under consideration. Modifying the typical SAMS boundaries allows the model to estimate the long term biomass inside and outside of various Habitat Management Areas.

The Scallop Plan Development Team evaluated three overall runs: Run 1 (no action); Run 2 (no habitat management areas); and Run 3 (closing one new area on Georges Bank and one in the Great South Channel). The SAMS model runs do not reflect actual alternatives except for Alternative 1 (No Action) and Alternative 2 (no habitat management areas). The purpose of the SAMS runs is to provide a range of the potential impacts in the context of how habitat closures impact scallop fishery allocations and catches. The long and short term yield section above should be used to assess the differences of each alternative in terms of impacts on the scallop resource and fishery.

The final runs include[24]:

1. No Action: Closed Area I, II, and Nantucket Lightship Habitat Closure Areas remain closed to the scallop fishery. Note that under No Action all of Closed Area II north of 41° 30' including the triangle-shaped deeper-water area is considered closed to the scallop fishery because it is closed to the scallop fishery under the Northeast Multispecies FMP.
2. No HMAs closed, open all existing habitat closed areas. The model run assumes that all existing habitat closed areas would be fished at a fishing mortality rate similar to an access area for several years (0.4), and then be fished at a more controlled level of access just below the fishing mortality associated with maximum sustainable yield (F_{MSY}) for Georges Bank for the remainder of the time period since it is possible that some of these EFH areas may be converted into scallop access areas in a future action.
3. Combination of Northern Edge HMA (Georges Bank Alternative 3) and Great South Channel HMA (Great South Channel Alternative 4) closed and existing habitat closed areas open

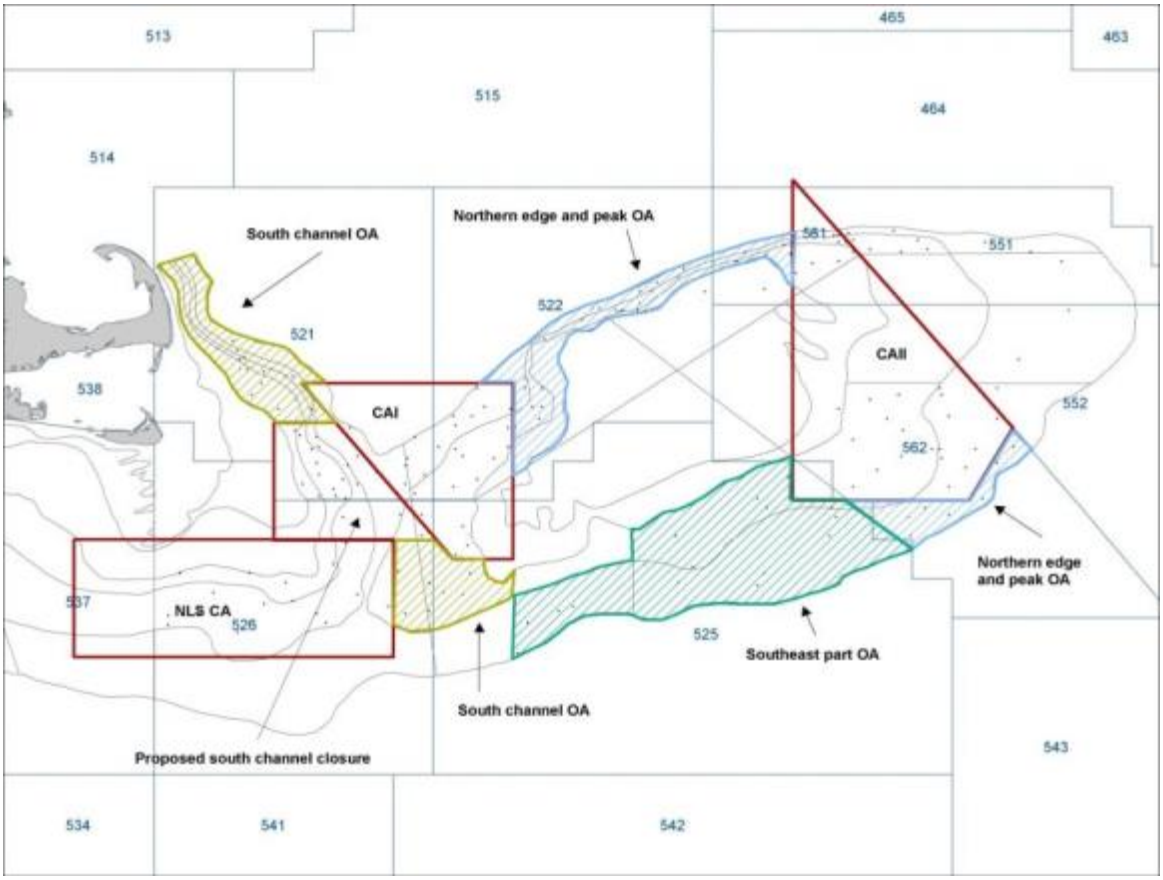
These analyses are more dynamic than the short term/long term yield estimates because they do not simply focus on the area being assessed. Rather, these analyses simulate fishing activity and associated impacts to the fishery overall. The model makes assumptions about where effort will be displaced based on fleet dynamics observed in the fishery and estimated catch rates in various areas. When reviewing the results it is important to keep in mind that there are a handful of constraints placed on the model in terms of how much effort is allowed in a certain area. Mainly, the principles used in the Scallop FMP to set target catches (total fishing mortality cannot exceed 0.28 in all areas and open area fishing mortality cannot exceed 0.38) are maintained in these simulations. Therefore, these results show the potential impacts of the HMAs under consideration, but as constrained by the area management principles in the Scallop FMP.

Modifying boundaries in the SAMS model is difficult and time consuming, so the Scallop PDT identified a feasible number of areas to assess, and did not run a separate SAMS projection for

[24] These analyses include five overall scenarios. It is possible after the public hearing process to run more scenarios based on additional input received. For example, different combinations can be run to help describe the potential cumulative impacts of several HMA alternatives together. Fishing year 2015 is the first year that this amendment is expected to be implemented; therefore, that is the first fishing year that is included in the results. SAMS is run through 2027 to capture long-term impacts. The Scallop PDT discussed that this time period is the length of time used to assess the impacts of specification alternatives in the Scallop FMP, but an even longer time period may be more appropriate for assessing the potential impacts on long-term habitat management closures. If time permits, the Scallop PDT may run these scenarios even longer to further assess the long-term impacts of these closures.

all groupings of Habitat Management Areas under consideration. The three model runs presented below were designed to capture the range of potential impacts from the numerous alternatives under consideration by evaluating the No Action, no habitat closures, and one combined alternative with two new habitat closure areas. Note that initially, two more model runs were included that evaluated just the Northern Edge HMA and just the Great South Channel HMA. Those runs were dropped from the final discussion below, although some of those results are still shown in the figures in this section (results were removed from the tables).

Map 135 – Typical SAMS model areas, with statistical areas and NEFSC shellfish stratum boundaries on Georges Bank



Short-term impacts

Table 141 summarizes short-term impacts during fishing year 2015, specifically overall F, open area F, landings, open area DAS, full time vessel DAS, and bottom area swept. Run 1/No Action, which the current habitat management areas closed to the scallop fishery, has the lowest 2015 projected landings (19,366 mt). Howver, open area DAS and associated F in open areas are higher, compared to alternatives that open current habitat management areas. The overall constraint on effort in 2015 for the No Action Alternative is the open area F limit of 0.38.

The overall constraint on effort in Run 2 (no habitat management areas) is that total F cannot exceed 0.28. When more areas become open to the scallop fishery, the main constraint becomes

the total F limit of 0.28, and not the open area F limit of 0.38, which is the main constraint when scallop biomass is within closed areas. For example, in Run 2 with no habitat management areas, most catch is estimated to come from Mid-Atlantic access areas and newly opened closure areas. That represents a large portion of the total F for the fishery, leaving less fishing opportunity available for open areas. In Run 2, open area F falls to 0.27 and 18 DAS per full time vessel in areas outside of Mid-Atlantic access areas and newly opened areas. Furthermore, in 2016 open area F would need to be reduced further to keep total F below 0.28. Specifically, the model projects open area F would need to be reduced to 0.13, or 10 DAS per full-time vessel in 2016, to keep total F below 0.28 since F would be higher in Mid-Atlantic access areas and newly opened habitat closure areas. While these DAS allocations are much lower than present values, total landings for this scenario are higher than current levels because substantial catches are expected in both Mid-Atlantic access areas and newly opened habitat closure areas. For example, for Run 2, total landings are projected to be 21,927 mt and 22,013 in 2016. This run has the lowest bottom area swept because more effort is in Mid-Atlantic access areas and newly opened habitat closure areas, which have higher LPUEs compared to open areas.

Because the current Closed Area II Habitat Closed Area and the new Northern Edge HMA modeled in Run 3 have such similar levels of biomass and potential yield, those runs overall are very similar. Run 3 provides higher landings in 2015 primarily because the Closed Area I North Habitat Closed Area is available to the scallop fishery in Run 3 and not Run 1, and that area is expected to have a substantial amount of exploitable biomass in 2015. Run 1 and Run 3 have the same DAS primarily because Run 3 keeps a substantial amount of biomass in a closed area, similar to Run 1. As noted previously, when biomass is within a closed area or areas, open area F can increase.

Overall, in terms of short term impacts, Run 3 (new HMAs) has the highest landings, followed closely behind by Run 2 (no closures). Therefore compared to No Action, both no closures and this particular set of new habitat areas would have beneficial impacts on the fishery in the short term. However, in terms of area swept, or associated impacts on the environment, Run 3 has higher estimates of area swept than No Action and no closures, in the short term (2015).

Table 141 – Summary of 2015 results for several scenarios developed to capture the range of HMA alternatives under consideration in OA2 based on SAMS model outputs

	Overall fishing mortality	Open area fishing mortality	Landings	Open area DAS	Full-time DAS	Bottom Area Swept
Run 1: No Action/Alternative 1	0.2	0.38	19,366	9,186	25	2,024
Run 2: No EFH Closures/Alternative 2	0.28	0.27	21,937	6,648	18	1,833
Run 3: NE and GSC HMAs combined (GB Alt 3 or 4, GSC/SNE Alt 4)	0.24	0.38	22,798	9,068	25	2,315

Long-term impacts

The SAMS model is even more useful for assessing the potential long-term impacts. Figure 58, Figure 59, and Figure 60 compare the projected landings, biomass, and bottom area swept

results. Run 1 = current closures in black; Run 2 = no closures in blue; and Run 3 = new NE and GSC closure in red. As noted above, other runs that only closed one new habitat management area at a time are in these figures as well (Northern Edge HMA only in purple and Great South Channel HMA only in green). The Northern Edge HMA only run is almost identical to Run 3 since those results are dominated by the new habitat closure on Georges Bank. The Great South Channel HMA only run is almost identical to the No Closure run since the new GSC closure contains very little scallop biomass, such that very little impact on the resource and fishery is expected if that area is closed.

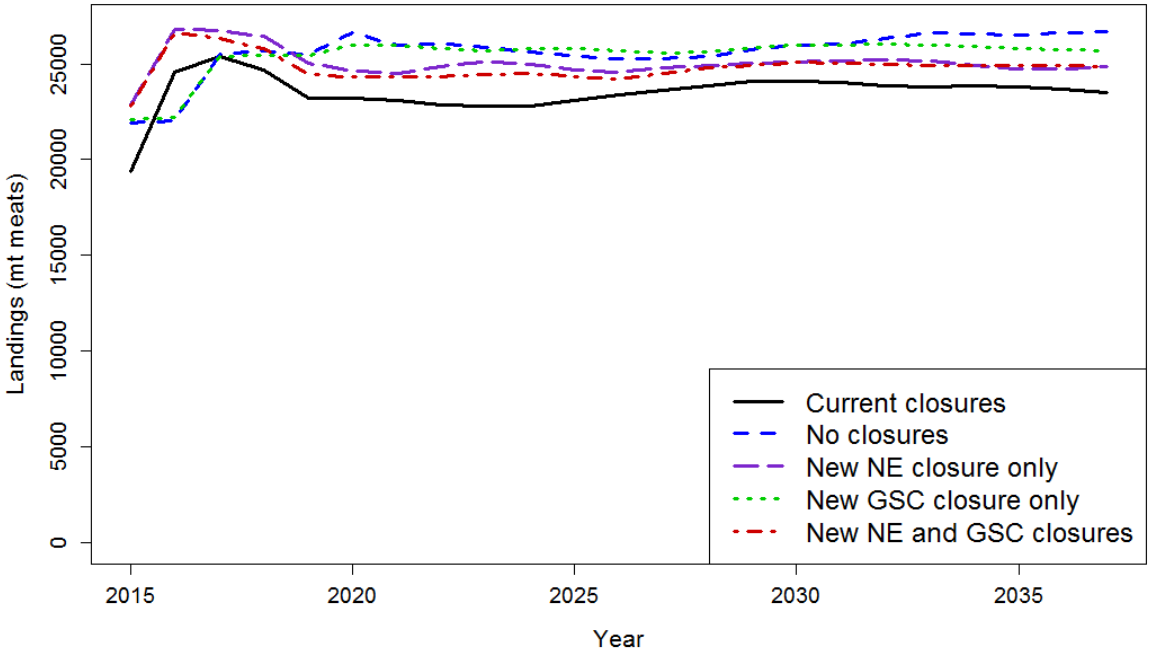
The No Action run has the lowest projected landings at first, then landings increase in 2016-2018 when the Mid-Atlantic access areas open, and over the long-term landings are lower for this run compared to all the others. This scenario is limited by the open are F constraint (max of 0.38) in all years because a substantial amount of biomass is contained in the current EFH closed areas.

For Run 2, no HMAs, the total F limit of 0.28 is already the constraining factor for fishery allocations. Because all areas would be available to the fishery, DAS would need to be reduced from current levels since there would no longer be biomass in closed areas with zero fishing mortality. Therefore, DAS and landings are lower for this run in the first few years because relatively little scallop biomass is in closed areas (22,000 mt in 2015 and increasing to 25,000 mt in 2017 and beyond).

However, long-term the projected landings for Run 2 (no HMAs) are the highest. This is evident after 2018 when the high biomass that is presently in the Mid-Atlantic access areas is fished during 2015-2018. Not surprisingly, these results suggest that long-term landings would be higher if long-term closures did NOT overlap productive scallop grounds. Since Run 2 (no HMAs) does not enclose very productive scallop grounds within habitat management areas, long-term landings are higher compared to other runs that close portions of relatively productive scallop grounds. Run 1 (No Action habitat closures) has the lowest long-term landings because it closes more area, and Run 3 has the highest landings at first when portions of current EFH closed areas reopen, but after a few years total landings are lower than Run 2 (no closures) since some biomass will remain within newer EFH closed areas.

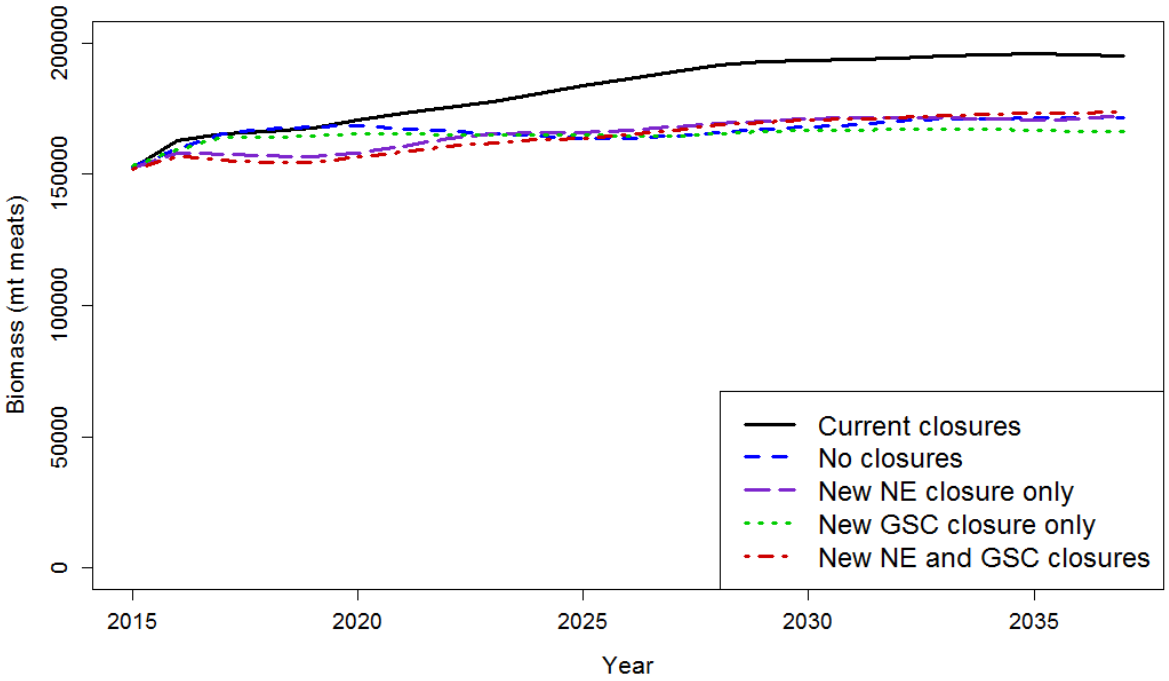
In terms of long-term biomass, Run 1 (No Action) would provide the highest long-term biomass. The other runs have similar long-term biomass. Run 2 (no HMAs) has higher biomass than Run 3 at first, but after about 10 years the estimated biomass is similar for Runs 2 and 3. After 20 years it seems that closing the Northern Edge HMA (Alternative 3) in Run 3 may provide higher biomass than Run 2 (no HMAs), but the differences are not very large.

Figure 58 – Projected scallop landings (mt) for 2015-2027 for the five model runs



Key: Run 1 = current closures (black); Run 2 = no closures (blue); Run 3 new NE and GSC closure (red). New NE closure only (Alternative 3) in purple and New GSC closure only (Alternative 4) in green

Figure 59 – Projected scallop biomass (mt) for 2015-2027 for the five model runs



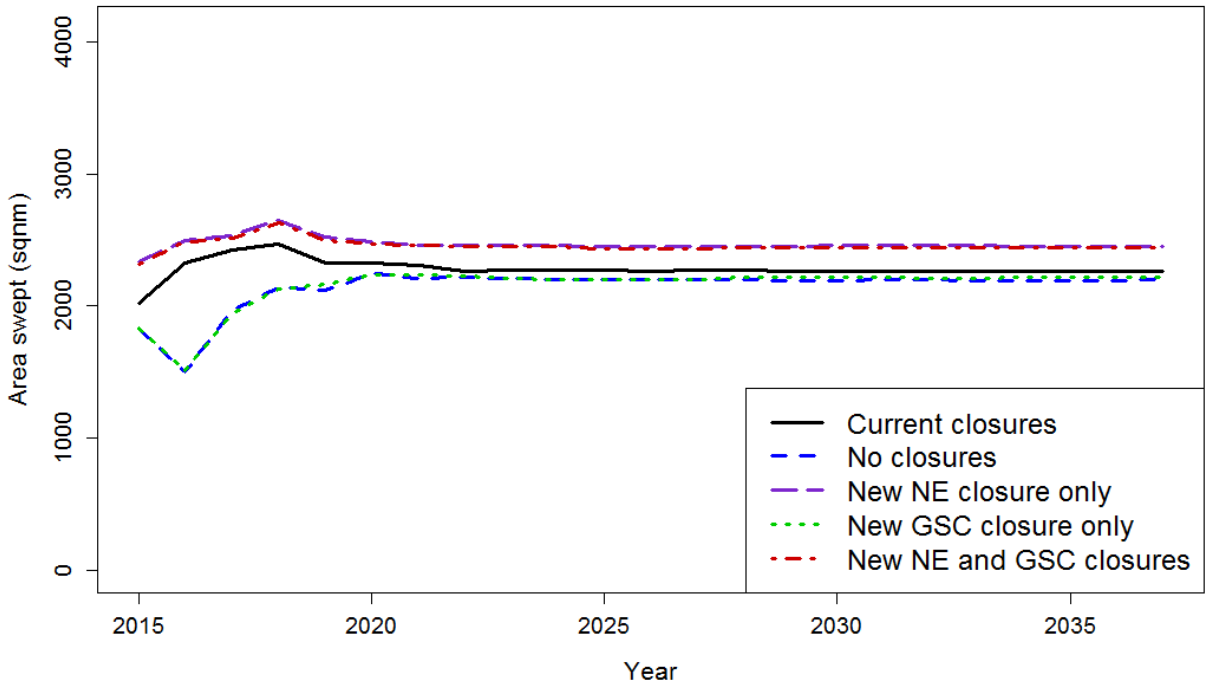
Key: Run 1 = current closures (black); Run 2 = no closures (blue); Run 3 new NE and GSC closure (red). New NE closure only (Alternative 3) in purple and New GSC closure only (Alternative 4) in green

The projections of area swept are quite different for the runs in the first few years. Again, some of these trends are an artifact of how F_{TARGET} is set in the Scallop FMP and the fact that a large proportion of total biomass is in the Mid-Atlantic access areas that are expected to open in 2015. These factors have a large impact on future landings and F, regardless of how the habitat management areas are potentially modified in this amendment. In brief, runs that have no HMAs have lower short-term and long-term bottom area swept because the fishery has access to all areas, so catch would be concentrated in areas with highest catch rates.

Run 3, which closes the Northern Edge HMA, has the highest short-term and long-term area swept estimates because these runs close a relatively productive scallop area. In addition, this run also provides access to more fishing grounds than the No Action alternative increasing overall bottom time compared to Run 1. Run 2 (no HMAs) has the lowest estimates of bottom area swept, especially in the first few years when most fishing is estimated to occur in the Mid-Atlantic access areas and newly opened habitat closure areas that have high catch rates.

When more area is closed to the fishery, effort is higher in open areas (up to max of 0.38), and higher open area days at sea increase overall bottom area swept. The model suggests that closing the Northern Edge HMA (Run 3) would increase overall bottom time long-term compared to the No Action alternative (No Action – Run1). This is the case because under Run 3 more area is open to the fishery. Area swept in open areas is similar for all the runs that close part of the northern edge (Run 1 and 3). But Run 1 (No Action) also closes Closed Area I North and other existing closed areas that have some level of scallop resource. Since those areas are open under Run 3, fishing activity is higher for that run, and thus total area swept is higher. Overall, the difference in area swept between all the runs is relatively minor. Run 2 with no HMAs is about 2,100 square nautical miles overall, and Run 3 (Northern Edge HMA) is about 2,400 square nautical miles overall.

Figure 60 – Projected area swept (nm^2) for 2015-2027 for the five model runs



Key: Run 1 = current closures (black); Run 2 = no closures (blue); Run 3 new NE and GSC closure (red). New NE closure only (Alternative 3) in purple and New GSC closure only (Alternative 4) in green

In summary, long-term projected landings for Run 2 (no HMAs) are the highest. Not surprisingly, these results suggest that long-term landings would be higher if long-term closures did NOT overlap productive scallop grounds. Run 1 (No Action) has the lowest long-term landings because it closes more area, and Run 3 has the highest landings at first when portions of current EFH closed areas reopen, but after a few years total landings are lower than Run 2 (no closures) since some biomass will remain within new EFH closed areas. Long-term biomass is highest for Run 1 (No Action EFH closures). After 20 years it seems that closing the Northern Edge HMA (Alternative 3) in Run 3 may provide higher biomass than Run 2 (no closures), but the differences are not very large. When more area is closed to the fishery, effort is higher in open areas (up to max of 0.38), and higher open area DAS increases overall bottom area swept. The model suggests that closing the Northern Edge HMA (Run 3) would increase overall bottom time long-term compared to the No Action alternative (No Action – Run1).

Short and long-term economic impacts

Short and long-term economic impacts presented below are estimated from a price/revenue model that uses the SAMS biological results presented above as its input data. Some of the tables and discussion compare the present value of the long-term revenue estimates. Present value is estimated using two different discount rates, 3% and 7%; these are standard discount rates recommended in the guidelines for evaluating the costs and benefits of Federal programs.
The discount rate is the rate at which society as a whole is willing to trade off present for future benefits, and is used to estimate the current or present value of the future benefits. Present value

of the revenue is the estimated value today of a stream of revenues projected to occur over time, as discounted through the use of an interest rate. A 7% discount rate places a lower value on future benefits as compared to a 3% discount rate, such that the present value of revenues associated with a fishery management alternative would be smaller if the values were estimated using a 7% discount rate versus 3% discount rate.

