Jordan Basin Closure Proposal to NMFS and the LWTRT; February 2, 2012

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Despite 15 years of effort by the fishing community, the National Marine Fisheries Service (NMFS), and the Atlantic Large Whale Take Reduction Team (TRT), North Atlantic right whales continue to die from entanglements in fishing gear at levels above the allowable Potential Biological Removal (PBR). Weak-links and sinking groundline are now mandated in most fixed gear fisheries, yet entanglement rates remain high, apparently from vertical lines. To address the vertical line problem, the proposals presented by NMFS to the TRT in January of 2012 used a co-occurrence model (using overlaps between fishing activity, right whales, and humpbacked whales) to assess potential risk areas. The proposed changes involve increasing the number of traps per endlines with different requirements by area and zone, which led to an estimated 38% reduction in vertical lines for all areas proposed for regulation in the Gulf of Maine combined (excluding exempted inshore waters). One problem with the proposal is that aggregating the right whales and humpback whales together confuses any analysis aimed at understanding the effects of such measures on each species separately. Because PBR for right whales is so low (0.7 whales per year), reducing the lethal entanglements of this species are a critical priority, and a 38% reduction (assuming this actually represented the probability of lethal entanglement) is not enough to get right whales below PBR under optimistic scenarios. Because of that alone, additional measures are needed, and such measures are feasible for right whales in light of our understanding of how they use the Gulf of Maine.

Although the co-occurrence model and the NMFS proposal reduce the probability of overlap between endlines and whales, it is only the first step in reducing risk from entanglements. Serious and fatal entanglement risk is a combination of 1) the probability of encounter (addressed in the NMFS proposal and co-occurrence model), 2) the probability of that encounter turning into an entanglement, and 3) the probability of that entanglement turning into a serious or fatal injury. Therefore, while the proposed level of reduction in endlines is a positive start that will lead to some entanglement risk reduction, the lack of data on the second two parts of the risk equation mean that it is impossible to translate it into a quantitative estimate of the likely reductions in entanglements. This lack of quantitative linkage between entanglement risk and the various proposals for endline reduction provides no evidence that they will meet PBR. Given the lack of viable alternatives to endline technology, the only certain and quantifiable method for reducing entanglements is to eliminate endlines in high density whale habitats. This proposal is intended as a supplement to the NMFS endline proposal, in order to ensure that right whale entanglements in northeastern fisheries are reduced to levels below PBR.

In the middle of winter, Jordan Basin is a high-use habitat for North Atlantic right whales, and we propose to eliminate the possibility of entanglement in that location for a critical period in the species life history. Because of the offshore nature of the area, very few fishermen work there in the winter months. However, those that do are fishing long trawls of lobster gear with limited endlines. It is therefore tempting to think that this should be a low priority for management. But the data show that the increased rope strengths are responsible for most adult whale entanglements (probably due to their inability to break free), and that juveniles may be dying in the stronger rope (see Appendix 1). Further, complex entanglements have been significantly increasing over time, and complexity is strongly correlated with mortality (Appendix 1). Since complex entanglements are characterized by longer trailing line, more body wraps, and heavier gear weights, the evidence suggests that complex entanglements are likely to be associated with offshore pot trawls and gillnet gear. Therefore, the Jordan Basin area must be considered a high risk area.

We propose to close a section of Jordan Basin (Figures 1 and 2) to all fishing with endlines from November 1 to January 31st (in addition to any endline reduction proposal). The proposed area, shown outlined in white in Figure 1, would cover 90% of the Jordan Basin hot spots identified to date. It would also protect a minimum of 45% of right whales observed and identified in the months November, December, and January within the analysis area shown in Figure 4 (based on Right Whale Consortium sightings data 1978 – 2010). The justification for closing this area is based on three facts. One, it appears that the area is the only known mating ground for the North Atlantic right whale, in which courtship activity is highly likely to produce conceptions. Two, this analysis suggests a high level of protection for a very small closure area relative to Gulf of Maine habitat. Three, there is very little fishing in the area during these months, so fishing displacement is minimal. This proposal does not exclude the possibility that alternative fishing methods may be discovered that could be allowed within this area if no endlines were used.

