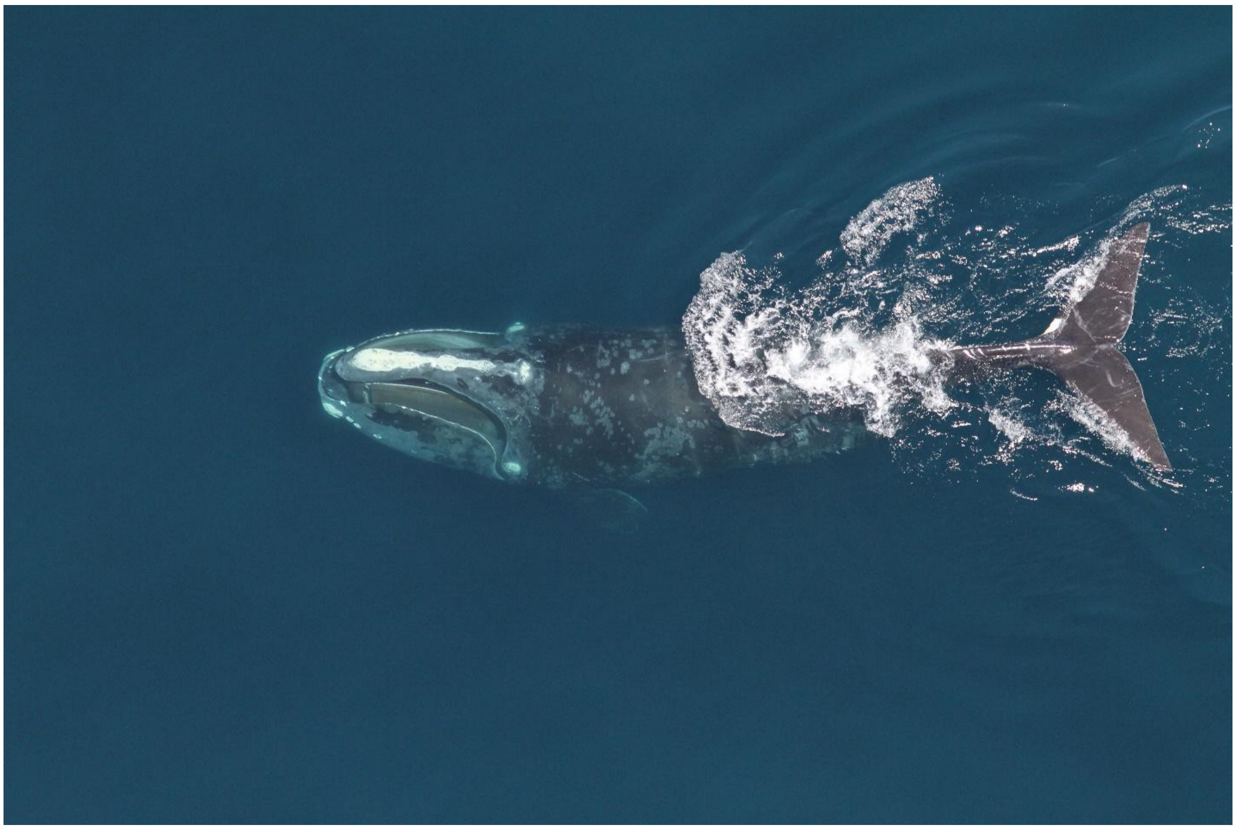
DRAFT ENVIRONMENTAL IMPACT STATEMENT,
REGULATORY IMPACT REVIEW, AND INITIAL REGULATORY FLEXIBILITY ANALYSIS
FOR AMENDING
THE ATLANTIC LARGE WHALE TAKE REDUCTION PLAN:
RISK REDUCTION RULE
VOLUME I



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National Marine Fisheries Service National Oceanic and Atmospheric Administration
DEPARTMENT OF COMMERCE

Prepared by: NOAA's National Marine Fisheries Service and Industrial Economics, Incorporated Draft EIS: November 2020 Draft

RESPONSIBLE AGENCY:

Assistant Administrator for Fisheries
National Oceanic and Atmospheric Administration
U.S. Department of Commerce Washington, DC 20235

PROPOSED ACTION:

Implementation of amendments to the Atlantic Large Whale Take Reduction Plan to reduce the risk of serious injury and mortality to Atlantic large whales due to incidental interactions with commercial fishing gear from Maine to Florida's east coast.

ABSTRACT:

The Atlantic Large Whale Take Reduction Plan (ALWTRP) was developed pursuant to Section 118 of the Marine Mammal Protection Act to reduce the serious injury and mortality of right, humpback, and fin whales due to incidental interactions with commercial fisheries. NMFS is preparing a Draft Environmental Impact Statement for the proposed amendments to the ALWTRP regulations (50 CFR 229.32). The proposed gear set modifications are designed to further reduce the risk and severity of serious injury and mortality to Atlantic large whales due to incidental interactions with commercial fishing gear.

TYPE OF STATEMENT:
(X) DRAFT ( ) FINAL

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GUIDANCE FOR SUBMITTING COMMENTS:

Comments on the DEIS may be submitted along with comments on the companion proposed rule, or by themselves, via:

Electronic Submission: You may submit comments, identified by NOAA-NMFS-2020-0031 as electronic public comments via the Federal eRulemaking Portal:
Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2020-0031*
Click the "Comment Now!" icon
Complete the required fields, and enter or attach your comments. Or,
Oral Comments at Public Meetings: See *fisheries.noaa.gov/ALWTRP* for information about remote public hearing opportunities to provide oral public comments. Or,

Comments on the DEIS must be received within 60 days of the publication of the Notice of Availability.

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1 INTRODUCTION AND EXECUTIVE SUMMARY

The Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan) includes measures to reduce the impacts of U.S. fixed gear fisheries on three large whale species – north Atlantic right whales, humpback whales, and fin whales, as well as on minke whales. The Plan consists of both regulatory and non-regulatory measures that, in combination, were designed to reduce the risk of serious injury and death caused by entanglement in commercial fishing gear to below each species potential biological removal level (PBR), prescribed by the Marine Mammal Protection Act (MMPA) as the maximum number of animals that can be removed annually while allowing a marine mammal stock to reach or maintain its optimal sustainable population level. Since the Plan's implementation in 1997, the Plan has been modified on several occasions to address the risk of large whale entanglement in gear employed by commercial fixed gillnet and trap/pot fisheries. In light of a low population level and persistent serious injuries and mortalities caused by incidental entanglements at rates above the North Atlantic right whale's PBR, most of the Plan's regulatory measures were designed to reduce the risk of fisheries to right whales, with collateral benefits to humpback and fin whales. NMFS intends to modify the Plan, including additional regulatory requirements, to further reduce the risk of entanglement related serious injuries and mortalities of right whales in the Northeast Region Trap/Pot Management Area (Northeast Region) lobster and Jonah crab trap/pot gear.

This Draft Environmental Impact Statement (DEIS) evaluates the biological, economic, and social impacts of alternatives for modifying the Plan, including NMFS' preferred alternative and the proposed federal regulations that would implement that alternative. The biological impacts to large whales from ongoing or reasonably foreseeable complementary risk reduction measures are also analyzed for their contribution toward right whale incidental entanglement risk reduction. Those include trap limits and other measures being implemented to manage the lobster fishery, as well as measures that will be implemented in Maine exempted areas by the state of Maine, and in Massachusetts state waters by the state of Massachusetts.

The discussion that follows briefly summarizes the DEIS content and key findings. Specifically:

- Section 1.1 provides information on the status of Atlantic large whale species and the nature of entanglements;
- Section 1.2 describes current ALWTRP requirements, as well as the requirements of the state measures, reasonably foreseeable fishery management measures, and new regulatory alternatives considered in this analysis;
- Section 1.3 summarizes the conclusions of the biological, economic, and social impact analyses and identifies NMFS' preferred federal regulatory alternative;
- Section 1.4 discusses areas of controversy that may influence interpretation of the report's findings; and
- Section 1.5 describes the organization of the report's remaining chapters.

1.1 Status of Large Whales and the Nature of Entanglements

North Atlantic right whales (*Eubalaena glacialis*) and fin whales (*Balaenoptera physalus*) are listed as endangered species under the Endangered Species Act, and are, therefore, considered strategic stocks under the Marine Mammal Protection Act (MMPA). Section 118(f)(1) of the MMPA requires the preparation and implementation of a Take Reduction Plan for any strategic marine mammal stock that interacts with Category I or II fisheries. A Category I fishery is one in which the human-caused mortality and serious injury rate of a strategic stock is greater than or equal to 50 percent of the stock's potential biological removal (PBR) level – defined under the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. A Category II fishery is one in which the mortality and serious injury rate of a strategic stock is greater than one percent but less than 50 percent of the stock's PBR. A strategic stock is one that is listed as threatened or endangered under the ESA or designated as depleted under the MMPA, is declining and likely to be listed within the foreseeable future, or is one for which human-caused mortality exceeds PBR.

Because North Atlantic right whales and fin whales interact with Category I and II fisheries, under the MMPA a Take Reduction Plan is required to assist in their recovery. The measures identified in the Plan are also beneficial to the Gulf of Maine humpback whale (*Megaptera novaeangliae*) population and Canadian east coast stock of minke whales (*Balaenoptera acutorostrata*). Humpbacks were intentionally protected by the Plan because they were listed as endangered until 2016, when the Gulf of Maine stock was considered sufficiently recovered to be removed from ESA listing. Currently neither species is listed as endangered or threatened under the ESA, or considered a strategic stock under the MMPA.

The status of each of these species is discussed in Chapter 4 and summarized briefly below.

- **Right Whale**: The western North Atlantic right whale (*Eubalaena glacialis*) is one of the rarest of all large cetaceans and among the most endangered species in the world. The 2019 stock assessment report published by NMFS estimates a minimum population size of 445 at the end of 2016, not counting 17 known mortalities in 2017, and a best estimate of population size to be 428 individuals (Hayes et al. 2019). Pettis et al. (2020) estimates a population size of 412 at the end of 2018. Since the end of 2018 there have been eleven documented mortalities and 17 births including a calf that was struck by a vessel offshore of Georgia and likely did not survive and another calf struck offshore of New Jersey that was killed. NMFS believes that the stock is well below the optimum sustainable population, especially given apparent declines in the population (Pace et al. 2017, Pettis et al. 2020); as such, the stock's PBR level has been set to 0.9 (Pace et al. 2017). Note that a draft population estimate has been developed by the North Atlantic Right Whale Consortium for their October 2020 meeting which indicates that the right whale population has declined further, to about 366 right whales as of January 2019. Further peer review of this preliminary estimate is anticipated during Scientific Review Group meetings in early 2021. This information along with other updates and analyses will be considered in drafting the final rule and environmental impact statement.

- **Humpback Whale:** As noted above, the North Atlantic humpback whale (Megaptera novaeangliae) is no longer listed as an endangered species under the ESA but is still protected under the MMPA. For the Gulf of Maine stock of humpback whales, the minimum population size and the best estimate of population size are both 896 at the end of 2016, and NMFS has established a PBR level of 14.6 whales per year (Hayes et al. 2019).

- **Fin Whale:** NMFS has designated one population of fin whale (*Balaenoptera physalus*) as endangered for U.S. waters of the North Atlantic, although researchers debate the possibility of several distinct subpopulations. NMFS estimates a best population size of 1,618 at the end of 2016, a minimum population size of 1,234, and PBR of 2.5 (Hayes et al. 2019).

- **Minke Whale**: As previously noted, the minke whale (*Balaenoptera acutorostrata*) is not listed as endangered or threatened under the ESA. The best estimate of the population of Canadian east coast minke whales is 2,591 at the end of 2016, with a minimum population estimate of 1,425 and PBR of 14 (Hayes et al. 2019).

Range-wide, Atlantic large whales are at risk of becoming entangled in fishing gear because the whales feed, travel, and breed in many of the same ocean areas utilized for commercial fishing. Fixed fishing gear such as traps and pots and fixed gillnets are set and fished continuously, using vertical lines that connect buoys at the surface to gear set on the bottom. While fishing gear is in the water, whales may become incidentally entangled in the lines and the nets that make up trap/pot and gillnet fishing gear. The effects of entanglement can range from no permanent injury to some scarring, or serious injury or death. While any interaction would be considered a "take" under both the ESA and the MMPA, the takes counted against PBR are those that cause mortalities and serious injuries.

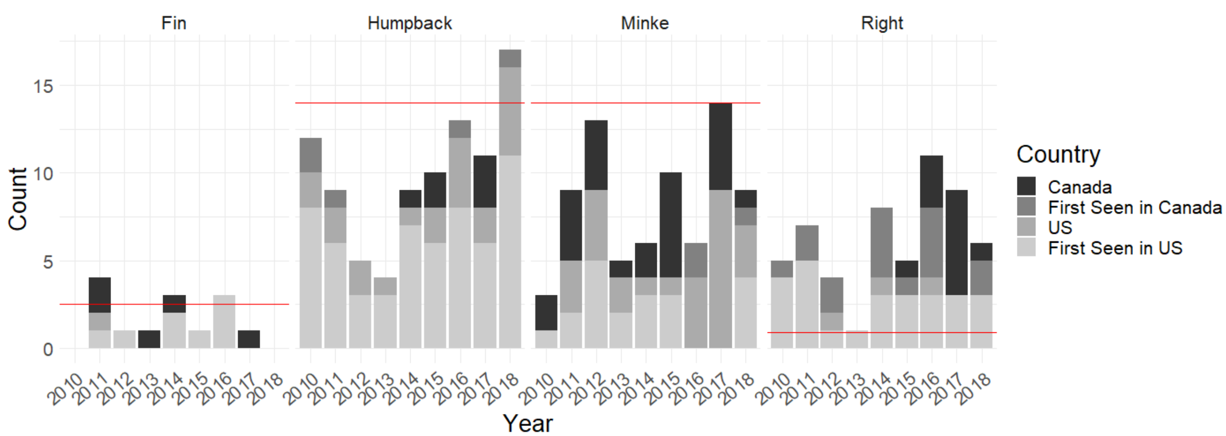

Figure 1.1: Documented serious injury and mortality cases caused by entanglements (including those with prorated injuries and where serious injury was averted by disentanglement response).

Figure 1.1 summarizes all mortality, serious injuries, and serious injuries averted through disentanglements of right, humpback, fin, and minke whales from entanglements between 2010 through 2018 documented in U.S. and Canadian waters, compared to PBR for each species as shown by the red line. Note that Canada prioritizes documentation of right whale interactions but other species are likely underreported. Over this period, documented minke whale serious injuries and mortalities have been higher than the other large whale species (267), followed by humpback (264), right (89), and fin whales (62). While humpback whale serious injuries and mortalities by entanglement exceeded PBR in one year, and minke whales reached it, only right whale serious mortalities and injuries exceed PBR nearly every year. As Figure 1.1 illustrates, considering only entanglements in U.S. gear or entanglements first seen in U.S. waters, since 2010 PBR has been exceeded in every year except for one, 2013. That is, despite modifications to the Plan (notably including the use of sinking groundlines effective in 2009; efforts to reduce the number of vertical buoy lines and an expansion of the Massachusetts Restricted Area, effective in 2014 and 2015) serious injuries and mortalities of right whales in U.S. gear and first seen in the U.S. at levels above PBR persist.