Landings and open area effort

The landings for scenarios that open current habitat closure areas (Run 2 and Run 3) are projected to exceed the landings for No Action scenario (that keeps those areas closed to the scallop fishery) both in 2015 and over the long-term from 2015 to 2037. Run 3 which includes the Northern Edge HMA results in higher landings (50.4 and 50.3 million lb) in 2015 compared to other scenarios (Table 142).

Over the long-term from 2015 to 2037 fishing years, Run 2 (no HMAs) results in the highest landings (1,298.9 million lb), 107.3 million lb more than Run 1 (No Action). Run 3 also exceeds Run 1 (No Action) landings, but only by 65.2 million lb. (Table 143).

During 2015, projected open area DAS per limited access vessel (Table 144) are lower for Run 2 (No HMAs, 18 days) compared to No Action (25) and Run 3 (also 25). This is because these runs have more areas open to the scallop fishery (or less biomass is closed to the fishery), such that the open area F limit of 0.28 becomes the constraining factor. This pattern holds over the long-term as well (Table 144).

Table 142 – Estimated landings (million lb)

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		42.7	48.4	50.3
2016-2018	2016	54.1	48.5	58.7
	2017	56.0	56.3	58.0
	2018	54.4	56.6	56.9
2016-2018 Total		164.5	161.4	173.6
2019-2027	2019	51.2	56.3	53.8
	2020	51.1	58.6	53.6
	2021	50.9	57.3	53.6
	2022	50.3	57.4	53.6
	2023	50.2	57.0	53.8
	2024	50.3	56.4	54.1
	2025	50.9	55.9	53.6
	2026	51.5	55.7	53.4
	2027	52.1	55.7	54.0
2019-2027 Total		458.5	510.4	483.5
2028-2037 Total		525.9	578.7	549.5
Grand Total		**1,191.7**	**1298.9**	**1,256.9**

Table 143 – Estimated landings net of No Action landings (million lb)

Sub-period	Fishing year	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		5.7	7.6
2016-2018	2016	-5.6	4.5
	2017	0.2	2.0
	2018	2.2	2.5
2016-2018 Total		-3.1	9.0
2019-2027	2019	5.1	2.7
	2020	7.5	2.5
	2021	6.4	2.7
	2022	7.1	3.3
	2023	6.8	3.7
	2024	6.1	3.8
	2025	5.0	2.6
	2026	4.2	1.9
	2027	3.6	1.9
2019-2027 Total		51.9	25.0
2028-2037 Total		52.8	23.6
Grand Total		**107.3**	**65.2**

Table 144 - Estimated open area DAS per limited access vessel (not including effort in newly opened EFH areas – catch from those areas is not considered in these DAS estimates)

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		25	18	25
2016-2018	2016	27	10	25
	2017	28	23	27
	2018	29	27	28
2016-2018 Total		84	60	80
2019-2027	2019	29	29	29
	2020	29	30	29
	2021	29	29	29
	2022	28	29	29
	2023	28	28	29
	2024	28	28	29
	2025	29	28	29
	2026	29	27	28
	2027	30	27	29
2019-2027 Total		259	255	260
2028-2037 Total		298	285	291
Grand Total		**666**	**618**	**656**

Impacts on price and revenue in the short and long term

The annual scallop revenues expressed in 2013 constant prices (undiscounted values) show that revenues will be considerably higher for scenarios that open current habitat closures areas (Run 2 and Run 3) compared to the No Action scenario both in the short- and long-term. These projections include revenue estimates from all areas open to fishing by scenario (access areas and open areas). The analysis does not take scallop meat quality into account.

In fishing year 2015, the present value of the revenues are projected to exceed the No Action values by over $50 million for scenarios with no habitat closures (Run 2) and by over $60 million for the scenarios that include a new closure on the Northern Edge (Run 3) using a 3% discount rate. These values are slightly lower if the present values were calculated using a 7% discount rate. From 2015 to 2037, Run 2 (no HMAs) would result in the largest cumulative revenues ($9,174 million). Present value of cumulative revenues will be lower when estimated using a 7% discount rate.

Over the long-term from 2015 to 2037, the present value of the projected revenues for the no closure scenario (Run 2) will exceed the no action values by $640 million or $399 million, using a 3% discount rate or 7% discount rate, respectively. The present value of the projected revenues for the new HMAs scenario (Northern Edge and Great South Channel HMAs combined) will exceed the no action values by $422 million or $295 million, using a 3% discount rate or 7% discount rate, respectively.

Table 145 – Preliminary projections for price (in 2013 inflation adjusted prices; average price in 2012=$9.77)

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		10.7	10.5	10.4
2016-2018	2016	10.1	10.5	10.0
	2017	10.0	10.1	10.0
	2018	10.1	10.1	10.1
2016-2018 Total		10.1	10.3	10.0
2019-2027	2019	10.3	10.2	10.2
	2020	10.3	10.1	10.3
	2021	10.4	10.2	10.3
	2022	10.4	10.2	10.3
	2023	10.4	10.2	10.3
	2024	10.5	10.3	10.3
	2025	10.4	10.3	10.4
	2026	10.4	10.3	10.4
	2027	10.4	10.3	10.4
2019-2027 Total		10.4	10.2	10.3
2028-2037 Total		10.4	10.2	10.3
Grand Total		**10.4**	**10.2**	**10.3**

Table 146 – Preliminary revenue projections (in 2013 inflation adjusted values prices, undiscounted)

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		456	510	521
2016-2018	2016	546	511	586
	2017	560	569	579
	2018	550	573	573
2016-2018 Total		1,656	1,653	1,738
2019-2027	2019	527	572	552
	2020	528	591	551
	2021	528	583	552
	2022	525	586	553
	2023	524	583	556
	2024	527	579	558
	2025	532	576	555
	2026	536	575	555
	2027	540	575	559
2019-2027 Total		4,767	5,219	4,992
2028-2037 Total		5,456	5,911	5,666
Grand Total		**12,335**	**13,293**	**12,918**

Table 147 – Cumulative present value of total scallop revenue (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	430	481	491
2016-2018	1,472	1,468	1,545
2019-2027	3,556	3,896	3,725
2028-2037	3,078	3,330	3,195
Grand Total	**8,535**	**9,174**	**8,957**

Table 148 – Present value of total scallop revenue net of no action revenue (using 3% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	51	62
2016-2018	(4)	74
2019-2027	340	169
2028-2037	253	118
Grand Total	**640**	**422**

Table 149 – Present value of total scallop revenue (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	398	446	455
2016-2018	1,265	1,260	1,329
2019-2027	2,458	2,695	2,575
2028-2037	1,487	1,606	1,543
Grand Total	**5,608**	**6,007**	**5,903**

Table 150 – Present value of total scallop revenue net of no action revenue (using 7% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	47	57
2016-2018	(5)	64
2019-2027	238	117
2028-2037	119	56
Grand Total	**399**	**295**

Landings per unit of effort and area swept

Landings per unit of effort (LPUE) for all areas are estimated to exceed 2,700 lb per DAS, and the estimate for Run 2 (no closures) is slightly higher compared to No Action and Run 3 in both in the short- and long-term. No closures provide the lowest values for area swept by providing access to a larger overall open area, but allocating lower open area DAS compared to the other scenarios, hence higher LPUE.

Table 151 – Average landings per unit of effort for all areas in pounds per day (meat weight)

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		2,729	2,840	2,745
2016-2018	2016	2,803	2,921	2,813
	2017	2,816	2,927	2,825
	2018	2,806	2,928	2,804
2016-2018 Total		2,808	2,925	2,814
2019-2027	2019	2,839	2,977	2,829
	2020	2,847	2,970	2,837
	2021	2,854	2,967	2,848
	2022	2,866	2,964	2,851
	2023	2,868	2,964	2,854
	2024	2,860	2,963	2,859
	2025	2,865	2,959	2,862
	2026	2,871	2,954	2,858
	2027	2,873	2,951	2,856
2019-2027 Total		2,860	2,963	2,850
2028-2037 Total		2,890	2,964	2,872
Grand Total		**2,861**	**2,953**	**2,850**

Table 152 – Area Swept

Sub-period	Fishing year	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015 Total		2,024	1,833	2,315
2016-2018	2016	2,325	1,503	2,487
	2017	2,424	1,970	2,517
	2018	2,472	2,142	2,628
2016-2018 Total		7,221	5,615	7,632
2019-2027	2019	2,328	2,119	2,500
	2020	2,322	2,248	2,469
	2021	2,308	2,207	2,456
	2022	2,268	2,221	2,453
	2023	2,272	2,213	2,451
	2024	2,275	2,205	2,454
	2025	2,270	2,201	2,434
	2026	2,267	2,203	2,432
	2027	2,275	2,200	2,436
2019-2027 Total		20,585	19,817	22,085
2028-2037 Total		22,655	21,961	24,417
Grand Total		**52,485**	**49,226**	**56,449**

Present Value of Producer Surplus

Producer surplus (benefits) for a particular fishery shows the net benefits to harvesters, including vessel owners and crew, and is measured by the difference between total revenue and operating costs. Present values of the producer surplus for scenarios other than No Action are expected to range from $449 million (Run 2 – No HMAs) to $458 million (Run 3), and to be about $49 - $57 million higher than the projected producer surplus for no action ($401 million) values for 2015 fishing year using a 3% discount rate (Table 153 and Table 154). Present value of the producer surplus estimated using a 7% discount rate are provided in Table 155 and Table 156. Although using a higher discount rate lowers the present values of the producer surplus, the ranking of the scenarios are not affected by the discount rate. In both cases, Run 3 results in largest producer surplus followed by Run 2 in the short-term.

Over the long-term from 2015 to 2037, the present value of the projected producer surplus for the no closure scenario (Run 2) will exceed the no action values by $611 million using a 3% discount rate, or by $383 million using a 7% discount rate. The scenario that includes both a Northern Edge and Great South Channel HMAs (Run 3) is estimated to result in a smallest increase the present value of the producer surplus. In short, both no closures (Run 2) and the scenario with new closures (Run 3) will have highly positive economic impacts on the producer surplus over the long-term, with Run 2 (No HMA) resulting in largest increases compared to No Action values.

Table 153 – Present value of producer surplus (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	401	449	458
2016-2018	1,370	1,372	1,438
2019-2027	3,322	3,644	3,477
2028-2037	2,877	3,115	2,985
Grand Total	**7,970**	**8,581**	**8,358**

Table 154 – Present value of producer surplus net of No Action values (using 3% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	49	57
2016-2018	2	68
2019-2027	322	155
2028-2037	238	108
Grand Total	**611**	**388**

Table 155 – Present value of producer surplus (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	371	417	424
2016-2018	1,178	1,178	1,237
2019-2027	2,296	2,521	2,404
2028-2037	1,390	1,503	1,442
Grand Total	**5,235**	**5,619**	**5,506**

Table 156 – Present value of producer surplus net of No Action values (using 7% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	45	53
2016-2018	0	59
2019-2027	225	108
2028-2037	113	51
Grand Total	**383**	**271**

Present Value of Total Economic Benefits

Economic benefits include the benefits both to the consumers and to the fishing industry and equal the sum of benefits to the consumers and producers. The cumulative present value of the total economic benefits for each run is summarized in Table 157 (3% discount rate) and Table 159 (7% discount rate). The net present values relative to No Action are shown in Table 158 (3% discount rate) and Table 160 (7% discount rate).

The estimated present value of total economic benefits will be about $722 million higher in 2015-2037 with Run 2 (No HMAs) compared to the no action (3% discount rate). Run 3 (Northern Edge and Great South Channel HMAs combined) would result in smaller total economic benefits compared to Run 2 in the long-term, whether a 3% or a 7% discount rate used, although total economic benefits would still be higher than the No Action values.

Table 157 – Present value of total economic benefits (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	436	492	503
2016-2018	1,522	1,518	1,603
2019-2027	3,655	4,040	3,838
2028-2037	3,170	3,455	3,297
Grand Total	**8,783**	**9,504**	**9,241**

Table 158 – Present value of total economic benefits net of no action values (using 3% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	56	67
2016-2018	(4)	81
2019-2027	385	183
2028-2037	285	127
Grand Total	**722**	**458**

Table 159 – Present value of total economic benefits (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	404	456	466
2016-2018	1,309	1,303	1,378
2019-2027	2,526	2,795	2,653
2028-2037	1,532	1,666	1,592
Grand Total	**5,770**	**6,221**	**6,091**

Table 160 – Present value of total economic benefits net of no action values (using 7% discount rate)

Sub-period	Run 2 No HMAs	Run 3 Northern Edge/Great South Channel HMAs
2015	45	53
2016-2018	0	59
2019-2027	225	108
2028-2037	113	51
Grand Total	**383**	**271**

In summary, the economic analyses in this section provide a way to compare both the short term and long term economic impacts on the scallop fishery in conjunction with existing principles that set fishery allocations, and not just as standalone measures. For example, fishing targets are constrained by an overall target fishing mortality rate, so if areas reopen and fishing pressure in that area goes from zero to something higher, fishing effort in a different area will need to be reduced to keep the overall fishing mortality under F_{msy}. In the end, these results are similar to the results presented in the previous section, which only focus on the yield potential of individual areas. Specifically, the short term economic impacts are more positive under Run 3, a scenario that modifies existing closed areas, relative to No Action. But in the long-term, economic benefits are highest for Run 2 (no HMAs), if all areas are fished at F_{msy}. The No Action scenario has the lowest short term and long term economic benefits since it keeps some productive scallop beds within closed areas.

4.6.4.2.2 Spawning management alternatives

In the Gulf of Maine, Alternative 2 could remove year round groundfish closures unless these areas remain in place under the habitat management alternatives. While this would provide some additional access to the fishery, the limited extent of the scallop resource in this region is not expected to result in substantial benefits in the context of the fishery as a whole. Therefore, Alternative 2 is expected to have neutral to slightly positive impacts on the scallop fishery relative to Alternative 1/No Action.

Seasonal variation in meat yield on Georges Bank is discussed above in the biological impacts section. Generally, the Alternative 2 and 3 spawning closure seasons coincide with times of lower yield. When evaluating fishery impacts, it is important to consider this seasonal restriction in combination with one that is already in place for Closed Area II under the access area regulations in the scallop FMP. Since FW24 (implemented during fishing year 2013), Closed Area II south is closed to the scallop fishery from August 15 – November 15 to reduce yellowtail flounder bycatch. If the two seasonal restrictions are implemented, the area would only be open to the scallop fishery for 6.5 months of the year, April 16 – August 14 and again from November 15 – January 31. Having both seasonal restrictions could shift more effort into the winter when scallop meat weights are lower, having negative impacts on the resource and fishery. However, seasonal closures tend to shift effort right before or after a closure, so if effort is mostly concentrated in May, impacts on the resource could be positive. Finally, six months is generally enough time for a vessel to make a trip or two in Closed Area II if allocated access, but it does reduce flexibility for the fishery, which can have potentially negative impacts. Overall, seasonal closures have tradeoffs: limiting flexibility for the fishery, but if closures are during periods of time when scallop meat weights are lower, there can be positive impacts on the resource by maximizing yield. Because this closure season is primarily when meat weights are lower, the overall impacts are expected to be positive on the resource and fishery by potentially maximizing yield.

4.6.4.3 ***Impacts of Dedicated Habitat Research Area alternatives***

The potential impacts of alternatives to designate Dedicated Habitat Research Areas (DHRAs) on the scallop resource and fishery were assessed qualitatively related to the potential indirect impacts on the scallop resource and fishery from research that may be conducted in the various areas. In addition, some input has been provided about potential fishery displacement from these candidate research areas.

The Scallop PDT considered the scallop resource and current or potential level of fishing activity in each dedicated habitat research area alternative. For the area in Closed Area I (Georges Bank DHRA, Alternative 4) the NEFSC dredge survey was used to get a sense of the scallop biomass within that alternative. For the areas in the Gulf of Maine (Eastern Maine DHRA, Alternative 2, and Stellwagen DHRA, Alternative 3), results from a 2012 RSA project were used. Sampling was not very dense in this survey. In addition, VTR data for the scallop fishery were plotted to get a sense of the level of Limited Access and Limited Access General Category fishing activity inside these areas.

In general, the dedicated habitat research areas are not expected to have major impacts on the scallop resource or fishery because none of the proposed areas overlap major concentrations of scallop biomass. Two of the areas (Alternatives 3 and 4) are within current habitat management closed areas and the one in the Eastern Gulf of Maine (Alternative 2) is not a major area for scallop abundance. There may be indirect benefits to the scallop resource or fishery if research is conducted in these areas, which improves the understanding of fishery impacts on EFH, and in turn, general fisheries management. There is one study already proposed for the area in Closed Area I South that is looking at scallop recruitment. To the extent this designation would help support research that has beneficial impacts on the scallop resource or fishery, Alternative 4 could have a positive impact.

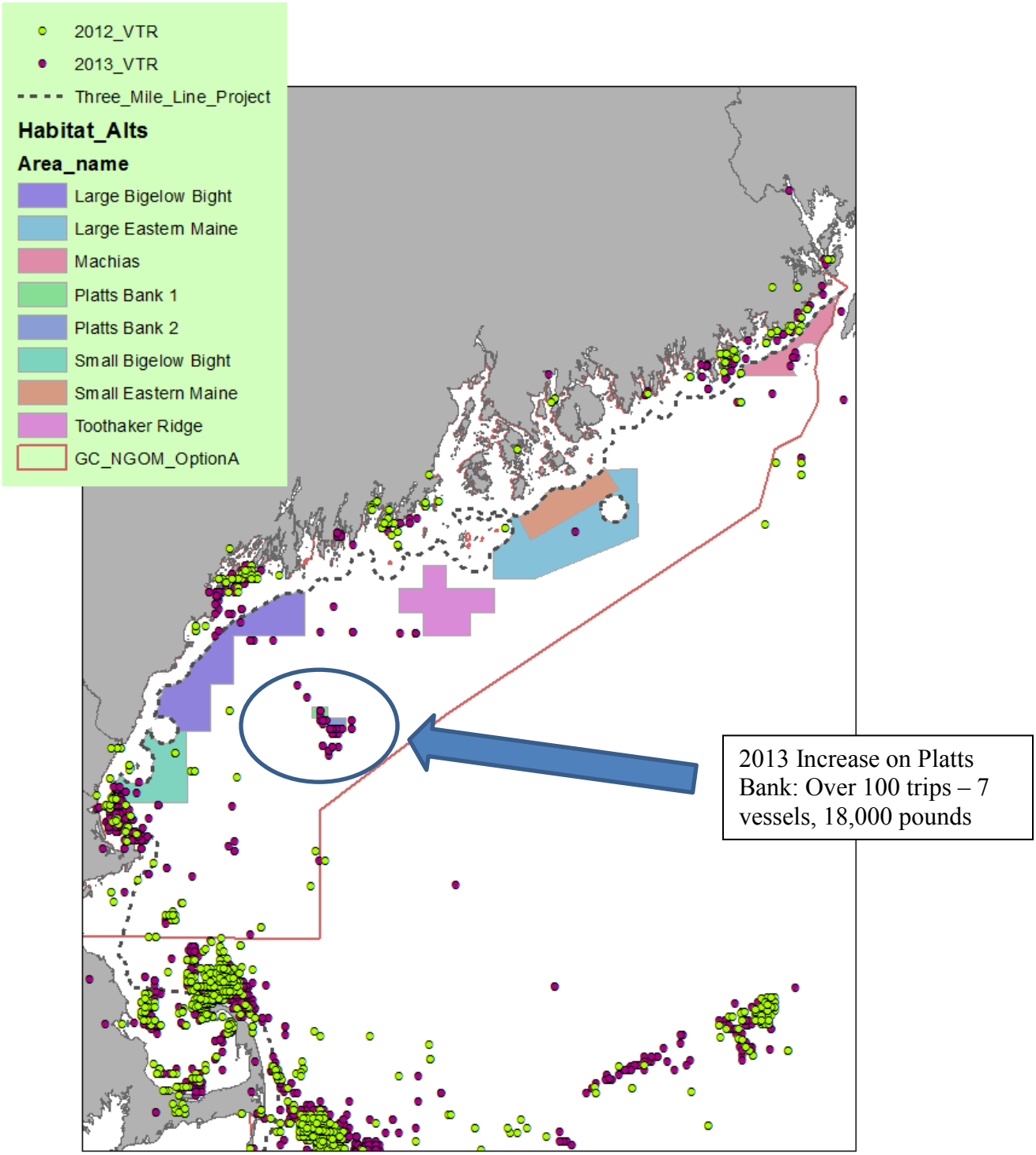
If this amendment modifies the Closed Area I and Western Gulf of Maine Habitat closed areas it is possible that some scallop vessels would want to prosecute those areas. Again, scallop abundance in these areas is relatively low, but closing the areas for research could have negative impacts on the fishery if scallop catch rates are higher in those areas compared to other areas. Table 140 in the habitat alternatives section above shows the long-term yield potential from Closed Area I South to be 29 mt (mean estimate), and 11 mt (median estimate). This is a very small proportion of total scallop long-term yield (about 0.1%). Therefore, the potential impacts on the scallop resource and fishery for a designation in this area are negligible.

The Stellwagen and Eastern Maine DHRAs are closer to shore so could have potentially higher impacts on smaller vessels that are homeported near these areas. VTR has been plotted for trips over 600 pounds to represent limited access trips (Map 136) as well as trips less than 600 pounds to represent limited access general category trips (Map 137). Based on these data there has been very little scallop fishing activity in any of the three DHRAs. However, any activity in the Stellwagen or Georges Bank DHRAs are likely misreported because these two areas have been closed to scallop vessels since 1998 and 1994, respectively. Inshore scallop populations, particularly off the coast of Maine are rebounding. Therefore, while there does not seem to be much fishing activity within the Eastern Maine DHRA, there may be more interest in that area if inshore populations continue to recover.

Map 136 – VTR effort CY2008-2012 for LA scallop fishery. VTR catch 600 pounds and less considered LAGC effort and trips above 600 pounds were considered LA effort.

Map 137 – VTR effort CY2008-2012 for LAGC scallop fishery.

Figure 61 – 2012 and 2013 VTR data for all scallop dredge vessels



4.6.5 Atlantic herring

4.6.5.1 ***Biological impacts***

This action will have limited impacts on the Atlantic herring resource. With the exception of their demersal egg beds, herring are a pelagic species, so measures that restrict mobile bottom-tending gears to protect seabed habitats are not expected to have much benefit for herring stocks. Some Habitat Management Areas do overlap with the preferred alternative herring egg Essential Fish Habitat designation (Map 138). Alternatives that include these areas would provide positive benefits for herring eggs. Spawning generally begins in July (earlier in the northern Gulf of Maine) and lasts until December, so the HMAs would have a benefit if they displace mobile bottom-tending gear fishing activities that occur during the second half of the calendar year.

Map 138 – Overlap between herring egg EFH (blue) with Habitat Management Areas (pinks/reds, labeled). Non-overlapping habitat areas are outlined in black.