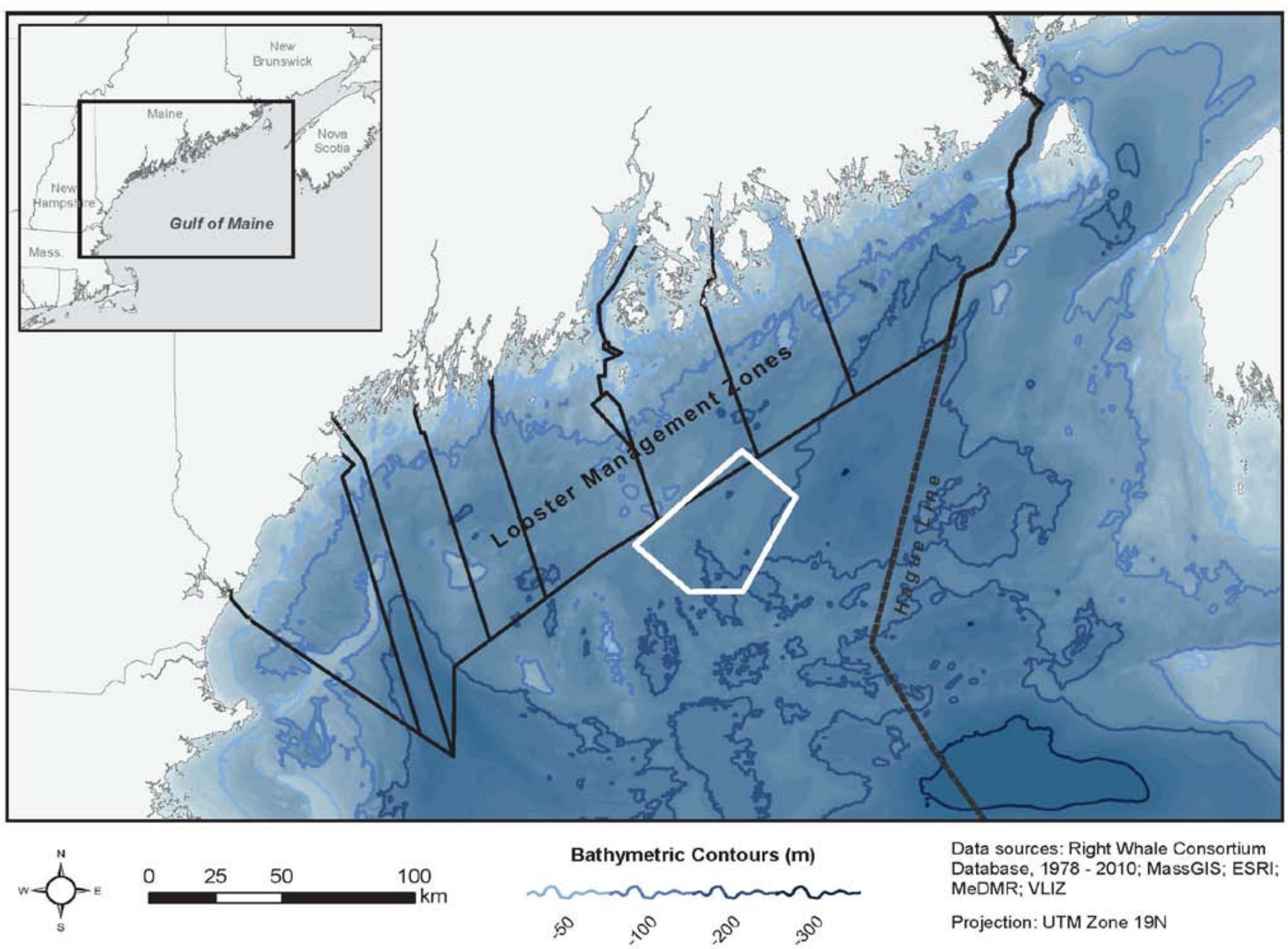

Figure 1. Jordans Basin with sightings, bathymetric contours, and boundaries of the proposed annual closure to vertical lines for November, December and January.