An obvious change during this period is the increase in entanglement related mortalities and serious injuries in Canadian gear or first seen in Canada. Since 2010, there has been a documented change in right whale prey distribution that has shifted right whales into new areas with nascent risk reduction measures, increasing documented anthropogenic mortality (Plourde et al. 2019, Record et al. 2019). In this same timeframe, between 2009 and 2017, Pettis et al. (2018a) observed an increased calving interval from an average of 4 to 10 years. Many factors could explain the low birth rate, including poor female health (Rolland et al. 2016, Christiansen et al. 2020) and reduced prey availability (Meyer-Gutbrod et al. 2015, Johnson et al. 2018, Meyer-Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018). Entanglement in fishing gear also can have substantial health and energetic costs that affect both survival and reproduction (Robbins et al. 2015, Pettis et al. 2017, Rolland et al. 2017, van der Hoop et al. 2017, Hayes et al. 2018a, Hunt et al. 2018, Lysiak et al. 2018, Christiansen et al. 2020). As described in Chapter 4, serious injuries and mortalities by ship strike in Canada and the U.S. have also been documented in recent years. During a period of lower calving rates, a sharp increase in serious injuries and mortalities by ship strike and entanglements in Canadian waters, and persistent serious injuries and mortalities of right whales above PBR in U.S. waters, is not sustainable.

The primary purpose of the alternatives analyzed in this DEIS is to reduce serious injury and mortality by entanglements in U.S. Northeast Region Jonah crab and lobster trap/pot gear to below PBR. The vast majority of vertical lines along the east coast belong to lobster and crab trap/pot fisheries in northeast waters. A model was developed to estimate the number of vertical lines fished by fisheries managed under the Atlantic Large Whale Take Reduction Plan, termed the IEC Line Model (documentation in Appendix 5.1). The 2017 buoy line estimates indicate that 93 percent of the buoy lines in U.S. waters in which right whales occur are fished by the Northeast Region lobster and Jonah crab fishery (IEC 11/9/2019 model run). Because multi-fishery coast wide regulations require more scoping and analysis, this DEIS focuses on the northeast lobster and Jonah crab fisheries to facilitate rapid rulemaking. The Take Reduction Team has been informed of the intention to consider other fixed gear fisheries, coastwide during the next Take Reduction Team deliberations.

NMFS estimated that to reduce serious injury and mortality below PBR, entanglement risk across U.S. fisheries needs to be reduced by 60 to 80 percent. As described in more detail in Chapter 2, there is no gear present or retrieved from most documented incidents of dead or seriously injured right whales. When gear is retrieved it can rarely be identified to a fishery or to a location. For the years 2009 through 2018, an average of five entanglement- related serious injuries and mortalities a year were observed. Only 0.2 a year could be attributed with certainty to U.S. fisheries and only 0.7 a year to Canadian fisheries. An annual average of four documented incidental entanglement mortalities and serious injuries could not be attributed to a country. For the purposes of creating a risk reduction target, NMFS assigned half of these unknown incidents to U.S. fisheries. Under this assumption, a 60 percent reduction in serious injury or mortality would be needed to reduce right whale serious injury and mortality in U.S. commercial fisheries from an annual average of 2.2 to a PBR of 0.9 per year.[1] The upper bound of the target considered estimated mortalities generated by a new population model that estimates unobserved mortality (Hayes et al 2019). Because all observed mortalities that can be attributed to a source are caused by either entanglements or vessel strikes (except for some natural neonate mortalities), estimated non-observed mortalities are likely to be caused by the same human interactions. However, there is no way to definitively apportion unseen but estimated mortality across causes (fishery interactions vs. vessel strike) or country of origin (U.S. vs. Canada). For the purposes of developing a conservative target, NMFS assumed that half of the estimated undocumented incidents occurred in U.S. waters and were caused primarily by incidental entanglements. However, given the assumptions and other sources of uncertainty in the 80 percent target, as well as the challenges achieving such a target without large economic impacts to the fishery, the Take Reduction Team focused on recommendations to achieve the lower 60 percent target.

Large whale entanglement data and the rationale for the scope of the alternatives considered in this DEIS are described in greater detail in chapter Two: Purposes and Needs. As mentioned, while entanglement is a significant source of mortality and serious injury for Atlantic large whales, other factors influence whale survival. Historically, commercial whaling has presented the greatest threat to whale stocks, and is largely responsible for reducing the populations of certain species to endangered status. Broad adherence to a voluntary international ban on commercial whaling has reduced this threat along the U.S. Atlantic coast. However, other human-caused threats remain, including primarily collisions between whales and ships, as well as the adverse effects that water pollution, noise pollution, climate change, offshore wind farm development, oil and gas development, and reductions in prey availability may have on whale stocks. These threats are discussed further in Chapter 8: Cumulative Effects Analysis.

1.2 Atlantic Large Whale Take Reduction Plan & Current Requirements

In response to its obligations under the MMPA, NMFS established the Atlantic Large Whale Take Reduction Team (ALWTRT or Team) in 1996 to develop a plan to reduce the incidental take of large whales in commercial fisheries along the Atlantic Coast. The Team consists of representatives from the fishing industry, state and Federal resource management agencies, the scientific community, and conservation organizations. The work of the Team is to provide

[1] The MMPA makes it clear that U.S. commercial fisheries are required to reduce incidental marine mammal mortality and serious injury to below a given stock's PBR. NMFS' Guidelines for Assessing Marine Mammal Stocks addresses how to consider PBR for transboundary stocks if certain information is available. Those Guidelines specify:

recommendations to NMFS in developing and amending the Plan.

The ALWTRP seeks to reduce serious injury to or mortality of large whales due to incidental entanglement in U.S. commercial fishing gear. Because of their low population numbers and persistent human-caused mortality and serious injury above PBR, Plan measures focus on reducing the risk of entanglements to right whales while ensuring it benefits other Atlantic large whale species. In its entirety, the Plan consists of state and federal regulatory components including restrictions on where and how gear can be set, as well as non-regulatory components, including; research into whale populations, whale behavior, and fishing gear; outreach to inform fishermen of the entanglement problem and to seek their help in understanding and solving the problem; enforcement efforts to help increase compliance with Plan measures; and a program to disentangle whales that do get caught in gear. The Category I and II fisheries currently regulated under the Plan that this DEIS seeks to modify include the Northeast Region trap/pot American lobster and Jonah crab fisheries.

Chapter 2 of this EIS reviews the current Plan requirements.

1.3 Alternatives Considered

NMFS is currently considering suites of regulatory measures under two alternatives that would modify existing Plan requirements to address ongoing large whale entanglements. The primary purpose of proposed Plan modifications is to reduce the mortality and serious injury of the North Atlantic right whale in the Northeast Region Trap/Pot Management Area (Northeast Region) lobster and Jonah crab trap/pot gear, which fishes approximately 93 percent of the buoy lines in U.S. waters in which right whales occur, to below PBR. Measures considered include reducing the number of lines in the water (e.g. via increasing the number of traps per trawl, areas restricted from buoy lines, or a cap and allocation of buoy lines in federal waters) and reducing mortality and serious injury in remaining lobster and crab buoy lines by specifying a low (no greater than 1,700 lbs) maximum breaking strength for vertical line to be used in certain areas depending on gear configurations. The alternatives would affect lobster and Jonah crab trap/pot fisheries currently covered under the Plan within the Northeast Region. Although the Atlantic Large Whale Take Reduction Team did not include seasonal buoy line restricted areas in the near-consensus recommendations that the Team provided to NMFS at their April 2019 meeting, wide application of weak rope and buoy line reductions were the primary risk reduction elements recommended

Table 1.1: A summary of the regulatory elements of the proposed risk reduction alternatives, arranging the requirements by lobster management area and geographic region (where appropriate). The shaded portion represents an area that will be managed by a state agency rather than NMFS.

Component	Area	Alternative Two	Alternative Three
Line	**Reduction**		
Trawl up/ Line Reduction	ME exempt area – 3 nm (5.56 km)	3 traps/trawl	-
	ME 3 (5.56 km) – 6 nm*	8 traps/trawl	Line allocations capped at 50 percent of average monthly lines in federal waters
	LMA 1, 6* – 12 nm (22.22 km)	15 traps/trawl	Same as above
	LMA 2, OCC 3 – 12 nm (5.56 – 22.22 km)	15 traps/trawl	Same as above
	LMA 1, 2 over 12 nm (22.22 km)	25 traps/trawl	Same as above
	MA State waters, all zones	No singles on vessels longer than 29’ (8.84 m) permits after 1/1/2020	-
	LMA3	Year-round: 45 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	May - August: 45 trap trawls; Year-round increase of maximum trawl length from 1.5 nm (2.78 km) to 1.75nm (3.24 km)
Seasonal Buoy Line Restricted Areas	Existing restricted areas would be modified to allow fishing without buoy lines	Allow trap/pot fishing without buoy lines. Will require exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would likely include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.	Allow trap/pot fishing without buoy lines. Requires exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.
	LMA1 Restricted Area, Offshore ME LMA1/3 border, zones C/D/E	Oct-Jan. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Oct – Feb. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts South Island Restricted Area	Feb-April: State of Massachusetts proposed buoy line restriction areas South of Nantucket Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Closed to buoy lines Feb – May: A. Large rectangular area, edited yearly B. L-shaped area Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts Restricted Area (MRA)	Credit for Feb-Apr, State water closed through May until no more than 3 whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA unless surveys confirm that right whales have left the area. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Georges Basin Restricted Area	-	Closed to buoy lines May through August. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)

Component	Area	Alternative Two	Alternative Three
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	Existing 18% reduction in the number of buoy lines
	LMA 3	Existing and anticipated fishery management resulting in an estimated 12 % reduction in buoy lines	Existing and anticipated fishery management resulting in an estimated 12% reduction in buoy lines
Weak Line			
Weak Link Modification	Northeast Region	Retain current weak link/line requirement at surface system but allow it to be at base of the surface system or, as currently required, at buoy	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system
Weak Line	ME exempt area	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exempt area – 3 nm (5.56 km)	2 weak insertions, at 25% and 50% down line	Same as above
	NH/MA/RI Coast – 3 nm (5.56 km)	1 weak insertion 50% down the line	Same as above
	All areas 3 – 12 nm (5.56 – 22.22 km)	2 weak insertions, at 25% and 50% down line	Same as above
	LMA 1, 2, OCC over 12 nm (22.22 km)	1 weak insertion 35% down the line	Same as above
	LMA 2	Same weak insertions as above based on distance from shore	Same as above
	LMA 3	One buoy line weak year round to 75%	One weak line to 75% year round OR
	LMA 3	Same as above	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak “toppers” to 20%
Gear Marking			
Gear Marking	All Northeast, except LMA3	Add a three-foot long state-specific colored mark in surface system within two fathoms of buoy in addition to existing three one-foot marks that must be changed to state color	Three-foot long state-specific colored mark in surface system within two fathoms of buoy and require identification tape indicating home state and fishery woven through buoy line
	Federal waters, except LMA3	Add a three-foot long state specific colored mark plus one six-inch long green mark within two fathoms of the buoy line in addition to existing three one-foot marks that must be changed to state color	Three-foot long state-specific colored mark in surface system within two fathoms of buoy and require identification tape indicating home state and fishery woven through buoy line
	LMA3	Add a three-foot long black mark plus one six-inch long green mark within two fathoms of the buoy line in addition to existing three one-foot marks that must be changed to state color	Three-foot long black mark in surface system within two fathoms of buoy and require identification tape indicating home state and fishery woven through buoy line

*Notes**:** See 50 CFR 229.32 for delineations of regulated waters and associated terms, such as exempted waters.
The 6 mile line refers to an approximation, described in 50 CFR 229.32 (a)(2)(ii).

Chapter Three describes in detail the regulatory alternatives including how they were created and analyzed in this DEIS. Briefly, collaborating with New England coastal states, NMFS used the Decision Support Tool (DST) created by the Northeast Fisheries Science Center to compare the effectiveness of state and federal regulatory elements in reducing the risk of entanglement to right whales relative to Alternative One, the status quo. States proposed suites of risk reduction elements that they believed would achieved the 60 percent risk reduction target. This target was identified by NMFS as the minimum target necessary to reduce serious injuries and mortalities to below PBR. Alternative Two (Preferred) is largely made up of recommendations from Maine, Massachusetts, and to a lesser extent Rhode Island. Many risk reduction elements considered by Team members or the states and analyzed while developing their proposals were grouped into Alternative Three for analysis and consideration of an alternative that would achieve greater risk reduction. Reviewers are asked to provide comments on the alternatives including which alternative should be selected.

The primary risk reduction features of the selected alternatives are summarized below and outlined for comparison in Table 1.1. These include some regulatory measures that are ongoing through state and federal lobster fishery management measures or that will be implemented by the states only (shaded) and measures that would be implemented through federal rulemaking analyzed within this DEIS. For reference, Figures 1.2 and 1.3 show the scope of the Northeast Region Trap/Pot Management Area (Northeast Region) and include the proposed seasonal restricted areas that would allow fishing without buoy lines, analyzed under each alternative.

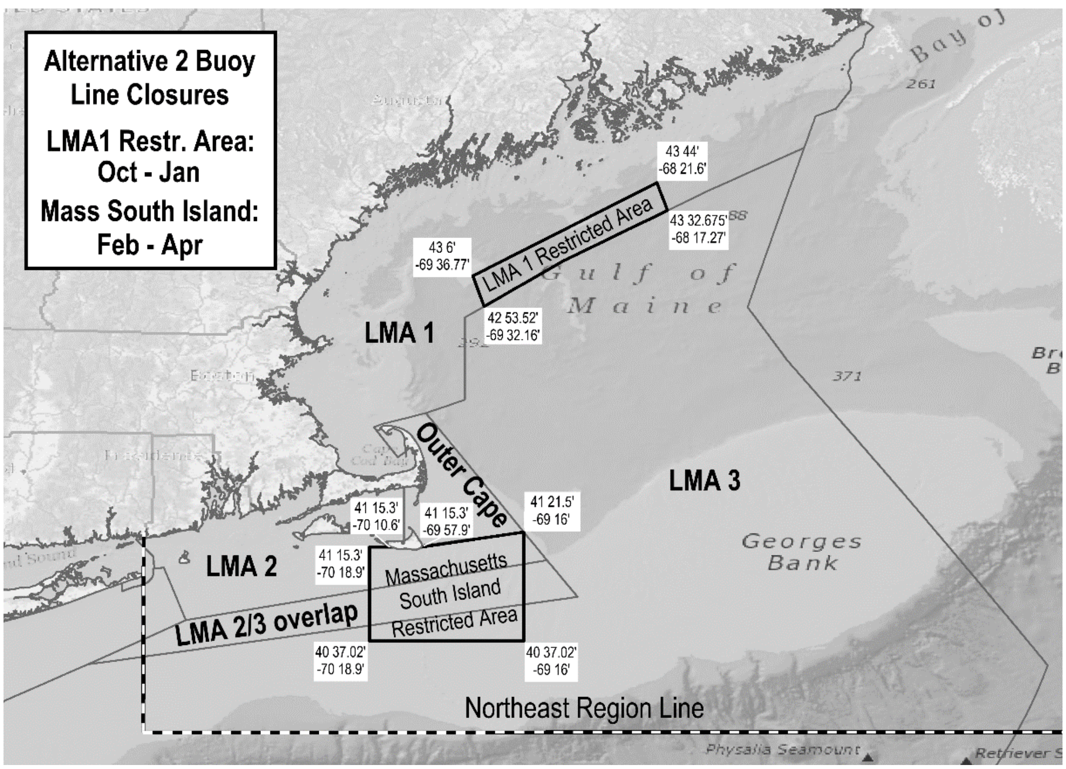

Figure 1.2: The buoy line restricted areas proposed in Alternative Two (Preferred). The Cape Cod Bay and Outer Cape State Water areas represent state-regulated "soft" restricted areas in May of state water portions of the Massachusetts Bay Restricted Area where persistent buoy lines will not be allowed until surveys demonstrate there are fewer than three whales remaining. The Massachusetts South Island Restricted Area is proposed from February

through April and the LMA1 Restricted Area is proposed from October through January. Not shown is a modification to existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines. This change is assumed to be neutral but may encourage some ropeless gear testing and accelerate the development of ropeless fishing and associated longterm benefits to right whales. The area north and east of the checked line and west of the EEZ encompasses the Northeast Region.