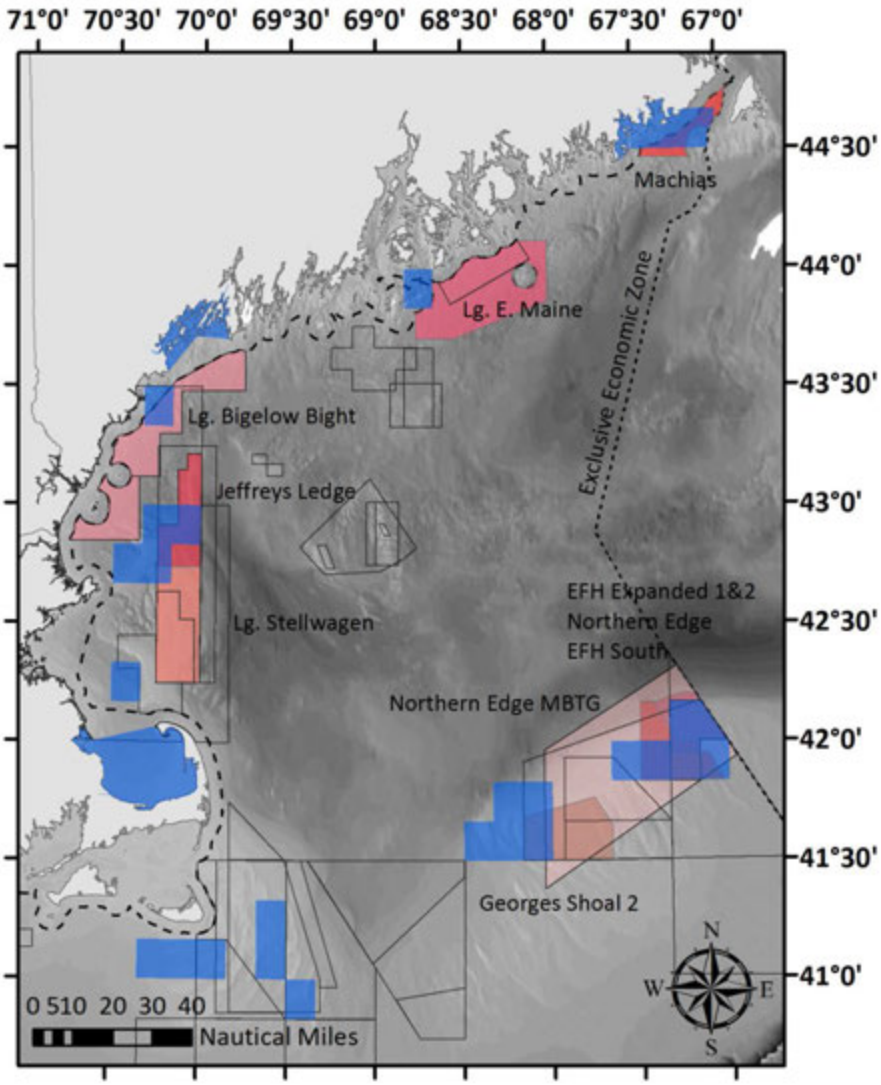


Table 161 – Impacts of spatial management alternatives on the Atlantic herring resource

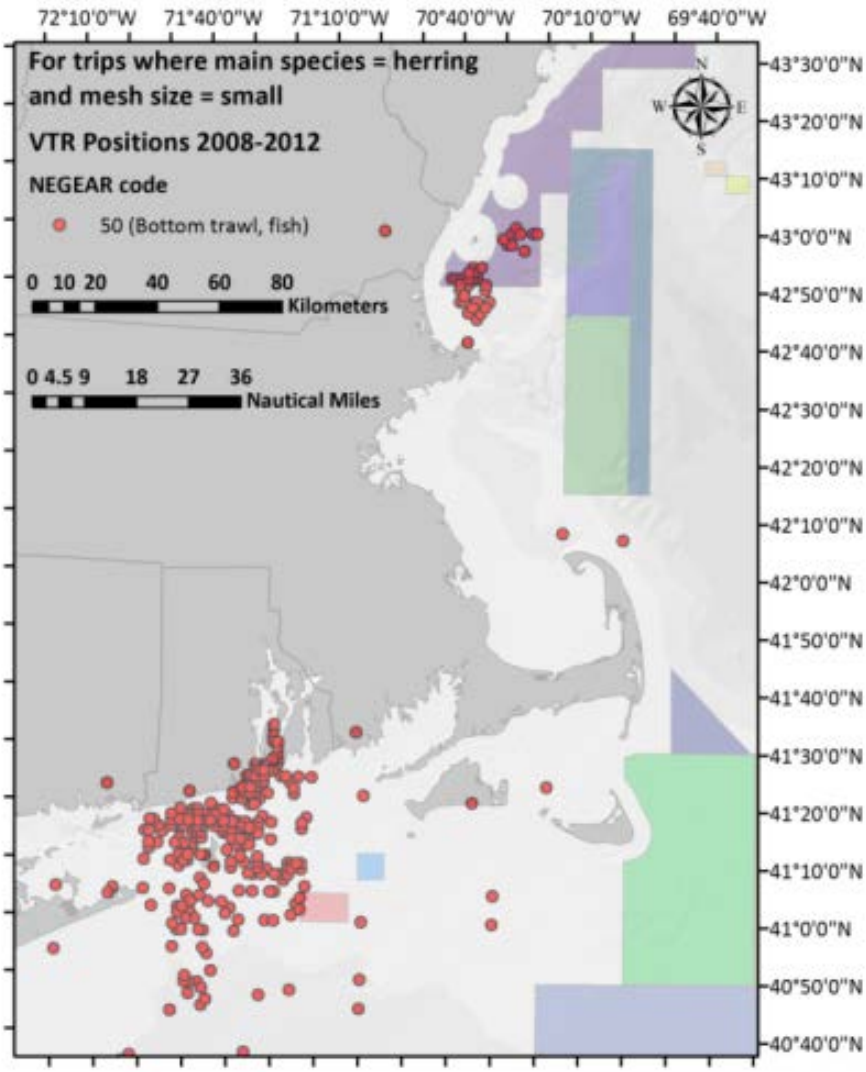
Alternative type	Alternative	Impacts
Habitat Management Alternatives	EGOM Alts 1	Neutral – currently no management areas that restrict MBTG in region, this would maintain no action
	EGOM Alts 2, 3	Slightly positive – adds Machias HMA, which would restrict MBTG
	CGOM Alts 1-4	Neutral – no herring egg beds in this region
	WGOM Alts 1, 3, 4, 5	Slightly positive – maintains or adds MBTG protections in areas with herring egg beds
	WGOM Alts 2, 6	Slightly negative – removes current MBTG protections in areas with herring egg beds
	GB Alts 1, 3, 4, 5, 6, 7, 8	Slightly positive – maintains or adds MBTG protections in areas with herring egg beds
	GB Alt 2	Slightly negative - removes current MBTG protections in areas with herring egg beds
	GSC-SNE Alts 1, 3, 4, 5, 6	Slightly positive - herring egg beds overlap areas included in all these alternatives
	GSC-SNE Alt 2	Slightly negative - removes current MBTG protections in areas with herring egg beds
Spawning Management Alternatives	GOM Alt 1, GB Alt 1	Slightly positive – maintains MBTG protections in areas with herring egg beds
	GOM Alt 2, GB Alt 2, 3	Slightly negative – makes areas seasonal, which will not protect herring eggs
Dedicated Habitat Research Area Alternatives	1-5	Neutral – little to no overlap between potential DHRAs and herring egg beds
Framework and monitoring Alternatives	1, 2	Neutral – alternatives do not/will not have a direct effect on the herring management process and indirectly on the herring resource

4.6.5.2 *Fishery impacts*

This action will likely have fairly limited impacts on the Atlantic herring fishery, as the fishing restrictions associated with the alternatives generally do not extend to gears used to target herring. One exception is small mesh bottom trawls used in specific locations. Small mesh bottom trawls would be restricted under all three types of alternatives, habitat, spawning, and research. Generally, the trawls are used in the Gulf of Maine to catch relatively small amounts of herring under a Category C permit, and in Southern New England off the coast of Rhode Island to target larger amounts of herring under Category A and B permits. Between 2008 and 2011, these small-mesh bottom trawls represented 4% of herring landings, so they constitute a small fraction of the fishery (2013-2015 Herring Specifications, NEFMC 2013). These landings are spatially concentrated, with the majority (roughly 14 mt) coming from Area 2, representing 16% of Area 2 landings during that same period.

Given the general fishing location of these small-mesh bottom trawls, in terms of evaluating the impacts of the habitat management alternatives in this amendment on this component of the fishery, the question is the extent to which these boats fish within the two Cox Ledge HMA or in the Gulf of Maine HMAs currently open to fishing. Category A and B vessels with higher possession limits may be directing effort on Atlantic herring in the Cox Ledge areas, and Category C vessels with lower possession limits may be fishing in the Gulf of Maine HMA areas in addition to or incidental to fishing for whiting. Map 139 indicates that there appears to be limited overlap between small mesh bottom trawl trips where the main species was identified as herring and the Cox Ledge area. There are small-mesh bottom trawl trips in the southern part of the Large Bigelow Bight HMA and the Small Bigelow Bight HMA that would be excluded from those areas if one or the other of them is closed to mobile bottom-tending gears. These trips probably represent a low value relative to the herring fishery overall, assuming that they are landing small amounts of herring, which is a low value species.

Map 139 – VTR locations (red circles) of small mesh bottom trawl trips where the main species was noted as 'herring', 2008-2012.



Also, Eastern Gulf of Maine Alternative 2, Option 5, would restrict purse seines. This gear is not used frequently in the Machias HMA, but it is used in the Large Eastern Maine HMA, and almost all the purse seine landings in that area are herring. Section 4.2.3.1.2 discusses purse seine revenues from this area in greater detail. According to the 2013-2015 herring specifications, 133,463 mt herring were taken from Area 1A over a four year period, with 52% landed by purse seine vessels. Assuming an equal distribution of landings across all four years, and a herring price per mt ranging between $221 and $296, this translates to annual Area 1A landings between $7.4 and $9.9 million. In the most recent three years (2010-2012), average annual purse seine revenues estimated for the Large Eastern Maine area were just over $1 million annually (see Section 4.2.3.1.2), or roughly 11-15% of total area 1A landings. More herring are landed from Area 1A than from any other herring management area. Year-round closure of the Large Eastern Maine HMA to purse seine fishing under Alternative 2 Option 5 would likely have a slightly negative impact on the herring fishery overall, although these effects would be more significant for the small subset of vessels conducting purse seine fishing for herring in the area. Additional discussion of this issue is provided in section 4.2.3.1.2.

Currently, there are impacts to the Atlantic herring fishery associated with monitoring programs in the year-round groundfish closed areas, implemented in Amendment 5 to the Atlantic Herring FMP (March 2014). According to Amendment 5, 100% observer coverage is required, along with full sampling provisions (and measures to address net slippage) on limited access midwater trawl herring vessels when fishing in the year-round groundfish closed areas. Midwater trawl herring vessels are prohibited from fishing in the year-round groundfish closed areas without an observer. If Federal funds are not available to pay for 100% observer coverage in the closed areas, then herring vessels will be responsible for the costs, under the provisions that will be implemented through the omnibus industry-funded monitoring amendment (in progress). The costs of these coverage requirements were estimated in the Amendment 5 FEIS (Section 6.5.6) to be around $169,000, assuming that Federal funds would cover around 30% of midwater trawl trips in the closed areas.

If the Council chooses, the monitoring requirements for the limited access midwater trawl herring fishery in the groundfish year-round closed areas could be eliminated if one or more of the corresponding areas are removed or made seasonal under the habitat or spawning action alternatives. In this case, the action alternatives may reduce impacts on the limited access midwater trawl herring fishery in terms of reduced monitoring costs from those expected under Amendment 5; this would result because the year round groundfish closures are eliminated or made seasonal under the sub-regional/regional habitat and spawning action alternatives. Alternatively, a trailing action might be developed by the Council to adjust or specify herring monitoring requirements in similar areas or in the new closed areas so that groundfish bycatch, specifically haddock bycatch, can continue to be effectively monitored. If the preferred alternatives or a subsequent action result in monitoring requirements that are consistent with those specified by Atlantic Herring Amendment 5 regardless of whether the year-round groundfish closures are adjusted, then the action alternatives will have neutral impacts on the herring fishery.

Table 162 – Impacts of spatial management alternatives on the Atlantic herring fishery

Alternative type	Alternative	Impacts
Habitat Management Alternatives	EGOM Alts 1-3; CGOM Alts 1-4; WGOM Alts 1, 2, 6, 7, 8; GB Alts 1-8; GSC-SNE Alt 1-2	Neutral, except for EGOM Alternative 2 if Option 5 is selected, which would restrict additional gears capable of catching groundfish, including purse seines and would therefore have a slightly negative impact on the herring fishery overall See economic impacts section for additional discussion.
	WGOM Alts 3, 4, 5	Slightly negative – small mesh bottom trawling for herring overlaps the large and small Bigelow Bight HMAs, which are included in these alternatives
	GSC-SNE Alt 3-6	Slightly negative – if small mesh bottom trawl herring fishing occurs on Cox Ledge it would be displaced, but it appears that this effort does not occur within the management areas
Spawning Management Alternatives	GOM Alt 1; GB Alt 1	Slightly negative - maintains year round groundfish closures which would maintain existing monitoring requirements
	GOM Alt 2A, 2B; GB Alt 2A, 2B, 3A, 3B	Neutral or slightly positive – removing groundfish closures might not impact monitoring (neutral), or might eliminate monitoring requirements (positive)
Dedicated Habitat Research Area Alternatives	1-5	Neutral – no effect on herring operations, probably limited research to benefit herring management
Framework and monitoring Alternatives	1, 2	Neutral – alternatives do not/will not have a direct effect on the herring management process

4.6.6 Atlantic deep-sea red crab

4.6.6.1 *Biological impacts*

Deep-sea red crabs are found in deep water areas of the Gulf of Maine and along the continental slope south of Georges Bank to the Gulf of Mexico. There may be limited overlap between their Gulf of Maine distribution and some of the habitat and spawning areas, but generally speaking red crabs occur in deeper waters than are contained within the management areas, particularly the habitat management areas which tend to be identified in waters shallower than 100m. Thus, there are likely no impacts of the spatial management alternatives (HMAs, Spawning, and DHRAs) on this stock.

4.6.6.2 *Fishery impacts*

The red crab fishery operates entirely along the continental slope in depths between 600-640 m. There is no overlap between this fishery and any of the spatial management alternatives proposed in this amendment, so therefore no impacts to the fishery are expected.

4.6.7 Atlantic salmon

4.6.7.1 *Biological impacts*

The alternatives in this amendment are expected to have negligble impacts on Atlantic salmon, as described in the protected species impacts discussion in Section 4.2.4.

4.6.7.2 ***Fishery impacts***

Although there is a fishery management plan for Atlantic salmon, there is not a directed fishery that would be impacted by the alternatives in this action.

4.6.8 Atlantic surfclams and ocean quahogs

4.6.8.1 ***Biological impacts***

Atlantic surfclams are found in the western North Atlantic from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. They are most abundant on Georges Bank, the south shore of Long Island, New Jersey, and the Delmarva Peninsula. EFH for juveniles and adults is found throughout the substrate, to a depth of three feet below the water/sediment interface, within Federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys. Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

Ocean quahogs are common around Iceland, in the eastern Atlantic as far south as Spain, and in the western Atlantic as far south as Cape Hatteras, North Carolina. Ocean quahogs live in water between 25 and 1,300 feet. In the northern part of their range, they are found in shallower water closer to shore. The U.S. stock is almost entirely within Federal waters (3 to 200 miles from shore), except for a modest amount off the coast of Maine and in waters between 65 and 260 feet deep. EFH for juveniles and adults is found throughout the substrate, to a depth of three feet below the water/sediment interface, within Federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys. Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60° F, and occur progressively further offshore between Cape Cod and Cape Hatteras. While the surfclam and ocean quahog juvenile and adult life stages are benthic, they are not considered highly susceptible to impacts from bottom tending fishing gears, other than hydraulic dredges.

In US waters, ocean quahogs are most abundant in the southern New England, Long Island, and Georges Bank regions. However, these regions have recently seen a loss of overall biomass, except Georges Bank where harvesting has historically been prohibited. The ocean quahog fishery has shifted north over the last three decades away from the original fishing grounds off Delmarva and New Jersey, and followed the concentrations of quahogs. In the 1980s, the bulk of the fishing effort was off Delmarva and southern New Jersey. In the 1990s, effort moved northward to the Long Island and Southern New England regions. For the past ten years, the majority of fishing effort has been in the Long Island region. The Georges Bank region, which had not been open to ocean quahog fishing since 1990 due to the risk of paralytic shellfish poison (PSP) contamination, contains about 43% of total ocean quahog fishable biomass (2011 NEFSC survey data). Portions of this area were reopened to harvesting at the beginning of 2013.

4.6.8.1.1 Habitat management alternatives

As described above, while there is overlap with surfclam and ocean quahog EFH and distributions and habitat management alternative areas, hydraulic and toothed clam dredges are the only mobile bottom-tending gears that capture surfclams and ocean quahogs Therefore, these species would not likely be impacted (either positively or negatively) by shifts in effort associated with prohibitions on use of trawls or scallop dredges in habitat management areas. Thus, adopting new Habitat Management Areas with Option 2 measures, which would restrict mobile bottom-tending gears but exempt hydraulic clam dredges, would have neutral impacts on surfclams and ocean quahogs. The same conclusion would hold for HMAs implemented with Options 3 or 4, which require trawl gear modifications but do not restrict other gears, including clam and scallop dredges.

Habitat Management Areas implemented with Option 1 (mobile bottom-tending gear closure) could influence spatial patterns of fishing with of clam dredges and could have an effect on the clam resource. The commercial fisheries for surfclams and ocean quahogs are managed using annual catch limits, which limit overall removals (landings and discards) to levels that are sustainable. <u>However, there may be the potential with both stocks for localized depletion of surfclams or ocean quahogs in some areas depending on the spatial distribution of fishing effort. These stocks are susceptible to local depletion because of their sessile nature and the manner in which the fisheries operate; fishing an area until catch rates decline.</u> The recent stock assessment for Atlantic surfclam at SAW 56 suggested there are source/sink dynamics relative to recruitment for this stock. The Georges Bank portion of the stock appears to be its own source for recruits, and does not appear to receive significant recruit contributions from other areas. In addition, the recruitment dynamic for ocean quahogs are poorly understood. These dynamics, particularly at a small, local scale are not well understood for either stock. <u>The closure of some areas to dredging for both surfclam and ocean quahogs has the potential to result in slightly positive impacts on the stock. Similarly, there is the potential for slightly negative impacts if substantial fishing effort shifts to areas not previously fished, potentially resulting in some areas of localized depletion.</u> Impacts would be expected to be slight given these areas proposed for closures are small relative to the overall distribution of the stock. <u>The biological impacts of the proposed habitat management alternatives on surfclams and ocean quahogs could vary from slightly negative to slightly positive, and these impacts may be localized and heterogeneous in nature.</u> <u>Impacts on the clam resource on the whole are expected to be neutral.</u>

Clam dredges are prohibited from the existing habitat closure areas identified in each of the sub-regional No Action alternatives. The Nantucket Lightship Habitat Closure Area contains both surfclams and quahogs, and would be open to clamming if not for the habitat closure (i.e. it is not a food safety or PSP closure). Thus, adopting one of the action alternatives in the Great South Channel/Southern New England region could shift clam dredging effort into the current Nantucket Lightship Habitat Closure Area. If Option 1 is adopted for any of these new habitat management areas, clam dredges would be prohibited. This would shift harvest of surfclams and ocean quahogs out of any newly designated habitat management areas and into other areas.

The existing Closed Area I North habitat closure (Alternative 1 Georges Bank) and the habitat closures in the Central Gulf of Maine are not known contain either species, however, the areas are not well surveyed for clams. Both species are thought to occur, but in an unknown quantity,

in the southwestern portions of the Western Gulf of Maine Closure Area. Beyond areas overlapping the southern part of the current Western Gulf of Maine Habitat Closure Area, i.e. the Small Stellwagen and Large Stellwagen HMAs, newly proposed habitat management areas in the Gulf of Maine are not known to contain either species, with the exception of the Machias area in the eastern Gulf of Maine, which contains quahogs. Because these quahogs are harvested with toothed dredges and not hydraulic dredges, effort would shift out of the Machias area and into nearby areas if that HMA were adopted under eastern Gulf of Maine Alternative 2 or 3 and managed with Option 1 (mobile bottom tending gear closure) or Option 2 (mobile bottom tending gear closure with hydraulic clam dredge exemption).

The Closed Area I South Habitat Closure contains both surfclams and quahogs, and the Closed Area II Habitat Closure contains surfclams, but these areas are closed as part of the Georges Bank PSP closure, and would remain closed to the harvest of clams even if reopened to mobile bottom-tending gears by this amendment. However, adoption of some of the other Georges Bank alternatives with management Option 1 could preclude clam dredging in recently opened portions of the PSP closure. Specifically, surfclams occur in the Georges Shoals 1 and 2 Mobile Bottom Tending Gear HMAs included in Georges Bank Alternative 5 and 7, in the western part of the EFH Expanded 1 and 2 HMAs (Alternatives 6A and 6B), and in much of the Northern Georges Mobile Bottom Tending Gear HMA (Alternative 8). The various gear modification areas would not affect use of clam dredges, and the Northern Edge HMA (Georges Bank Alternatives 3 and 4) is largely inside a PSP closure that would remain closed.

4.6.8.1.2 Spawning management alternatives

Clam dredges would be exempt from spawning closures and therefore patterns of clam harvest would not be affected by these alternatives. As described above, while there is overlap with surfclam and ocean quahog EFH and distributions and spawning management alternative areas, surfclam and quahog life stages are not susceptible to gears other than hydraulic and toothed clam dredges, and would not likely be impacted (either positively or negatively) by any prohibitions on use of other gear types. Therefore, the biological impacts of the proposed spawning management alternatives on surfclams and ocean quahogs are expected to be neutral when compared to Alternative 1/No Action.

4.6.8.1.3 Dedicated Habitat Research Area alternatives

Dedicated Habitat Research Areas would restrict all mobile bottom tending gear fishing, including clam dredging. The only DHRA that contains either surfclams or quahogs is the Georges Bank DHRA. However, clam dredges are currently prohibited from the Closed Area I South Habitat Closure Area, which could become the Georges Bank DHRA, so designation of this DHRA as a mobile bottom-tending gear closure would have neutral impacts relative to No Action (this area is also inside the Georges Bank PSP closure). Because the Eastern Maine and Stellwagen DHRAsdo not contain surfclams or quahogs, adoption of these alternatives (Alternative 2 and 3, respectively) would not have any effect on the clam resource.

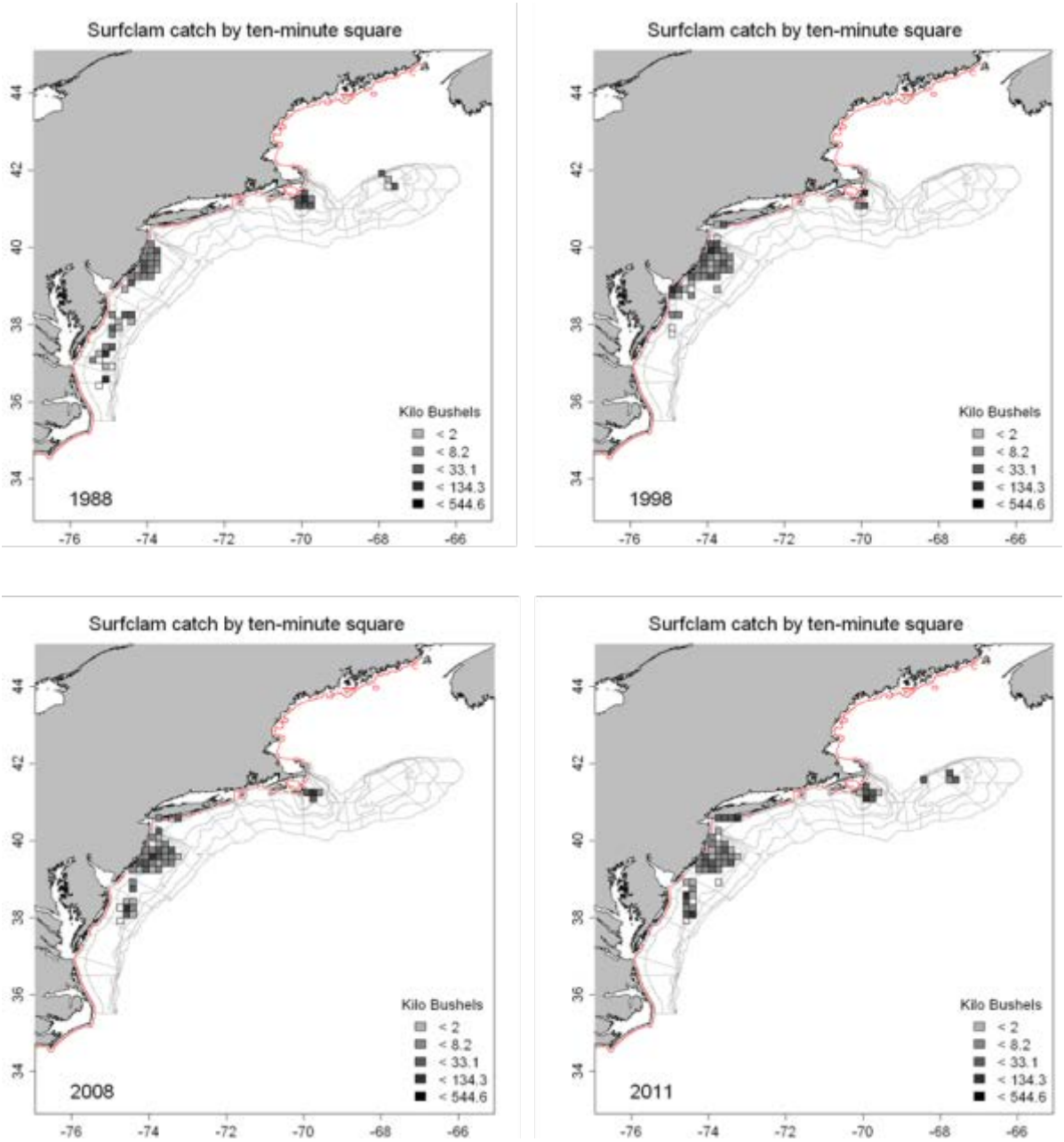
4.6.8.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes of Atlantic surfclams and ocean quahogs; therefore no biological impacts are expected on these species when compared to No Action.