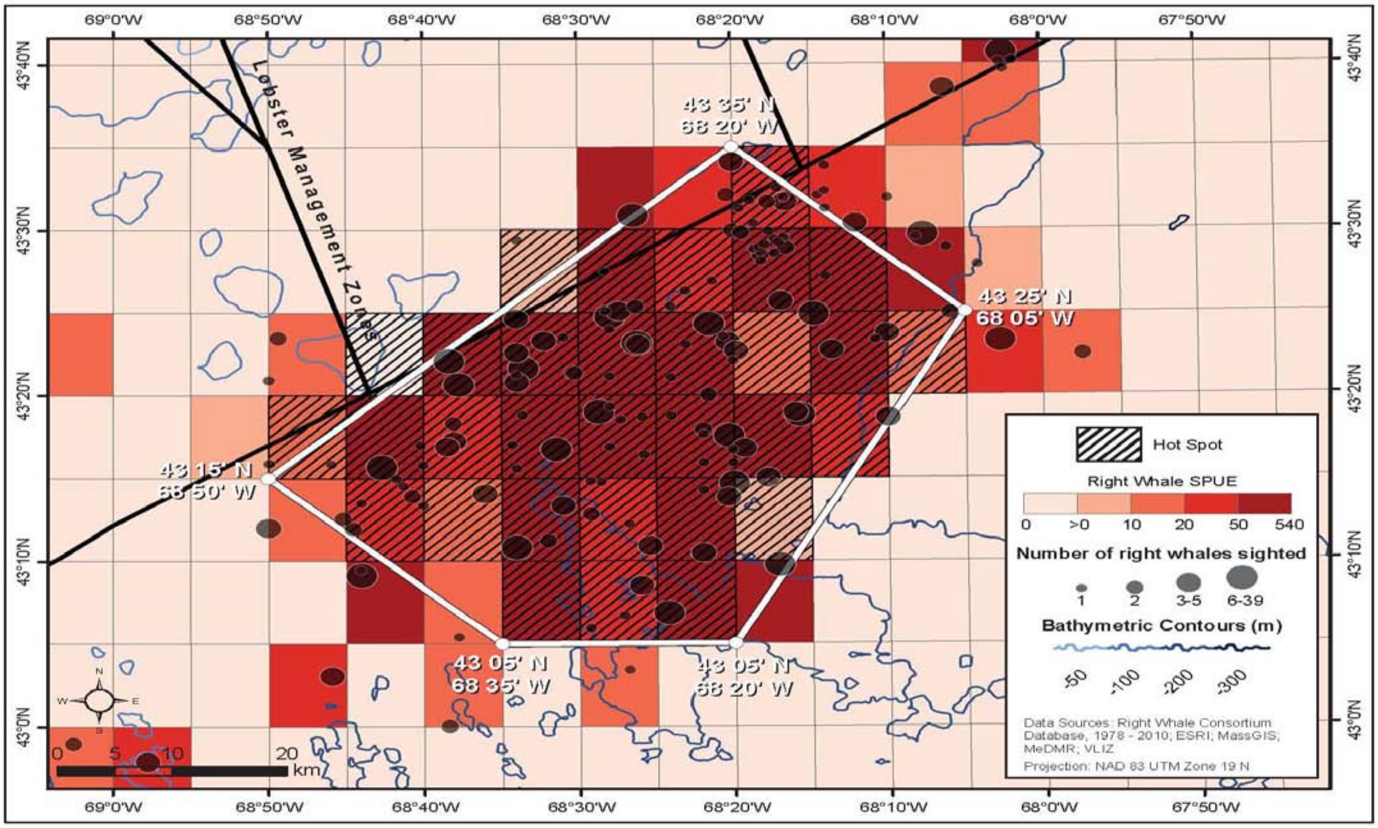

Figure 2. The proposed Jordans Basin November/December and January Closure area in relation to Maine's lobster management zones, the Hague line, SPUE and sightings data, and bathymetric contours.

Methods

The *Hot Spot Analysis* tool in ArcGIS 10 was used to identify statistically significant hot spots of right whale distribution using the Getis-Ord Gi* statistic. The input values were North Atlantic right whale sightings per unit effort (SPUE) based on a 5' X 5' grid covering the Gulf of Maine and extending south past Georges Bank (extent: SW corner 39 N, 72 W; NE corner 45 10' N, 66 W: Figure 4). On-effort variable parameters remained consistent with those set by Dr. Robert Kenney and The North Atlantic Right Whale Consortium Database, with the exception of inclusion of animals sighted in a beaufort sea state 4 or less, appropriate for right whales, where sightability is only slightly compromised. The Beaufort sea state of 4 is also consistent with the IE/NMFS co-occurrence model dataset, and all subsequent analyses. The SPUE data for the months of November, December, and January showed the highest density of right whales in the Jordan Basin area, and only those three months were used in this analysis. To account for unreliable SPUE values where too little survey effort occurred, only 5' grid cells with total survey trackline effort of greater than 50 km were used.

SPUE = (Number of animals / Distance of survey trackline (km)) * 1000. In the formula given below, x = the SPUE value for each 5' square (j). This analysis was applied to the entire study area (Figure 4) for the months of November, December and January. The analysis parameter applied was *Fixed Distance Band*, which analyzes each feature within the context of neighboring features found within the threshold distance, specified here at 10 km. The analysis was applied to the whole Gulf of Maine, and resulted in 36 5' cells identified as statistically significant hot spots, with p-values < 0.01 and z-scores > 0 (Figure 3). Table 1 includes those identified cells and their corresponding p-values, z-scores, and SPUE value for the months of November, December, and January. For cell reference numbers, see Figure 3.