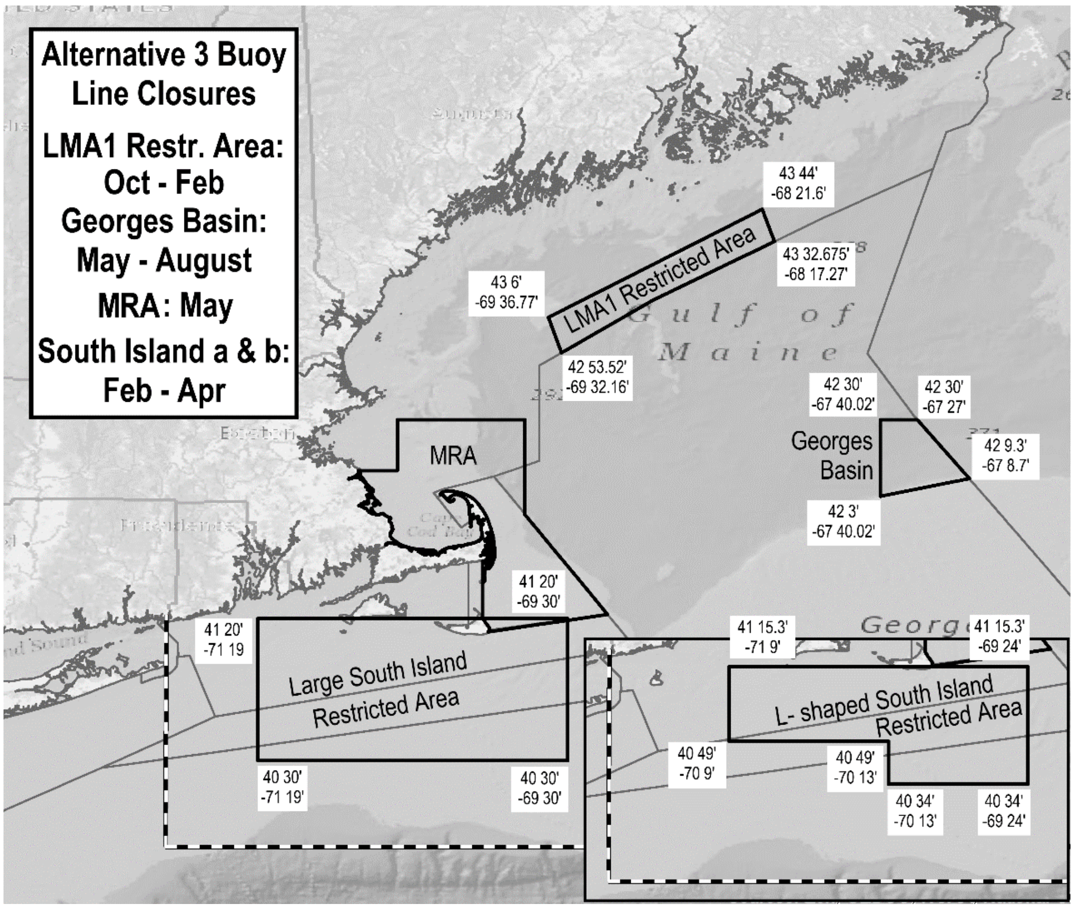

Figure 1.3: The buoy line restriction options proposed in Alternative Three (Non-preferred). There are two different options for a restricted area south of Cape Cod from February through April, a large restricted area (3a) and an L-shaped restricted area (3b). The LMA1 Restricted Area is proposed from October through February. The Georges Basin Restricted Area is proposed from May through August. An extension of the Massachusetts Bay Restricted Area through May, with a potential opening if whales are no longer present, is also included. Not shown is a modification to existing seasonal restricted areas. Existing areas would become areas restricted to fishing with buoy lines. This change is assumed to be neutral but may encourage some ropeless gear testing and accelerate the development of ropeless fishing and associated longterm benefits to right whales.

Alternative One (No Action): Under Alternative One, NMFS would continue with the status quo Plan requirements currently in place (Appendix 2.1).

Alternative Two (Preferred): This alternative would increase the number of traps per trawl based on area fished and miles fished from shore in the Northeast Region (Maine to Rhode Island). Trawling up regulations in all coastal regions would be managed based on distance from shore, primarily outside of exempt or state waters as detailed in Table 1.1. Under this alternative, existing closure areas would be modified to be closed to fishing with persistent buoy lines. Two new seasonal restricted areas would be created that would allow fishing without the use of persistent buoy lines, and state waters within the Massachusetts Restricted Area would be closed into May until surveys demonstrate that whales have left the area. Measures also include conversion of a vertical buoy line to weak rope, or insertions in buoy lines of weaker rope or other weak inserts, with a maximum breaking strength of 1,700 lbs (771.1 kg). The Alternative also includes more robust gear marking requirements that differentiate vertical lines by state and expands into areas previously exempt from gear marking. Commenters that believe these additional restricted areas are not warranted to achieve PBR should provide specific information or analysis in support of recommended removal of restricted areas from the proposed rule. If NOAA receives information indicating that we can achieve the 60% risk reduction without the restricted area, we would consider eliminating the restricted area from the preferred alternative. Additionally, if commenters believe that information will be available after issuance of the final rule on this topic, commenters should articulate the nature of that information, how the information might affect the decision, and propose a mechanism for evaluating that information in determining whether or not to continue with the restricted area.

Alternative Three: This alternative would reduce the amount of line in the water via a line cap allocation capped at 50 percent of the lines fished in 2017 in federal and non-exempt waters throughout the Northeast except in offshore lobster management area (LMA) Three. A seasonal increase in the minimum traps per trawl requirement would be implemented in LMA Three. Additionally, under this alternative, existing closures would be modified to allow fishing without the use of persistent buoy lines. The entire Massachusetts Restricted area would be extended with a soft closure through May, opening if surveys demonstrate whales have left the restriction area. Three new seasonal restricted areas would be created including a longer seasonal restricted period for the LMA One Restricted Area and a summer restricted area north of George's Bank at Georges Basin. Fishing without the use of persistent buoy lines would be allowed during these seasons. Two seasonal restricted area options larger than the area in Alternative Two are analyzed south of Cape Cod and the southern coast of Massachusetts. Additional measures include conversion of the top 75% of all lobster and crab trap/pot vertical buoy lines to weaker rope with a maximum breaking strength of 1,700 lbs (771.1 kg). The alternative also includes more robust gear marking throughout the buoy line that differentiates vertical lines by state and fishery and expands into areas previously exempt from gear marking.

1.4 Major Conclusions and Preferred Alternative

1.4.1 Biological Impacts of Alternatives

As delineated in Table 1.1, gear modification requirements, buoy line seasonal restricted areas, and gear marking are key components of the ALWTRP modifications under consideration. Section 5.2 of this EIS discusses the potential impact of these requirements on reducing the risk of large whale entanglements and associated serious injury and mortality. The major strategies to reduce risk include:

Line Reduction Requirements: Measures to reduce the number of vertical lines fished benefit large whales by reducing co-occurrence and associated opportunity for entanglement in buoy lines and associated gear. Both alternatives include requirements to increase the minimum number of traps per trawl in the Northeast to reduce the number of vertical buoy lines in the water without necessarily having to reduce the number of traps. The 50 percent cap in line allocation in federal waters considered in Alternative Three would reduce the number of lines fished but would allow states and their permitted fishermen to choose their own strategies for achieving line reduction (i.e. trawling up, ropeless on one end, trap reductions) rather than specifying how gear would need to be configured.

Seasonal Restricted Areas: Seasonal restricted areas, which are open to fishing without buoy lines but closed to fishing with persistent buoy lines, are intended to protect areas of predictable seasonal aggregations of right whales. The potential regulatory changes analyzed include several restrictions on when and where trap/pot gear can be set with persistent buoy lines. Two existing closures to trap/pot fishing would be modified to be closed to fishing trap/pot gear with persistent buoy lines, allowing “ropeless” fishing. Ropeless fishing is usually done by storing buoy lines on the bottom and remotely releasing the buoy to retrieve the line when fishermen are on site to haul in their trawl of traps, or other bottom gear. Alternative Two (Preferred) considers two new seasonal restricted areas and Alternative Three proposes three new seasonal restricted areas areas and including an analysis of two options for the one south of Nantucket and Martha’s Vineyard.

Weak Line Requirements: The potential regulatory changes analyzed include provisions to require that lobster and crab trap/pot gear modify buoy lines to use rope that breaks at 1,700 lbs for substantial lengths of the buoy line or to require weak insertions at varying depths on the buoy line. The specified strength rope or weak inserts is based on a study that suggested that, if a large whale does become entangled, it is more likely to exert enough force to break the rope before a severe entanglement occurs, reducing risk of serious injury or mortality.

The general objective of the risk reduction elements analyzed is to use feasible measures that limit the frequency and severity of interactions between whales and regulated trap/pot gear in the Northeast. The measures assessed were selected to reduce risk of right whale mortality and serious injury caused by entanglement in the lobster and crab trap/pot fisheries in the northeast by at least 60 percent in order to achieve PBR. The measure of risk reduction used is a product of the spatiotemporal distribution of vertical lobster and Jonah crab trap/pot lines, predicted right whale habitat distribution, and risk of different gear configurations. In developing the alternatives, the DST was used as described in Chapter Three to estimate that Alternative Two (Preferred) achieves greater than 60 percent risk reduction and Alternative Three achieves close to 70 percent risk reduction.

Risk reduction was an essential measure for selecting alternatives that are sufficiently broad to reduce right whale serious and mortality below PBR. The biological impacts analysis uses independent quantitative and qualitative indicators that facilitate a separate comparison of the regulatory alternatives for all large whales as related to the objectives above: reduction in number of vertical buoy lines where whales occur to reduce entanglement likelihood, and the amount of rope in buoy lines that is weakened to increase likelihood of a whale breaking free before a serious injury is caused. The biological impacts analysis are summarized in Table 1.2 and evaluate the percent reduction in vertical buoy lines, reduction of co-occurrence of buoy lines and large whale sightings data, and the percent of total rope weakened within buoy lines.

Table 1.2: The annual summary of all quantitative measures for each alternative, including the change in annual vertical line numbers (summed across months), co-occurrence, and total annual conversion to weak line. Two fishermen restricted area responses are considered; buoy lines are fully removed (includes ropeless) or buoy lines are relocated. Alternative Three considers two weak line options in LMA3: option one is a year round 75 percent buoy line "topper" made of full weak line on one end and option two seasonally (May through August) requires weak rope in the top 20 percent on one end and the top 75 percent of the other buoy line.

		Alternative 1 (No Action; i.e. baseline)	Alternative 2 Lines Out	Alternative 2 Relocation	Alternative 3a Lines Out	Alternative 3a Relocation	Alternative 3b Lines Out	Alternative 3b Relocation
Vertical Lines								
Maine Exempt		4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835
Outside ME EX		2,125,588	1,718,264	1,725,817	1,050,711	1,061,148	1,052,025	1,061,874
% Reduction			**19.2%**	**18.8%**	**50.6%**	**50.1%**	**50.5%**	**50.0%**
Co-Occurrence								
Right Whale		138,199	42,572	42,641	16,020	19,414	18,745	22,389
% Decrease			**69.2%**	**69.1%**	**88.4%**	**86.0%**	**86.4%**	**83.8%**
H-back Whale		333,209	268,318	268,599	141,790	144,848	142,623	145,728
% Decrease			**19.5%**	**19.4%**	**57.4%**	**56.5%**	**57.2%**	**56.3%**
Fin Whale		177,502	127,926	127,940	72,525	74,044	72,961	74,393
% Decrease			**27.9%**	**27.9%**	**59.1%**	**58.3%**	**58.9%**	**58.1%**
Weak Line								
Maine Exempt	**Total Weakened Line**		1,276,741	1,276,741	3,021,823	3,021,823	3,021,823	3,021,823
Waters	**Proportion of full line weakened**		**31.7%**	**31.7%**	**75.0%**	**75.0%**	**75.0%**	**75.0%**
Area 3	**Scenario**		**-**	**-**	**Option 1/2**	**Option 1/2**	**Option 1/2**	**Option 1/2**
Outside Maine	**Total Weakened Line**		457,779	458,077	776,123/ 770,747	783,02/ 777,814	776,995/ 771,571	783,573/ 778,358
Exempt Waters	**Proportion of full line weakened**		**26.6%**	**26.5%**	**73.9%/ 73.4%**	**73.8%/ 73.3%**	**73.9%/ 73.3%**	**73.8%/ 73.3%**

The co-occurrence value estimated in the NMFS/IEC Co-occurrence model used in this DEIS is an index figure, integrated across the northeast spatial grid, indicating the degree to which whales and the vertical line employed in crab and lobster trap/pot fisheries coincide in the Northeast Region waters subject to the Plan. Biological impacts anticipated are a reduction in buoy line and whale interactions, characterized by the percentage reduction in the overall co-occurrence indicator each alternative would achieve. Unlike the DST, co-occurrence takes into account whale sightings data directly (rather than a habitat distribution model). Data for right, humpback, and minke whales are used. Co-occurrence does not consider the risk of different gear configurations. The analytical method used to evaluate measures using the co-occurrence model is compatible with accepted peer-reviewed methods used in previous environmental impact analyses for the ALWTRP.

In order to account for monthly variation in fishing effort, and therefore line numbers, monthly line numbers and co-occurrence were summed to provide an annual total for the purpose comparing the alternatives and does not represent the number of lines in the water at a given time within the Northeast Region trap/pot area. Vertical line and weak rope numbers are reported based on how they will be regulated; lines in Maine Exempt Waters are reported separately because they will be regulated separately by Maine DMR and all other lines will be regulated by NMFS. However, these regulatory measures are all considered as part of the Take Reduction Plan, therefore, all risk reduction measures are counted in this DEIS toward the summative risk reduction, regardless of the regulating entity.