4.6.8.2 ***Fishery impacts***

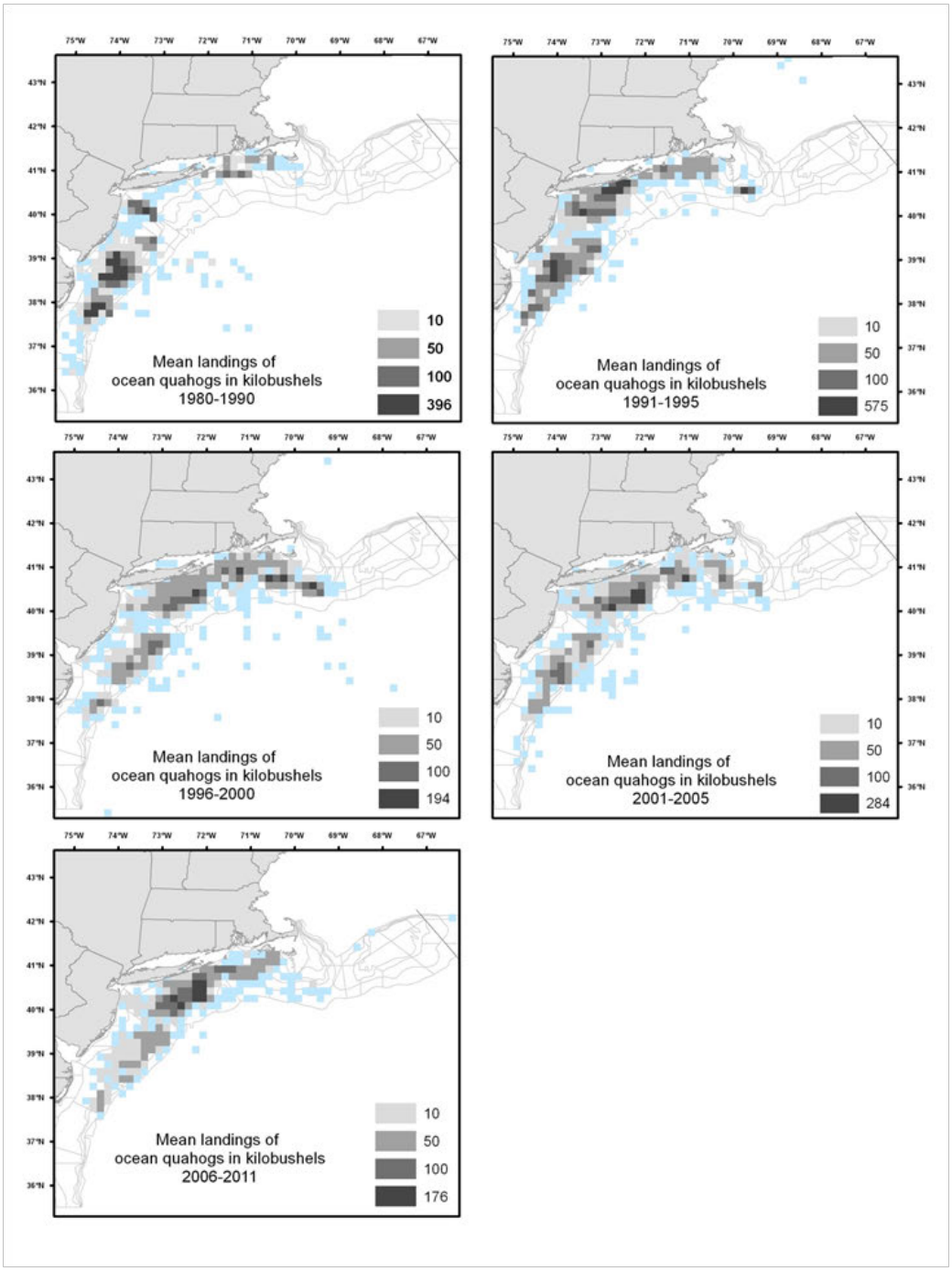
The commercial fishery for Atlantic surfclams and ocean quahogs in Federal waters is prosecuted with large vessels and hydraulic dredges, except in Eastern Maine where toothed dredges are used to harvest quahogs. The distribution of the surfclam fishery has changed over time, as shown in Map 140. The distribution of the ocean quahog fishery has changed over time, with the bulk of the fishery from 1980-1990 being prosecuted off the Delmarva region, to more Northern areas (Map 141).

Map 140 – Surfclam landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, by year (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Summary (NEFSC 2013)[25]



[25] Northeast Fisheries Science Center. 2013. 56th Northeast Regional Stock Assessment Workshop (56th SAW) Assessment Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-04; 42 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Map 141 – Ocean quahog landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, and time period. TMSQ in light blue had reported landings, but from fewer than three vessels (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Update (Chute at al. 2013)[26]



[26] Chute A, Hennen D, Russell R, Jacobson L. 2013. Stock Assessment Update for Ocean Quahogs (Arctica islandica) through 2011. NEFSC Ref Doc 13-17; 156 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

4.6.8.2.1 Habitat management alternatives

Because of the lack of overlap of the fishery within areas under consideration in the Gulf of Maine, impacts from other alternatives in these sub-regions are generally expected to be neutral. An exception to this is the Machias HMA, included in Eastern Gulf of Maine Alternatives 2 and 3. While fishing effort appears to be more concentrated south of the Machias area boundary, if an action alternative is selected in this sub-region and the area is managed as a mobile bottom tending gear closure (Option 1 or 2), there may be some displacement of mahogany quahog catches. As stated in the economic impacts section of this document (Eastern Gulf of Maine and the Scotian Shelf), "in Machias, the fishery with the most potential revenue displacement is the clam fishery. The annual revenue metric is high, despite the average revenue displaced per trip being on the order of $100. This can be explained by the fact that the Machias alternative abuts productive quahog clam beds to the south (see for instance the 44th SAW Assessment Report Appendix A8, Stock Assessment for Ocean Quahog in Maine Waters), and although there is evidence of clam dredge fishery activity, the majority of the clam dredge activity in the area, as represented by the logbook data, looks to occur outside of the Machias management area alternative."

It is important to note pending changes in potential clam harvest areas in the western and central Gulf of Maine that are independent of this action. At the end of 2014, potentially sooner, the Northern Temporary Paralytic Shellfish Poisoning Closure Area will reopen to allow harvest of clams. This area is shown in yellow on the map in the clam fishery portion of the affected environement section of Volume 1. It extends north/south from 43° N to 41° 39’ N and west to east from the state waters boundary to 69° W. As noted in the biological impacts section, the distribution and biomass of clams in this area is not well known, but there may be overlap between clam distributions and existing or new habitat management areas. If these management areas are closed to all mobile bottom-tending gears, these closures would the ability of the clam fishery to be prosecuted in the reopened PSP closure. Because the area is not currently accessible to the clam fishery, and has not been accessible since 2005 (see 70 FR 35047), this would not represent a displacement of current fishing effort, so it is very difficult to assess the magnitude of the impact.

The habitat management alternatives for the Georges Bank region include various combinations of fourteen areas: Closed Area II Habitat Closure Area (no action), Closed Area I North Habitat Closure Area (no action), Closed Area I South Habitat Closure Area (no action), Closed Area II Groundfish Closed Area (no action), Closed Area I Groundfish Closed Area (no action), Northern Edge HMA (Alternatives 3 and 4), Georges Shoal Gear Modification Area (Alt 4), Georges Shoal 1 Mobile Bottom Tending Gear HMA (Alternative 5), Northern Georges Gear Modification Area (Alternative 5), EFH Expanded 1 (Alternative 6A), EFH Expanded 2 (Alternative 6B), Georges Shoal 2 MBTG (Alternative 7), EFH South Mobile Bottom Tending Gear HMA(Alt 7), and Northern Georges Mobile Bottom Tending Gear HMA(Alternative 8). The habitat management alternatives for the Great South Channel and Southern New England region include various combinations of seven areas: Nantucket Lightship Habitat Closure Area (no action), Great South Channel East HMA (Alternative 3), Great South Channel HMA (Alternative 4), Nantucket Shoals HMA (Alternative 5), Nantucket Shoals West HMA (Alternative 6), Great South Channel Gear Modification Area (Alternative 6), and the Cox Ledge HMA (which is comprised of two sub-areas that would be implemented together, Alternatives 3-

6). Depending on the options selected, these areas could include a complete prohibition of bottom tending mobile gear use, including exclusion of hydraulic dredges (clam dredges), or hydraulic clam dredges could be exempted from the requirements in those areas. The "Gear Modification Areas" listed would not restrict dredge activity, only bottom trawls.

The commercial clam dredge fishery operates in the Mid-Atlantic Bight and also in Southern New England and on Nantucket Shoals. Recently, the fishery has expanded into the Georges Bank area now that portions of that area are accessible to the fishery (previously closed due to paralytic shellfish poisoning and now accessible when following a testing protocol). Thus far, this effort shift has not been significant relative to the distribution of landings in the fishery as a whole due to the increased costs associated with a longer steam time to the Georges Bank grounds and the costs to comply with PSP testing protocols. The greatest shift in effort is expected for surfclams. The catch rates for surfclams in the Mid-Atlantic Bight have decreased over time and are lower than the catch rates expected in the previously unfished areas of Georges Bank. Therefore, industry has indicated they will be shifting substantial amounts of effort to these newly opened areas, and away from areas with lower catch rates. It is unclear whether current effort for surfclams fishing on Nantucket Shoals would shift to Georges Bank, or continue in those areas. Fishing conditions on Georges Bank are more hazardous and the steam time is longer, therefore small clam dredge fishing vessels are not expected to shift their effort to Georges Bank. For ocean quahogs, there is not the disparity in catch rates between the near shore area catch rates versus Georges Bank. Industry has indicated that they will be fishing for ocean quahogs on Georges Bank; however, it is not clear if the incentive to shift effort to these areas is as strong for the quahog fishery.

The extent of overlap between the various HMAs and the clam fishery, relative to the total extent of the clam fishery, is small. However, for some HMAs, clam catch rates are higher than other areas fished. The distribution of the clam resource relative to various management areas is shown on Map 142 (Georges Bank) and Map 143 (Great South Channel/Southern New England). Note that this provides a somewhat incomplete view of clam distribution, as the clam survey does not cover some areas of Nantucket Shoals, including areas within the proposed Habitat Management Areas that are currently fished for clams. All zero tows are shown on the maps.

<u>Based on overlaps with the clam resource and the estimates of displaced revenue provided in the economic impacts sections (4.2.3.4 and 4.2.3.5), the year round closure of one or more of the habitat management areas in these two sub-regions has the potential for negative impacts on the clam fisheries.</u> Impacts will vary by alternative (Table 163), and will depend on whether fishermen using clam dredges would have chosen to dredge in these areas and would be excluded under the alternatives. A few factors make precise determinations of the degree of impacts to the clam fishery challenging. First, the extent of overall fishery expansion onto Georges Bank fishing grounds in the coming years is not precisely known, as discussed above. It can be assumed that recent fishing effort in the Georges Bank areas previously closed due to PSP occurred in locations expected to have relatively high catch rates, such that these past estimates of displaced revenue are a good indicator of future revenue displacement, but it is likely that past revenue displacements underestimate future fishing activity on Georges Bank. In the Great South Channel sub-region, there is a tradeoff between the existing Nantucket Lightship Habitat Closure Area (Alternative 1) and the new areas proposed in Alternatives 3-6. Because

the Nantucket Lightship Habitat Closure has been in effect since 2004, it overlaps completely with the time period reflected in the economic analysis (2005-2012), making it difficult to compare the potential for revenue displacement in the existing vs. new areas. Overall, the bulk of the clam fishery is prosecuted in the Mid-Atlantic, such that impacts could be high for vessels fishing exclusively or predominately in New England, but impacts for the fishery as a whole may be slight. Individual-level impacts on small businesses will be evaluated in the regulatory flexibility analysis prepared for the FEIS.

Across all fisheries, the short-term impacts of the habitat management alternatives for the Georges Bank and Great South Channel/Southern New England sub-regions are expected to be neutral to negative, when compared to No Action (see sections 4.2.3.4 and 4.2.3.5). However, some management areas implemented with Option 1 (no use of mobile bottom-tending gears) would displace mainly revenue from clam dredges, such that the short-term impact on the clam fishery would be greater than the overall net short-term impact. Because the expected long-term conservation outcomes associated with these areas are expected to have little effect on the clam resource, the long-term net impacts on the clam fishery would be less positive that the long-term net impacts projected across all fisheries combined, where conservation measures are expected to translate into increased productivity and thereby positive economic impacts.

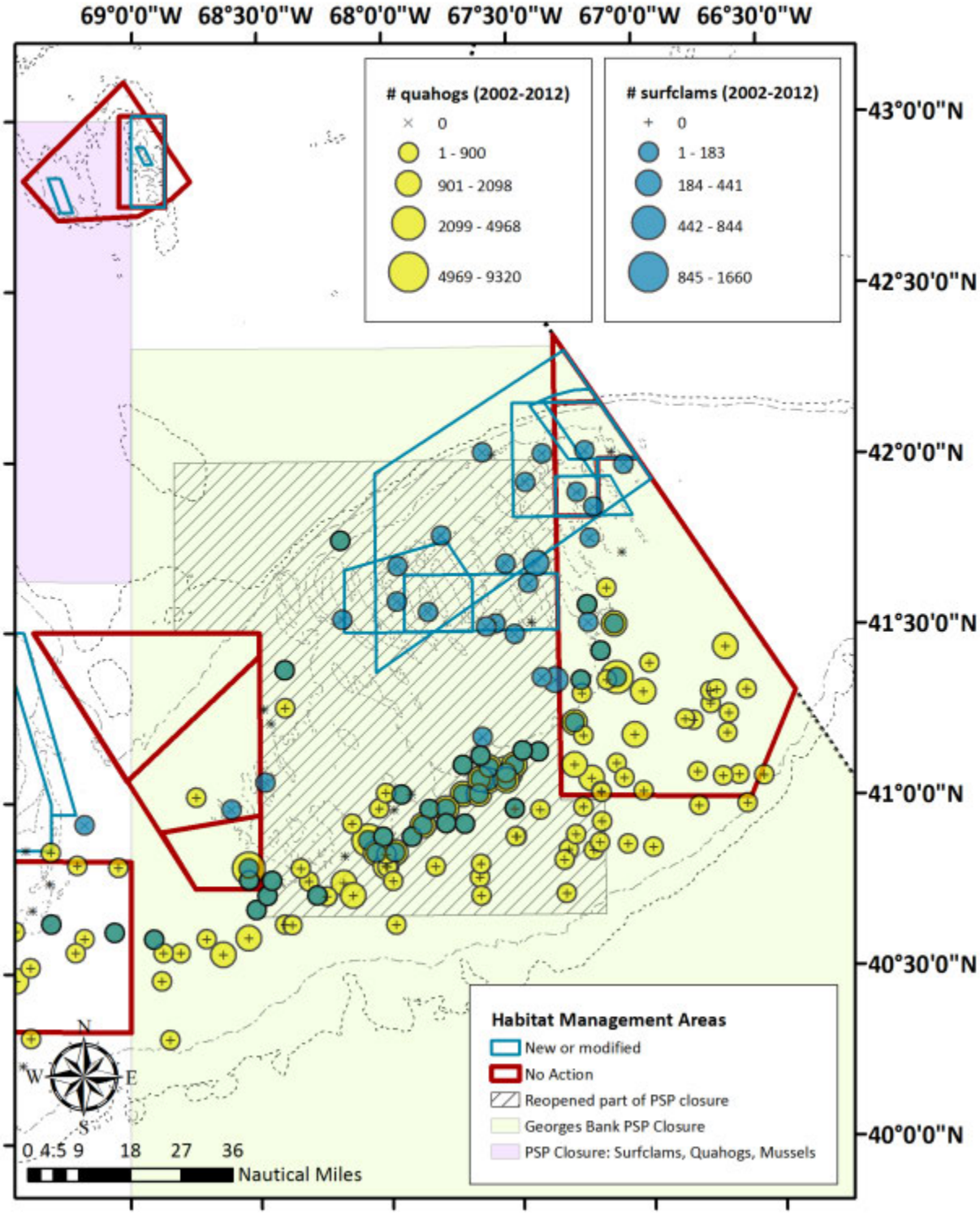
If hydraulic dredging is exempted from these restrictions (management Option 2), or if dredges are not restricted generally (management Options 3 or 4) impacts on the clam fishery would be neutral.

Table 163 – Current and future clam dredge effort in GSC/SNE and GB habitat areas

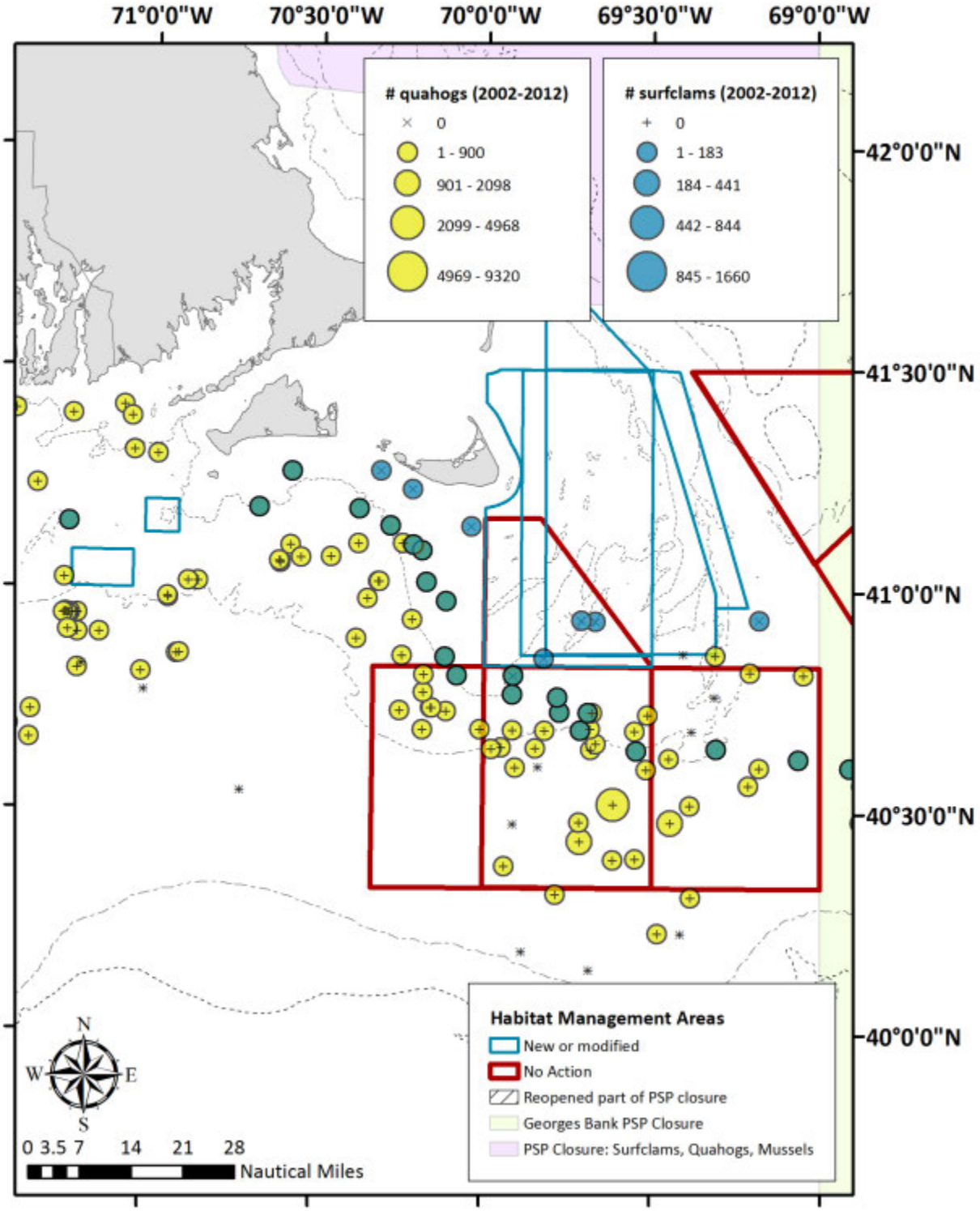
Area	Alternative	Species	Current clam effort	Potential for future clam effort	Impacts on clam fishery of removing current area or adding new area
CAII groundfish (current closure)	GB1	SC (north) and OQ (south)	None – PSP closure and clam dredges are not exempt from the fishery closure	None immediately – area would still be a PSP closure even if CAII is eliminated or made seasonal	Neutral
CAII EFH (current closure)	GB1	SC	None – PSP closure	None immediately – area would still be a PSP closure even if CAII EFH is eliminated	Neutral
CAI groundfish (current closure)	GB1	SC and OQ	None – PSP closure and clam dredges are not exempt from the fishery closure	None immediately – most of the area would still be a PSP closure even if CAI is eliminated or made seasonal, and there do not appear to be clams in the parts outside the PSP closure	Neutral
CAI N EFH (current closure)	GB1	Neither	None – PSP closure	None immediately – most of the area would still be a PSP closure even if CAI N EFH is eliminated, and there do not appear to be clams in the parts outside the PSP closure	Neutral
CAI S EFH (current closure)	GB1	SC and OQ	None – PSP closure	None immediately – area would still be a PSP closure even if CAI S EFH is eliminated or made seasonal	Neutral
Northern Edge (new area)	GB3 and GB4	SC	None – PSP closure	None – PSP closure	Neutral
Georges Shoal 1 MBTG (new area)	GB5	SC	Yes – area is in recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
EFH Expanded 1	GB6A	SC	Yes – southwestern corner in recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
EFH Expanded 2	GB6B	SC	Yes – southwestern corner in recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
Georges Shoal 2 MBTG	GB7	SC	Yes – area is in recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
EFH South MBTG	GB7	SC	None – PSP closure	None – PSP closure	Neutral

Area	Alternative	Species	Current clam effort	Potential for future clam effort	Impacts on clam fishery of removing current area or adding new area
Northern Georges GMA	GB8	SC	Roughly half the area overlaps recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
NL groundfish (current closure)	GSC-SNE1	SC and OQ	Yes – especially quahogs	Yes	Neutral – area already accessible to gear
NL EFH (current closure)	GSC-SNE1	SC and OQ	No – gear prohibited by EFH closure	Yes	Positive
Great South Channel East HMA (new area)	GSC-SNE3	SC	Yes	Yes	Negative
Great South Channel HMA (new area)	GSC-SNE4	SC	Yes	Yes	Negative
Nantucket Shoals HMA (new area)	GSC-SNE5	SC	Yes	Yes	Negative
Nantucket Shoals West HMA (new area)	GSC-SNE6	SC	Yes	Yes	Negative

Map 142 – Distribution of the surfclam and ocean quahog resource during summer clam dredge surveys from 2002-2012, relative to PSP closures, the PSP exemption area, and No Action and new/modified habitat management areas in the Georges Bank sub-region. Locations where both species were caught may appear green due to the overlap of blue and yellow shading.