The Getis-Ord local statistic is given as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \bar{X} \sum_{j=1}^{n} w_{i,j}}{S \sqrt{\frac{\left[n \sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j} \right)^2 \right]}{n-1}}} \tag{1}$$

where x_j is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \tag{2}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \left(\bar{X}\right)^2} \tag{3}$$

The G_i^* statistic is a z-score so no further calculations are required.

Table 1: Hot Spot analysis results.

Cell Ref. Number	P-Value	Z-Score	Nov/Dec/Jan SPUE
1	0.004175	2.864658	47.434239
2	0.001327	3.210065	4.786979
3	0.000061	4.010415	74.626866
4	0.000001	4.986095	23.618328
5	0.000388	3.548393	101.455668
6	0	5.040196	61.2323
7	0.000004	4.613215	0
8	0.000612	3.426265	66.955494
9	0	5.576322	150.486869
10	0	7.469889	95.436922
11	0	6.25217	106.549671
12	0	6.183191	16.402406
13	0.006334	2.72998	85.027726
14	0.009636	2.588639	11.883541
15	0.000038	4.118223	12.143291
16	0.000017	4.299515	228.273929
17	0	5.90403	25.393601
18	0	6.262767	53.807947
19	0	6.438294	57.666214
20	0	7.89973	169.902913
21	0.000003	4.674836	98.347758
22	0.004008	2.877556	26.631158
23	0	5.100526	29.271862
24	0.004269	2.857603	16.650017
25	0.000009	4.445204	125.189681
26	0.000001	4.983526	46.232085
27	0	10.893938	78.017439

28	0.004448	2.844476	6.253909
29	0.001454	3.183622	61.919505
30	0	8.338674	28.901734
31	0	10.198619	389.221557
32	0.003499	2.920148	44.296788
33	0.000148	3.79373	9.380863
34	0.000167	3.763869	12.406948
35	0.000214	3.701853	146.627566
36	0.000015	4.323294	90.909091

The proposed closure area, shown outlined in white in Figure 1, would cover 75% of the total hot spot area, and would cover 88% of the hot spot area excluding outlying cells 32-36 (see Figure 3). It would also eliminate the threat of any entanglement for 45% of right whales found in the Gulf of Maine and Georges Bank (extent: SW corner 39 N, 72 W; NE corner 45 10' N, 66 W) in the months November, December, and January. The number of animals within the proposed area was defined as the sum number of animals sighted within 5' grid cells with centerpoints that fell within the proposed area boundary, based on Right Whale Consortium sightings data 1978 – 2010. This proposal has a high benefit (protection for 45% of wintering right whales in the analysis area) with a very low cost to fisheries (total closure of only 1% the total analysis area.