Table 1.2 displays the estimated change in co-occurrence achieved through vertical line reduction under each action alternative relative to the no-action alternative (Alternative One). Both alternatives reduce the co-occurrence of buoy lines and large whales.

- Alternative Two (Preferred), which includes broad trawling up requirements and two new seasonal restricted areas closed to lobster and Jonah crab buoy lines, is estimated to yield a reduction in right whale co-occurrence of approximately 69 percent.
- Alternative Three includes a 50 percent line cap allocation in federal waters, trawling up requirements in LMA3, and additional seasonal restricted areas and is estimated to reduce co-occurrence by approximately 83 to 88 percent, depending on which area is selected south of Cape Cod. The upper and lower range are bounded by the analysis assumptions of lines removed or lines relocated from a restricted area. The estimated impact of these restricted areas is greater when affected vessels are assumed to remove buoy lines rather than relocate to alternative fishing grounds. The greatest reduction in co-occurrence is achieved under both Alternative Three options when lines are fully removed. Under this alternative, the estimated upper-bound reduction in co-occurrence is 88.4 percent.

Both alternatives also convert a portion of buoy line from full strength rope to weakened rope that is either manufactured with a low maximum breaking strength or includes inserts with the same breaking strength spaced throughout the line. For this analysis, inserts placed at least every 40 ft. (i.e. equal to or shorter than the average length of an adult north Atlantic right whale) are considered to be equivalent to full weak rope.

- Alternative Two (Preferred) proposes weak inserts in all buoy lines, but very few inserts relative to inserts every forty feet. So only about 26% of the rope in buoy lines are converted to the equivalent of full length weak ropes. Within this alternative, weak rope is a precautionary measure to reduce serious injury and mortalities if whales are entangled. Weak insertions are proposed down to 50 percent in the rope in nearshore areas but only down to 35 percent in offshore areas due to fishermen's concern that the rope poses safety risks and increased chances of gear loss when fished with heavier offshore gear.
- Under Alternative Three, approximately 73% of the rope in buoy lines in the northeast would be converted to the equivalent of full weak rope.

Weak rope should reduce the severity of entanglements for right whales, fin whales, and to a lesser extent humpback whales, but would not reduce the encounter rates and associated risk of entanglement.

In addition to impacts on large whale species, changes to Plan regulations may affect other aspects of the marine environment, including other protected species and habitat. Analysis of these issues, addressed in Sections 5.3 and 5.4 of this EIS, suggests no significant differences among Alternatives Two and Three (preferred and non-preferred, respectively) with respect to impacts on habitat because the impacts are generally expected to be minor. The alternatives differ, however, with respect to the ancillary benefits that would be afforded to other protected species. These differences stem from the extent to which the alternatives would mandate requirements, such as fewer buoy lines, that would prove to benefit other whales and sea turtles.

1.4.2 Economic and Social Impacts of Alternatives

Chapter Six evaluates the economic and social impacts of Alternatives Two and Three relative to the status quo (Alternative One), including a yearly distribution of the compliance costs for the six years following implementation. For the purpose of summarizing and comparing the economic impact of the alternatives, this discussion will focus on initial implementation costs of the two action alternatives. Additionally, although the risk reduction analysis considered the contribution of fishery management, state and federal risk reduction measures toward achieving the target risk reduction, the economic analysis considers only the costs of the federal rules that would be implemented. The costs of Maine gear marking that has already occurred, Maine weak insert and line reduction requirements, Massachusetts extension of state water restricted areas and line diameter restrictions, and fishery management measures that are being phased in or are reasonably foreseeable through other regulatory actions are not analyzed in the DEIS.

The first year costs of all proposed federal regulatory measures for Alternative Two including gear marking, weak rope, restricted areas, and trawling up costs range from $6.9 million to $15.4 million. As described in Chapters Six, the range of costs depends on assumptions about catch/landings loss caused by trawling up and about whether fishermen choose to remove lines or relocate due to buoy line restricted areas. Year one compliance costs for Alternative Three A range from $27.9 million to $46.3 million and for Alternative Three B (a smaller restricted area option south of the islands), from $27.8 million to $46.1 million. Thus, the costs associated with Alternative Two are well under one third the total costs associated with Alternatives Three.

Alternative Two achieves less reduction in co-occurrence between vertical lines and large whales than Alternative Three. The Co-Occurrence model suggests North Atlantic right whale co-occurrence would be reduced by approximately 69 percent. The costs associated with the co-occurrence reduction (trawling up and buoy line restricted area) under Alternative Two range from $2.8 million to $11.3 million (Table 1.3), depending on implementation assumptions (buoy lines relocated vs. buoy lines removed). For every unit of co-occurrence reduction, the costs of Alternative Two is estimated at $40.1 thousand to $163.4 thousand.

Both options evaluated under Alternative Three performed better at reducing large whale co-occurrence than Alternative Two, achieving a co-occurrence reduction of greater than 83 percent. This alternative would increase the likelihood of achieving the higher target that takes into account estimated right whale mortalities. However, the costs associated with co-occurrence reduction in Alternatives Three (trawling up, buoy line restricted area, federal water line caps) are substantially higher, ranging from $13.4 million to $31.9 million dollars; or $156 thousand to $367 thousand for each unit of co-occurrence reduction. That is, each risk reduction unit of Alternative Three would cost more than 2 or 3 times the cost per risk reduction unit in Alternative Two.

Analysis of the weak rope modification measures are similar, with Alternative Three performing better but at a high cost. Proposed modifications in Alternative Two would convert over 26 percent of the rope in buoy lines to weak lines, with an estimated cost of $2.2 million dollars, about $81 thousand for each percent of rope converted (Table 1.4). Alternative Three would convert over 73 percent of the rope in buoy lines to weak rope, with an estimated cost of $10.2 million or about$139 thousand for each percent of line converted.

Table 1.3: A summary of initial compliance costs associated with trawling up, buoy line closures, and a line cap compared to Co-Occurrence reduction for each alternative (2017 dollars). Note: the lower and upper bounds of co-occurrence reduction score are based on the assumptions of 100% lines out and 100% relocation respectively.

	Alternative 2	Alternative 3A	Alternative 3B
Trawling Up Lower	$2,660,792	$905,233	$905,233
Trawling Up Upper	$10,957,354	$1,847,949	$1,847,949
New Buoy Line Closure Lower	$106,259	$1,258,265	$1,091,997
New Buoy Line Closure Upper	$315,300	$1,854,057	$1,675,984
Line Cap Lower		$11,397,973	$11,397,973
Line Cap Upper		$28,229,779	$28,229,779
Total Lower	$2,767,051	$13,561,471	$13,395,203
Total Upper	$11,272,654	$31,931,785	$31,753,712
Co-occurrence Reduction Score	69.1%-69.2%	86% to 88.4%	83.8% to 86.4%

Chapters Six and Nine provides a full analysis and comparison of the economic impacts of federally regulated components of the alternatives. While this comparison of the costs of implementation of the risk reduction elements in each action alternative is an oversimplification, it demonstrates that Alternative Two achieves the purposes laid out in Chapter Two of this DEIS while minimizing the potential economic impacts of the proposed modifications to the Plan.

Table 1.4: A summary of annualized Federal Plan modification compliance costs related to weak line. The percent of rope weakened in Alternative 3 is the average of restricted area scenarios as well as two nearly identical conversions to weak rope in LMA Three proposed in Alternative Three.

	Percent of rope weakened	First year cost of converting to weak rope
Alternative 2	26.6%	$2,152,497
Alternative 3A & B	73.6%	$10,202,645

According to the estimation in the Vertical Line Model, there are 3,970 vessels in crab and lobster trap/pot fisheries in Northeast Region except for Maine exempt waters (which will be regulated by the state of Maine, therefore economic analysis is not included here). These represent 3,504 unique entities including 3,500 small entities. Impacts do not appear to be disproportionate across small and large entities. These vessels fish for lobster and Jonah crab. Under both Alternatives Two and Three, proposed gear marking and weak rope requirements would affect every lobster and Jonah crab vessel fishing in the Northeast Region. Line reduction measures (i.e. trawling up) under Alternative Two would affect 1,712 vessels, slightly more than the 1,565 vessels affected by the Alternative Three line reduction measures (line caps, trawling up in LMA Three). Federally regulated seasonal buoy line closures of Alternative Two would affect up to 48 vessels, compared to more than 230 vessels affected by the buoy line closures under Alternative Three. Chapter Six provides further details on the economic impacts of the Alternatives.

Community impacts vary across the region, with more vulnerable communities in mid- coast and Southeast Maine, where the lobster fishery is a major economic driver. The value of 2018 lobster landings in Hancock and Knox Counties each exceeded $130 million. Southern Maine and New Hampshire have a more diversified economy, making communities more resilient to adverse economic impacts that may stem from Plan modifications. Similarly, Massachusetts and Rhode Island communities may also be resilient due to diversified economies, although revenues from Take Reduction Plan fisheries exceed $15 million per year in some counties.

1.4.3 Preferred Alternative

Integration of the biological, economic, and social impact findings allows for a meaningful comparison of the federal regulatory alternatives. Integrating these findings typically allows formulation of measures that characterize the benefits derived relative to the costs (or other negative effects) incurred. However, in the case of the Plan modifications, development of a unifying cost-benefit analysis is complicated because the costs and benefits are characterized using diverse metrics (e.g., dollars for material, labor, and catch impacts, numbers of heavily affected vessels) that cannot be readily reduced to a single number. In many cases, costs or benefits are described only in qualitative terms or are characterized with imperfect indicators (e.g., comparative measures of risk reduction potential).

NMFS has identified Alternative Two as the preferred alternative in this DEIS. The alternative includes measures largely drawn from proposals from New England states, developed with input from fishermen. Measures were aggregated and evaluated using the DST, which estimated that Alternative Two, along with concurrent fishery management measures and measures implemented by Maine and Massachusetts for fishermen in exempted or state waters, would achieve at least a 60 percent risk reduction in the northeast lobster and Jonah crab trap/pot fisheries through a substantial reduction in co-occurrence and associated reduced encounter opportunity and the broad introduction of weak rope into buoy lines. Alternative Two achieves the minimum target estimated to meet PBR based on document right whale entanglement incidents. Finally, although the Alternative is not identical to the recommendations that the Atlantic Large Whale Take Reduction Team made to NMFS in April 2019 TRT meeting (Table 3.1), they align with the basic principles within those recommendations:

- They were estimated by the DST to achieve at least 60 percent risk reduction in the Northeast Region lobster and crab trap/pot fisheries,
- Risk reduction is distributed across jurisdictions.
- Measures include primarily line reductions through trawling up and requiring weak rope or weak inserts.

Modification of existing restricted areas to allow ropeless fishing without the use of persistent buoy lines did not have the Team's consensus support but was included to support fishermen's participation in the development of ropeless fishing methods that are feasible under commercial fishing conditions. Two new seasonal restricted areas that would allow ropeless fishing are included in the preferred alternatives that also did not receive consensus support. One was recommended by the state of Massachusetts (South Islands Restricted Area) and the LMA One Restricted Area was included to boost the LMA One risk reduction toward the target. Both are areas of predictable right whale aggregations that would provide valuable protection to whales analogous to the protection afforded by the Massachusetts Bay Restricted Area. Commenters that believe these additional restricted areas are not warranted to achieve PBR should provide specific information or analysis in support of recommended removal of restricted areas from the proposed rule. If NOAA receives information indicating that we can achieve the 60% risk reduction without the restricted area, we would consider eliminating the restricted area from the final rule.

Analysis of Alternative Two using the NMFS/IEC co-Occurrence model estimated a high reduction in co-occurrence (69 percent). Consistent with past analyses of Plan modifications, co-occurrence is considered a proxy for risk, as reducing co-occurrence would reduce the opportunity for encounters between whales and U.S. trap/pot buoy lines. Alternative Two also includes precautionary weak insert and weak rope requirements across all lobster and crab trap/pot trawls, converting more than 26 percent of the rope in the buoy lines to the equivalent of line that breaks at 1,700 lbs. or less. The broad application of these measures to weaken rope across the area is resilient to changes in right whale distribution. Finally, an economic analysis of the measures that would be implemented under Federal rulemaking under Alternative Two would have a much lower economic impact relative to the federal measures proposed under Alternative Three.

The public welfare benefits associated with increased whale protection are likely to be similar across Alternatives Two and Three. As noted, the analysis measures the change in whale protection offered by a given alternative as a change in the co-occurrence of whales and vertical lines as well as by the amount of rope within buoy lines changed to be weak enough for whales to break free more easily. By these measure, Alternative Three option A, with the largest restricted area south of Cape Cod, offers the greatest protection to all large whales when evaluated with an assumption that all lines are removed from a restricted area. This Alternative is estimated to reduce co-occurrence (upper bound scenario) by 88.4 percent for right whales, 57.4 percent for humpback whales, and 59.1 percent for fin whales. Approximately 75 percent of the rope in buoy lines in the Northeast will be modified to be equivalent to weak line. Alternative Two offers less benefit, with a reduction in co-occurrence (lower bound scenario) of 69.1, 19.4, and 27.9 percent for right, humpback, and fin whales respectively. Approximately 26 percent of the rope in buoy lines would be weak rope. These biological benefits to whale populations have socioeconomic implications for the general public. Increasing whale populations would have a positive impact on the consumer surplus derived from whale watching (a use benefit) and may increase producer surplus for operators of whale watch vessels. Likewise, whale conservation may enhance intrinsic values that society holds for healthy, flourishing whale populations.

NMFS has considered the benefit and cost information presented above and designated Alternative Two as its preferred alternative. The reduction in co-occurrence achieved under this alternative is considerable despite more moderate line reduction measures compared to Alternative Three. The broad use of line reduction and weakened line across most vessels that fish in the Northeast Region would be resilient to the potential shifts in right whale distribution and density. The reduction in co-occurrence achieved under Alternative Three is greater than that achieved under Alternative Two (Preferred) but at nearly three times the cost and greater uncertainty regarding how allocations would be applied and how fishermen would react, and how implementation and reaction would affect risk seasonally in response to a 50 percent line cap allocation in federal waters. Alternative Three applies a broader use of line reduction and even greater percent of weakened rope in buoy lines, compared to Alternative Two. Less line and weaker line across most vessels that fish in the Northeast Region is resilient to the potential continued shifts in right whale distribution and density. The inclusion of additional buoy line closures that are larger in size or time period may also provide greater benefit to whales. However, the implementation costs of Alternative Two are at least two thirds lower than the costs of implementing Alternative Three, making Alternative Two the most cost- effective of the alternatives. Additionally, the measures in Alternative Two were derived primarily from proposals submitted by Maine and Massachusetts, and to a lesser extent from Rhode Island, and were informed by extensive outreach with fishermen in those states and in the LMA Three offshore fleet. The measures are therefore more likely to be feasible and result in higher compliance because of fishermen’s input on the development of the measures.

