

Atlantic Sturgeon Migratory Movements and Bycatch in Commercial Fisheries Based on Tagging Data

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****Data summarized in this report are based on data contributed by several sturgeon research programs and state agencies including: Maine Department of Marine Resources, Connecticut Department of Environmental Protection, New York State Department of Environmental Conservation, Cornell University, University of Maryland – Chesapeake Biological Laboratory, New Jersey Department of Environmental Protection, US Army Corps of Engineers, Delaware Division of Fish and Wildlife, Maryland Department of Natural Resources, Virginia Marine Resources Commission, Virginia Institute of Marine Science, North Carolina Division of Marine Fisheries, University of North Carolina, North Carolina State University, National Marine Fisheries Service and the U.S. Fish and Wildlife Service (Northeast Fishery Center, Maryland Fishery Resources Office, and Virginia Fisheries Coordinator).**

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Background

The U.S. Fish and Wildlife Service's Maryland Fishery Resources Office has been coordinating a coast-wide tagging effort for Atlantic sturgeon since 1992. Researchers and state resource agencies have been providing data from tagging programs ranging along the Atlantic coast and tributaries from Maine to North Carolina. Atlantic sturgeon have been captured through both fishery dependent and independent sampling, and additional recaptures also come from reports (through a toll-free phone line) from commercial fishermen. Since the program was started, release tagging data have been provided for nearly 5,000 wild fish and about 1,500 fish of hatchery origin.

At the recent ASMFC workshop on Assessment of Atlantic Sturgeon Bycatch, the U.S. Fish and Wildlife Service provided a presentation on data from the Coastal Sturgeon Tagging Database to the members of the Technical Committee. The main topics of the presentation included:

1. An evaluation of migratory patterns of hatchery released Atlantic sturgeon to determine when they become migratory.
2. An evaluation of migratory patterns of tagged wild sturgeon to determine the extent of migratory routes in relation to tagging location.
3. A summary of recaptured sturgeon reported by the public (primarily commercial fishermen) to evaluate most frequently encountered gear types and information on gear related mortality.
4. Shortfalls of the current tagging data and suggestions on how to use tagging programs to more systematically monitor sturgeon movement and to collect stock assessment data such as bycatch mortality.

Section 1. Hatchery Atlantic Sturgeon Releases

There have been three releases of hatchery reared Atlantic sturgeon in the past 15 years. Two of the releases occurred in the Hudson River and the other release occurred in the Nanticoke River, a tributary to the Chesapeake Bay. Through the hatchery releases, about 8,400 marked fish were released and 675 have been recaptured.

A. Hudson River – 1994

About 5,000 young-of-the-year hatchery-reared fish were released in October 1994 near Newburg on the Hudson River. Fish averaged 100 mm (3 in.) total length when released. All fish were marked by inserting a coded wire tag (CWT) under the first dorsal scute, as well as receiving a clip of the left pelvic fin. Two-hundred and two fish of those fish have been recaptured at least one time with some fish being recaptured up to three times. Most of the recaptures were from the identification of the pelvic fin clip, which has remained a recognizable mark, even for fish captured as recently as 2005. Most recaptures were provided through a research study conducted by Cornell University on the Hudson from 1994-1998, but additional captures have been provided through other tagging programs and commercial fishermen as well. Only one fish was reported to be found dead (1997 – Hudson River) of all recaptures, and there were no reports of gear-related mortalities of these fish. Recaptures of fish were summarized for each year at large after release to evaluate migratory patterns.

Table 1. Recapture summary based on time at large after release of hatchery-reared Atlantic sturgeon released in the Hudson River in 1994.

Time At Large (years)	Number Recaptured	Number Recaptured in Hudson River	Average Size at Recapture (FL – mm)	Range of Recapture Locations
1-2	16	16	594	Hudson River only
2-3	87	83	608	Delaware & Ches. Bays
3-4	105	104	638	Chesapeake Bay
4-5*	3	0	832	Long Island Sound to Virginia Coast
>5	5	1	960	Raritan Bay to Ches. Bay

*Cornell University ended sampling in the Hudson River prior to the fall of 1998.

B. Hudson River – 2004

In the summer and fall of 2004, 210 hatchery-reared Atlantic sturgeon were released into the Hudson River. The fish were of the 1994-1998 year classes and averaged 875mm fork length at release. All fish were tagged with Carlin dangler tags attached through the dorsal musculature at the base of the dorsal fin and also with a passive integrated transponder (PIT) tag inserted into the dorsal musculature. Eighteen of those fish have been recaptured in their first year at large. Some of the sturgeon appeared to leave the Hudson River shortly after release, and recaptures of fish ranged from the Hudson River (4 fish), the Delaware Bay (5 fish), the Chesapeake Bay (8 fish) and Albemarle Sound, NC (1 fish). The size at recapture averaged 921mm total length. Two of the Hudson River recaptures and one of the Chesapeake Bay recaptures were of fish that were found dead on shore or floating in the water. None of the dead fish were reported as gear-related mortalities.

C. Nanticoke River – 1996

In July 1996, about 3,200 hatchery-reared Age-1 Atlantic sturgeon were released into the Nanticoke River which is a tributary to the Chesapeake Bay in Maryland. Fish averaged 215 mm TL at release, but there were two distinct size groups at release (150mm and 300mm). All fish were tagged with a CWT under the third dorsal scute and released. In addition, fish from the larger size group were tagged with a T-Bar tag inserted into the dorsal musculature. Four-hundred and fifty-five fish have been recaptured, with individual fish being recaptured up to four times. Most of the recaptures have come through Reward Programs for sturgeon in the Chesapeake Bay where a monetary reward is paid to commercial fishermen who incidentally capture sturgeon and hold them for USFWS staff to tag and release.

The reward program has been functioning in the Maryland portion of the bay nearly continuously since 1996 and has also occurred in the Virginia tributaries, but not on a continuous basis. No recaptures of these fish have been reported since 2003, but no sturgeon researchers are actively scanning for CWTs during

their sturgeon encounters. Of the recaptures, one fish was found dead in the Chesapeake Bay in 1997. In addition to the fish found dead, six fish from the Chesapeake Bay were reported to be gear-related mortalities, five in drift gillnets and one in a pound net. Recaptures of fish were summarized for each year at large after release to evaluate migratory patterns.

Table 2. Recapture summary based on time at large after release of hatchery-reared Atlantic sturgeon released in the Nanticoke River in 1996.