Map 143 – Distribution of the surfclam and ocean quahog resource during summer clam dredge surveys from 2002-2012, relative to PSP closures, the PSP exemption area, and No Action and new/modified habitat management areas in the Great South Channel/Southern New England sub-region.



4.6.8.2.2 Spawning management alternatives

Many types of fishing gears are currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31. Under Georges Bank spawning Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have restrictions in place during 3 months of the year (February-April) as opposed to year round. Clam dredges are currently exempted from the Nantucket Lightship Closure Area, and although they are not allowed in Closed Area I or Closed Area II, there remains a PSP closure in these areas, so making Closed Area IIand Closed Area IIseasonal would not have an immediate impact on the clam fishery. These alternatives do not alter other aspects of the fishery, including the limits on catch and landings in this fishery. Therefore, the impacts of the spawning management alternatives on the surfclam and ocean quahog fisheries are expected to be neutral.

4.6.8.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would restrict mobile bottom-tending gears including clam dredges, and in the case of Alternative 3 (Stellwagen DHRA), additional gear types as well. The only DHRA that is in close proximity to the commercial fisheries for Atlantic surfclam and ocean quahog is the Georges Bank DHRA, Alternative 4. This area is currently a habitat closure area and is thus closed to all mobile bottom-tending gears, including clam dredges. Recently, the clam fishery has expanded onto Georges Bank given an exemption area from a previous PSP closure. However, the Georges Bank DHRA boundaries remain within the PSP closure, and the area's PSP closure status is unlikely to change in the near term. This means that in the short term, the DHRA would have neutral impacts on the clam fishery. Because of the lack of clam resource overlap within other areas under consideration in Alternatives 2 and 3, impacts from these alternatives are expected to be neutral as well. Over the longer term, if the current PSP exemption area on Georges Bank is expanded, it might be desirable to harvest clams from the Georges Bank DHRA. If the exemption area is expanded, Alternative 4 would have a negative impact on the clam fishery. The magnitude of this negative impact is probably not substantial given the overall distribution of clams on Georges Bank, but it would depend on the location of any other closures to clam dredges and the resulting amount of clam resource available for harvest elsewhere.

4.6.8.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on Atlantic surfclam and ocean quahog fisheries. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.6.9 Atlantic bluefish

4.6.9.1 ***Biological impacts***

Bluefish (*Pomatomus saltatrix*) are found along the entire east coast of the United States from Maine through Florida. Bluefish travel in schools of like-sized individuals and undertake seasonal migrations, moving into the Mid-Atlantic Bight during spring and south or farther offshore during fall.

North of Cape Hatteras, North Carolina, EFH for bluefish eggs and larvae is pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), most commonly in the upper 49 ft (15 m) of the water column, from Montauk Point, New York south to Cape Hatteras, in the highest 90% of the area where bluefish larvae were collected during the MARMAP surveys. For bluefish juveniles, EFH is pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the NEFSC trawl survey. EFH for adult bluefish is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey. All bluefish life stages are pelagic and are therefore not highly susceptible to impacts from bottom tending fishing gears.

4.6.9.1.1 Habitat management alternatives

As described above, there is little to no overlap between bluefish distribution and EFH and the proposed habitat management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic and not susceptible to mobile bottom tending gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, the commercial and recreational fisheries for bluefish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on bluefish are expected to be neutral when compared to Alternative 1/No Action.

4.6.9.1.2 Spawning management alternatives

As described above, there is little to no overlap between bluefish distribution and EFH and the proposed spawning management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic not susceptible to mobile bottom tending gears or fixed gears used to catch groundfish and prohibited from spawning areas, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, the commercial and recreational fisheries for bluefish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed spawning management alternatives on bluefish are expected to be neutral when compared to Alternative 1/No Action.

4.6.9.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). As described above, there is little to no overlap between bluefish distribution and EFH and the proposed DHRA management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic not susceptible to bottom tending gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives on bluefish are expected to be neutral when compared to Alternative 1/No Action.

4.6.9.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological process of bluefish; therefore no biological impacts are expected on bluefish when compared to No Action.

4.6.9.2 ***Fishery impacts***

About 98% of the commercial fishery for bluefish is prosecuted with gillnets (sink or anchored) and hook and line. About 2% of the fishery landings are in "other" gears such as mobile bottom-tending gear. However, mobile bottom-tending gear is not an efficient gear type for catching bluefish, which are highly mobile, pelagic, schooling fish. Bluefish are not typically targeted with trawls or other mobile bottom-tending gear and are considered incidental catch in those gear types.

Table 164 – Commercial gear types associated with bluefish harvest by federally permitted vessels in 2011.

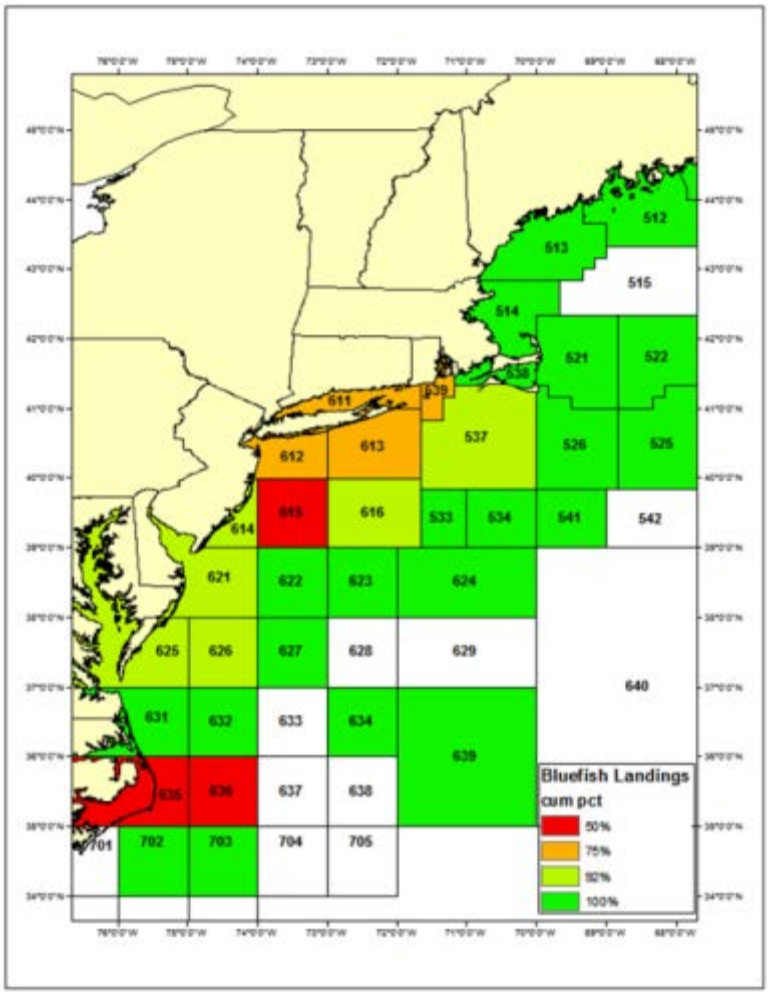
Commercial Gear Type	Trips	Landings (lb)	Pct Total
Gillnet	818	1,494,252	93.4%
Hook and line	545	72,404	4.5%
Other	20	33,319	2.1%
Total	1,383	1,599,975	100%

Source: VTR Data as of Nov 20, 2012.

4.6.9.2.1 Habitat management alternatives

The Northeast region is divided into 46 statistical areas for Federal fisheries management. According to VTR data, bluefish were commercially harvested in 40 statistical areas in 2011 (Map 140). Seven statistical areas collectively accounted for 75.1% of VTR-reported landings in 2011, with individual areas contributing 7% to 14% of the total. These areas also represented 69.6% of the trips that landed bluefish. Because the core of the commercial fishery does not coincide with the areas under consideration, it is unlikely to be impacted by any proposed measures that restrict or prohibit the use of mobile bottom-tending gear under the habitat management alternatives proposed.

Map 144 – Bluefish catch by NMFS Statistical Areas. Shading reflects the cumulative percentage of landings with red and orange being the primary areas where the commercial landings are taken.



4.6.9.2.2 Spawning management alternatives

The core of the commercial fishery (about 92% of the landings) is prosecuted in areas south of Nantucket Island. The only area of overlap is the Nantucket Lightship Closed Area, which was intended to protect groundfish spawning. The use of sink or anchored gillnets is currently prohibited in this area year round. Under Georges Bank/Southern New England spawning Alternatives 2 and 3, the Nantucket Lightship Closure Area would be eliminated. Therefore, there is the potential for slightly positive impacts on the bluefish fishery, if fishermen choose to expand the use of sink or anchor gillnets used to catch bluefish into this area. Recreational vessels are exempted under Alternatives 2A and 3A, but limited recreational fishing effort is expected to flow into Closed Areas I and II even if they did reopen to recreational fishing (see economic impacts analysis section). Therefore, impacts on the recreational fishery are not expected.

4.6.9.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Sink or anchored gillnets would be prohibited in the Stellwagen DHRA. However, because the core of the bluefish commercial fishery (about 92% of the landings) is prosecuted in areas south of Nantucket Island, it is unlikely the fishery will be impacted by these proposed measures.

4.6.9.2.4 Framework and monitoring alternatives

These alternatives are administrative and are unlikely to have impacts on the bluefish fishery because of minimal overlap with the directed fishery.

4.6.10 Atlantic mackerel, squids, and butterfish

4.6.10.1 ***Biological impacts***

Atlantic mackerel (*Scomber scombrus*) are found on both sides of the North Atlantic Ocean, including the Baltic Sea. In the western Atlantic, they are found from Labrador to North Carolina. Atlantic mackerel are common in cold and temperate waters over the continental shelf. They swim in schools near the surface, and travel to and from spawning and summering grounds.

Butterfish (*Peprilus triacanthus*) range from Florida to Newfoundland, but are primarily found from Cape Hatteras, North Carolina, to the Gulf of Maine. Butterfish are sensitive to and migrate in response to seasonal changes in water temperature. During summer, butterfish move northward and inshore to feed and spawn. During winter, butterfish move southward and offshore to avoid cold waters. Butterfish are semi-pelagic, and form loose schools that feed upon small squid, and crustaceans.

The northern shortfin squid (*Illex illecebrosus,* referred to in this section as Illex) is a highly migratory, transboundary species that is distributed in the Northwest Atlantic Ocean from the Florida Straits to Newfoundland. The southern and U.S. stock component extends from the Gulf of Maine to Florida.

Longfin squid (*Doryteuthis (Amerigo) pealei*) is found from Newfoundland to the Gulf of Venezuela. In the northwest Atlantic Ocean, longfin squid are most abundant between Georges Bank and Cape Hatteras, North Carolina. Squid eggs are attached to rocks and small boulders or aquatic vegetation on sandy or muddy bottoms. Larvae are found in surface waters. Juveniles also live in the upper water column in water 165 to 1,650 feet deep. Adults live over mud or sand/mud substrates of the continental shelf and upper continental slope in waters up to 1,300 feet deep.

EFH for life stages for Atlantic mackerel, longfin squid, Illex, and butterfish are pelagic (water column itself), and the species have temperature and prey preferences/needs that drive the suitability of any particular area/depth, thus fishing activity has minimal impacts on their habitats. Longfin squid also use hard bottom, submerged vegetation, other natural or artificial structure, and sand or mud to attach/anchor eggs, but there are no known preferences for

different types of substrates or indications that fishing activity may negatively affect longfin squid egg EFH.

4.6.10.1.1 Habitat management alternatives

As described above, there is overlap between Atlantic mackerel, longfin squid, Illex (shortfin squid), and butterfish distribution and EFH and the proposed habitat management alternatives. However, because EFH for these species are not susceptible to mobile bottom-tending gears, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. If these gear restrictions go into place, it is expected that fishing effort with mobile bottom-tending gear would likely shift to other unrestricted areas. In addition, the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on these species are expected to be neutral when compared to Alternative 1/No Action.

4.6.10.1.2 Spawning management alternatives

Because EFH for Atlantic mackerel, longfin squid, Illex, and butterfish life stages are not susceptible to the gears regulated in spawning areas, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types under the spawning management alternatives. In addition, the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed spawning management alternatives on these species are expected to be neutral when compared to Alternative 1/No Action.

4.6.10.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Because EFH for Atlantic mackerel, longfin squid, Illex, and butterfish life stages are not susceptible to mobile bottom-tending gears, or other gear types, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. The commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measure proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives on these species are expected to be neutral, when compared to Alternative 1/No Action.

4.6.10.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes of Atlantic mackerel, longfin squid, Illex, and butterfish; therefore no biological impacts are expected on these species from these alternatives.

4.6.10.2 *Fishery impacts*

Mackerel are primarily caught by mid-water trawls, but longfin squid, Illex, and butterfish are primarily caught with bottom trawls (mobile bottom-tending gear). A small recreational fishery exists for Atlantic mackerel and butterfish. While there is a recreational fishery for longfin squid, information on the recreational landings of invertebrates is not collected.

4.6.10.2.1 Habitat management alternatives

The core of the fishery for Atlantic mackerel is prosecuted in four statistical areas in the Mid-Atlantic Bight (Table 165).

Table 165 – Mackerel landings (mt) in statistical areas with at least 1,000 mt of mackerel landed in at least one recent year.

Year	612	616	622	621	Total fishery harvest (commercial and recreational) all statistical areas
2010	57,602	383	1,260	1,131	10,635
2011	4	100	18	59	1,463
2012	2,393	1,527	3	-	6,085

Source: Unpublished NMFS vessel trip reports

The core of the commercial fishery for butterfish and longfin squid is in the Mid-Atlantic region; however, significant catch and landings occur in the Southern New England and Georges Bank area in statistical areas 522, 525, and 562 for butterfish (Table 166), and 525 and 562 for longfin squid (Table 167).

Table 166 – Butterfish landings (mt) in statistical areas with substantial recent butterfish catch.

Year	537	611	539	616	613	525	522	562	612	Total commercial fishery harvest, all statistical areas
2010	128	54	65	37	29	26	20	68	12	576
2011	105	81	62	72	31	31	10	9	9	664
2012	103	58	64	37	44	31	19	13	23	627

Source: Unpublished NMFS vessel trip reports

Table 167 – Longfin squid landings (mt) in statistical areas with at least 250 mt of longfin squid landed in at least one recent year.

Year	616	537	622	612	613	539	538	626	525	623	611	632	562	526	Total commercial fishery harvest, all statistical areas
2010	2,505	604	1,043	475	474	333	199	173	348	52	226	275	224	51	6,750
2011	1,321	1,252	1,608	1,630	642	327	114	417	459	235	313	137	110	324	9,556
2012	1,419	2,501	1,244	1,765	1,699	407	722	385	114	433	174	130	95	12	12,750

Source: Unpublished NMFS vessel trip reports

During summer through fall, a bottom trawl fishery for Illex occurs on the U.S. shelf, primarily in the Mid-Atlantic Bight. Annual landings by state are given in Table 168; in 2012 Illex were landed in mainly in New Jersey (6,054 mt) and Rhode Island (5,366 mt), and to a lesser extent in Virginia (288 mt).

Table 168 – Illex landings (mt)

Year	Total commercial fishery harvest
2010	15,825
2011	18,797
2012	11,709

Source: unpublished NEFSC dealer reports

Because the core of the commercial fisheries for Atlantic mackerel and Illex do not coincide with the habitat management areas under consideration, these fisheries are unlikely to be significantly impacted by proposed measures that restrict or prohibit the use of mobile bottom-tending gear under the habitat management alternatives proposed. There are areas of overlap in the butterfish and longfin squid fisheries on Georges Bank and in Southern New England area. Any prohibitions on mobile bottom-tending gear may affect landings of these species in these areas, resulting in slight negative impacts. Therefore, the impacts on the directed butterfish and longfin squid fisheries are expected to be neutral to slightly negative. The impacts are expected to be slight, because these areas only represent a small portion of the overall area over which these fisheries are prosecuted. The impacts on the Atlantic mackerel and Illex fisheries are expected to be neutral.

4.6.10.2.2 Spawning management alternatives

Many types of fishing gears are currently prohibited in the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II year round; most vessels are exempt from the Georges Bank Seasonal Closure from May 1 to May 31. Under Alternatives 2 and 3, the Nantucket Lightship Closed Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Areas I and II would only have these gear prohibitions in place during 2.5 months of the year (February-April 15) as opposed to year round. The core of the Atlantic mackerel and Illex fisheries are not prosecuted in these areas. There is the potential for neutral to slightly positive

impacts on the butterfish and longfin squid fisheries. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of bottom trawls into these areas during the open times of the year. These impacts are considered slight because these areas only represent a small portion of the overall area over which these fisheries are prosecuted. These alternatives do not alter other aspects of these fisheries, including the limits on catch and landings. Therefore, expected impacts range from neutral to slightly positive, resulting in increased flexibility and area in which butterfish and longfin squid fishermen can choose to use bottom otter trawling gear.

Neutral to slightly positive impacts on the recreational fisheries are expected. Party and charter vessels may obtain a letter of authorization to fish in the Nantucket Lightship Closed Area, and this area would be removed under Alternatives 2 and 3. Recreational vessels are currently prohibited from fishing in Closed Area I and II (unless they are using pelagic hook and line gear) such that making these areas seasonal under Alternative 2 or 3 would expand party/charter access. If Alternative 2A is selected, Closed Areas I and II would be closed to commercial vessels capable of catching groundfish only, which would allow recreational fishing in the areas year round. Because there is currently limited charter/party recreational fishing activity surrounding Closed Areas I and II, it is assumed that there is limited interest in party/charter fishing within these closures, such that any positive benefits associated with increased access under Alternatives 2 and 3 would be slight.

4.6.10.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Because the core of the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish do not overlap to a large extent with the DHRAs proposed, these fisheries are unlikely to be significantly impacted by proposed measures. The butterfish and longfin squid fishery overlap with the Georges Bank DHRA. However, the extent of overlap of these fisheries with the Georges Bank DHRA, relative to the total extent of the fishery, is small. The commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the impacts of the proposed dedicated habitat research area alternatives on the longfin squid and butterfish fisheries are expected to be neutral to slightly negative, when compared to Alternative 1/No Action. The impacts on the Atlantic mackerel and Illex fisheries are expected to be neutral.

4.6.10.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on the Atlantic mackerel, longfin squid, Illex, and butterfish fisheries. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.6.11 Spiny dogfish

4.6.11.1 ***Biological impacts***

Spiny dogfish (*Squalus acanthias*) in the Northwest Atlantic are found from Labrador to Florida and are most abundant between Nova Scotia and Cape Hatteras. Spiny dogfish live inshore and offshore, usually near the bottom but also in mid and upper water column and at the surface. They are also found in enclosed bays and estuaries. Spiny dogfish swim in large schools and migrate seasonally, with changes in water temperature. Much of the population travels north in the spring and summer and south in the fall and winter. Some spiny dogfish remain in northern waters throughout the year and move offshore during the winter.

North of Cape Hatteras, EFH is:

Juveniles (male and female, <36 cm): Pelagic and epibenthic habitats, primarily in deep water on the outer continental shelf and slope between Cape Hatteras and Georges Bank, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Recently-born dogfish (neonates, <24 cm in length) have been collected in bottom trawl survey tows in nearshore waters, but less often and/or in fewer numbers than on the outer shelf.

Female Sub-Adults (36-79 cm): Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, sub-adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 8 to 14°C and 50-160 meters. The females are more widely distributed over the continental shelf than the males.

Male Sub-Adults (36-59 cm): Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, sub-adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 8 to 14°C and 50-160 meters. The males are not as widely distributed over the continental shelf as the females and are generally found in deeper water.

Female Adults: Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 7 to 15°C and 20-160 meters. Young are born mostly on the offshore wintering grounds from November to January, but new borns (neonates or "pups") are sometimes taken in the Gulf of Maine or southern New England in early summer.

Male Adults: Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 7 to 15°C and 20-160 meters.

4.6.11.1.1 Habitat management alternatives

As described above, there is overlap between spiny dogfish distribution and EFH and the proposed habitat management alternatives. Because EFH for all the spiny dogfish life stages are

not susceptible to mobile bottom-tending gears, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. If these gear restrictions go into place, it is expected that fishing effort with mobile bottom-tending gear would likely shift to other unrestricted areas. It is expected that spiny dogfish will continue to be incidentally caught in bottom tending gears (such as bottom trawls). However, the commercial fishery for spiny dogfish is managed using annual catch limits, which limit removals of spiny dogfish (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on spiny dogfish are expected to be neutral when compared to Alternative 1/No Action.

4.6.11.1.2 Spawning management alternatives

The use of sink or anchored gillnets is currently prohibited in the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 for common pool groundfish vessels. Under Georges Bank spawning Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Areas I and II would only have sink or anchored gillnet gear prohibitions in place during 2.5 months of the year (February-April 15) as opposed to year round.

Because EFH for all the spiny dogfish life stages are not susceptible to mobile bottom-tending gears, their EFH would not likely be impacted (either positively or negatively) by any expansion of gear types used in these areas. There is the potential that spiny dogfish fishermen will choose to expand the use of sink or anchored gillnets into these areas during the open times of the year. However, the commercial fishery for spiny dogfish is managed using annual catch limits, which limit removals of spiny dogfish (landings and discards) to levels that are sustainable. Therefore, biological impacts are expected to be neutral on spiny dogfish as a result of the proposed spawning management measures.

4.6.11.1.3 Dedicated Habitat Research Area alternatives

Dedicated Habitat Research Areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Spiny dogfish life stages are not generally targeted mobile bottom-tending gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, these measures are not expected to alter the sustainability of spiny dogfish. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives on spiny dogfish are expected to be neutral when compared to Alternative 1/No Action.

4.6.11.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes associated with spiny dogfish; therefore no biological impacts are expected on spiny dogfish when compared to Alternative 1/No Action.