NMFS believes that Alternative Two, the preferred alternative, addresses the Purpose and Need for Action stated in this DEIS, incorporating measures that will help to conserve large whales by reducing the potential for and severity of interactions with commercial fishing gear that may lead to mortalities and serious injuries. Included are region wide measures that will be resilient to shifting whale distribution, informed by stakeholders and therefore considered feasible, underlaid by seasonal restrictions that protect predictable aggregations of right whales, and supplemented by state conservation measures that will be implemented before or simultaneously by Massachusetts and Maine. In addition, NMFS believes that its preferred alternative achieves these goals while reducing, to the extent possible, the adverse socioeconomic impacts of the rule. On this basis, NMFS believes that Alternative Two (Preferred) offers the best option for achieving compliance with MMPA requirements.

1.5 Areas of Controversy

Numerous interest groups have participated in the formulation and refinement of the Plan. In addition to Team meetings, NMFS supported this rulemaking by conducting a series of public meetings held at various locations on the east coast during the summer of 2019. Through public outreach, NMFS has attempted to gather and accommodate many viewpoints, pursuing whale conservation objectives while remaining sensitive to the many regulatory pressures on the fishing industry. Additional scoping meetings were held by Maine, New Hampshire, Massachusetts and Rhode Island throughout the summer and fall of 2019 and into January and February of 2020. The Maine Congressional delegation has provided regular attention and input. There is also ongoing litigation largely related to non-governmental organizations' and whale conservationists' allegations that NMFS has not authorized the incidental take of right whales under the ESA or MMPA. The non-governmental organizations suggest that rapid changes to current fishing practices are needed to prevent continued mortality and serious injury of right whales in U.S. fisheries and reverse the decline of the North Atlantic right whale population. The dialogue that has occurred highlights a number of key areas of controversy that NMFS attempted to address in the regulatory alternatives examined:

- Whale conservationists emphasize that whale entanglements have continued despite the existing Plan requirements. Continued serious injury and mortality of right, humpback, and fin whales due to entanglement is the primary motivating factor behind refinement of the Plan. Conservationists support larger seasonal buoy line closure areas, similar to the larger area included in Alternative Three, and accelerated support for ropeless fishing alternatives. The alternatives under consideration seek to reduce large whale entanglement by decreasing the number of vertical lines in the water or modifying the gear so that the resulting entanglement does not result in a serious injury or mortality. Restricted areas that allow ropeless fishing are proposed to accelerate the development of operationally feasible ropeless technology. Chapter Three further explains the revisions under consideration to the existing Plan.

- The Take Reduction Team did not broadly support the modification of existing closure areas to closures to buoy lines rather than closures to fishing. Additionally, although Massachusetts proposed a closure south of Nantucket and Cape Cod, they did not propose it as a closure to buoy lines. Fishing industry participants disagree that ropeless technology is ready for use in commercial fisheries or affordable, so do not consider it an available alternative to current fishing practices in most areas. In addition to operational concerns on a vessel at sea, fishermen express concerns about the time it takes to haul and re-deploy ropeless gear, gear conflict by fishermen unaware of sets on the bottom, an increase in gear loss, and cost effectiveness. The Atlantic States Marine Fisheries

Commission's Law Enforcement Committee expressed similar concerns as related to their ability to retrieve and re-deploy gear set with ropeless technology. By proposing modification of existing seasonal closures and establishing new seasonal closures as closures to buoy lines rather than closures to harvesting crab and lobster, allowing the use of ropeless technology gives fishermen access to those areas (with authorization for exemptions from surface system requirements under other laws), but it is not a requirement. NMFS believes that encouraging industry use of ropeless fishing is necessary to accelerate the development of operationally effective ropeless fishing systems that would allow trap/pot fisheries to occur without serious injury and mortality to right whales.

- For the majority of seriously injured and killed right whales demonstrating signs of entanglement, no gear remains on the whales, no gear is retrieved, or retrieved gear is unidentified. Undocumented mortalities estimated in North Atlantic right whale population models (cryptic mortality) result in further uncertainty about the extent of the threat of U.S. fisheries, including trap/pot fisheries, to right whales. As a result, fishermen, particularly lobster fishermen, fundamentally disagree that U.S. trap/pot fishing gear entanglements are causing right whale mortalities and serious injuries above the potential biological removal level. The fishing industry feels singled out unfairly within the overall context of factors that contribute to Atlantic large whale population decline. The cumulative effects analysis in this EIS considers other stresses on whales (for example, ship strikes, climate change, and water pollution) and identifies parallel measures underway to address these stresses through other initiatives.

- A Decision Support Tool and Co-occurrence model were used to develop and evaluate the risk reduction measures in Alternatives Two and Three. The models apply the best available information about whale distribution, buoy line numbers, and configurations of trap/pot gear. There is uncertainty in each data set. Because whales exhibit regular behavioral patterns (e.g., migration, feeding), NMFS seeks to use distribution data to reduce impacts on the fishing industry but maximize the effectiveness of the Plan by designating requirements tailored by region and season This DEIS examines regulatory alternatives that introduce new gear modification requirements and other provisions that incorporate information about whale movements and behavior Development of these spatial and temporal requirements involves the consideration of the inherent uncertainties and the integration of complex technical input from NMFS researchers and other experts. Both models underwent Center of Independent Expert peer reviews that acknowledged uncertainty and suggested modifications that were made when possible. Although much of the data is subject to uncertainty, the information employed in developing the spatial and temporal elements of the alternatives under consideration is the best information currently available.

- The data used to assess the restricted area options south of Cape Cod were of particular concern given that right whale sightings data suggest they are currently present in this area more than is reflected in long-term monitoring data within the databases that support distribution models. To address this, we used the most recent sightings data from 2014 through 2018 to compare a few options for a restricted area in this region. Any seasonal buoy line closures implemented will be reviewed by NMFS and the Take Reduction Team every three years considering new whale sightings data to ensure that, given shifting right whale distribution, regulations are adequately protecting areas of seasonal aggregations.

- A common concern expressed has been the lack of data about the lobster and crab trap/pot fisheries and associated challenges evaluating compliance and implementation of enforcement, particularly in waters beyond 12 nm (22 km) from shore. The effectiveness of proposed regulations is dependent upon compliance, including the ability of enforcement to ensure compliance. Parallel actions to increase vessel trip reporting will improve data regarding the fishery, and vessel monitoring systems are being piloted for use in the lobster fishery in federal waters. Monitoring and enforcement efforts will be developed in collaboration with the Take Reduction Team and enforcement partners.

- Delineation of exempt waters has been a recurring area of disagreement. Conservation advocates stress that extending regulations to all waters offers the greatest protection against entanglement, while other groups argue for exemptions in nearshore waters where recorded whale activity is minimal and where small vessel sizes and solo fishing practices present safety concerns. NMFS sightings data suggest that large whales rarely venture into certain nearshore areas. However, the alternatives considered in this EIS include both gear marking and precautionary weak insertion modifications in exempted areas. Planned Maine regulations identified in the Maine DMR proposal, and the measures considered in both Alternatives Two and Three include precautionary measures that would reduce the likelihood of a severe entanglement should a whale enter these areas and become entangled.

The fishing industry is concerned that interactions between large whales and Canadian fishing gear and vessel strikes are not being adequately addressed, that mortalities in Canada must also be reduced to less than one per year to allow the right whale population to recover. They cite twenty years of effort to adapt fishing practices to protect large whales. Fishermen express their belief that the U.S. fishing industry is bearing a disproportionate regulatory burden and in particular, they disagree with NMFS approach dividing unassigned entanglement related mortalities and serious injuries and cryptic mortalities evenly between the U.S. and Canadian fisheries. NMFS recognizes that large whales face mortality risks throughout their range and that the shifting distribution of right whales has increased mortality incidents to unprecedented levels in Canadian waters, particularly the Gulf of St. Lawrence. NMFS continues to work with representatives from the Canadian Department of Fisheries and Oceans (DFO) to advise on protective measures for right whales in Canadian waters. Since 2017, DFO has implemented and modified regulations to address the recent increase in right whale mortality in Canadian waters. In addition, NMFS is working with Canadian whale biologists and support teams to improve and expand disentanglement efforts in Canadian waters. The emergence of new mortality sources in Canada does not exempt NMFS from implementing the Marine Mammal Protection Act. Although in recent years serious injuries and mortalities in U.S. fisheries may cause fewer incidents than the anthropogenic mortalities in Canadian waters, they remain above PBR and, given other stressors, are not sustainable while the population is in decline. Further modifications to the Plan to reduce risk from U.S. fisheries by at least 60 percent are necessary to achieve PBR.

- Some segments of the commercial fishing industry have expressed concern about gear configuration modifications, particularly the trawling up and weak rope requirements, stressing safety concerns. Most commercial fishermen have optimized their fishing operations based on what their vessels and skills can safely fish. However most of the measures in the Alternative Two (preferred) come from New England states and after frequent meetings and close collaboration with trap/pot fishermen. The alternatives also consider where and how weak line or weak insertions can be implemented and reflect data available on forces generated on the line during trawling. Buoy line weak insertion measures as well as trawl lengths were also informed by industry tolerances. The alternatives considered in this DEIS offer options for areas with smaller vessels and crews that operate in inshore waters.

- Maine has published rules, effective September 1, 2020 to require purple gear marking on all lobster/trap buoy lines fished by Maine permitted vessels throughout LMA1, hoping to demonstrate that Maine buoy lines are not involved in right whale entanglement incidents (DMR Chapter 75.02). For the same reason, the South Atlantic Fishery Management Council implemented measures seasonally requiring a one foot purple mark to be added adjacent to other colored marks required in the black sea bass trap/pot fishery from North Carolina, south. The sea bass marks would then be two foot long marks of two or three colors, including a one foot purple band. Although concerns that having more than one purple marking may confound the ability to distinguish between Maine lobster/crab and black sea bass trap/pot gear, the NMFS gear team indicated that the multiple colors in the black sea bass marking regime would be sufficient to distinguish the two fisheries.

- Rhode Island proposed measures for modifications in LMA2 that have not been included in the preferred alternative because they were not consistent with the measures proposed by Massachusetts, which has more permitted fishermen fishing in these waters. Specifically: (1) Rhode Island did not propose or support a closure area in LMA Two, or weak insertions in buoy lines. Instead, they proposed the use of two weakened buoy lines (the top 75 percent of the lines) throughout LMA2. Although not currently required, most Rhode Island vessels already use break away line at the top 33 percent of their vertical line, usually ¼ inch or 5/16ths inch line demonstrated to break at below 1,700 lbs. (2) Rhode Island also did not recommend a change in the number of traps per trawl. They requested an analysis of trawling up from ten traps/trawl (status quo) to 12 traps/trawl for consideration in waters from 3 to 12nm from shore if deemed necessary, but as estimated by the Decision Support Tool this contributes less than one percent risk reduction for LMA2 because most vessels are already fishing more traps per trawl than the ten traps required. Rhode Island expressed concern that the increased traps/trawl proposed by Massachusetts and included in the preferred alternative would pose safety issues for small vessels that participate in the fishery in those waters. (3) Rhode Island agreed to a specific state color but did not identify a color in their written proposals, however in discussions expressed a preference for green. Because green is widely used as a mark for gillnet buoy lines and often found on humpback whales, the NMFS gear team recommended against green markings. As one of the few remaining colors available, pink is proposed for the Rhode Island gear marking color, likely to be somewhat controversial.

1.6 Report Structure

The remainder of this DEIS is organized as follows:

- **Chapter 2** reviews entanglement data and current Plan requirements.
- **Chapter 3** describes the proposed alternatives considered within this DEIS for modifying the ALWTRP.
- **Chapter 4** examines the affected environment, focusing on the status of Atlantic large whales, other protected species, habitat, and the basic features of the regulated fisheries and fishing communities.
- **Chapter 5** analyzes the biological impacts of the alternatives.
- **Chapter 6** analyzes the economic and social impacts of the alternatives.
- **Chapter 7** reviews and summarizes the findings of the biological, economic, and social impact analyses.
- **Chapter 8** examines the cumulative impacts of the alternatives.
- **Chapter 9** provides the Regulatory Impact Review (RIR) as required by Executive Order 12866 and the Initial Regulatory Flexibility Analysis (IRFA) in accordance with the requirements of the Regulatory Flexibility Act (RFA) of 1980. The purpose of the RFA is to evaluate the impacts that the regulatory alternatives under consideration would have on small entities and to examine opportunities to minimize these impacts.
- **Chapter 10** briefly summarizes the statutes and executive orders that have guided development of this DEIS and explains how the document meets the requirements of all applicable laws.

The document also includes a list of preparers and contributors (Chapter 11), a list of persons or agencies receiving the DEIS for review (Chapter 12), and a glossary, list of acronyms, and index (Chapter 13).

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2 PURPOSE AND NEED FOR ACTION

The National Marine Fisheries Service (NMFS) is considering revisions to the Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan) to conserve and provide additional protection to Atlantic large whales, including North Atlantic right whales (*Eubalaena glacialis*), Gulf of Maine humpback whales (*Megaptera novaeangliae*), and Western North Atlantic fin whales (*Balaenoptera physalus*). Canadian Eastern Coastal minke whales (*Balaenoptera acutorostrata acutorostrata*) have also previously been monitored for serious injury and mortalities in commercial fisheries and considered in the Plan because of persistent entanglement impacts. The revisions would fulfill NMFS' obligations under the Marine Mammal Protection Act (MMPA). Revisions to the Plan would reduce the risk to the North Atlantic right whale and other large whale species due to serious injuries and mortalities caused by entanglement in commercial fishing gear. For additional background information on the Atlantic Large Whale Take Reduction Team (ALWTRT or Team), and implementation of the Plan, see the 2014 Final Environmental Impact Statement for Amending the Plan (NMFS 2014).

The following sections will discuss large whale entanglement patterns since 2010, describe the current need for rulemaking (i.e. right whale population decline), and identify the amount of risk reduction that is needed to reduce serious injury and mortality below the potential biological removal (PBR) level. The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The PBR level is the product of the minimum population estimate of the stock, one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size, and a recovery factor of between 0.1 and 1.0, where 0.1 is used for species listed as endangered; 0.5 for stocks of depleted, threatened or unknown status; and up to 1 for stable stocks with no recent issues with incidental fishery takes.

The data included here are primarily sourced from the large whale incident data that are maintained by the NMFS' Northeast Fisheries Science Center and used to create annually published reports, including the *Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces*, and the *Atlantic and Gulf of Mexico Marine Mammal Stock Assessments* for humpback, North Atlantic right, fin, and minke whales. The period between 2010 through 2018 is being considered because it represents the period during which the North Atlantic right whale population decline occurred (Pace et al 2017), when a shift in distribution was documented (Davies et al. 2019, Record et al. 2019), and high mortalities in Canadian waters occurred. Under these conditions, it has become more urgent to ensure that serious injuries and mortalities of right whales in U.S. fisheries be reduced below PBR.

This chapter describes in detail the purpose and need for revisions to the existing Plan. It is organized as follows:

- Section 2.1 provides background information including the current statutory and regulatory context of the ALWTRP recommendations being considered, summarizes the existing Plan regulations, and recent trends in large whale serious injury and mortality.