Time At Large (years)	Number Recaptured	Number Recaptured in Ches. Bay	Average Size at Recapture (TL – mm)	Range of Recapture Locations
0-1	263	261	635	Inland North Carolina waters
1-2	272	268	860	Long Island Sound to North Carolina Coast
2-3	28	23	943	New York to Virginia Coast
3-4	9	3	1003	Rhode Island to VA Coast
>4	3	1	1020	New York to Virginia Coast

D. Hatchery Summary

The three hatchery programs have provided valuable information to understand movement and migratory patterns of young sturgeon that would be difficult to assess since few wild fish have been captured and tagged at similar sizes to the 1994 and 1996 hatchery releases. The releases of YOY and yearling fish indicate that fish remain in their stocked tributaries for two to three years before they begin their coastal migrations. Coastal movements appeared to occur at a variable rate based on size with some fish leaving the stocked tributaries as small as 635mm TL from the Nanticoke and 840mm TL from the Hudson. In all cases it appeared that fish larger than 800mm TL, tended mostly to be migratory, which was reinforced by the release program in the Hudson River in 2004 which were larger fish and were found in other coastal tributaries shortly after release.

Section 2. Wild Atlantic Sturgeon Tagging

A. Recaptures Based on Regions

Nearly 5,000 wild Atlantic sturgeon have been tagged and released in various research and tagging programs along the Atlantic coast and major tributaries from Maine to North Carolina. Overall, there have been 368 recaptures of those wild tagged fish and with some fish recaptured up to three times. Tagging has been conducted in both fishery independent and dependent sampling and recaptures come from those sources as well as commercial fishery reports (via the toll-free phone number). Since several tagging programs can occur in the same geographic areas along the coast, the release and recapture summaries were divided into eight regions to describe Atlantic sturgeon migratory patterns on a regional basis rather than evaluating each tagging program separately.

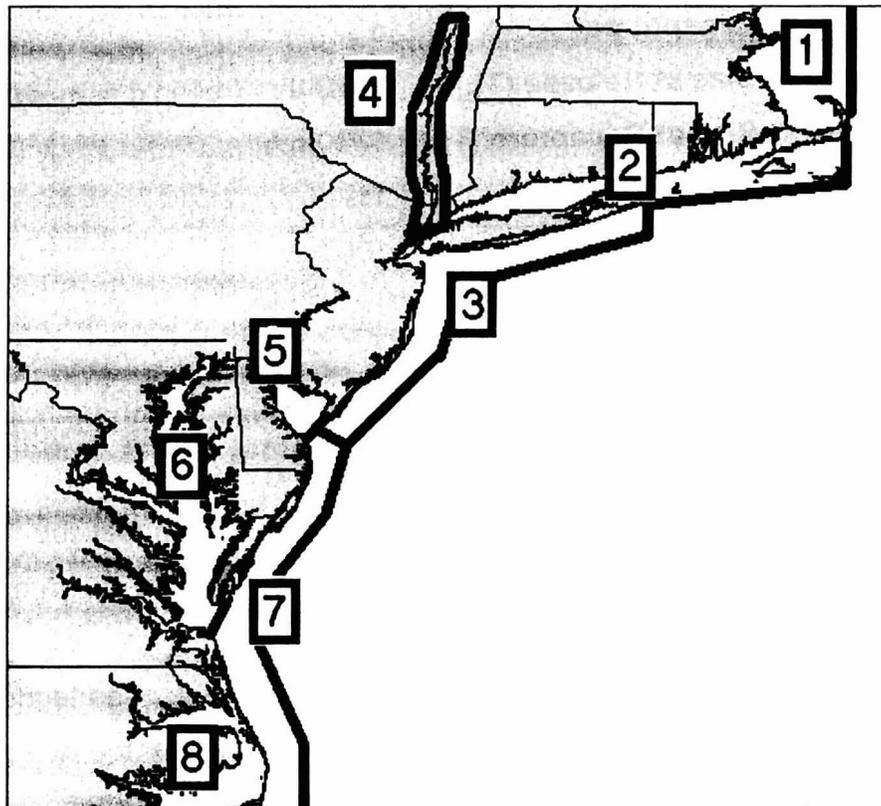


Figure 1. Tagging and recapture regions used to summarize tagged wild sturgeon movements.

**Region 1. Atlantic Coast and tributaries north of Cape Cod,
Massachusetts**

A tagging program was conducted by the state of Maine. All tagging was conducted on adult fish on the spawning grounds in the Kennebec and Sasanoa Rivers. There has only been one recapture, reported from the St. John River in New Brunswick, Canada. The fish was recaptured during a spawning survey by sturgeon researchers in New Brunswick.

Region 1 Summary:

Tagging Agencies	Maine DMR
Tagging Locations	Kennebec and Sasanoa Rivers, ME
Tagging Years	1999-2000
Number Tagged	99
Number Recaptured	1
Average Size at Release (TL)	1220 mm (recap'd fish - 1819mm)
Average Size at Recapture (TL)	1830mm
Recapture Rate	1%
Fidelity to Tagging Region	100%

**Region 2. Long Island Sound to Cape Cod, Massachusetts, including
the Connecticut River and Narragansett Bay**

A tagging program was conducted by the state of Connecticut. The Connecticut based tagging was a result of fishery independent sampling in Long Island Sound and the Connecticut River. Tagging has been conducted annually since 1993. Most of the over 400 fish that have been tagged were sub-adults at the time of tagging. Recaptures ranged from the Atlantic Coast of Rye, New Hampshire to Cape Charles, Virginia in the Chesapeake Bay. Fidelity to tagging region was similar to other Atlantic Coast tagging programs.

Two of the 12 recaptures came from the Connecticut River, where they were originally released. Fish tagged from the Connecticut River have not been captured in any other regions. Fish tagged in Long Island Sound have also never been recaptured in the Connecticut River. Although the Connecticut River and Long Island Sound fish were combined for this analysis, it appears that fish in the River experience high fidelity to tagging region similar to other inland tagging programs (i.e. Hudson River, Chesapeake Bay, etc.).