4.6.11.2 *Fishery impacts*

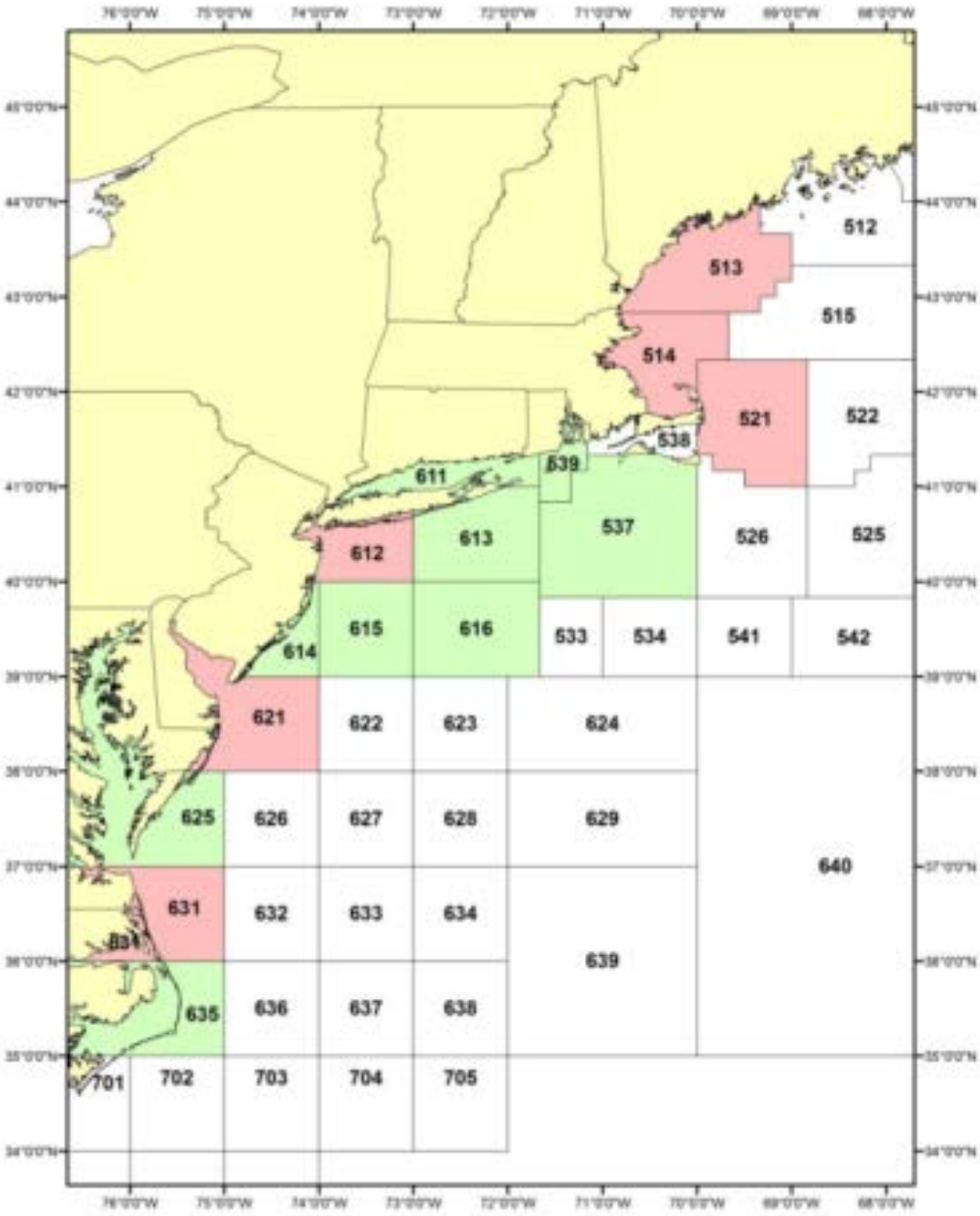
Sink and anchored gear nets produced about 71% of the landings for spiny dogfish from 2008-2012 (Table 169). Bottom trawls followed by hook and line were responsible for the bulk of the landings that remained. Spiny dogfish are not typically targeted with trawls or other gears and are considered incidental catch in those gear types. No significant recreational fishery exists for spiny dogfish, although some retention of recreationally caught spiny dogfish does occur.

Table 169 – Commercial gear types associated with spiny dogfish harvest for calendar years 2008-2011. Note that vessels with state issued permits only are not required to complete VTRs so total VTR landings are less than total dealer-reported landings.

Year	Gillnet	Bottom trawl	Hook and line	Other*	Total
2008	2,619,441	531,572	336,444	24,114	3,511,571
2009	6,144,699	1,904,194	766,083	22,338	8,837,314
2010	5,892,778	1,533,946	1,225,233	10,004	8,661,961
2011	10,757,661	2,381,889	1,542,412	53,513	14,735,475
2012	12,367,393	1,791,693	3,067,743	29,962	17,256,791
Average % 2008-2012	71.4%	16.2%	12.1%	0.3%	100.0%

** Combined landings which may include unknown, mid-water trawl, beam trawl, seine, pots and traps, and dredge.*

Map 145 – 2010 spiny dogfish catch by statistical area. Shaded areas indicate where spiny dogfish harvest occurs. Red areas comprise 5% or more of harvest and green areas 1% to 5% of harvest.



4.6.11.2.1 Habitat management alternatives

Vessel trip report data indicate that six statistical areas collectively accounted for 73.04 % of spiny dogfish landings in 2010, with each contributing greater than 5.0 % of the total (Map 145). These areas also represented 73.5% of the trips that landed spiny dogfish.

Statistical areas 513, 514, and 521 do coincide with areas proposed for habitat management alternatives. However, the directed fishery for spiny dogfish is prosecuted primarily with sink or anchored gillnets. Shifts in spatial management areas may have some effect on the locations in which gillnets are deployed to target spiny dogfish, and some individuals may experience lower variable costs of fishing due to closer access to fishing grounds. However, economic conditions in the dogfish fishery in particular relatively low demand for spiny dogfish product are currently driving low landings relative to catch limits, and access to the resource is not limiting (J. Armstrong, personal communication). Therefore, the directed fishery is unlikely to be impacted by any proposed habitat management measures that restrict or prohibit the use of mobile bottom-tending gear. It is expected that spiny dogfish will continue to be incidentally landed in smaller amounts in other gear types such as trawls or hook and line while targeting other species, wherever that fishing effort may occur. Therefore, the habitat management alternatives are expected to have neutral impacts on the fishery when compared to Alternative 1/No Action.

4.6.11.2.2 Spawning management alternatives

The use of sink or anchored gillnets is currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 for common pool vessels only. Under Alternatives 2 and 3, the Nantucket Lightship Closed Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Areas I and II would only have sink or anchored gillnets gear prohibition in place during 2.5 months of the year (February-April 15) as opposed to year round. Therefore, there is the potential for neutral to slightly positive impacts on the spiny dogfish fishery. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of sink or anchor gillnets into these areas during the open times of the year. These alternatives do not alter other aspects of the fishery, including the limits on catch and landings in this fishery. Therefore, the slightly positive impacts are a result of increased flexibility and less constraint on where and when the spiny dogfish fishermen choose to use sink or anchored gillnets to target spiny dogfish. Impacts on the recreational fishery are expected to be negligible because the recreational component of the spiny dogfish fishery is very small, less than 2% of total catch.

4.6.11.2.3 Dedicated Habitat Research Area alternatives

Dedicated Habitat Research Areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Sink or anchored gillnets would be prohibited in the Stellwagen DHRA. Because the core of the spiny dogfish commercial fishery overlaps with these areas, there is the potential for slightly negative impacts if use of this gear continues to be prohibited in the Stellwagen DHRA (sink/anchored gillnets are currently prohibited in the Western Gulf of Maine Closure Area, of which the Stellwagen DHRA is a subset). However, given that the research areas proposed are relatively small, it is likely that spiny dogfish fishermen would shift their effort to other surrounding areas that are not under such gear restrictions. On that basis, the impacts on the spiny dogfish fishery are expected to range from neutral to slightly negative, depending which research areas are implemented and how fishermen respond to the prohibition of sink or anchored gillnets use in those areas. Bottom otter trawl catches of spiny dogfish would be restricted in all DHRAs, but this is expected to have a smaller impact on the fishery as this gear contributes a small amount of overall landings.

4.6.11.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on the spiny dogfish fishery. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.6.12 Summer flounder, scup, and black sea bass

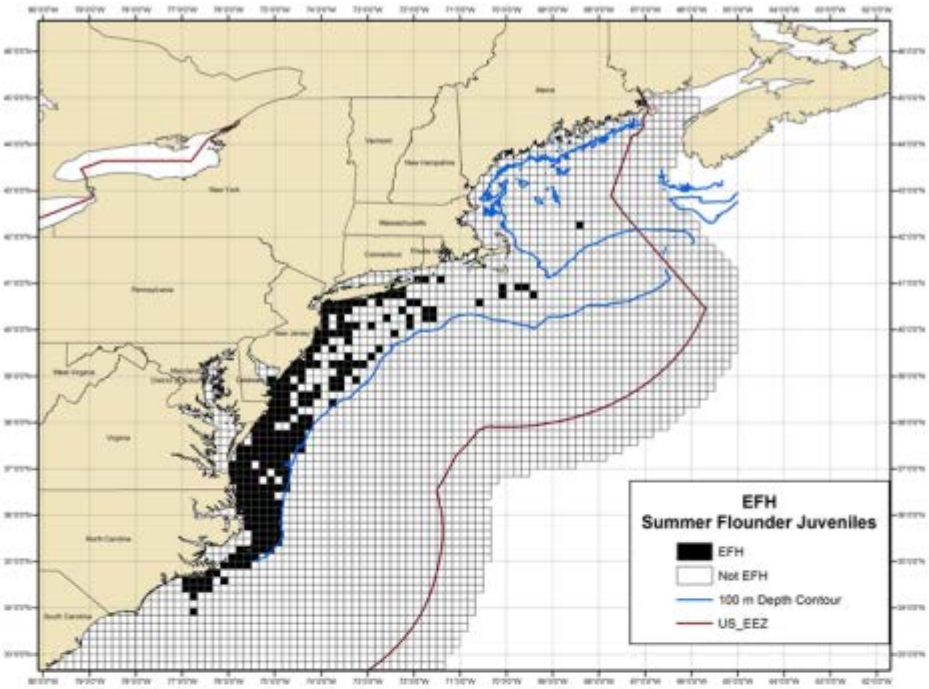
4.6.12.1 *Biological impacts*

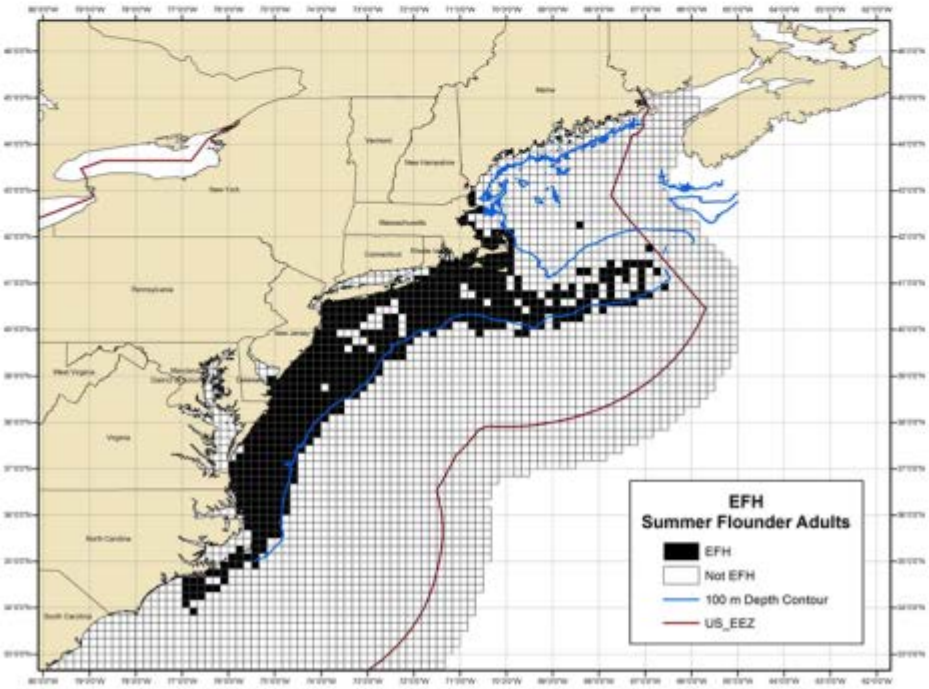
Summer flounder are found in the Atlantic Ocean from Nova Scotia to the east coast of Florida. In U.S. waters, summer flounder are most common in the Mid-Atlantic region from Cape Cod, Massachusetts, to Cape Fear, North Carolina. Larval summer flounder live in estuaries and coastal lagoons. Juveniles bury in the sediment in marsh creeks, seagrass beds, mud flats, and open bays, notably Pamlico Sound and Chesapeake Bay. Adult summer flounder migrate inshore and offshore seasonally with changes in water temperature. In the winter and early spring, they are found offshore along the outer edge of the continental shelf. In late spring and early summer, they move inshore into shallow coastal waters and estuaries. Summer flounder migrate back offshore in the fall. Both summer flounder juvenile and adult EFH are considered vulnerable to mobile bottom-tending gears. The distribution of EFH for those life stages is shown in Map 146.

Scup are found in the Northwest Atlantic Ocean, primarily between Cape Cod and Cape Hatteras, North Carolina. Their eggs and larvae are found in the water column in coastal waters during warmer months. As larvae mature, they settle to the seafloor and develop into juveniles. Juveniles live in a variety of habitats including rocky ledges, artificial reefs, mussel beds, sand, silty-sand, shell, and mud bottoms, and eelgrass. During the summer and early fall, juveniles and adults are common in large estuaries, open sandy bottoms, and structured habitats such as mussel beds, reefs, or rock rubble. Scup migrate north and inshore to spawn in the spring, then migrate south and offshore in autumn as the water cools, arriving by December in offshore areas where they spend the winter. Both scup juveniles and adult EFH are considered vulnerable to mobile bottom-tending gears. The distribution of EFH for those life stages is shown in Map 147.

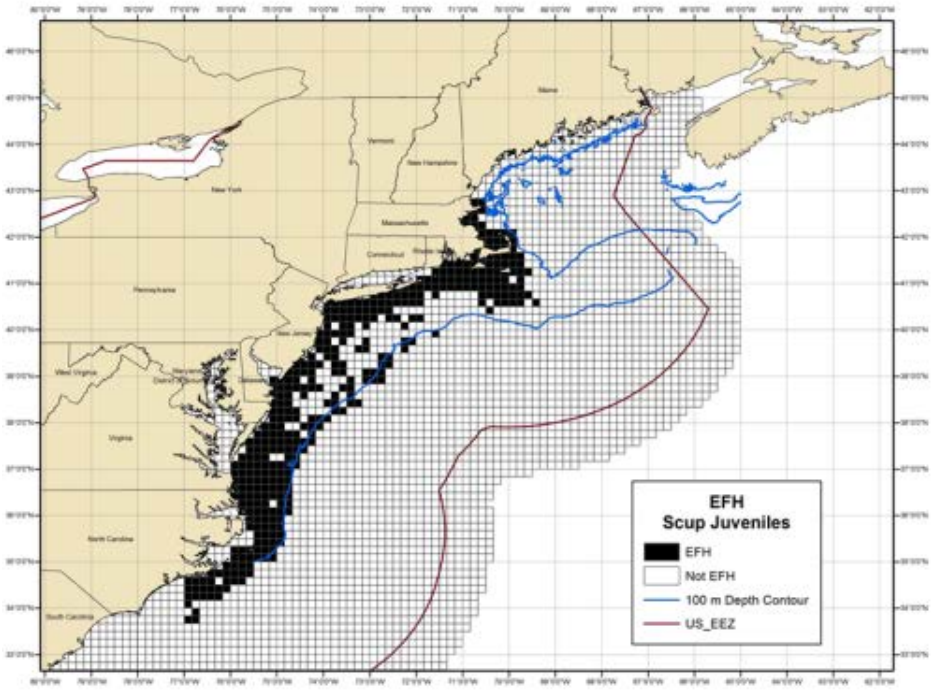
Black sea bass are found along the U.S. East Coast from Cape Cod to the Gulf of Mexico. They prefer structured habitats such as reefs, wrecks, or oyster beds in temperate and subtropical waters. In the Mid-Atlantic (north of Cape Hatteras, North Carolina), black sea bass migrate seasonally as water temperature changes. They generally migrate to inshore coastal areas and bays in the spring and offshore in the fall. Both black sea bass juveniles and adult EFH are considered vulnerable to mobile bottom-tending gears. The distribution of EFH for those life stages is shown in Map 148.

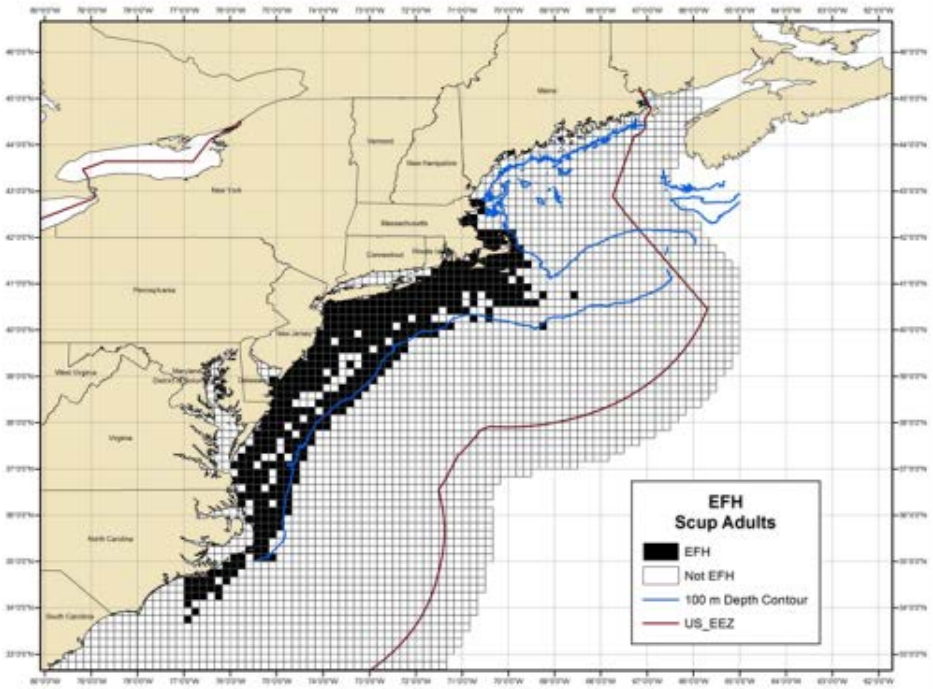
Map 146 – Distribution of EFH for juvenile and adult summer flounder.



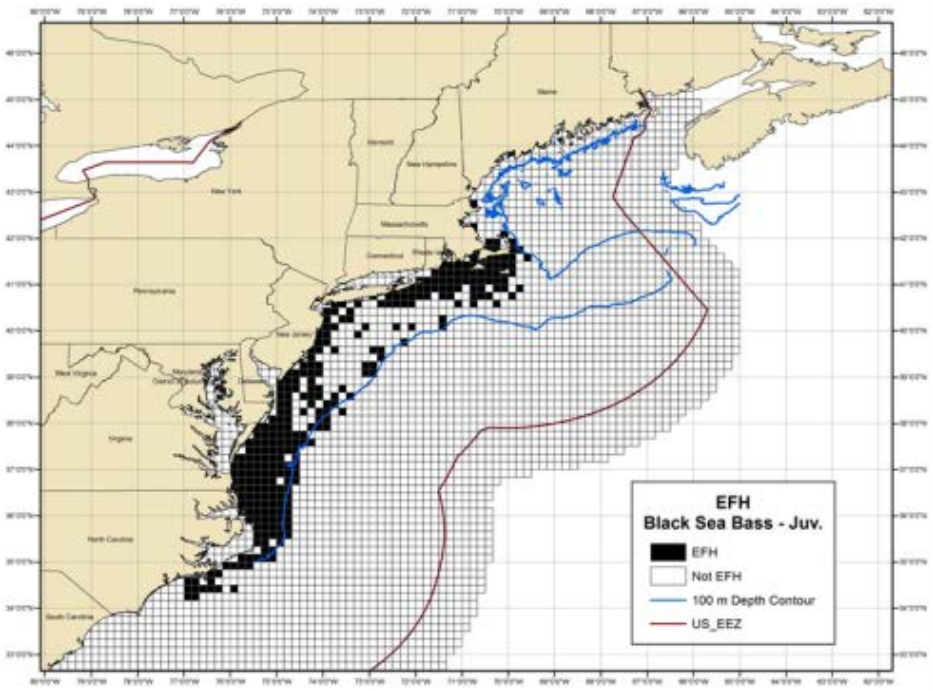


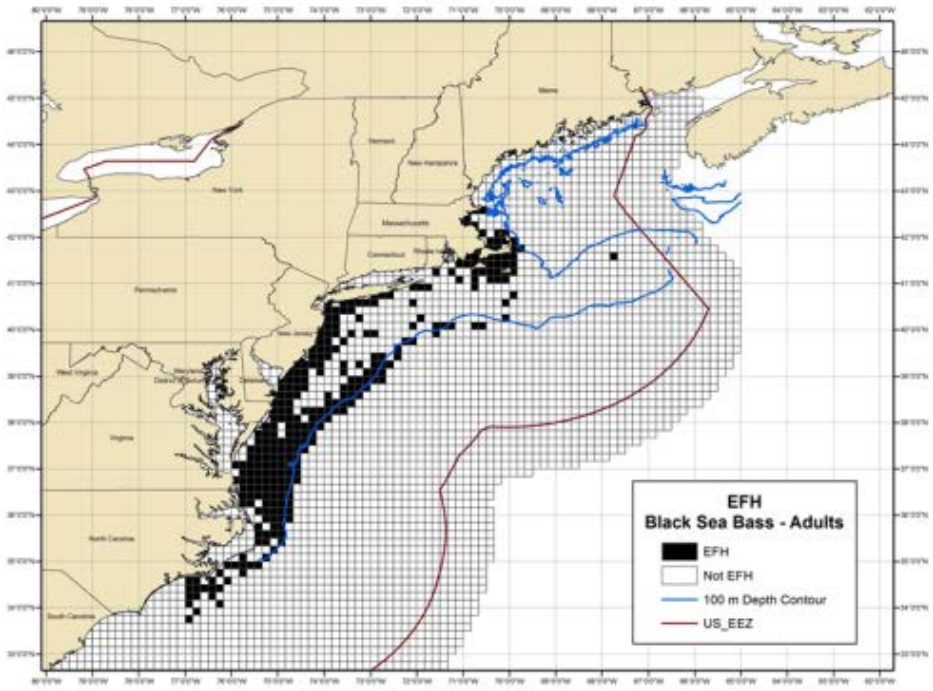
Map 147 – Distribution of EFH for juvenile and adult scup.





Map 148 – Distribution of EFH for juvenile and adult black sea bass.





4.6.12.1.1 Habitat management alternatives

As shown above, the summer flounder juvenile and adult distributions and EFH overlap with some of the proposed habitat management alternatives. In particular, the juvenile and adult summer flounder EFH extends through Southern New England and the Great South Channel, with adult EFH extending out to Georges Bank. Because juvenile and adult summer flounder

EFH is susceptible to mobile bottom-tending gears, their EFH would likely be positively impacted by prohibitions on use of these gear types. If these gear restrictions go into place, it is expected that fishing effort with mobile bottom-tending gear would likely shift to other unrestricted areas, which would offset possible benefits of reduced impact to EFH. Because summer flounder juvenile and adult distribution and EFH has minimal to no overlap with the Gulf of Maine, the proposed habitat alternatives in those areas are expected to have neutral biological impacts on summer flounder. The commercial fishery for summer flounder is managed using annual catch limits, which limit removals of summer flounder (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed habitat management alternatives on summer flounder are expected to be neutral to slightly positive when compared to Alternative 1/No Action.

Juvenile and adult scup and black sea bass distributions and EFH overlap with some the proposed habitat management alternatives. In particular, the scup and black sea bass EFH extends through Southern New England/Great South Channel and the western Gulf of Maine. Because juvenile and adult scup black sea bass EFH are susceptible to mobile bottom-tending gears, their EFH would likely be positively impacted by prohibitions on use of these gear types. If these gear restrictions go into place, it is expected that fishing effort with mobile bottom-tending gear would likely shift to other unrestricted areas, which would offset possible impacts of reduced impact to EFH. Because juvenile and adult scup and black sea bass distribution and EFH has minimal to no overlap with the eastern Gulf of Maine and Georges Bank, the proposed habitat alternatives in those areas are expected to have neutral biological impacts on scup and black sea bass. The commercial fishery for scup and black sea bass is managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed habitat management alternatives on scup and black sea bass are expected to be neutral to slightly positive when compared to Alternative 1/No Action.

4.6.12.1.2 Spawning management alternatives

The use of many gears capable of catching groundfish is currently prohibited in the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31(common pool vessels only). Under Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Areas I and II would only have the mobile bottom-tending gear prohibition in place during 2.5 months of the year (February-April 15) as opposed to year round.

As shown above, adult summer flounder, juvenile and adult scup, and juvenile and adult black sea bass distributions and EFH overlap with the proposed spawning management alternatives. Because these EFH life stages are susceptible to bottom tending fishing gears, there is potential for neutral to slightly negative impacts on summer flounder, scup, and black sea bass as compared to the No Action Alternative. The impacts are considered slight as these measures have the potential to affect a small portion of the species ranges. The extent of impacts will depend on whether fishermen choose to take advantage of the newly open areas and expand the use of mobile bottom-tending gears in particular into these areas during the open times of the year. The commercial fisheries for summer flounder, scup, and black sea bass are managed using

annual catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed spawning management alternatives on summer flounder are expected to be neutral to slightly negative when compared to Alternative 1/No Action.