- Section 2.2 demonstrates the purposes and needs for additional action under the ALWTRP.

2.1 Background

2.1.1 Statutory and Regulatory Context

The Plan consists of regulatory restrictions on where and how fixed U.S. commercial fishing gear can be set and informs research into whale populations, whale behavior, and fishing gear. The Plan also includes monitoring requirements, outreach to inform fishermen of the entanglement problems and their help in solving the problem, and a program to disentangle whales that do get caught in fishing gear.

The Plan was first created in 1997 to fulfill the MMPA mandate requiring NMFS to reduce human caused mortality of North Atlantic right whales as well as humpback and fin whales along the U.S. Atlantic coast. The immediate goal of any take reduction plan is to reduce, within six months of its implementation, the mortality and serious injury of strategic stocks incidentally taken in the course of U.S. commercial fishing operations to below the PBR levels established for such stocks. A stock is considered strategic if it is listed as threatened or endangered under the Endangered Species Act (ESA), is listed as depleted under the MMPA, or is undergoing anthropogenic mortality at rates higher than PBR. The long-term goal of a take reduction plan is to reduce, within five years of its implementation, the incidental mortality and serious injury of marine mammals taken in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans.

To comply with the MMPA mandates, NMFS annually estimates the level of human- caused mortality and serious injury for strategic stocks. Baleen whale interactions are rarely detected by marine mammal observers on fishing vessels or through other traditional monitoring methods, therefore most fishery interactions are determined through careful review of incident reports collected opportunistically (from dedicated aerial and shipboard surveys, marine mammal disentanglement and stranding networks, U.S. Coast Guard, whale watch vessels, mariners, etc.). Following established national policy (*Policy for Distinguishing Serious from Non-Serious Injury of Marine Mammals Pursuant to the Marine Mammal Protection Act*), NMFS reviews incident reports to determine whether an injury is "serious" and likely to lead to death. For reported deaths of baleen whales in the Atlantic, NMFS applies regionally developed criteria to determine whether ship strikes or entanglements caused these documented mortalities (NMFS 2012). NMFS publishes the results of these analyses annually, and they are incorporated into annual stock assessment reports, which identify whether mortality and serious injury during the most recent five-year period exceed the PBR established under the MMPA (Henry et al. 2014, Henry et al. 2019). Take reduction teams including representative stakeholders are convened to help NMFS reduce serious injuries and mortalities in commercial fisheries when the rate exceeds PBR.

Throughout the history of the Plan, the primary species driving modifications has been the North

Atlantic right whale. PBR for the endangered North Atlantic right whale stock has never been greater than one serious injury or mortality per year, and the most recent Stock Assessment Report (Hayes et al. 2019) identified PBR as 0.9 right whale serious injuries or mortalities a year. Coast-wide, human-caused serious injuries and mortalities of right whales have been well above PBR for many years, and since 2000 entanglement has been the primary cause of death identified when a cause has been determined (Kraus et al. 2005, Sharp et al. 2019).

Although right whales have always been the primary species of concern, when the Plan was created, humpback, and fin whales were also considered strategic stocks because they were listed as endangered. Primary causes of anthropogenic mortality for all three species were fishery interactions and vessel strikes. Humpback whales along the U.S. East Coast are primarily from the West Indies humpback population, which were delisted in 2016 when the listing status of distinct population segments was reexamined individually. However, West Indies humpbacks are still protected under the MMPA throughout its' range and continue to be monitored for human interactions when they approach PBR.

2.1.2 Current Gear Modification Requirements and Restrictions

The Plan specifies both universal gear modification requirements and restrictions that apply to all trap/pot fisheries and anchored gillnets, as well as area- and season-specific gear modification requirements and restrictions. The general gear requirements for gillnet and trap/pot fisheries are delineated in 50 CFR 229.32 and include:

- No floating buoy line at the surface
- No wet storage of gear (all gear must be hauled out of the water at least once every 30 days. In Federal waters in the southeast U.S., trap/pots must be returned to shore at the end of every trip).
- In most waters, surface buoys and buoy lines need to be marked to identify the vessel or fishery.
- Knots – Fishermen are encouraged, but not required, to maintain knot-free buoy lines. Splices are not considered to be an entanglement threat and are thus preferable to knots.
- In most waters, groundline must be made of sinking line.
- All buoys, flotation devices, and/or weights must be attached to the buoy line with a weak link. Specific breaking strengths vary by area. This measure is designed so that if a large whale does become entangled, it should be able to exert enough force to break the weak link and break free of the buoy (lobster gear) or net panels (gillnet), increasing the chance of releasing the gear and reducing the risk of injury or mortality.
- All buoy lines need to be marked three times (top, middle, bottom) with three marks along a 12-inch (30.48cm) area. This measure is intended to help managers learn more about where, when, and how entanglements occur.
- Minimum trap per trawl requirements based on area fished and miles from shore (See Appendix 2.1).
- In the Southeast calving grounds, there are restrictions on breaking line strength as well as a limitation that only allows single pots to be fished. Singles are favored in this area to protect calves that would be more likely to survive an entanglement with a single pot compared to a heavier string/trawl of multiple traps.

There are also two seasonal trap/pot closures: the Massachusetts Restricted Area (MRA; 50 CFR 229.32(c)3) and the Great South Channel Trap/Pot Closure (50 CFR 229.32(c)4). The Massachusetts Restricted Area prohibits fishing with, setting, or possessing trap/pot gear in this area unless stowed in accordance with regulations found at 50 CFR § 229.2, from February 1 to April 30. Great South Channel Trap/Pot Closure prohibits fishing with, setting, or possessing trap/pot and gillnet gear in this area unless stowed in accordance with the regulations, from April 1 through June 30. Cape Cod Bay, part of the MRA, is also closed to gillnet fishing from January 1 to May 15. These time periods coincide with the presence of right whales in these areas. Additional details on current regulations are available in appendix 2.1.

2.1.3 Atlantic Large Whale Injuries and Mortalities, 2010 to 2018

Large whales in the Atlantic are impacted by a variety of threats, both natural and human induced (Table 2.1). It is important to note that, the methods followed to make annual mortality and serious injury determinations (see Henry et al. 2019), may underreport entanglements. Determinations are only made when they can be decided with absolute certainty. As a result, unknown cause of death or injury determinations are ascribed to a high proportion of incidents even when some have been found with fishing gear attached, but where the cause of death could not be confirmed. The number of incidents summarized in Table 2.1 also represent only those that were spotted and reported, and does not include estimated but unseen mortalities. Therefore, serious injury and mortality determinations discussed in this section are likely to be underestimates. Additionally, different species may not be reported at the same rate due to habitat usage as well as prioritization based on a species status, and the amount of perceived threat. For example, entangled right whales are more likely to be reported because the species is highly endangered and declining, so areas of aggregations are relatively well monitored and reports of entanglement generate a monitoring and disentanglement response.

As delineated in Table 2.1, entanglements represent the highest proportion of all documented large whale incidents, including non-serious injury reported for humpback, North Atlantic right, fin, and minke whales, with humpbacks and right whales experiencing higher numbers of entanglements compared to other causes. For all large whale species except right whales, the majority of documented serious injuries and mortalities did not have a cause definitively determined. For North Atlantic right whales, human sources were the leading causes of serious injuries and mortalities; 63% percent of all right whale serious injuries and mortalities between 2010 and 2018 occurred as a result of entanglement[2] and 15% were caused by vessel strikes. There were no confirmed non-human induced serious injury and mortality incidents reported for right whales during this time period. Entanglement was also the highest cause of known serious injury and mortality for humpback, fin, and minke whales in those instances when cause of death could be determined. Vessel strikes represent the next highest contributor to human-caused large whale serious injury and mortality, followed by non-human causes and a single entrapment,

[2] This estimate includes 7 disentangled whales where serious injury was avoided in order to better estimate the frequency at which serious injury and mortality would occur if not observed. Including these cases provides a better estimate of the threat of fisheries and associated reduction in entanglements needed and recognizes that relying on disentanglement to reduce serious injury and mortality rates puts peoples' safety at risk and may not always be an available conservation measure

where an individual is confined or otherwise restricted in movement but can reach the surface for air.

Table 2.1: Atlantic coast-wide causes of large whale human interaction incidents between 2010 and 2018 of with all health outcomes by species, including non-serious injuries and those that resulted in serious injury or mortality. The purpose of this table is to identify the risk of human interactions. Therefore these data include 7 incidents where right whale serious injury or mortality due to incidental entanglement were averted due to successful disentanglement. Also included are 72 individuals (39 humpback, 16 minke, 10 right, and six fin whales) where injuries were "prorated" as highly likely to have a serious outcome.

Cause	*Fin N*	*Fin %*	*Humpback N*	*Humpback %*	*Minke N*	*Minke %*	*Right N*	*Right %*	*Total N*	*Total %*
All Incidents										
Unknown	38	51%	126	30%	162	52%	22	13%	348	36%
Entanglement	19	25%	209	50%	99	32%	105	64%	432	45%
Vessel Strike	14	19%	58	14%	11	4%	34	21%	117	12%
Non-human Induced	3	4%	14	3%	36	12%	1	1%	54	6%
Entrapment	1	1%	8	2%	5	2%	3	2%	17	2%
TOTAL	**75**		**415**		**313**		**165**		**968**	
Serious Injury & Mortality										
Unknown	38	57%	126	47%	161	56%	20	22%	345	49%
Entanglement	14	21%	90	34%	80	28%	56	63%	240	34%
Vessel Strike	12	18%	38	14%	11	4%	13	15%	74	10%
Non-human Induced	3	4%	14	5%	34	12%	-		51	7%
Entrapment	-		-		1	0.40%	-		1	0.10%
Total	**67**		**268**		**287**		**89**		**711**	

Large whale entanglements and vessel strikes occur in both the U.S. and Canadian waters. While vessel strikes are often first observed near the strike location, only in rare instances is the exact location of an entanglement incident determined. In some incidents, injured whales are first documented in U.S. waters but are entangled in gear that was set in Canadian waters, and vice versa. Gear was only retrieved 21 percent of the time between 2010 and 2018, and can rarely be identified to a specific fishery. It is impossible to confirm the country of origin for every incident. And although in recent years Canada has provided some data on large whale entanglements documented in U.S. waters, only right whales are prioritized and fully represented in the Canadian data.

When coastwide serious injuries and mortalities are aggregated based on the country where the incident occurred or, in the absence of a confirmed initial location, where the individual was first sighted, entanglements incidents occur in higher numbers than vessel strikes each year for all species except fin whales (Figure 2.1). Vessel strikes have been reported more frequently in U.S. waters than Canadian waters for all four large whale species, but entanglement is the primary source of serious injury and mortality regardless of the location of first sighting or origin of the incident.

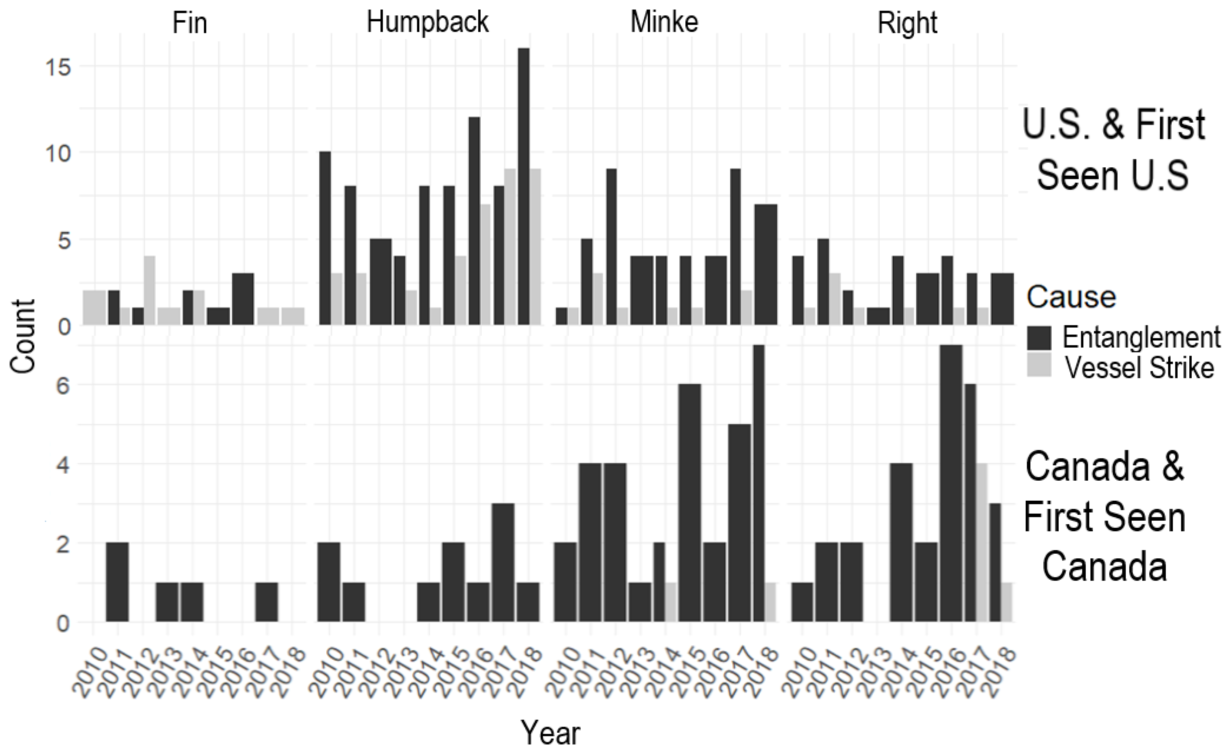

Figure 2.1: Serious injury and mortality cases (including those averted by disentanglement response or prorated injuries) caused by entanglements and vessel strikes according to the country where the incident occurred or, in the absence of that information, where the individual was first sighted.

Given reporting biases between species, trends in entanglements are difficult to examine, but there is some evidence that country-specific trends have shifted over the years, possibly in concert with regulatory and ecosystem changes that have shifted human activities and species' distribution (Hayes et al. 2018, Davies et al. 2019, Record et al. 2019). For example, figure 2.1 shows a potential recent uptick in humpback vessel strikes in U.S. waters and a sharp increase in new reports of right whale vessel strikes and entanglements in Canada. Coast wide, annual right whale serious injuries and mortalities caused by entanglement far exceed the PBR level for the population (Figure 2.2). This remains true even when removing incidents first seen in Canada or known to be in Canadian gear. Coast-wide humpback and minke whale entanglements have remained high and serious injury and mortality has approached PBR in some years but this represents the minimum number of takes by U.S. fisheries. Using only documented incidents, the five-year rates of serious injuries and mortalities have remained below PBR for these stocks as well as for fin whales. Impacts on other large whales will be analyzed and discussed, however the primary focus of this document will be reduction in entanglement risk on the North Atlantic right whale stock.