Region 2 Summary:

Tagging Agencies	Connecticut DEP
Tagging Locations	Connecticut River and Long Island Sound
Tagging Years	1993-2005
Number Tagged	403
Number Recaptured	12
Average Size at Release (TL)	1220mm
Average Size at Recapture (TL)	1241mm
Recapture Rate	3%
Fidelity to Tagging Region	33%

Table 3. Recaptures by Region for wild Atlantic sturgeon tagged in the Connecticut River and Long Island Sound.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	2	17
2. LIS	4	33
3. NY-NJ Coast	2	17
4. Hudson	1	8
5. Delaware Bay	0	0
6. Chesapeake Bay	2	17
7. DE-NC Coast	1	8
8. Inland NC	0	0

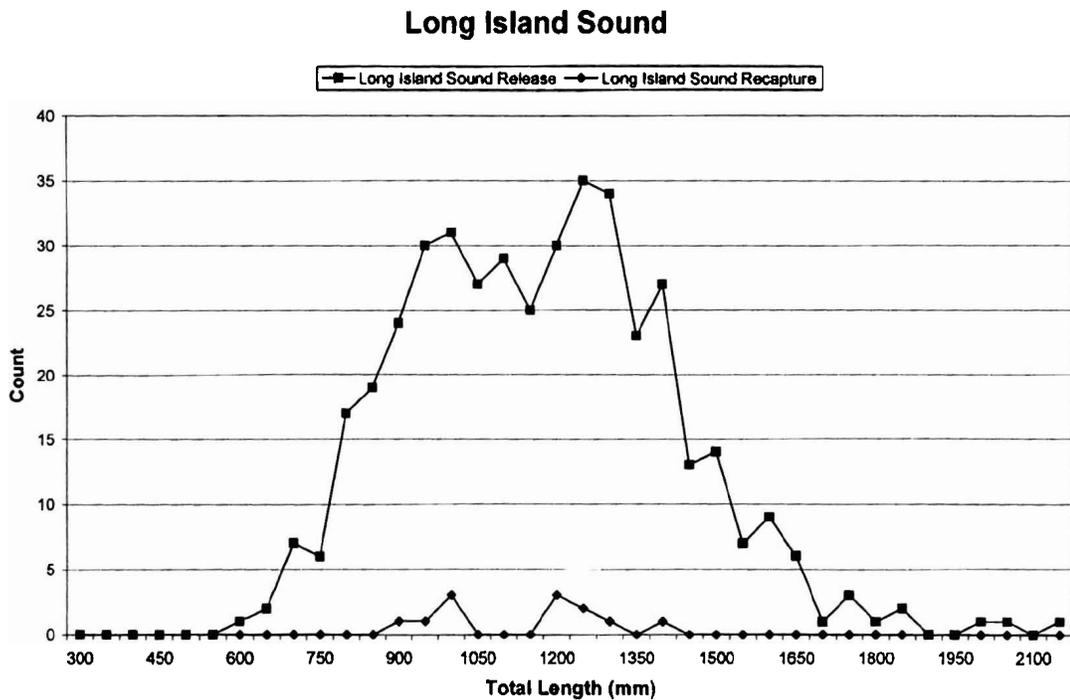


Figure 2. Size distribution of wild Atlantic sturgeon tagged in Long Island Sound and the Connecticut River. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 3. Atlantic Coast of New Jersey and New York, including Raritan Bay

One tagging program, organized by the state of New Jersey, was conducted in this region. Sampling was done from 1992 through 2001 using both fishery dependent and independent sources to collect fish. Nearly 400 fish were tagged in nine years, with most fish being subadults at the time of tagging. A total of 37 have been recaptured, ranging from the Gulf of Maine in Rye, New Hampshire to Nags Head off the coast of North Carolina. Many recaptures were reported from the coast of New Jersey and New York, but fidelity was low, similar to other Atlantic Coastal tagging programs.

Region 3 Summary:

Tagging Agencies	New Jersey DEP
Tagging Locations	Atlantic Coast, NJ
Tagging Years	1992-2001
Number Tagged	390
Number Recaptured	37
Average Size at Release (TL)	1143mm
Average Size at Recapture (TL)	1175mm
Recapture Rate	9%
Fidelity to Tagging Region	35%

Table 4. Recaptures by Region for wild Atlantic sturgeon tagged along the Atlantic Coast of New Jersey.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	3	8
2. LIS	7	19
3. NY-NJ Coast	13	35
4. Hudson	1	3
5. Delaware Bay	5	14
6. Chesapeake Bay	1	3
7. DE-NC Coast	7	19
8. Inland NC	0	0

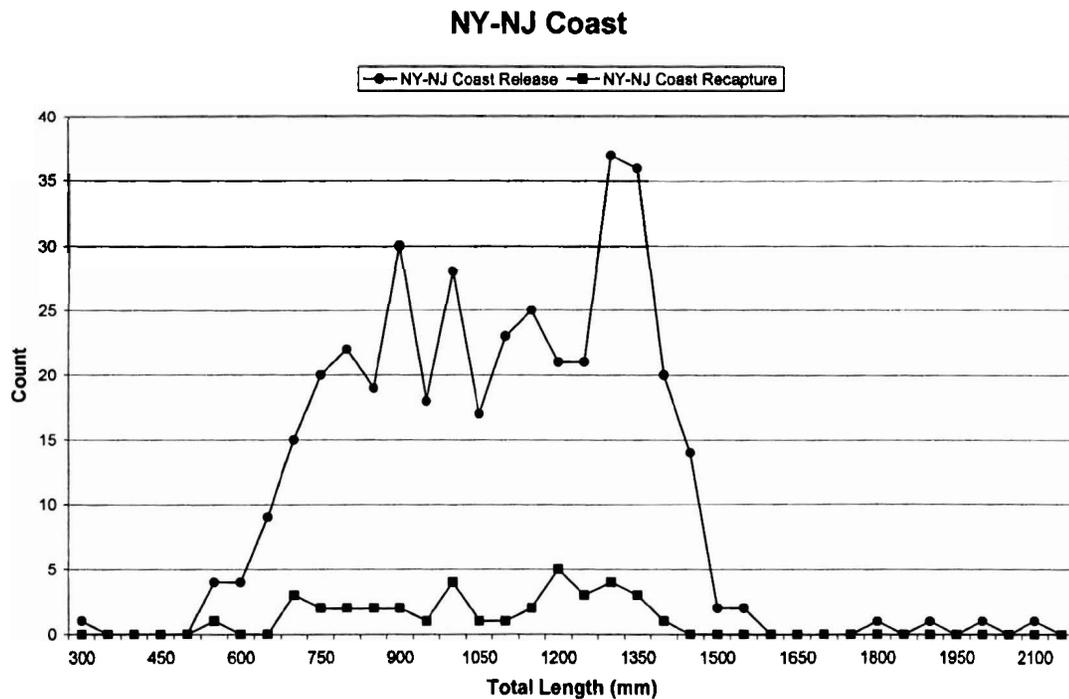


Figure 3. Size distribution of wild Atlantic sturgeon tagged along the Atlantic Coast of New Jersey. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 4. Hudson River

Tagging has been conducted in the Hudson River nearly every year since 1992. Tagging has been done by the state of New York, the U.S. Fish and Wildlife Service, and Cornell University. Over 1,500 fish have been tagged, with a bimodal distribution of small fish and large fish and a noticeable absence of larger subadults (950mm-1550mm TL) from the tagging data. Recaptures have been reported for 92 fish, ranging on the Atlantic Coast from Marshfield, Massachusetts to Diamond Shoals, North Carolina. Most fish were recaptured in the Hudson River, which had recapture fidelity similar to other inland tagging programs.