4.6.12.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Summer flounder adult and juvenile EFH overlaps with the Georges Bank DHRA. Scup and black sea bass EFH does not. Adult and juvenile summer flounder EFH is susceptible to mobile bottom-tending gears, and would likely be impacted positively by any prohibitions on use of those gear types in the Georges Bank DHRA. However, the extent of overlap with the Georges Bank DHRA when compared to the overall extent of the species range is quite small. The commercial fisheries for summer flounder, scup, and black sea bass are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives management alternatives on summer flounder are expected to be neutral to slightly positive, and neutral for scup and black sea bass, when compared to Alternative 1/No Action.

4.6.12.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological process of summer flounder, scup, and black sea bass; therefore, no biological impacts are expected on these species when compared to the status quo.

4.6.12.2 ***Fishery impacts***

Based on VTR data for 2012, the bulk of the summer flounder landings were taken by bottom otter trawls (over 97 percent), with other gear types (e.g. hand lines, scallop dredges, sink gillnets) each accounting for less than 1 percent of landings. The bulk of scup landings in 2012 were taken by bottom otter trawls (96 percent), followed by pots and traps (~1 percent), and hand lines (~1 percent). Other gear types each accounted for less than 1 percent of landings. The majority of black sea bass landings were taken by bottom otter trawls (51 percent), followed by pots and traps (30 percent), hand lines (10 percent), and offshore lobster pots and traps (6 percent). Other gear types each accounted for less than 1 percent of landings.

4.6.12.2.1 Habitat management alternatives

Six statistical areas individually accounted for greater than 5 percent of the summer flounder catch in 2012 (Table 170). Collectively, these six areas accounted for 71 percent of the summer flounder catch. There were five statistical areas that individually accounted for greater than 5 percent of the scup catch in 2012 (Table 170). Collectively, these five areas accounted for 82.5 percent of the scup catch. There were five statistical areas that individually accounted for greater than 5 percent of the black sea bass catch in 2012 (Table 170). Collectively, these four areas accounted for 60.3 percent of the black sea bass catch.

Table 170 – Statistical areas that accounted for at least 5 percent of the summer flounder, scup, or black sea bass catch in 2012, NMFS VTR data.

Statistical Area	Summer Flounder (percent)	Scup (percent)	Black Sea Bass (percent)
616	18.55	9.02	16.56
537	18.15	26.79	6.99
613	11.36	18.73	4.90
612	9.79	2.24	2.38
626	6.85	0.02	3.67
622	6.32	0.09	9.20
539	4.60	13.02	4.52
621	3.82	0.06	16.52
615	3.27	1.54	11.05
611	1.90	14.95	2.37

The bulk of the commercial fishery landings for all three species occur in statistical areas south of Cape Cod, as indicated by the 2012 VTR data. Because the core of the commercial fisheries for summer flounder, scup, and black sea bass do not coincide with the habitat management areas under consideration, the fishery is unlikely to be significantly impacted by proposed habitat management measures that restrict or prohibit the use of mobile bottom-tending gear. Some areas of overlap include Georges Bank and in the Southern New England area, where mixed fishery bottom trawls may catch summer flounder, scup, or black sea bass. Any prohibitions on mobile bottom-tending gear may affect landings of these species in these areas, resulting in slightly negative impacts. Therefore, the impacts on the directed summer flounder, scup, and black sea bass fisheries are expected to be neutral to slightly negative.

4.6.12.2.2 Spawning management alternatives

The use of various gears capable of catching groundfish, such as bottom trawls, is currently prohibited in the Nantucket Lightship Closed Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 (common pool vessels only). Under Alternatives 2 and 3, the Nantucket Lightship Closed Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Areas I and II would only have these gear prohibitions in place during 2.5 months of the year (February-April 15) as opposed to year round. Therefore, there is the potential for neutral to slightly positive impacts on the summer flounder, scup, and black sea bass fisheries. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of bottom trawls into these areas during the open times of the year. For scup and black sea bass, the use of pots and traps to catch these species was already an exempted gear type. These impacts are considered slight because the areas under consideration are a small portion of these species range and their EFH. These alternatives do not alter other aspects of the summer flounder, scup, or black sea bass fisheries, including the limits on catch and landings in this fishery. Therefore, expected impacts range from neutral to slightly positive, resulting increased flexibility and area in which summer flounder, scup, and black sea bass fishermen can choose to use bottom otter trawling gear.

Impacts on the recreational fishery are not expected. In the Nantucket Lightship Closed Area, party and charter vessels may obtain a letter of authorization to fish under Alternative 1/No

Action, and under Alternatives 2 or 3 this area would be eliminated. Recreational fishing is currently restricted in Closed Areas I and II under Alternative 1/No Action, but it would be allowed for much of the year under Alternatives 2 and 3, or for the entire year if recreational vessels are exempted from the spawning area restrictions (Option A). Therefore in all cases the action alternatives provide increased opportunities and therefore positive impacts for recreational fishing as compared to Alternative 1/No Action. These are probably slightly positive impacts since summer flounder is the only species found in Closed Areas I and II, and all three species are concentrated south of the management areas in this amendment.

4.6.12.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Because the core statistical areas in which the commercial fisheries for summer flounder, scup, and black sea bass do not with the DHRAs proposed, the fishery is unlikely to be significantly impacted by proposed measures that restrict gear use or put constraints on commercial fishing access in these areas. Some areas of overlap with a small part of the fishery include Georges Bank, where mixed fishery bottom trawls may catch summer flounder, scup, and/or black sea bass. However, the extent of overlap of the fisheries with the Georges Bank DHRA, relative to the total extent of the fishery, is small. The commercial fisheries for summer flounder, scup, and black sea bass are managed using annual catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the impacts of the proposed DHRA alternatives on summer flounder, scup, and black sea bass are expected to be neutral to slightly negative, when compared to Alternative 1/No Action.

4.6.12.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on the summer flounder, scup, and black sea bass fishery. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.6.13 Golden tilefish

4.6.13.1 ***Biological impacts***

Golden tilefish (*Lopholatilus chamaelonticeps*) are found along the outer continental shelf and upper continental slope of the entire U.S. East Coast and Gulf of Mexico. They are most abundant from Nantucket Island, Massachusetts to Cape May, New Jersey. Tilefish typically live at depths of 250 - 1,500 feet (76 m - 457 m) where water temperatures range from 49 to 58°F. They are often found in and around submarine canyons where they burrow in mud or sand sediment. Some tilefish build large sand and rubble mounds, which provide habitat for other bottom-dwelling creatures and fishes. Tilefish eggs and larvae are found along similar isobaths as the adults.

There is little to no overlap between tilefish distribution and EFH and the proposed habitat management, spawning management, or research area alternatives. Therefore, the biological impacts of the proposed alternatives on tilefish are expected to be neutral when compared to Alternative 1/No Action. The framework and monitoring alternatives are administrative and do not have any impacts on the biological processes of tilefish; therefore no biological impacts are expected on tilefish when compared to the status quo.

4.6.13.2 ***Fishery impacts***

The fishery is prosecuted where tilefish are found, at depths of 250 - 1,500 feet (76 m - 457 m) where water temperatures range from 49 to 58° F. The Northern areas for this fishery are typically prosecuted in deeper waters within the range.

There is no overlap between the tilefish fishery and the habitat management, spawning management, or research area alternatives proposed in this amendment; therefore, no impacts to the fishery are expected. The framework and monitoring alternatives are administrative and do not have any impacts on the tilefish fishery because there is no overlap with the fishery.

4.6.14 Northern shrimp

4.6.14.1 ***Biological impacts***

4.6.14.1.1 Habitat management alternatives

The management alternatives selected will influence the distribution of mobile bottom-tending gear fishing effort including shrimp trawl effort. With the exception of shrimp trawls and traps, catch rates of shrimp in fishing gears are very minimal. Shrimp traps would not be restricted by any of the alternatives. Therefore, the redistribution of effort by gears other than shrimp trawls will have no impacts positive or negative on the shrimp resource. The shrimp fishery, if available in a given year, typically begins on or around December 1, when many shrimp have already hatched their eggs for the breeding season. Therefore, no particular biological impacts are expected if the management alternatives lead to shifts in the distribution of shrimp trawling effort, because the seasonality of the shrimp fishery already controls for impacts on shrimp spawning. While the fishery is open access in terms of participation, it is limited by a total allowable catch which triggers closure of the fishery once harvested. There are also trip limits, trap limits, and days out which control the rate of harvest within the season.

4.6.14.1.2 Spawning management alternatives

As noted above, there is little to no bycatch of shrimp in gears other than shrimp trawls and shrimp traps, and the spawning management alternatives will not affect the use of shrimp trawl or trap gears. Therefore, no impacts to the shrimp resource are expected to result from the spawning alternatives.

4.6.14.1.3 Dedicated Habitat Research Area alternatives

There is some overlap between the shrimp fishery and the two DHRAs in the Gulf of Maine, Eastern Maine (Alternative 2) and Stellwagen (Alternative 3), but neither of these areas is a

center of shrimp fishing effort. The conclusions above under the habitat management alternatives section apply here as well, i.e. no particular biological impacts are expected if the management alternatives lead to shifts in the distribution of shrimp trawling effort.

4.6.14.1.4 Framework and monitoring alternatives

As none of the above alternative types are expected to impact the shrimp resource, the schedule and approach to adjusting these impacts will also have no impacts.

4.6.14.2 ***Fishery impacts***

The shrimp fishery is prosecuted out of Massachusetts, New Hampshire, and Maine ports in the inshore Gulf of Maine during the winter months. The stock status and specifications are evaluated annually. Due to collapse of the stock, there will not be a fishery during the 2013-2014 season. It is not known whether a fishery will be possible in 2014-2015, or if not then, when a fishery may be resumed. Therefore, in the short term, the spatial management alternatives will not affect prosecution of the shrimp fishery.

Prior distributions of shrimp trawl effort relative to the various management areas are discussed in the human community and fishery impacts sections for each type of alternative, and shrimp trawl effort is generally separated out as a separate gear type, unless data confidentially issues caused shrimp trawl data to be pooled with other bottom trawls. The intent of this section is to briefly summarize the information already provided specifically with respect to the shrimp trawl fishery, but the reader interested in impacts to the shrimp fishery should also review the human and community impacts sections for the Gulf of Maine habitat, spawning, and research area alternatives.

4.6.14.2.1 Habitat management alternatives

If management option 1 or 2 is selected for a particular alternative set of habitat management areas, shrimp trawl vessels would be prohibited along with other mobile bottom-tending gears. One metric that can be used to assess the impacts of these habitat management alternatives on the shrimp fishery is the amount of shrimp trawl effort in currently open HMAs. If areas currently fished are closed, that effort would have to be displaced to other locations. Another consideration is how much effort might occur in areas that are now closed that might reopen to the fishery under an alternative action. This is more difficult to assess because it requires an inference about future fishing effort based on past effort and/or a distribution of the shrimp stock.

Because shrimp undergo inshore/offshore migrations seasonally, the distribution of shrimp and therefore shrimp fishing effort relative to habitat management areas may vary from year to year. Mature female shrimp move inshore in early winter and offshore following larval hatching. The shrimp assessment defines inshore vs. offshore using a depth of 55 fathoms (about 100 m). Much of the Small and Large Bigelow Bight areas are considered inshore according to this definition. In seasons where the fishery occurs earlier in the calendar year, there would presumably be a greater overlap with this area, and therefore a greater displacement of effort if it were adopted as a mobile bottom-tending gear closure (western Gulf of Maine Alternatives 3, 4, or 5 with Options 1 or 2; Alternatives 3 and 4 include the larger area, and Alternative 5 includes the smaller area).

The revenue data in the table below are excerpted from the western Gulf of Maine human communities and fishery impacts section. Mean annual revenues are for calendar years 2010, 2011, and 2012. According to the 2013 shrimp assessment update, overall commercial landings of northern shrimp during the seasons ending in 2010, 2011, and 2012 were 6.99 million, 10.63 million, and 5.21 million dollars, respectively, or an average of 7.61 million dollars across the three seasons (ASMFC NSTC 2013). Given total Large Bigelow Bight revenues estimated at 1.55 million, this means this area accounted for roughly 20% of revenues in the fishery across these years. Revenues from the Small Bigelow Bight area, which is a subset of the Large Bigelow Bight area, accounted for about 4% of total shrimp fishery revenues across the three years. These percentages may be slight underestimates because only Federal VTRs were used in the revenue analysis, and some shrimp vessels report on state VTRs only. Overall, Federal VTRs used in the revenue analysis accounted for approximately 82% of total shrimp trawl revenues in the dealer data during 2012; somewhat less than this during 2010 and 2011 (see VTR/observer/dealer comparison section in Volume 1). Also note that the shrimp season generally starts December 1 of the previous year (i.e. the 2010 season started on December 1, 2009, whereas the VTR revenue analyses are based on a calendar year).

Table 171 – Shrimp trawl revenue in the Large and Small Bigelow Bight areas, calendar years 2010-2012. All variables represent annual estimates derived from federal VTRs. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dashes indicate information dropped due to privacy concerns. Note that the small area is a subset of the large area.

Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individ.	Trips
Bigelow Large	L/U	176,087	155,447	37,396	-	-	4	87
Bigelow Large	M	524,001	457,520	210,129	759,329	355,154	19	470
Bigelow Large	S	847,795	969,194	298,789	1,066,776	507,414	59	1,128
Bigelow Large	***Total***	***1,547,883***	***1,582,161***	***546,314***	***1,826,105***	***862,568***	***82***	***1,685***
Bigelow Small	OTHER	144,517	144,517	79,146	200,482	88,552	11	278
Bigelow Small	S	205,282	205,282	117,275	288,207	122,356	30	518
Bigelow Small	***Total***	***349,799***	***349,799***	***196,421***	***488,689***	***210,908***	***41***	***796***

<u>Thus, western Gulf of Maine Alternatives 3 and 4 with Options 1 or 2 could have a highly negative impact on the shrimp fishery; Alternative 5 which includes the smaller Bigelow Bight Area would have a moderately negative impact.</u> Shrimp traps could continue to be used in the area, although the bulk of the fishery is prosecuted using trawls. It is unlikely that vessels would switch between the two gear types. Other than alternatives that include the Large or Small Bigelow Bight areas and would close them to trawl gears, the alternatives in this amendment would result in relatively little displacement of future shrimp fishing effort, assuming that effort in the future has a similar spatial distribution to that observed in recent years. It is possible that some of this effort could be displaced into more offshore grounds if these alternatives are

adopted, because deeper mud habitats west of Jeffreys Ledge would be open to shrimp trawls under these alternatives, as well as under Alternative 2 and Alternative 6. There has been shrimp fishing in these areas historically, although this only occurs when the season is long enough that the shrimp move back from their spawning grounds into offshore waters. As shown in the table above, smaller vessels (<50 ft) constitute the bulk of the revenue in the Bigelow Bight areas, and they may be less able to fish further offshore. Nonetheless, western Gulf of Maine Alternative 8, which would exempt the shrimp fishery from habitat management restrictions in the northwestern corner of the Western Gulf of Maine Habitat Closure Area, would have some slight positive impacts on the shrimp fishery.

4.6.14.2.2 Spawning management alternatives

As currently written, shrimp trawls would be exempted from the Gulf of Maine spawning management areas, so the no action and action alternatives are not expected to impact this fishery. There is no shrimp fishery in the Georges Bank/Southern New England region so those alternatives would have no impact on the shrimp fishery.

4.6.14.2.3 Dedicated Habitat Research Area alternatives

Shrimp trawl vessels would be prohibited in the Alternative 2 (Eastern Maine DHRA) and Alternative 3 (Stellwagen DHRA) research areas because they are a mobile bottom tending gear. The Eastern Maine DHRA is currently open to shrimp trawls and there appears to be little overlap with this gear type, so neutral to slightly negative impacts are expected if this area is implemented as a DHRA. The Stellwagen DHRA is currently closed, so it is difficult to infer the potential for different types of fishing activities, but it is generally south and east of where shrimp fishing typically occurs, so impacts are expected to be neutral. The types of information expected to be generated by research in these areas is not expected to have a direct benefit on management of the shrimp fishery.

4.6.14.2.4 Framework and monitoring alternatives

The process by which spatial management measures are evaluated and updated is not expected to have a direct impact on the fishery. The direct impacts of any future changes on the shrimp fishery would be evaluated in future framework or amendment analyses.

4.6.15 American lobster

The American lobster fishery occurs from Maine to Cape Hatteras, North Carolina. There are seven Lobster Conservation Management Areas (Areas), Areas 1, 2, 3, 4, 5, and Outer Cape Cod Area. The American lobster resource and fishery are cooperatively managed by the states (0-3 nautical miles) and the National Marine Fisheries Service (3-200 nautical miles) under the framework of the Atlantic States Marine Fisheries Commission. There are three distinct lobster stock areas, the Gulf of Maine lobster stock, the Georges Bank lobster stock, and the Southern New England lobster stock. This action is relevant to the Gulf of Maine and Georges Bank stocks.

The assessment of all US stocks is currently being updated, but based the 2009 lobster stock assessment, the Gulf of Maine and Georges Bank lobster stocks are not depleted and overfishing is not occurring. The 2009 lobster stock assessment states that the Georges Bank stock was at

record high abundance. The exception being that statistical area 514 is currently experiencing historically low stock abundance and declines in lobster recruitment. In addition, it has been determined that statistical area 514 is experiencing high levels of exploitation. The Southern New England lobster stock is depleted mainly due to recruitment failure, but the stock is not experiencing overfishing.

Over the period 1981-2007, the Georges Bank stock averaged 5% of the US fishery, although landings from this stock have increased in recent years to over 2,000 mt annually. The Georges Bank fishery is prosecuted by fishermen from Rhode Island, Massachusetts, Connecticut, and New Hampshire. Trap hauls would be the most useful effort metric (ASMFC 2009) but catch and effort data is not available for all states. According to tabulations of trap hauls by stock area and state in the assessment through 2007, vessels from Massachusetts contribute about three times more trap hauls than those from New Hampshire. Massachusetts vessels tend to fish the northern and eastern side of Georges Bank, and landings from these areas (Statistical Areas 521, 522, 561, 562) have increased recently. The 2007 stock assessment notes that effort on Georges Bank is not well characterized due to a lack of both mandatory reporting and appropriate resolution in the reporting system. Based on Massachusetts data only, the number of traps fished has remained stable around a mean value of 43,000. Based on 2012 permit data, there are a dozen vessels from New Hampshire and eleven vessels from Maine that may fish on Georges Bank, and most of the activity from the New Hampshire vessels is likely relevant. Total Area 3 trap allocations for both states are roughly 23,500 traps, although not all of these traps are active. For comparison, in 2012 there were 38 Massachusetts vessels permitted for Area 3 with 46,000 traps allocated.

Over the same timeframe (1981-2007), the Gulf of Maine stock averaged 76% of the US fishery, increasing to 87% from 2002-2007. Southern New England constitutes the remainder of the fishery and landings have declined recently in response to stock conditions.

The majority of lobsters (about 98%) are taken with traps, but lobsters are also taken as bycatch by Federal lobster permit holders who primarily use bottom otter trawl, gillnet, and scallop dredge. Information on commercial discards and bycatch is incomplete because Federal lobster permit holders with only a Federal lobster permit are not required to report their harvest to the Federal government, and limited sea sampling in the offshore fishery has resulted in minimal fishery-dependent information in this portion of the fishery. Regulatory discards include under and oversized animals, v-notched females, and egg-bearing females. Incidental catch limits for non-directed trips (e.g. groundfish trawl trips) may also lead to discards. There are no discard mortality studies from Georges Bank. A comparative study in Long Island Sound (Smith and Howell 1987) investigated trap vs. trawl mortality during different seasons, to quantify lobsters with minor or major external damage.

The results of the study discussed immediate mortality rates caused by trawl-induced physical injury to lobsters, and delayed mortality rates for lobsters with or without physical damage. Immediate mortality rates were low for both trap and trawl gears across all lobsters, including egg bearing females, which have not yet molted and still have hard shells. Immediate mortality rates of trawl-caught lobsters ranged from 0-2.2% depending on the month. Major damage rates were also relatively low at 0-11.8% depending on the month. Delayed mortality, measured by holding fishery caught lobsters in a laboratory setting, was relatively high for lobsters that

sustained major damage (42.4-100%, depending on the month), or for lobsters that were newly molted and had soft shells (33%). Undamaged trawl caught lobsters and trap caught lobsters showed little delayed mortality. These results suggest that the fraction of the catch that sustains immediate major damage or is soft-shell can be used to predict delayed mortality rate in lobsters caught by trawl gear. In addition, undamaged lobsters with long laboratory exposures to freezing temperatures (-9.5° C) also sustained high mortality rates (none at 30 minutes, but 70% at 60 minutes and 100% at 120 minutes). While the authors note that the laboratory conditions may have resulted in greater exposure for each lobster as compared to catch piled on the deck of a vessel where some lobsters were insulated from the cold, this result indicates that long exposures during sorting would cause incidental mortality.

Another study (Jamieson and Campbell 1985) examined incidental catch and damage rates in lobster caught in the Gulf of St. Lawrence scallop dredge fishery. Researchers observed that spatial shifts in the distribution of lobsters affected the overlap of lobsters within the scallop fishery in this region. Overall, the study concluded that the scallop fishery did not have substantial negative impacts on the lobster resource since few lobsters occurred on the fishing grounds during the months in which the scallop fishery was most heavily prosecuted. It was not clear whether scallop fishing activity was driving lobsters off the fishing grounds, or if the lobsters were moving off the grounds during that time for other reasons. Lobster catch rates in three types of dredges were compared; one of their dredge types, the Gulf sweep chain dredge, was noted as being most similar to the offshore dredge. Catches of lobsters in unlined Gulf sweep chain dredges were low – 0.07 lobsters per meter per minute – but were higher for lined dredges, and in hoods and covers attached to the dredges. This indicated that some lobsters escaped through the rings and others swam over the dredge.

Recent sex ratios in commercial and survey catches on Georges Bank have indicated a heavily skewed number of female lobsters. The reason for this is not clear but may relate to increased conservation of egg-bearing females (which cannot be landed as a conservation measure) and the influence this conservation has over time on population structure. It is also not clear if the population is experiencing sperm limitation. The reproductive patterns for larger lobsters are not very well known. Large females may molt and extrude eggs in alternate years, and many factors appear to influence molt rate/intermolt interval. As indicated by the Smith and Howell study, incidental mortality rates on these females would be affected to the extent that these females are post-molt and therefore softshell during times when other fisheries are being heavily prosecuted in the area, and during the times when there are more lobsters in the area in general (similar to Gulf of St. Lawrence observations).

4.6.15.1 ***Biological impacts***

This action proposes to alter fishing privileges in specific Habitat Management Areas, Spawning Management Areas, and Dedicated Habitat Research Areas. Changes to areas in and around Closed Area II are of particular concern to the American lobster fishery.

Some of the habitat management alternatives would result in maintenance of existing areas or portions of them as mobile bottom-tending gear closures. Others would result in reopening of existing areas to mobile bottom-tending gears, or closure of new areas to mobile bottom-tending gears. Biological concerns center on how alternatives that increase access for mobile bottom-

tending gear fishing might change the rate of incidental mortality of lobsters in non-trap gears. In addition, juvenile lobsters are known to benefit from association with seabed structure in terms of reduced predation, such that habitat protection measures are likely to have positive impacts on lobster populations.

In terms of incidental mortality impacts, as discussed above, fishing mortality rates are relatively high for lobsters that have recently molted and have soft shells, and for hard shelled lobsters that suffer major damage. The magnitude of the interaction between lobsters and mobile bottom-tending gears could increase if the number of lobsters increases on a seasonal basis, or if the rate of mobile bottom-tending gear use is high in an area. The fraction of recently molted lobsters will influence the incidental mortality rate. Whether or not any increase in incidental mortality constitutes a significant impact on the stock depends on the magnitude of incidental mortality relative to stock size.