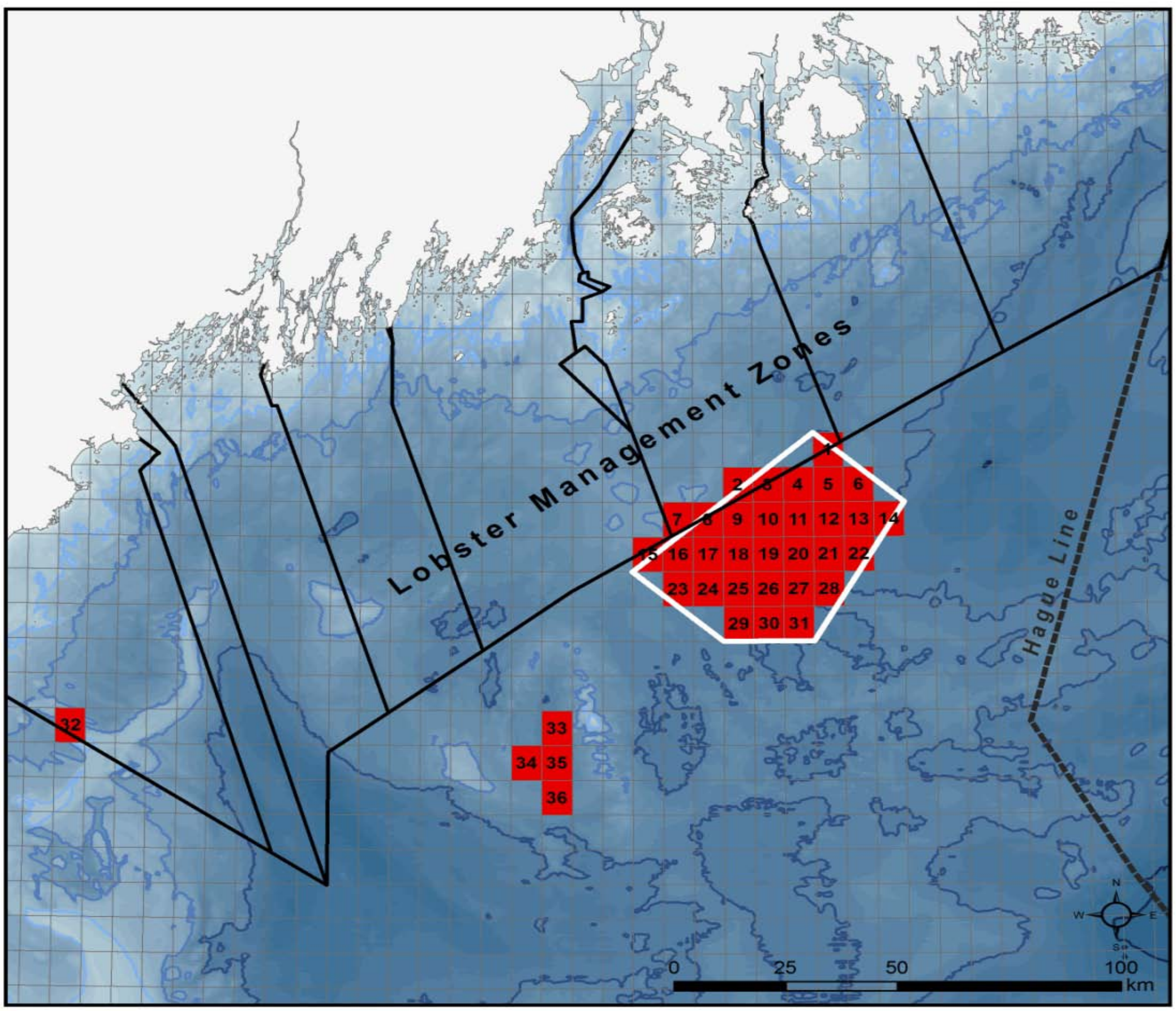

Figure 3: Hot spot analysis results. Significant hot spots shown in red, and numbers within each 5' square represent the data cells shown in Table 1 above.