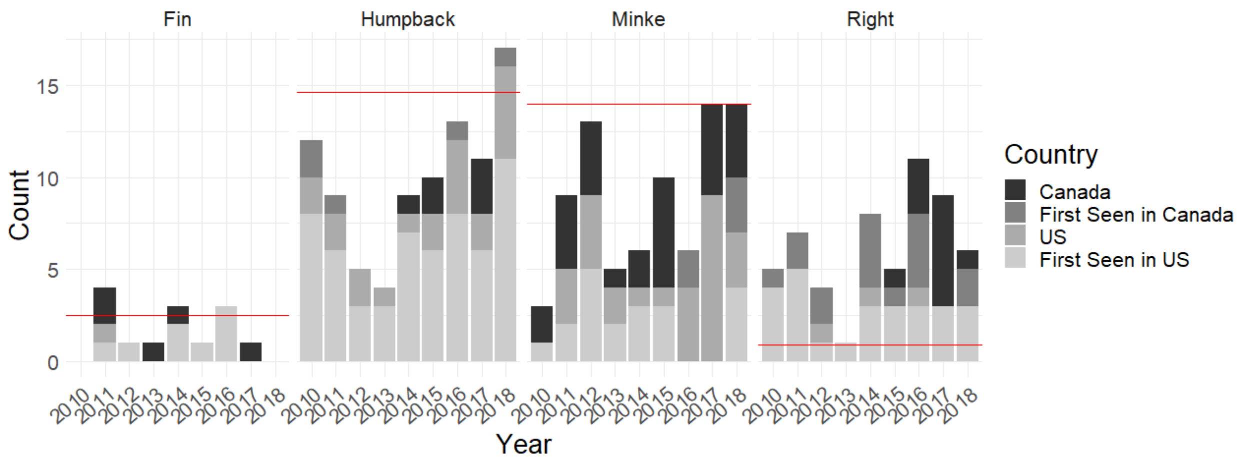

Figure 2.2: Entanglements, according to the fate and the country. Incidents with prorated injuries and where serious injury was averted by disentanglement response are included as serious injuries and mortalities. The red line represents the current potential biological removal for the stock.

As described in Table 2.2, large whales are entangled in a variety of both fishing and non-fishing gear (e.g. boat moorings or debris). However, fishing gear represents the vast majority of documented sources of entanglements with only three documented non- fishing gear entanglements out of 440 incidents documented between 2010 and 2018. No gear is retrieved and/or the fishery of origin or type of fishing gear are not identifiable for a large portion of entanglements, including 76% for right whales. Those incidents for which gear was identified are primarily from fisheries that use trap/pot gear, gillnet or other types of netting, or monofilament line. A few incidents have been attributed to fisheries using trawls, seines, or a weir. Trap/pot gear is the highest known documented source of entanglement for all whale species, with a high number of humpback and minke whale entanglements in confirmed U.S. lobster gear. Gillnet and netting gear have been found on all species except fin whales but are most frequently found on humpbacks in the U.S. Monofilament line is also primarily a concern in the U.S. for humpback whales and not commonly found on the other species.

Figure 2.3 shows the major types of gear found on entanglements by outcome and demonstrates the large knowledge gap when it comes to unidentified gear types that are contributing to serious injury and mortality. Of the identifiable gear, it appears that humpbacks generally experience a higher number of entanglements than other species (48% of all entanglements) but that many (57%) of them do not result in serious injuries. Conversely, minke whale entanglements more often resulted in serious injury or mortality. This is consistent with the likely scenario suggested by Knowlton et al (2016) where a species' or age class' relative strength is linked to the likelihood of mortality and discovery. For those reported right whale entanglements for which gear was recovered and identified, trap/pot gear was more likely to result in serious injury and mortality. However, for most entanglements, no gear, only rope, or rope with buoys is retrieved, making it difficult to assign a specific fishery or fishery type in these cases. It is most likely these belong to some type of fixed fishing gear, making this gear type a particular concern for the endangered North Atlantic right whale.

Table 2.2: (A) The types of fishery gear that have been identified on all documented entanglement incidents (including those not causing serious injury), identified to the fishery and country if possible. (B) The nature of the gear that was observed on all unknown entanglement incidents where the gear could not be traced back to a specific fishery. In the few entanglements with two gear types, both were counted separately here to account for gear types.

A) Gear Type	Fishery	Fin	Humpback	Minke	Right	Total
Unknown	Unknown	10	64	21	73	**168**
	U.S. Unknown	1	14	16	4	**35**
	Canadian Unknown	1	1	14	3	**19**
	Subtotal	**12**	**79**	**51**	**80**	**222**
Trap/Pot	U.S. lobster	2	31	20	1	**54**
	Canadian crab	3	3	4	13	**23**
	Canadian lobster	-	7	8	-	**15**
	U.S. trap/pot	-	8	-	2	**10**
	Canadian trap/pot	1	1	-	-	**2**
	Unknown trap/pot	-	1	1	1	**3**
	Canadian whelk	-	-	1	-	**1**
	U.S. recreational lobster	-	1	-	-	**1**
	Unknown Lobster	-	1	-	-	**1**
	Subtotal	**6**	**53**	**34**	**17**	**110**
Gillnet/Netting	Unknown gillnet	-	6	1	5	**12**
	Unknown netting	-	4	2	2	**8**
	U.S. gillnet	-	7	-	-	**7**
	U.S. dogfish	-	3	1	-	**4**
	U.S. netting	-	-	1	1	**2**
	Canadian cod	-	-	1	-	**1**
	Canadian lumpfish	-	-	1	-	**1**
	U.S. croaker	-	1	-	-	**1**
	U.S. smooth dogfish	-	1	-	-	**1**
	Canadian herring	-	-	1	-	**1**
	Canadian salmon	-	-	1	-	**1**
	US menhaden	-	1	-	-	**1**
	Subtotal	**0**	**23**	**9**	**8**	**40**
Monofilament line	U.S. monofilament line	-	31	-	-	**31**
	Unknown monofilament line	1	21	1	-	**23**
	U.S. sport monofilament line	-	2	-	-	**2**
	U.S. tuna	-	1	-	-	**1**
	Subtotal	**1**	**55**	**1**	**0**	**57**
Other	U.S. tuna anchor system	-	2	-	-	**2**
	Marine mammal seine	-	1	1	-	**2**
	Canadian herring	-	1	1	-	**2**
	Canadian mooring	-	-	1	-	**1**
	Debris	-	-	1	-	**1**
	U.S. Atlantic herring	-	-	1	-	**1**
	Canadian mackerel	-	-	1	-	**1**
	Canadian cod	-	-	1	-	**1**
	Subtotal	**0**	**4**	**7**	**0**	**11**
	Total	**19**	**214**	**102**	**105**	**440**

B) Characteristics of Unknown Gear	Fin	Humpback	Minke	Right	Total
None available	12	58	47	67	**184**
Line & buoy	-	13	3	3	**19**
Line	-	7	1	10	**18**
Buoy	-	1	-	-	**1**
Total	**12**	**79**	**51**	**80**	**222**

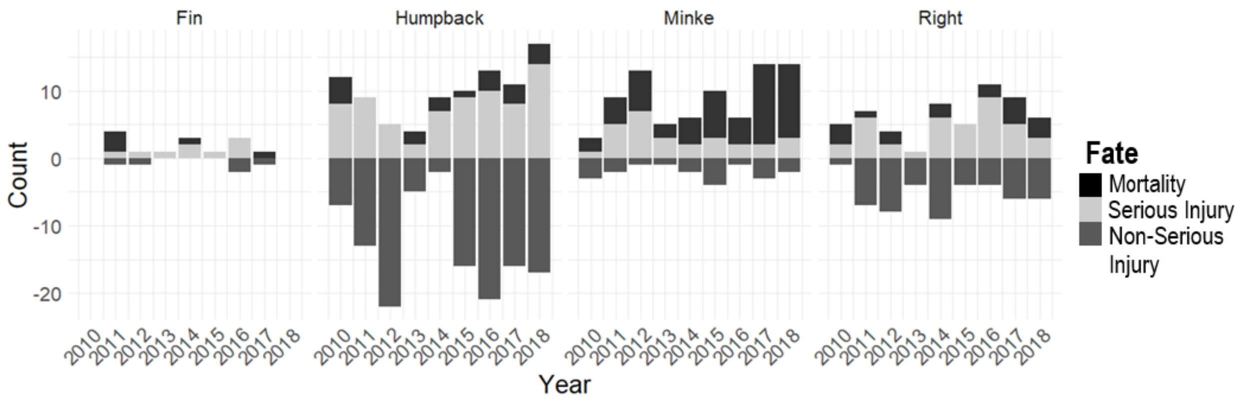

Figure 2.3: Entanglement cases by species relative to the fate of the incidents for documented incidents between 2010 and 2018.

A 2017 buoy line estimate derived through a model created by a federally contracted firm, Industrial Economics, Inc. (IEc), to support the Team efforts indicate that outside of exempted waters, over 93% of fixed gear endlines within right whale habitats along the U.S. Atlantic coast are fished in Northeast Region Trap/Pot Management Area (Northeast Region) by the U.S. lobster fishery. Table 2.3 delineates the relative abundance of various fixed gear buoy lines in the U.S. Northeast, Mid-Atlantic, and Southeast commercial fisheries for comparison.

Table 2.3: The average buoy line estimates across months in non-exempt waters

Fishery	Northeast	Mid-Atlantic	Southeast	Total
Lobster Trap/Pot	93.7%	1.5%	0.0%	95.2%
Gillnet	1.5%	0.4%	0.0%	1.9%
Other Trap/Pot	0.1%	1.3%	0.9%	2.3%
Blue Crab Trap/Pot	0.0%	0.0%	0.5%	0.6%
Total	95.3%	3.3%	1.4%	100.0%

Note: IEc Line Model, 2017 endline estimates per 11/9/2019 model run. See Model Documentation in Appendix 5.1

Coast-wide rulemaking to modify diverse, relatively data-poor, fisheries can take three to four years. The fishery source and/or country of serious injury and mortality to right whales cannot be determined in 76% of documented entanglements but, in the cases where gear can be identified, entanglements to North Atlantic right whales are frequently the result of trap pot line. Because of the urgency of responding to the rapid decline in the right whale population, described below, NMFS is focusing the scope of initial modifications to the ALWTRP on northeast lobster and crab fisheries (Figure 2.4), representing the highest number of endlines in the U.S. Atlantic. The red crab fishery is not included, with only an estimated 24 buoy lines set in the area within the scope of this DEIS. The Take Reduction Team will focus on other coastwide trap/pot fisheries and gillnet fisheries in developing further Plan modifications.

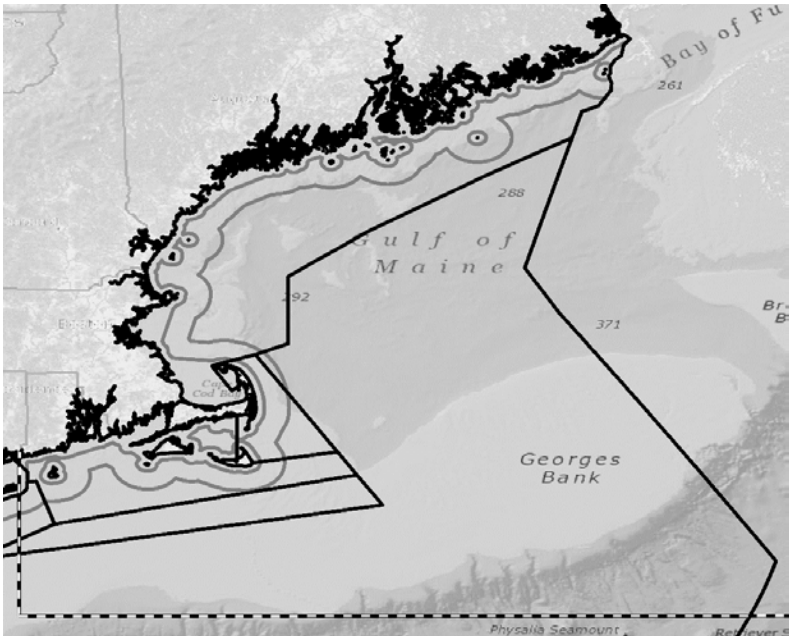

Figure 2.4: The Northeast Region that will be regulated by this EIS are those north and east of the dashed line that lie within US waters. The black line represents the Lobster Management Areas that will be analyzed. Three and 12 nautical mile lines are represented in gray.

2.1.4 Right Whale Population Decline

Despite efforts by the Team over the last two decades to reduce human-caused mortality of large whales in the Atlantic, North Atlantic right whales have continued to experience unsustainable levels of mortality from entanglement, as discussed above. The North Atlantic right whale population is critically endangered and in 2017 it was demonstrated that the population has been in decline since 2010 (Figure 2.5, 2.6; Pace et al. 2017). The most recent estimate of the North Atlantic right whale population is that there were no more than 411 whales at the end of 2017, with a strong male bias (approximately 60% male) (Pace et al. 2017, Pettis et al. 2018a). Additionally, an Unusual Mortality Event was declared in 2017 when 17 individuals died on the Atlantic coast in both U.S. and Canadian waters (Pettis et al. 2018b). This event has continued through 2019, with an additional three mortalities documented in 2018, and 10 in 2019. In addition, NARWs have also been determined to be in poor body condition in comparison to other right whale populations worldwide (Christiansen et al. 2020). In particular, a poor female body condition may be contributing to reduction in calf survival or an increase in female calving intervals, which is an additional concern for NARW viability and recovery (Christiansen et al. 2020).

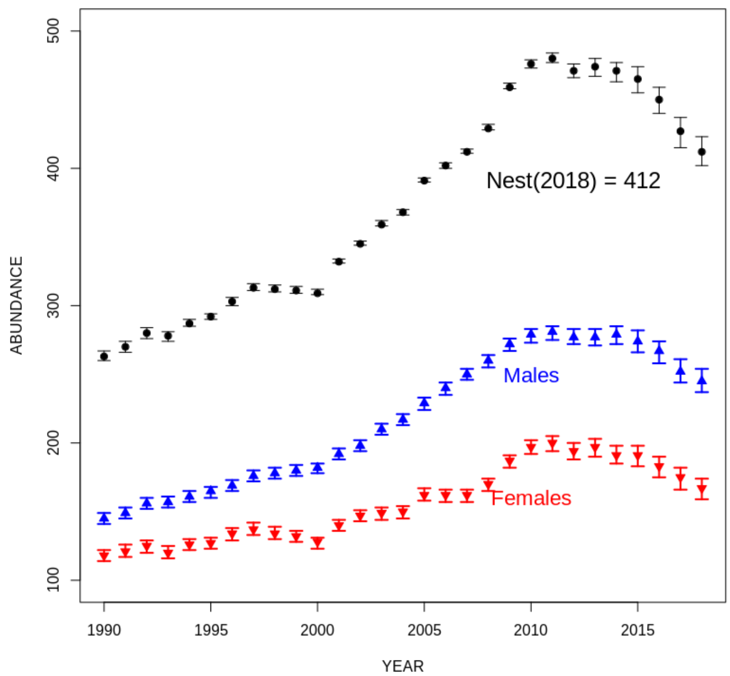

Figure 2.5: The estimated abundance of all North Atlantic right whales and sex-specific abundance 1990 and 2018 (Hayes et al. 2019).