In the Gulf of Maine, the lobster population is concentrated relatively inshore (see distribution map in the Affected Environment section of Volume 1). In general, the habitat management alternatives might impose additional restrictions on mobile bottom-tending gears inshore, but would not increase their use. Therefore, incidental mortality increases are of limited concern in this region, and the habitat management alternatives there would likely have a neutral to slightly positive impact on the resource if they reduce use of mobile bottom-tending gears inshore.

On Georges Bank, lobsters are concentrated along the edges of the bank and in the eastern part of the bank on either size of the EEZ. The Georges Bank sub-region habitat management alternatives other than Alternative 1/No Action would remove Closed Areas I and II from a habitat protection perspective. Closed Area II is under consideration to be opened to mobile gear fishing. Currently, specific areas within the closure have been closed to mobile gear, with exceptions including Special Access Programs and scallop access fisheries. Closed Area II is located within Lobster Management Area 3, and is fished year-round by some or all of its 137 lobster trap permit holders that have access to these fishing grounds. If an action alternative is also selected for spawning, Closed Areas I and II would be closed seasonally only (February, March, and the first half of April). Some parts of eastern Georges Bank might still be off limits to mobile bottom tending gears depending on the alternative and option selected (Georges Bank habitat alternatives 3-8). The question is how abundant lobsters are in these reopened areas between April 15 and January 31, and when and at what rate soft-shell lobsters are present. Based on data provided by the Commission, lobster fishing effort peaks from July to October, and discard rates appear to be highest in August and September. Discards would be due to lobsters being undersized, oversized, egg bearing females, or v-notched females.

The Commission provided the Council with lobster bycatch data collected by the Atlantic Offshore Lobstermen's Association from two vessels. These data indicate that about half the lobsters sampled in July-September are egg bearing females, and about 80% of lobsters sampled October-December are egg bearing females, which would help explain the high discard rates. It is not clear from the data provided whether lobsters are more abundant on Eastern Georges Bank during July-October, or if that is simply the preferred season for lobster fishing. Because most of these lobsters are ovigerous, they have not yet molted, so there should not be an increase in incidental mortality on most of the animals as a result of their soft-shell status. Nonetheless,

injury-related delayed incidental mortality on these females may be of concern. This concern is tempered by the fact that the Georges Bank stock status is at record high abundance as of the last assessment, with large numbers of female lobsters in the population. Overall, the Georges Bank habitat and spawning action alternatives that increase mobile bottom-tending gear access to currently closed areas, particularly Closed Area II, may have a slightly negative impact on the lobster resource.

Another consideration is the extent to which habitat management areas that minimize impacts to structural seabed features could benefit lobsters in terms of providing increased shelter and feeding opportunities, particularly for smaller animals. Improved protection for structural habitats occupied by lobsters could lead to positive impacts on the resource, whereas decreased protection for structural habitats could have negative impacts. Wahle and Steneck (1991) identify lobsters from settlement size (.5 cm carapace length) to between 2 and 4 cm carapace length as 'early benthic phase'. They note these animals are ecologically and behaviorally distinct from larger lobsters, and that the upper size limit on this phase appears to vary by location. During an observational field study of coastal benthic habitats in the Gulf of Maine, these early benthic phase lobsters (up to 4 cm CL) were found almost exclusively in shelter-providing habitats, generally with cobble substrates, and were generally absent from other habitat types. They theorize that due to the relative rarity of cobble habitats over the range of the American lobster, availability of habitat suitable for sheltering young juveniles may represent a recruitment bottleneck. Conversely, they noted that cobble habitats at some of their study sites did not have juveniles of this size; obviously pre-settlement sized lobsters must be present for the structured habitats in a particular area to provide this type of sheltering function to post-settlement animals. In the context of this amendment, habitat management areas that do not have large numbers of early benthic phase lobsters will not have a biological benefit for lobster stocks. A subsequent experiment by the same authors (Wahle and Steneck 1992) provided evidence that early benthic phase lobsters are using shelter as a mechanism to escape predation; perhaps because lobsters of this size are unable to rapidly bury themselves in the sediment to avoid capture.

A 1993 field experiment by Bologna and Steneck demonstrated that kelp habitats also provide suitable shelter for lobsters. Compared to otherwise similar, nearby, unvegetated habitats, natural or artificial kelp habitats had significantly higher biomass of lobsters. These animals were slightly larger than early benthic phase on average (5-6 cm CL depending on the treatment and year). Because lobsters were present in similar abundance at artificially-placed and natural kelp habitats, the authors surmised that the structural characteristics of the kelp were most critical to determining lobster abundance, as compared to higher trophic/feeding benefits associated with natural kelp habitats. With the exception of the Ammen Rock habitat management area, kelp habitats are not likely to be found in the alternatives proposed in this amendment, because kelp is generally a shallow water feature due to light dependence. However, this study does indicate that larger juvenile lobsters occur in higher densities in a structured habitat as compared to more featureless seabed.

4.6.15.2 ***Fishery impacts***

Lobster trapping, which comprises the vast majority of lobster fishing effort, would not be restricted under any of the management alternatives in this amendment, so there would not be any direct impacts through displacement of lobster trapping effort. Any positive or negative

impacts on the lobster fishery would be indirect, and will relate to increases or decreases in the use of other gears on lobster fishing grounds.

One of the main concerns with opening Closed Area II to mobile gear is that gear conflicts may arise between fixed lobster gear vessels and mobile gear vessels. The lobster industry, specifically in Area 3, and the Commission are aware of this potential for increased gear conflict. Therefore, the Commission has addressed the issue by adopting Addendum XX to Amendment 3 of the Interstate Fishery Management Plan for American lobster. Addendum XX formalized a previous agreement between the groundfish sector industry and the offshore Area 3 lobster industry. Within the document, specific measures are outlined to establish different seasons for lobster vs. mobile gear fishing within Closed Area II. Because this agreement was established, the potential for negative impacts has been greatly reduced, while allowing for the lobster industry to continue fishing in the area without trawl gear during specified time frames. However, this agreement is not codified in Federal regulations.

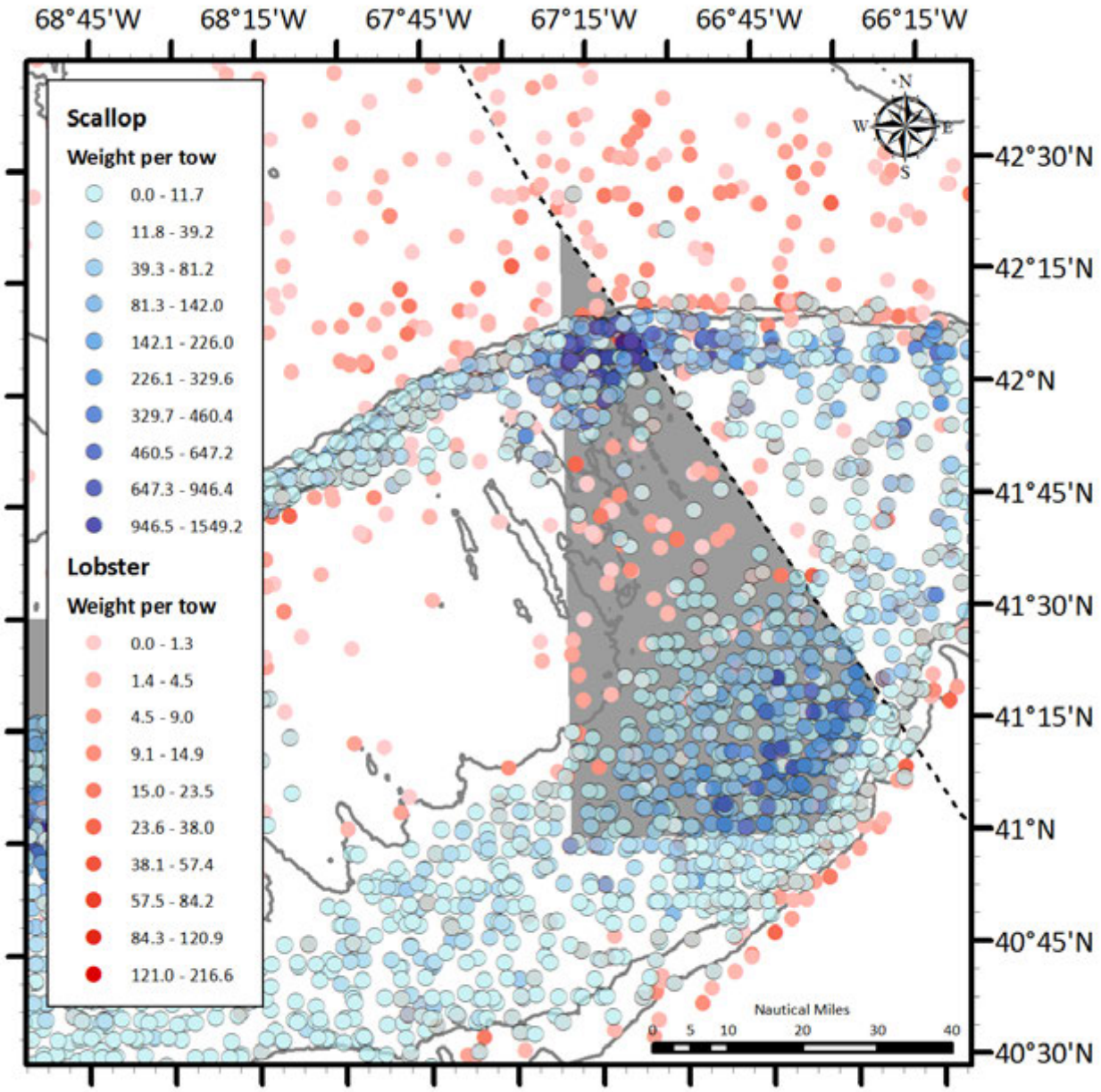
Interactions between the lobster trap and scallop dredge fisheries could also occur under the alternatives under consideration, and there is not a formal or informal agreement to prevent gear conflict similar to the trawl/trap agreement described above. Impacts of scallop dredge/lobster trap interactions could range from neutral to slightly negative, depending on various factors. One factor is the behavior of individual fishermen, specifically whether they seek to avoid gear conflict or not. It is difficult to predict how actively fishermen would seek to avoid such conflicts.

A second factor is the spatial overlap between the two target stocks (Map 149), with greater overlap leading to higher potential for gear conflicts. Sea scallops are a sedentary species that occur patchily on the northern edge of Georges Bank including within Closed Area II, with local abundance ranging from extremely high in the northern part of the closure to no abundance in the central part of Closed Area II. Lobsters are more widely distributed throughout the area, including in the center of the closure where scallops do not occur. Thus, lobster effort occurring south of the existing habitat closure would likely have no or very limited potential gear conflict impacts with scallop dredging.

A third factor is the temporal overlap between the two fisheries. If part or all of the Closed Area II Habitat Closure reopens under one of the action alternatives, the area is most likely to be developed as a scallop access area rather than as an open-access fishery. There could be specific seasons associated with this access area, or it could be prosecuted year-round. Currently the southern part of Closed Area II is an access area, with a seasonal closure during the late summer/early fall to avoid times when bycatch ratios between yellowtail flounder and sea scallops are highest. These ratios relate partly to seasonal fluctuations in scallop meat yield, and partly to seasonal fluctuations in fish abundance. In general, late spring through summer is the preferred time to harvest sea scallops to optimize their yield. As an access area, the number of trips would be specified annually, and over the long term the area would be fished sporadically, although access might be more frequent in the near term given high levels of biomass in areas that are currently closed to scalloping. So, in some years there would be no conflicts with the lobster fishery, and in other years there would be access fishing, with the number of trips depending on resource conditions and the size of the access area. Similar to the seasonal closure

in Closed Area II south for yellowtail flounder bycatch, it is possible that a seasonal restriction could be developed in a future scallop action to minimize gear conflict with lobster gear if necessary. Overall, the potential for gear conflict would be limited if the area was managed as a scallop access area compared to an open area.

Map 149 - Overlap between lobster and scallop distributions in all NEFSC surveys, 2002-2012. Scallop weight per tow (blue) is partially transparent to show lobster distribution underneath (red). The central part of Closed Area II (shaded) contains lobsters but few scallops.



5 Index

Accountability Measure 605
Annual Catch Limit ACL..... 150, 515, 605, 618
Atlantic salmon ... 1, 146, 161, 162, 676, 677
Atlantic States Marine Fisheries Commission 714, 715, 716
Biological Impacts . 189, 587, 627, 631, 634, 667, 678, 679, 680, 683, 691, 692, 695, 700, 708, 709, 712, 713
Black sea bass . 704, 707, 708, 709, 710, 711
Bluefish, Atlantic 691, 692, 693, 694
Clam ... 36, 39, 41, 44, 47, 48, 54, 56, 61, 62, 64, 66, 71, 75, 77, 78, 80, 82, 84, 87, 89, 90, 92, 95, 104, 105, 106, 150, 151, 155, 156, 175, 192, 203, 212, 221, 222, 223, 229, 235, 236, 253, 265, 266, 267, 268, 352, 359, 364, 365, 366, 367, 368, 383, 384, 403,418, 419, 420, 430, 432, 434, 435, 436, 437, 438, 439, 440, 449, 450, 452, 453, 455, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 502, 594, 678, 679, 683, 684, 685, 686, 688, 689, 690
Closed Area Technical Team..... 36, 39, 137, 138, 142, 143, 146, 167, 178, 182, 310, 334, 335
Crab, red deep-sea..... 133, 161, 676
Cumulative Effects..... 35, 120, 272
Days-at-sea (DAS) ... 98, 109, 122, 278, 293, 602, 603, 604, 605, 607, 610, 611, 612, 614, 616, 632, 633, 652, 653, 654, 656, 657, 658, 659, 662
Dedicated Habitat Research Area 35, 117, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 136, 137, 144, 493, 523, 544, 545, 546, 547, 548, 549, 551, 552, 553, 554, 555, 556, 557, 559, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 575, 576, 577, 581, 582, 583, 584, 586, 587, 594, 595, 596, 607, 612, 625, 626, 630, 631, 667, 668, 673, 676, 679, 690, 692, 694, 695, 698, 700, 703, 709, 711, 712, 715, 717
Dogfish, spiny 394, 424, 603, 699, 700, 701, 702, 703, 704
Economic impacts 61, 65, 67, 138, 189, 191, 197, 203, 212, 256, 267, 284, 380, 381, 384, 385, 399, 400, 402, 403, 406, 407, 408, 409, 429, 431, 437, 440, 471, 502, 526, 537, 542, 570, 572, 576, 586, 657, 664, 666, 676, 683, 684, 685, 693
Essential Fish Habitat .. 1, 35, 36, 37, 41, 51, 52, 54, 56, 59, 61, 63, 65, 67, 71, 72, 73, 75, 81, 82, 87, 89, 91, 93, 95, 117, 119, 121, 128, 133, 135, 136, 137, 139, 148, 158, 159, 160, 161, 162, 165, 166, 168, 205, 213, 214, 217, 218, 219, 221, 223, 224, 225, 228, 229, 235, 242, 243, 244, 245, 246, 247, 255, 256, 257, 258, 261, 262, 266, 268, 269, 270, 279, 280, 328, 329, 334, 335, 414, 415, 418, 421, 436, 437, 438, 500, 551, 584, 585, 594, 604, 605, 610, 611, 613, 615, 616, 643, 644, 645, 646, 647, 648, 650, 651, 653, 654, 657, 659, 668, 672, 677, 678, 679, 683, 686, 687, 691, 692, 694, 695, 699, 700, 704, 705, 706, 707, 708, 709, 710, 712
Exclusive Economic Zone . 46, 81, 123, 211, 245, 254, 335, 436, 481, 603, 604, 605, 646, 677, 691, 718
Fishery Management Plan.. 1, 37, 51, 59, 68, 72, 86, 97, 113, 116, 131, 133, 136, 142, 192, 195, 196, 380, 399, 502, 515, 525, 585, 586, 602, 605, 633, 651, 656, 667, 675, 677, 699, 720
Flounder, summer .. 704, 705, 707, 708, 709, 710, 711
Flounder, windowpane47, 49, 162, 213, 214, 242, 243, 256, 257, 269, 514, 556
Flounder, winter ... 47, 49, 61, 159, 162, 213, 214, 225, 242, 243, 256, 257, 258, 269, 270, 279, 295, 297, 298, 311, 323, 344, 345, 352, 425, 426, 429, 440, 466, 471, 472, 514, 515, 556
Flounder, witch 47, 49, 61, 159, 162, 213, 214, 225, 242, 243, 257, 258, 270, 283, 284, 297, 377, 380, 425, 426, 466, 514, 556
Flounder, yellowtail . 61, 113, 116, 159, 162, 213, 214, 223, 224, 225, 242, 243, 256,

257, 258, 269, 297, 298, 310, 311, 328, 336, 343, 425, 426, 429, 496, 514, 515, 518, 525, 667, 720
Habitat Area of Particular Concern.... 35, 38, 72, 73, 74, 109, 429
Habitat impacts 54, 118, 120, 151, 156, 165, 172, 174, 237, 256, 267, 272, 500, 501, 502, 503, 570, 577, 602
Habitat Plan Development Team 36, 117, 137, 144, 146, 222, 369
Hake, offshore. 150, 161, 162, 223, 586, 587
Hake, red .. 61, 162, 214, 225, 243, 256, 257, 258, 269, 270, 293, 294, 295, 297, 298, 316, 317, 323, 352, 586, 587, 588, 590, 591, 592, 593, 594
Hake, silver 47, 49, 55, 61, 150, 159, 162, 213, 214, 225, 242, 243, 256, 257, 258, 269, 270, 278, 283, 293, 294, 295, 297, 298, 556, 586, 587, 589, 590, 591, 592, 593, 594, 597, 598, 599, 600
Hake, white .. 47, 49, 61, 162, 178, 214, 225, 243, 256, 257, 258, 269, 270, 283, 295, 377, 380, 425, 426, 548, 556
Herring, Atlantic .. 1, 42, 133, 162, 213, 214, 225, 242, 243, 257, 258, 269, 270, 283, 284, 297, 298, 306, 307, 366, 672, 673, 674, 675, 676
Hotspot. 36, 37, 39, 40, 47, 54, 84, 106, 137, 138, 142, 146, 147, 166, 167, 168, 174, 175, 178, 179, 181, 182, 184, 185, 186, 187, 188, 189, 195, 273, 275, 276, 278, 279, 280, 281, 283, 284, 286, 287, 288, 289, 290, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 304, 307, 308, 310, 311, 312, 313, 314, 316, 317, 318, 319, 323, 324, 328, 329, 330, 334, 335, 336, 337, 343, 344, 345, 346, 347, 348, 352, 353, 504, 505, 506, 508, 509, 512, 514, 516, 517, 518, 520, 523, 524, 525, 554, 555, 556, 557, 559, 566, 587, 590, 591, 592
Lobster, American.. 39, 43, 54, 56, 216, 251, 289, 290, 364, 366, 367, 376, 377, 393, 394, 423, 424, 425, 429, 430, 431, 432, 435, 447, 479, 480, 496, 498, 557, 709, 715, 716, 717, 718, 719, 720, 721
Magnuson-Stevens Fishery Conservation and Management Act ... 37, 124, 127, 148, 551
Marine mammals ... 151, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 544
Monkfish 1, 61, 133, 150, 162, 213, 214, 225, 242, 243, 256, 257, 258, 269, 270, 296, 297, 298, 306, 307, 310, 376, 377, 380, 393, 394, 423, 425, 426, 447, 466, 477, 497, 498, 601, 602, 603, 604, 605, 606, 607, 608, 610, 611, 612, 613, 614, 615, 616, 626
Ocean pout 40, 105, 106, 146, 162, 178, 213, 214, 223, 224, 225, 243, 256, 257, 258, 269, 270, 297, 514
Ocean quahog38, 42, 43, 45, 52, 59, 98, 104, 105, 106, 109, 112, 113, 115, 116, 430, 432, 434, 435, 437, 438, 439, 466, 467, 469, 471, 677, 678, 679, 680, 682, 683, 684, 688, 689, 690
Paralytic shellfish poisoning .. 175, 223, 235, 364, 367, 402, 404, 432, 437, 466, 677, 678, 679, 683, 684, 686, 687, 688, 689, 690
Plaice, American 55, 61, 159, 162, 213, 214, 225, 243, 257, 258, 270, 278, 293, 294, 295, 297, 298, 299, 376, 377, 393, 423
Pollock 40, 61, 146, 162, 178, 213, 214, 225, 243, 256, 257, 258, 269, 270, 297, 376, 377, 380, 393, 394, 399, 424, 425, 514
Porpoise, harbor 478, 480, 491, 496, 497, 498
Practicability 138
Redfish, Acadian..... 40, 47, 49, 54, 61, 146, 162, 213, 214, 224, 225, 242, 243, 257, 258, 270, 278, 283, 284, 293, 294, 295, 297, 298, 299, 376, 377, 380, 393, 394, 424, 514, 556
Scup..... 704, 706, 708, 709, 710, 711
Shrimp, northern .. 38, 41, 42, 43, 44, 45, 52, 57, 59, 69, 70, 98, 104, 105, 106, 109, 149, 152, 158, 160, 190, 195, 212, 227, 228, 229, 235, 238, 240, 242, 243, 244, 272, 289, 296, 297, 298, 299, 300, 306, 307, 359, 360, 361, 364, 367, 368, 374, 375, 382, 383, 385, 388, 389, 390, 391,

400, 401, 402, 403, 405, 406, 407, 409, 449, 450, 457, 468, 470, 473, 475, 548, 570, 587, 591, 624, 628, 712, 713, 714, 715
Skate, barndoor 162, 214, 225, 243, 256, 257, 269, 270, 621, 622, 623, 625, 626, 631
Skate, clearnose..... 161, 162, 617, 623, 625, 626, 628, 630
Skate, little 162, 214, 225, 243, 256, 257, 258, 269, 270, 621, 627
Skate, rosette .. 162, 616, 623, 625, 626, 628, 630
Skate, smooth . 162, 214, 224, 225, 242, 243, 256, 257, 258, 270, 617, 619, 620, 621, 622, 624, 626, 627, 631
Skate, thorny .. 162, 213, 214, 223, 225, 242, 243, 256, 257, 258, 270, 617, 618, 619, 620, 622, 624, 626, 627, 628, 630, 631
Skate, winter .. 159, 162, 214, 225, 242, 243, 256, 257, 258, 270, 425, 429, 466, 621, 628, 629, 630
Social impacts 197, 584
Special Access Program..... 38, 73, 109, 251, 429, 496, 718
Squid 150, 267, 595, 694, 695, 696, 697, 698
Squid, longfin..... 694, 695, 696, 697, 698
Squid, shortfin..... 694, 695
Sturgeon . 146, 151, 481, 490, 492, 494, 496, 497, 499, 544
Surfclam, Atlantic 38, 42, 43, 45, 52, 59, 98, 109, 112, 113, 115, 116, 430, 432, 434, 435, 437, 438, 439, 466, 467, 469, 471, 677, 678, 679, 680, 681, 688, 689, 690
Swept Area Seabed Impact Approach/Model .. 36, 40, 47, 61, 75, 83, 84, 117, 118, 119, 120, 137, 146, 147, 155, 156, 159, 168, 189, 206, 210, 211, 212, 219, 220, 222, 231, 232, 233, 234, 235, 236, 237, 239, 250, 264, 266, 267, 297, 343, 547, 551, 552, 553
Tilefish, golden 711, 712
Turtle, sea146, 477, 479, 483, 489, 491, 492, 493, 495, 497, 544
Vulnerability .. 37, 39, 40, 61, 117, 119, 120, 138, 146, 147, 155, 162, 167, 168, 175, 197, 201, 206, 208, 209, 210, 211, 216, 218, 219, 220, 221, 222, 223, 227, 229, 230, 231, 232, 233, 234, 236, 237, 239, 247, 248, 249, 250, 251, 253, 254, 255, 262, 263, 264, 266, 267,268, 297, 299, 306, 366, 383, 429, 431, 433, 435, 437, 500, 501, 540, 542, 545
Whale, fin..... 485, 544
Whale, North Atlantic right ... 479, 496, 498, 544
Wolffish, Atlantic 40, 146, 160, 162, 213, 214, 224, 225, 242, 243, 257, 258, 270