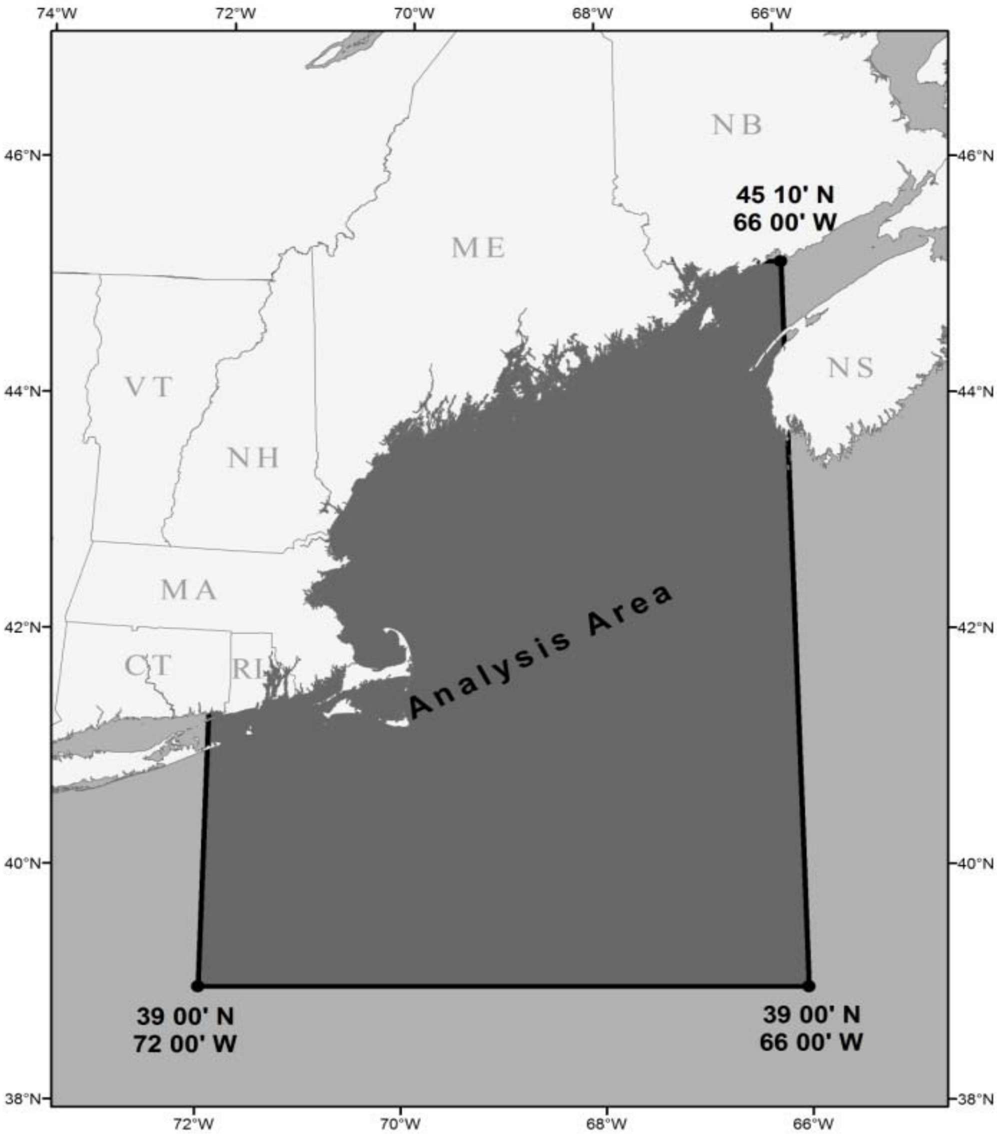

Figure 4. Hotspot Analysis Area

Appendix 1. Jordan Basin Closure proposal: Gear Considerations

An analysis of entanglements and rope strength shows that juvenile whales are not represented in heavier rope, suggesting that they are likely drowning and remain undetected (Figure A1). Analyses of entanglements where there is adequate data suggest that animals that are severely entangled are likely to die (Figure A2). While these correlations suggest that stronger rope is catching adults and killing juveniles, rope strength did not appear to correlate with entanglement severity. Entanglement severity did appear to increase with the complexity of the entanglement, and the number of complex entanglements has increased significantly over the last 30 years (Figure A3). Entanglement complexity was defined as follows: low = less than one body length of line trailing, no tight wraps anywhere, and no heavy weight attached; high = line trailing longer than one body length, constricting wraps around the whale, and or multiple anchor point or heavy weights. It is likely that complex entanglements are derived from longer pot trawls or gillnet gear, but that the variability in regional fishing methods means that rope strengths are not correlated with longer trawl configurations. Because PBR is not measured against all entanglements, but only with the serious and potentially fatal ones, both the complexity of entanglements (which creates serious injuries) and rope strength data suggest that longer trawls may present special risks to large whales, that could affect management strategies in unanticipated ways.