Larger sturgeon (>1000mm TL) tagged in the Hudson River had a higher fidelity rate to their tagging region than larger fish tagged in other regions, regardless of time at large between tagging and recapture. Overall, 72% of large fish tagged in the Hudson were recaptured in the Hudson, where large fish tagged in other regions only had 41% fidelity to their tagging region. Moreover, large fish tagged in the Hudson and recaptured more than one year after tagging had 63% fidelity to the tagging region compared to 17% fidelity for fish tagged in other areas.

Region 4 Summary:

Tagging Agencies	New York DEC, USFWS-Northeast Fishery Center, Cornell University
Tagging Locations	Hudson River
Tagging Years	1992-2005
Number Tagged	1542
Number Recaptured	92
Average Size at Release (TL)	1685mm
Average Size at Recapture (TL)	1333mm
Recapture Rate	6%
Fidelity to Tagging Region	68%

Table 5. Recaptures by Region for wild Atlantic sturgeon tagged in the Hudson River.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	1	1
2. LIS	2	2
3. NY-NJ Coast	15	16
4. Hudson	63	68
5. Delaware Bay	2	2
6. Chesapeake Bay	4	4
7. DE-NC Coast	5	5
8. Inland NC	0	0

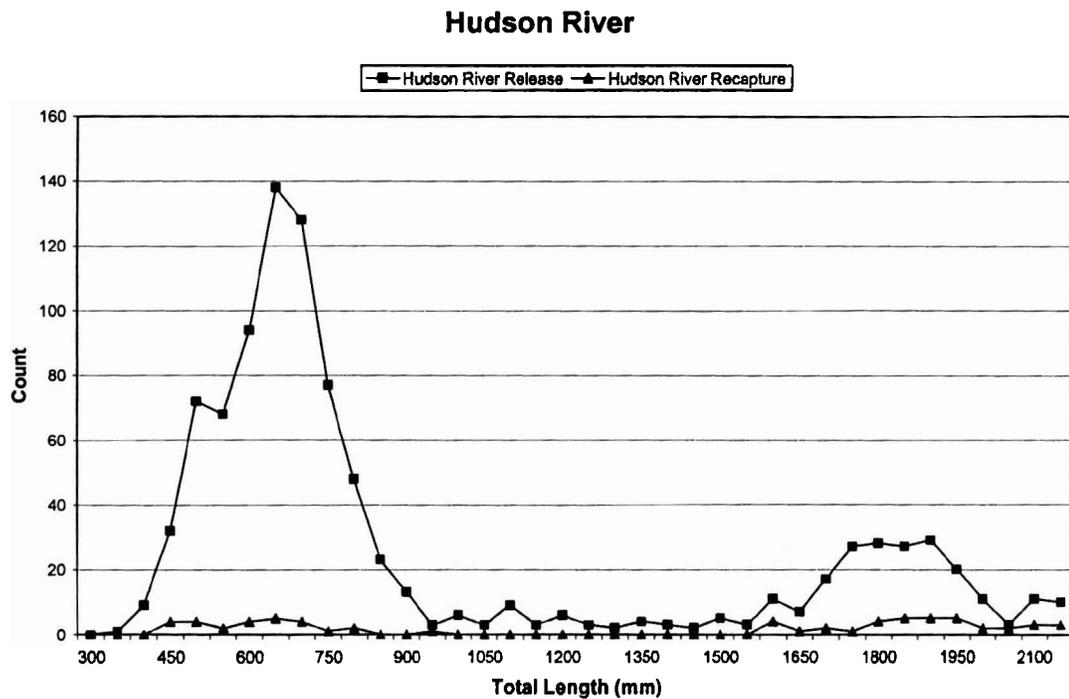


Figure 4. Size distribution of wild Atlantic sturgeon tagged in the Hudson River. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 5. Delaware River and Delaware Bay

Several tagging programs have operated in the Delaware River and Bay, but most tagging has been conducted by the state of Delaware. Tagging has been done nearly every year since 1993, resulting in 629 fish being tagged. Most fish tagged have been sub-adults ranging from 600 to 1300mm TL. Recaptures have been reported from 49 fish that have ranged along the Atlantic Coast from Chatham, Massachusetts to south of Oregon Inlet, North Carolina. Of the inland tagging programs, fish tagged in the Delaware River and Bay had the lowest fidelity to tagging region for recaptured fish.

Region 5 Summary:

Tagging Agencies	Delaware DFW, New Jersey DEP, Army Corps, National Marine Fisheries Service
Tagging Locations	Delaware River and Delaware Bay
Tagging Years	1993-2004
Number Tagged	629
Number Recaptured	49
Average Size at Release (TL)	900mm
Average Size at Recapture (TL)	1079mm
Recapture Rate	8%
Fidelity to Tagging Region	49%

Table 6. Recaptures by Region for wild Atlantic sturgeon tagged in the Delaware River and Delaware Bay.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	1	2
2. LIS	2	3
3. NY-NJ Coast	7	14
4. Hudson	1	2
5. Delaware Bay	24	49
6. Chesapeake Bay	1	2
7. DE-NC Coast	13	27
8. Inland NC	0	0

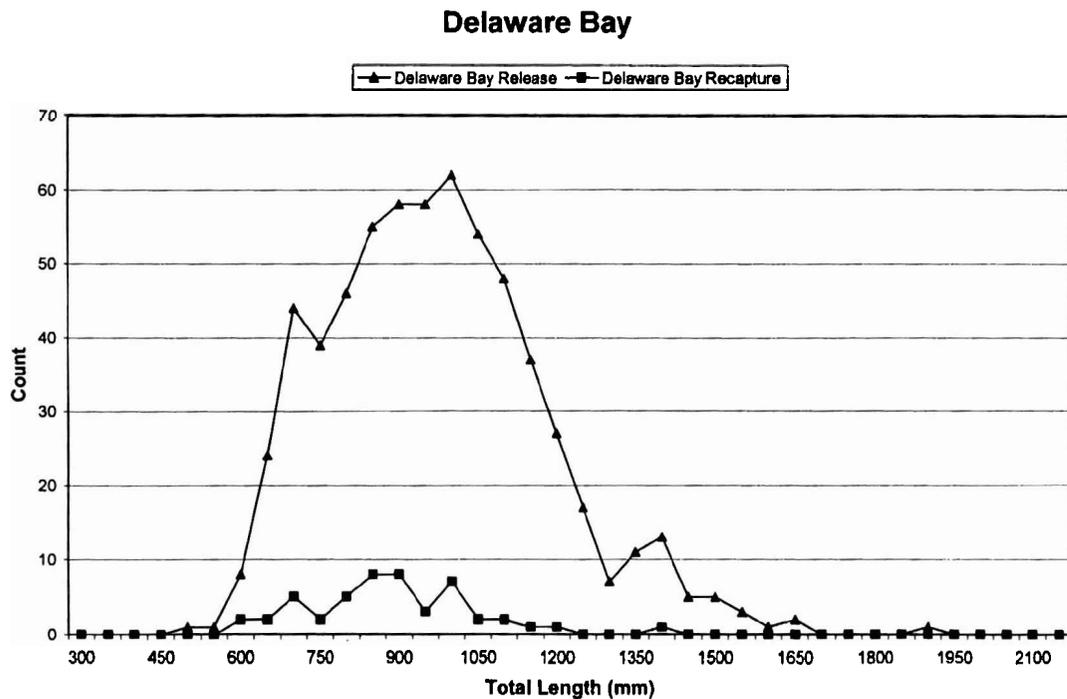


Figure 5. Size distribution of wild Atlantic sturgeon tagged in the Delaware River and Delaware Bay. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 6. Chesapeake Bay, including all tributaries

Tagging done in the Chesapeake Bay and tributaries has been coordinated by the Maryland Department of Natural Resources, Virginia Institute of Marine Sciences, and the U.S. Fish and Wildlife Service Offices in Maryland and Virginia. Tagging has been conducted annually since 1993, resulting in over 1,200 wild fish tagged. Most fish were captured and tagged during reward programs where fish were incidentally captured by commercial fishermen targeting other species. The majority of fish tagged have been subadults (less than 1000mm TL). The smaller individuals (generally less than 500mm TL) were captured and tagged in the James River, Virginia. The Chesapeake Bay had a high recapture rate compared to other tagging programs, with 141 tagged fish reported. Although fish tagged in this region also had a high recapture fidelity to the Chesapeake Bay, other recaptures ranged from Long Island Sound, Connecticut to Hatteras on the Atlantic Coast of North Carolina. Recaptures were also reported in the inland Sounds of North Carolina.

Region 6 Summary:

Tagging Agencies	USFWS – Maryland and Virginia, Maryland DNR, VIMS
Tagging Locations	Chesapeake Bay and tributaries
Tagging Years	1993-2005
Number Tagged	1,208
Number Recaptured	141
Average Size at Release (TL)	690mm
Average Size at Recapture (TL)	818mm
Recapture Rate	12%
Fidelity to Tagging Region	78%

Table 7. Recaptures by Region for wild Atlantic sturgeon tagged in the Chesapeake Bay and Tributaries.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	0	0
2. LIS	1	1
3. NY-NJ Coast	6	4
4. Hudson	0	0
5. Delaware Bay	2	1
6. Chesapeake Bay	110	78
7. DE-NC Coast	18	13
8. Inland NC	4	3

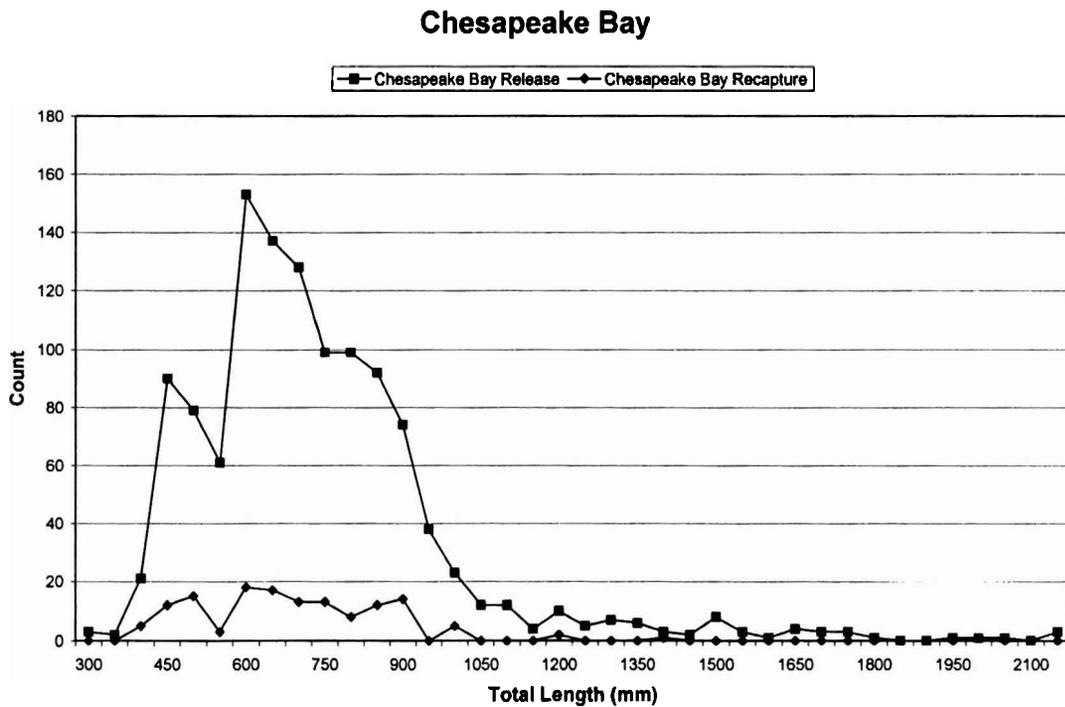


Figure 6. Size distribution of wild Atlantic sturgeon tagged in the Chesapeake Bay and tributaries. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 7. Atlantic Coast from Hatteras, North Carolina to the mouth of Delaware Bay

Several tagging programs have been conducted in this region, including efforts by the states of Maryland, Delaware, Virginia, the U.S. Fish and Wildlife Service, the University of North Carolina, and the National Marine Fisheries Service. Tagging has been done every year in this area since 1998, but not all agencies have tagged each year. A total of 276 fish have been tagged in this region, with most of those fish being less than 1200mm TL. Fourteen fish have been recaptured, ranging from Rhode Island Sound, Rhode Island to the New and Cape Fear Rivers in North Carolina. Fidelity to tagging region for recaptures has been relatively low and similar to other Coastal tagging programs.