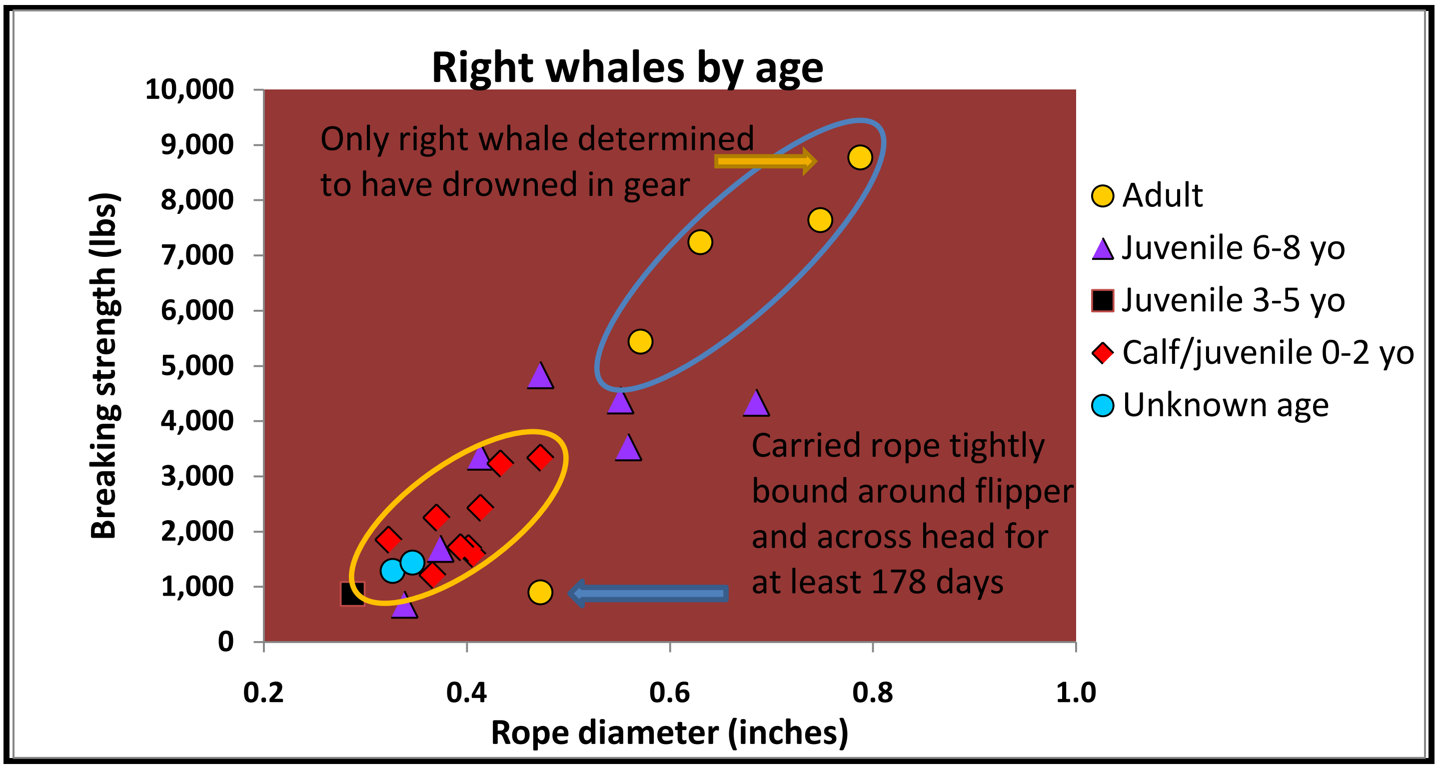

Figure A1. Age of entangled right whales vs rope strength and diameter (A.Knowlton analysis)

These data also indicate that offshore fisheries may be a special entanglement concern that is not captured in the co-occurrence model. As a start, the offshore nature of such entanglements means that their detectability is lower, as survey and observer efforts is extremely low. If observed, entangled whales offshore face a much greater risk of dying, since disentanglement attempts which are known to reduce mortality (Figure A2) are usually infeasible because of the large distances, and our inability to resight entangled whales in remote areas. The significant increase in complexity of entanglements over time (Figure A3) coincides with the shift of many Gulf of Maine fishermen from groundfish fisheries into lobster fishing in the 1990's. Those fishermen who went into the lobster fishery at that time frequently started fishing further offshore than the traditional lobster areas, because they had the capability and opportunity, and sometimes to avoid conflicts with well-established near-shore lobstermen. Because these waters are deeper, those emerging lobster fisheries usually involved longer pot trawls and longer endlines. While circumstantial, the trend in complexity of entanglements suggests more involvement by longer, heavier, and more complex fishing gear, which is consistent with most offshore fixed gear fisheries.