Region 7 Summary:

Tagging Agencies	Maryland DNR, Delaware DFW, NMFS, Virginia MRC, VIMS, UFWS-MD, and U of NC
Tagging Locations	Atlantic Coast of DE, MD, VA, and NC
Tagging Years	1988-2005
Number Tagged	276
Number Recaptured	14
Average Size at Release (TL)	876mm
Average Size at Recapture (TL)	1263mm
Recapture Rate	5%
Fidelity to Tagging Region	50%

Table 8. Recaptures by Region for wild Atlantic sturgeon tagged along the Atlantic Coast from Delaware to North Carolina.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	0	0
2. LIS	1	7
3. NY-NJ Coast	1	7
4. Hudson	1	7
5. Delaware Bay	0	0
6. Chesapeake Bay	2	14
7. DE-NC Coast	7	50
8. Inland NC	2	14

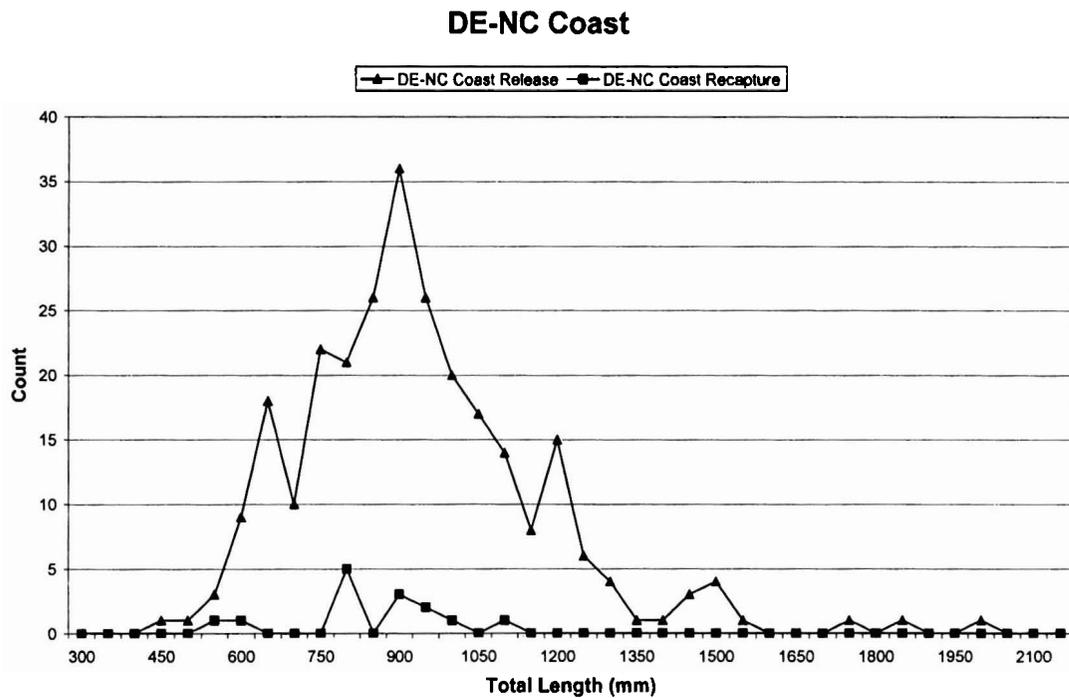


Figure 7. Size distribution of wild Atlantic sturgeon tagged along the Atlantic Coast from Delaware to North Carolina. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

Region 8. Inland waters of North Carolina, including all Sounds and Rivers

Tagging in this region has been done primarily by the state of North Carolina with assistance from Universities. Over 380 fish have been tagged in this region, with no adults, and most fish being some of the smallest tagged in any tagging program. These fish had the highest recapture rate of 15% and the highest fidelity to tagging region of any other program (96%). Of the 57 recaptures, only two were recaptured outside of their tagging region, and those recaptures occurred at the mouth of the Potomac River in Virginia and 3 miles off the Atlantic Coast of North Carolina at Big Fatty. Fish tagged in the inland waters of North Carolina have never been recaptured along the coast north of the Chesapeake Bay, and no fish tagged along the Atlantic Coast north of the Chesapeake Bay have been recaptured in the inland waters of North Carolina.

Region 8 Summary:

Tagging Agencies	North Carolina DMF, U of NC, and NCSU Coop Unit
Tagging Locations	Albemarle Sound and Tributaries, Cape Fear River
Tagging Years	1998-2005
Number Tagged	382
Number Recaptured	57
Average Size at Release (TL)	565mm
Average Size at Recapture (TL)	561mm
Recapture Rate	15%
Fidelity to Tagging Region	96%

Table 9. Recaptures by Region for wild Atlantic sturgeon tagged in the inland waters of North Carolina.

Region of Recapture	Number of Recaptures	Percent of Recaptures
1. Northeast	0	0
2. LIS	0	0
3. NY-NJ Coast	0	0
4. Hudson	0	0
5. Delaware Bay	0	0
6. Chesapeake Bay	1	2
7. DE-NC Coast	1	2
8. Inland NC	55	96

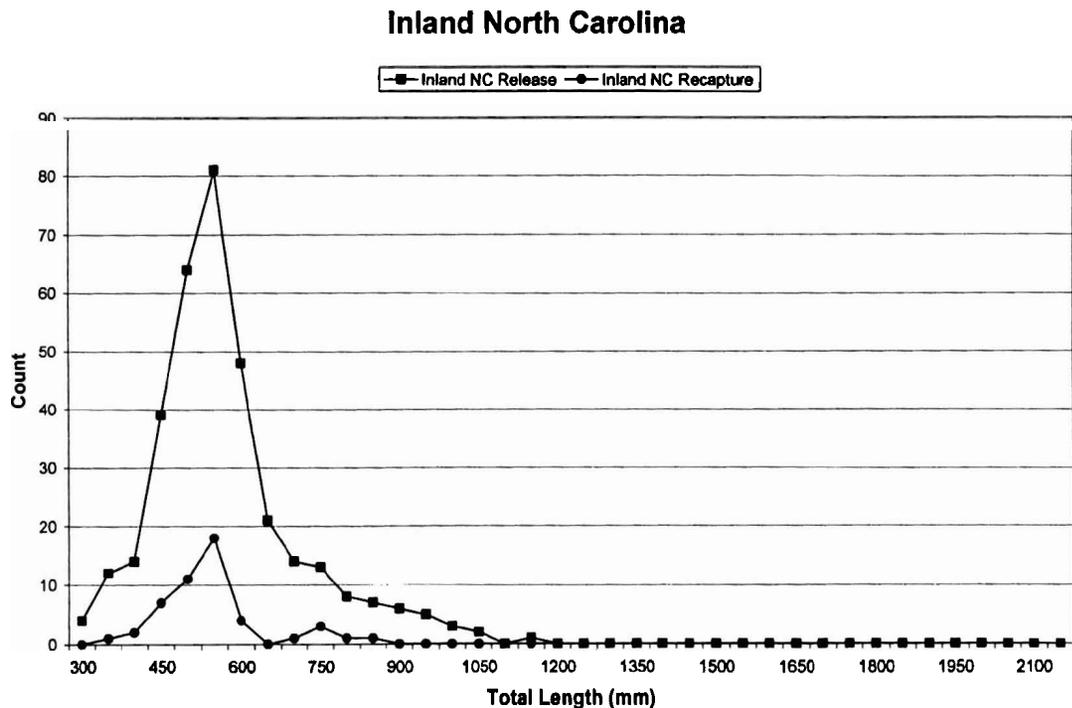


Figure 8. Size distribution of wild Atlantic sturgeon tagged in the inland waters of North Carolina. The top line indicates sizes at initial release for all tagged fish and the bottom line indicates sizes at initial release for all fish that have been recaptured.

B. Coastal Migratory Range Summary

The Coastal range of recaptures was related to original release locations. Fish that were tagged from Delaware Bay and north had recaptures reported north of Cape Cod and south to the Atlantic Coast of North Carolina, but never in the inland waters of North Carolina. Fish tagged from the Atlantic Coast of Delaware and south (including Chesapeake Bay) were never recaptured north of Cape Cod, but were recaptured in the inland waters of North Carolina. Fish tagged in inland waters had higher fidelity to a tagging region than those fish tagged on the Atlantic coast. Fish tagged in the inland waters of North Carolina had the highest fidelity of all tagging programs, and those fish were only recaptured in the Chesapeake Bay and along the Atlantic coast of North Carolina.

C. Coastal Movements Based on Size

Wild Atlantic sturgeon regional fidelity was linked to size at release and time at large. Sturgeon had the highest fidelity to a tagging region if they were tagged at a smaller size (<600mmTL) and were recaptured within one year of tagging. The sturgeon tagged at a larger size (>1000mmTL) and recaptured more than one year after tagging had the lowest fidelity to their tagging region.

Table 10. Fidelity to tagging region at recapture for wild Atlantic sturgeon based on time at large after tagging and size at release.

Size at Release (mm TL)	Time At Large	Percent in Tagging Region	Number of Recaps.
<600	<1 Year	94	62
600-1000	<1 Year	79	121
>1000	<1 Year	65	65
<600	>1 Year	65	20
600-1000	>1 Year	43	68
>1000	>1 Year	36*(17)	39

*Large fish tagged in the Hudson tended to be recaptured in the Hudson (63%, N=16), the 17% value is from the Hudson River fish being removed from the analysis.

Tagging programs conducted in inland areas typically tagged smaller fish, where coastal tagging programs tagged larger sub-adults. Coastal tagging programs apparently encountered fish during migratory movements which was reinforced by the low fidelity to tagging region when coastal fish were recaptured.

Section 3. Recaptures in Commercial Gear

The general public, mostly commercial fishermen, who encounter a tagged Atlantic sturgeon can call the toll-free phone number to report the tag and capture information to the USFWS in Annapolis, MD. Since 1992, 6,552 Atlantic sturgeon (wild and hatchery-reared) have received external tag(s). Of those fish, 312 (5%) have been recaptured and reported through this system. Of the recaptured fish, 286 (92%) were captured alive, 14 (5%) fish were found dead and 12 (4%) fish suffered gear related mortalities.

A. Commercial Gear Types

Gillnets were the primary gear reported with sturgeon as bycatch (82% comprising anchored, drift, and unspecified gillnets). Anchored gillnets were the most common gear type, with 55% of all bycatch reports. The next most common gear types besides gillnets were trawls and pound nets at 7% each, and 2% of reports coming from hook-and-line captures.

Recaptures by gear type varied among regions, but gillnets (primarily anchored) had the highest percentage of recaptures in all regions. Gear effort varied by time of year and region.

Table 11. Percentage of sturgeon recaptured in each region based on gear type and time of year gear was reported to be fished.

Region	Gillnet	Trawl	Other	Number of Reports
1 – Northeast	June-August (100%)	-	-	7
2 – LIS	May-June (50%)	Year Round (42%)	Trap – 8%	12
3 – NY-NJ Coast	April-June & Sept.-Dec. (81%)	June-Dec (14%)	Hook & Line – 5%	43
4 – Hudson	April-June (83%)	-	Hook & Line – 17%	6
5 – DE Bay	March-October (100%)	-	-	14
6 – Ches. Bay	Year Round (76%)	-	Pound Net – 19% Other – 3%	98
7 – DE-NC Coast	Nov.-May (87%)	Year Round (10%)	Pound Net – 2% Hook & Line – 2%	60
8 – Inland NC	Oct.-May (91%)	Year Round (7%)	Hook & Line – 2%	45

B. Gear Related Mortality

Of the 312 reports from the public (primarily commercial fishermen), 12 (3.6%) of those fish were reported dead because of interaction with fishing gear. Ten of the 12 reports were from anchor gillnets, one from drift gillnet and one fish without a gear type reported.

Table 12. Gear mortalities of tagged Atlantic sturgeon described by recapture region, percentage of gillnet captures, and time of year.

Region	Number Dead	Percent of all Anchor Gillnet	
		Reports	Time of Year
3 – NY-NJ Coast	2	8%	December
5 – DE Bay	1	no gear type reported	April
6 – Ches. Bay	2 (anchor) 1 (drift)	5.7 (anchor) 3.7 (drift)	March, June, October
7 – DE-NC Coast	3	6.5	May, June, October
8 – Inland NC	3	9	February, April, May

C. Non-Gear Mortality

Of the 312 reports from the public, 14 fish (4.3%) were reported to be found dead, not directly related to fishing activity. Nearly half (43%) of those reports were within one month of initial tagging and release. Most (71%) of the reports of dead fish came in the summer months. Most fish did not have a cause of death apparent, but two fish had obvious injuries from propellers in the Hudson River and one fish was impinged on a water intake gate at a nuclear power plant in the Delaware River.

D. Target Species

In some cases, when commercial fishermen report a tagged sturgeon, they provide information on the target species for their fishery. Of the 238 reports on bycatch information, 11 reports stated that sturgeon was their target species (prior to the fishery closure), and half of those fish were harvested. One hundred fifty-nine of the remaining reports had various target species identified. The target species and gear types are described by region of recapture.