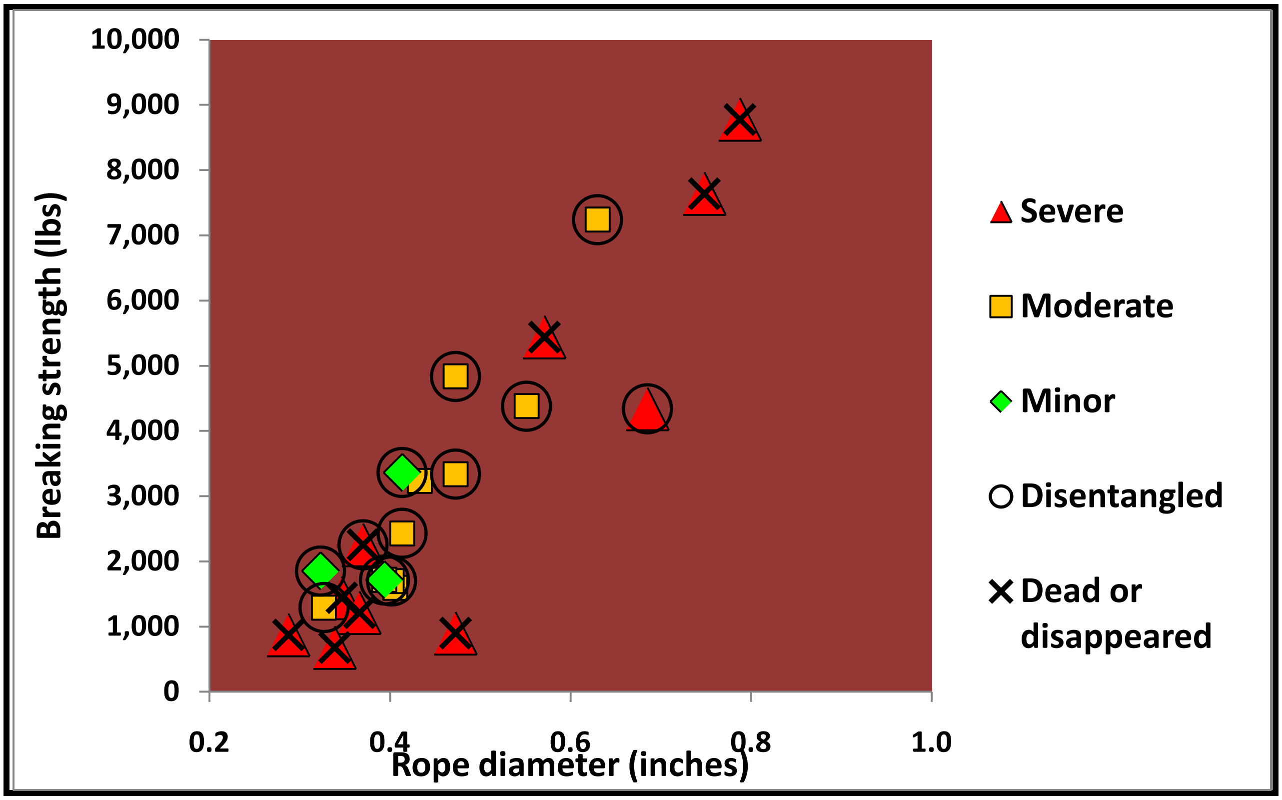

Figure A2. Rope breaking strength and diameter and entanglement outcomes (A. Knowlton analysis).

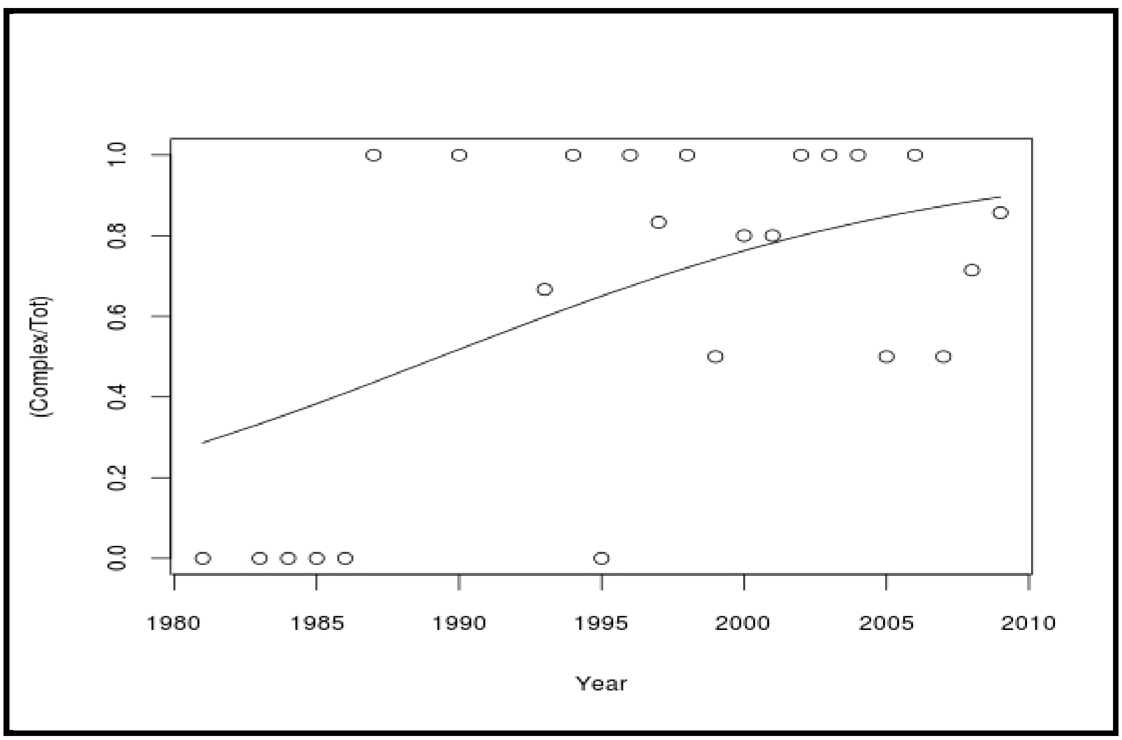

Figure A3. Trend in entanglement complexity; fitted model output for linear logistic (Prob of Complexity as a function of Year). Entanglement complexity has increased significantly ($p<0.01$) across the period. Analysis by R. Pace, NEFSC/NMFS.