Region 1. Northeast

Five reports came from the northeast region, all reports from gillnets. Three of the reports targeted dogfish, all prior to 1999. One report was from monkfish in 2000 and the remaining report was from a flounder fisherman.

Region 2. LIS

Three reports came from LIS, all targeting flukes and flounder. Recaptures came from two anchored gillnets and a trawl.

Region 3. NY-NJ Coast

Eighteen reports came from the NY-NJ coast. Primary target species included Bluefish, Weakfish, and Menhaden which were indicated in 10 of the reports, using anchored (n=5) and drift gillnets (n=4) as well as trawls (n=1). Monkfish, using anchored gillnets, were indicated in 4 of the reports, all prior to 1999. Flounder were indicated in two of the trawl recaptures. Seabass were indicated in one trawl recapture and striped bass were indicated as the target for a hook-and-line recapture.

Region 4. Hudson

One recapture was reported from a Hook & Line fisherman targeting striped bass.

Region 5. Delaware Bay

Three reports came from the Delaware Bay region, all from gillnets. Two reportedly were targeting shad and one targeting striped bass and perch.

Region 6. Chesapeake Bay

Fifty-six reports came from the Chesapeake Bay region. Striped bass were the primary target species, indicated in 41 reports (73%). Striped bass captures came in anchored gillnets (n=17), drift gillnets (n=13), unspecified gillnets (n=9), pound nets (n=1), and hook-and-line (n=1). White perch were targeted in five reports, two in anchored gillnets, two in drift gillnets and one in a pound net. Baitfish were targeted in five reports, three from anchored gillnets and two from pound nets. Other target species included weakfish, croaker, and spiny dogfish (in 1993).

Region 7. DE-NC Coast

Forty-four reports came from the Atlantic Coast region from Delaware to North Carolina. Striped bass were the primary target species, indicated in 26 (59%) reports. Striped bass captures came in anchored gillnets (n=24) and drift gillnets (n=2). Dogfish were the next highest reported target species, with nine reports from anchored gillnets. American shad had five reports, four from anchored gillnets and one from a drift gillnet. Other target species included menhaden, weakfish, sand shark, flounder, and horseshoe crabs.

Region 8. Inland NC

Twenty-nine reports came from the inland waters of North Carolina. Flounder were the primary target species in this region with 13 reports (45%), all from anchored gillnets. Striped bass were reported seven times (24%), all captured in anchored gillnets as well. American shad had six reports (21%) from anchored gillnets (n=5) and drift gillnets (n=1). Other target species included mullet, grey trout, and white perch, all in anchored gillnets.

Target Species Summary

Some of the 159 target species reports indicated more than one target species. From the reports, Striped Bass were the most commonly reported target species (49%). Other notable target species included flounder, shad, dogfish, and Sciaenids.

Regarding gear-related mortality, target species were indicated for six of the sturgeon reportedly killed in recapture gear (all anchored gillnets). In some cases, more than one target species was identified. In one of the reports, dogfish were cited as the target species (in 1994), striped bass were

cited in four reports, flounder were cited in three reports and menhaden were cited in one report.

Table 13. Target species and gear type reported by commercial fishermen reporting bycatch of tagged Atlantic sturgeon. Information was taken from 159 reports where one or more target species were indicated.

Target Species	Anchored Gillnet	Drift Gillnet	Unspec. Gillnet	Other	Total Reports	% of All Reports
Striped Bass -43	50	15	9	3-Hook&Line 1-Pound Net	78	49
Flounder -13	12		4	8-Trawl	24	15
Shad -4	11	3			14	9
Dogfish -7	11		2		13	8
Sciaenids -7	7	3	1	2-Pound Net	13	8
Baitfish/Menhaden -4	6			2-Pound Net	8	5
White Perch -4	3	2	1	1-Pound Net	7	4
Monkfish -3	5		1		6	4
Bluefish -3	3	2		1-Trawl	6	4
Other -8	6		2	4-Pound Net 2-Trawl	14	9

114 25 20 24 / 159

Section 4. Benefits of a Coordinated Tagging Program

Tagging and recapture information for sturgeon can provide valuable information for sturgeon management, but there are shortfalls to the data presented in this report that must be mentioned. Although there has been good participation by sturgeon researchers and state agencies along the Mid-Atlantic and Northeast U.S., efforts are not consistent between studies or across the species range. Studies on sturgeon have been conducted for varying lengths of time and of varying intensity, with few projects keeping consistent effort over a long time period. Further, tagging methods have not been consistent between studies, and tag retention and tag loss issues are a factor when analyzing migratory movements of fish over time. Further, if relatively rigorous sampling programs end in a particular area (ex. Hudson River) after a period of time, and there is little or no commercial fishing effort there, we will not have any recapture data for those fish; not because the fish are not there, but rather because no one is looking for them. Currently, the program is not coordinated to the point where well

coordinated sampling efforts along the Coast are occurring so that we can address large-scale sturgeon management questions.

To improve data collection on tagged sturgeon, tagging programs must be standardized, and captured sturgeon must be examined for existing tags. The program is currently attempting to standardize tagging to one external tag and one PIT tag. The external tag provides a means for commercial fishermen and other non-sturgeon researchers to report captures of fish in the first one to two years after tagging. The PIT tag allows sturgeon researchers to identify previously tagged sturgeon for potentially as long as the life-span of the fish. Data collection over long periods of time and over a wide geographic range will be invaluable in management of the stocks. Increased effort of identifying recaptured fish through fishery dependent sampling, such as the NOAA Observer Program, could provide better data regarding bycatch, and mortality in current commercial fisheries, as well as provide largely unknown information about sturgeon migratory behavior along the Atlantic Coast. The observer program coupled with comparably rigorous sampling programs in inland areas will significantly increase our understanding of current commercial fishery impacts on sturgeon as well as increase our knowledge of sturgeon's migratory behavior.

Summary

The USFWS currently is operating a voluntary tagging program that has had good participation from different sturgeon studies along the coast and tributaries. Data from this program provide important information on migratory movements of Atlantic sturgeon in the mid-Atlantic and Northeast U.S. and gives some insight on potential issues with bycatch and bycatch mortality. Further standardization of tagging programs between jurisdictions may provide enough information about sturgeon to determine stock size, get better estimates of migratory patterns, better evaluate growth and how it relates to migratory behavior, and better understand which commercial fisheries encounter sturgeon and which may cause mortality. Improved standardization of Atlantic sturgeon tagging data can ultimately assist fishery managers in better managing existing stocks and to more effectively rebuild stocks in areas where they have been depleted.