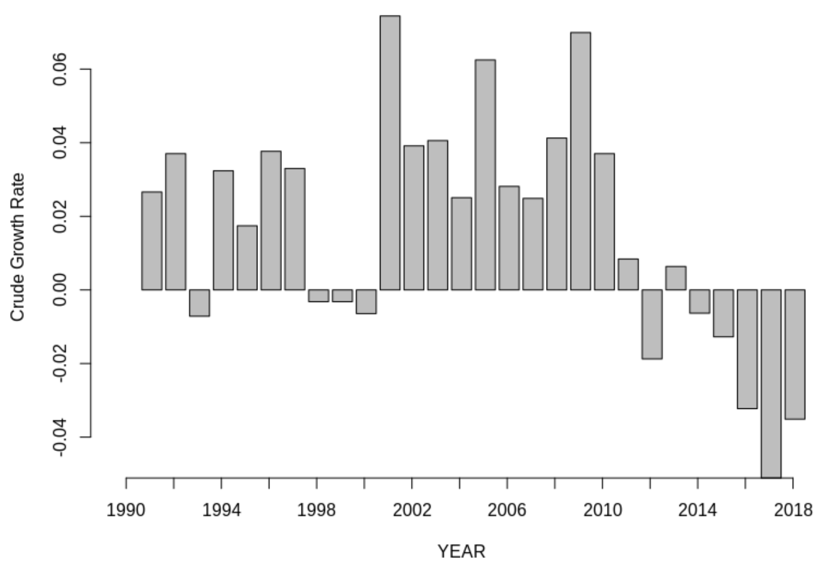

Figure 2.6: Crude annual growth rates derived from North Atlantic right whale abundance values (Pace et al. 2017, Hayes et al. 2019).

In recent years, low birth rates are an increasing concern for North Atlantic Right whale recovery, with the detection of only 5 births in 2017 (Pettis et al. 2018b), no births in 2018 (Pettis et al. 2018a), only 7 births in 2019 (Pettis et al. 2020), and 10 births in the 2019/2020 calving season (B. Zoodsma Pers. Comm.). This is well below the average: 12.8 calves per year over the last decade, or 22 per year in the first decade of this century, with an average 14 or more births per year since monitoring began in 1990. The persistent low birth years are insufficient to counteract current population mortality rates (Figure 2.5; Pace et al. 2017), increasing concern regarding current levels of entanglement mortality.

Documented, minimum counts of anthropogenic serious injuries or mortalities of right whales from fishing gear have exceeded the allowable PBR in all but one year (Figure 2.2). The 2018 North Atlantic right whale stock assessment establishes a potential biological removal level of 0.9 right whales a year based on 2016 population estimates (Hayes et al. 2019). The report documents a minimum rate of average annual right whale mortalities and serious injuries caused by entanglements over the five-year period from 2012 to 2016 as 5.15 whales per year. An annual average of 0.4 of these mortalities and serious injuries were attributed to U.S. fisheries and 0.4 mortalities per year were attributed to Canadian fisheries; 4.2 of the documented mortalities and serious injuries could not be specifically attributed to a fishery in one of the two countries.

Entanglement rates are higher than the serious injury and mortality rates reflected in the Stock Assessment Report, in part because whales often free themselves of gear following an entanglement event. In an analysis of the scarification of right whales, 519 of 626 (82.9%) whales examined during 1980-2009 were scarred at least once by fishing gear (Knowlton et al. 2012). Further research using the North Atlantic Right Whale Catalog has indicated that between 8.6% and 33.6% of right whales acquire new scars annually (Knowlton et al. 2012). Along with evidence collected following right whale mortalities, entanglement remains the biggest threat, range wide, to North Atlantic right whales (Sharp et al. 2019). The rate of human-caused serious injury and mortalities to North Atlantic right whales exceeds the potential biological removal during a sustained period of population decline, requiring additional modifications to the Plan to reduce entanglement serious injury and mortality risk.

2.1.5 Needed Reduction in Entanglement Serious Injury and Mortality

As presented to the Team in an October 2018 meeting, there is only one year since 2010 (when the decline in the North Atlantic right whale population began) in which right whale entanglement serious injuries and mortalities first seen in U.S. waters or known to be caused by U.S. gear (Figure 2.2 & 2.6) was below PBR. NMFS, through the take reduction planning process, must reduce the impacts of U.S. commercial fisheries to below a stock's PBR level.

The uncertainty regarding the type of gear that entangles whales and the location and country of origin where the entanglement occurred creates challenges for the Plan in determining the magnitude of reduction in serious injury and mortality that is needed. As delineated in Table 2.2 and described previously, many entanglements are never seen by humans, there is often no gear present on whales showing scars, wounds and injuries clearly caused by entanglement, gear cannot always be recovered from those whales that are seen entangled, and even when gear is recovered, it can rarely be identified to a source fishery, and even more rarely to a precise fishing location.

In developing serious injury and mortality estimates for use in Stock Assessment Reports and by the Team, NMFS attributes definitive sources of serious injuries and mortalities only when gear is present and identified to a fishery source. The Canadian snow crab fishery has clearly identifiable ropes and splices that allow identification when gear is present on a whale.

Gillnet gear is also readily identifiable when present. However, in most cases gear is not present or cannot be identified to a specific fishery therefore most entanglement related serious injuries and mortalities are unassigned in the Stock Assessment Reports.

To determine the impact of U.S. fisheries on entanglements, the challenge is to determine what percentage of the unknown sources are U.S. vs. Canadian fisheries. In attempting to create a risk reduction target to achieve PBR, NMFS considered how to assign a country of origin to unknown entanglement cases. As illustrated in Figure 2.7, assigning those seen first in U.S. waters to U.S. gear would suggest that a two- or threefold reduction is necessary to achieve PBR. An alternative approach provided very similar results, discussed below.

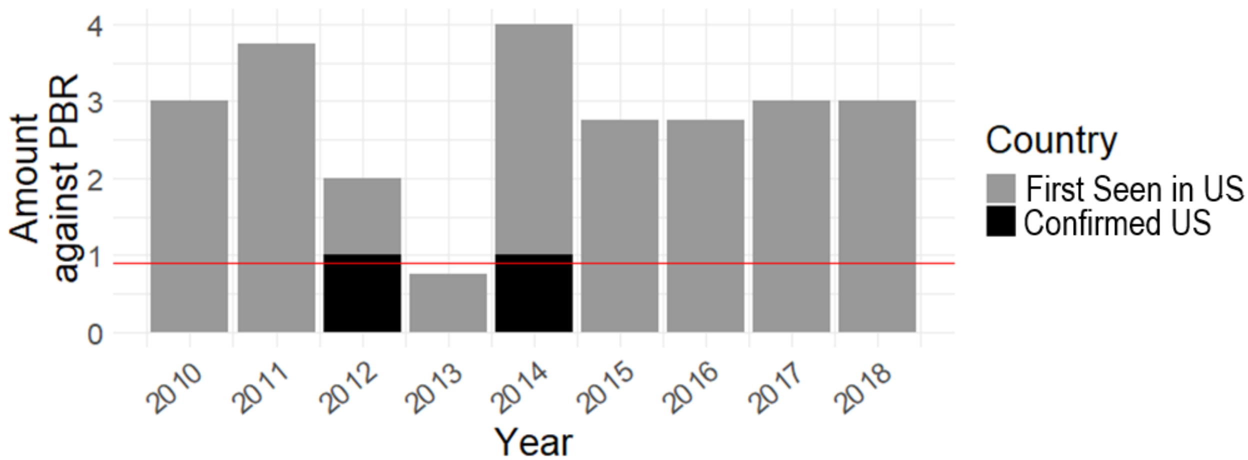

Figure 2.7: Documented entanglement incidents that caused serious injuries or mortalities of right whales, counted against potential biological removal for North Atlantic Right whales from 2010 to 2018. For this purpose, mortalities or confirmed serious injuries are counted as one animal and injuries with a 0.75 probability of becoming serious are adjusted accordingly (e.g. only one prorated injury was detected in 2013). The red line represents the potential biological removal for each year.

Table 2.4 uses draft serious injury and mortality determinations for 2017 and 2018 to determine how the target might change using more recent information (Hayes et al. 2018, 2019). For purposes of comparison, the table below considers two methods for assigning unattributed mortalities to a particular country across multiple rolling five-year averages: a 50/50 split, or assigning them by first location observed. The necessary reduction ranges from 60 to 71% in each case. Additionally, for the purposes of this Draft Environmental Impact Statement, the time series of 2010 – 2018 will be considered.

Although since 2010 right whale aggregation distribution has continued to shift, much of the North Atlantic right whale population is believed to spend more time exposed to fisheries in U.S. waters than in Canadian waters. Serious injuries and mortalities from unknown sources could be allocated by percentage of time spent in each country's waters, which would apportion more of these unknown serious injuries and mortalities to U.S. commercial fisheries. However, for the following reasons, it can be assumed that about 50% of right whale mortalities and serious injuries occur in each country:

Knowlton et al (2016) demonstrated the positive relationship of large diameter line to breaking strength and association with serious injuries to large whales. Snow crab gear recovered from dead and seriously injured right whales and identified by the NMFS gear specialists, include heavy traps on knot free and fairly uniform large diameter ropes, stronger than the rope used in most U.S. trap/pot gear. Offshore U.S. gear may be equivalent in risk of injury and mortality given the large diameter of rope fished and the long and heavy trawls. However, other than three one-foot black buoy line marks there is little to distinguish this gear from other rope, and offshore U.S. lobster gear has not been definitively identified from gear retrieved from large whale entanglements(Morin, personal communication 2020).

U.S. take reduction measures over the past two decades have been implemented coastwide rather than in finite areas like those implemented in July 2017 by Canada. Although the ALWTRP measures are not achieving PBR, and they cannot be evaluated, relative to no measures at all the existing sinking ground line, closures, weak links, and other risk reduction Plan measures are affording protections to right whales.

Under this assumption, from 2010 through 2018, and during any five-year rolling average period from 2012 on, an annual average of up to 2.5 - 2.6 mortalities and serious injuries would be attributed to U.S. fisheries, more than 2.5 times greater than potential biological removal, suggesting a 60 to 66 percent reduction of those serious injuries and mortalities would be needed to achieve PBR (see last two columns of Table 2.4). As delineated in Table 2.4, these findings are similar results attained by attributing unknown serious injuries and mortality sources to the country of first sighting.

Table 2.4: Average serious injury and mortality by country of origin or country where the individual was first sighted for different date ranges. The amount of reduction in serious injury and mortality needed to meet PBR based on where the unattributed individuals were first sighted and with 50% of unattributed individuals assigned to each country. Reduction needed is calculated by dividing 0.9 from all cases assigned to the US and subtracted from one.

				Unattributed:	First	Sighted	50:50	Split
Date range	**Total**	**U.S.**	**Canada**	**U.S.**	**Canada**	**Reduction Needed**	**U.S. & CN**	**Reduction Needed**
2012-2016	5.15	0.4	0.6	2.05	2.1	0.63	2.08	0.64
2013-2017	5.55	0.2	1.2	2.45	1.7	0.66	2.08	0.6
2014-2018	6.54	0.2	1.4	2.9	2.04	0.71	2.48	0.66
2010-2018	5.23	0.22	0.78	2.56	1.67	0.68	2.12	0.61

These calculations include only documented mortalities and serious injuries. Actual mortalities and serious injuries of right whales in U.S. fisheries are likely higher than the observed 2.78 per year between 2010 and 2018 (0.22 confirmed U.S. and 2.56 first sighted in the U.S.). Population models provide an estimate of mortalities that suggest that 40% of right whale mortalities and serious injuries are unobserved (R. Pace, personal communication applying the methods from Pace et al. 2017). If the average observed mortalities and serious injuries caused by entanglements for 2010 through 2018 is 5.23, given the 49.6% detection rate, the estimated annual mortality and serious injury by entanglements is 10.5 per year. If we assume half of the estimated mortalities and serious injuries occur incidental to U.S. fisheries (5.25), mortality and serious injury is more than five times higher than potential biological removal and require an 83% reduction in serious injury and mortality (equation: 1-(0.9/5.25)). Thus, serious injury and mortality of right whales in U.S. fishing gear must be reduced by 60% (documented) to 80% (estimated) to achieve potential biological removal.

The population estimate and associated PBR for 2019 has not yet been finalized, but the population estimate will be lower and the associated 2019 PBR is anticipated to be around 0.8 due to the Unusual Mortality Event that began in 2017, and recent low calving rates. For the five year period from 2014 to 2018 the draft average annual documented mortality and serious injury and mortality caused by entanglement is 6.54, including 0.2 attributed to U.S. fisheries, 1.2 attributed to the Canadian snow crab fishery, and 4.95 that could not be identified to a particular fishery.

Assigning half of 4.95 unattributed mortalities to U.S. fisheries results in annual mortality rate of 2.48 right whales per year based on documented mortalities. While the annual average number of documented mortalities and serious injuries attributable to U.S. fisheries may have gone down, if potential biological removal for this period is as low as 0.8, a reduction in mortality and serious injury by at least 60% would still be needed to achieve potential biological removal.

Because of the urgency of responding to the rapid decline in the right whale population and because the fishery source of serious injury and mortality to right whales cannot be determined in 76% of documented cases, NMFS is focusing its scope on the area and fishery that fishes the greatest number of endlines in the U.S. Atlantic: lobster and crab trap pot fisheries in the Northeast Region (Figure 2.5). As shown in Table 2.3, the 2017 endline estimates derived through a model created to support the Team efforts indicate that over 93% of fixed gear endlines within right whale habitats along the Atlantic coast are fished by the U.S. lobster and crab fisheries in the Northeast Region. Further risk reduction for other trap/pot fisheries and gillnet fisheries along the U.S. East Coast will be addressed through the Take Reduction Team process in the near future.

The regulatory options for reducing the risk of entanglement serious injury and mortality fall into two categories: reduction in overall entanglement risk and reduction in the severity if an entanglement occurs. Reducing the likelihood of entanglement is primarily accomplished by reducing the amount of line in the water column through line reductions and through seasonal restricted areas with predictable aggregations of right whales. Further reducing the severity of entanglements through gear modifications that allow lines to break prior to causing a serious injury could minimize serious injury and mortality of entangled whales and mitigate potential sublethal impacts. Most whales in the North Atlantic right whale stock are entangled at least once throughout their lifetime, and researchers have suggested that continuous sublethal stress of entanglement could be impacting population health and contributing to increased reproductive intervals (Rolland et al. 2016, Pettis et al. 2017, (Christiansen et al. 2020). There is new evidence that lower strength rope (i.e. 1,700 lb.) may be less likely to remain on entangled whales (Knowlton et al. 2016), thereby allowing modifications in rope strength to be used to minimize the lethality of fishing gear.

In addition to reducing risk of serious injury and mortality, there is an additional need to acquire more data to inform future management actions. Additional regulations will be considered that improve the quantity and quality of data available for future rulemaking and investigating some of the uncertainties discussed above regarding gear type and the country where the entanglement occurred.

Finally, because right whale distribution, particularly the location of aggregations of feeding right whales, continues to shift, monitoring the population continues to be a Plan priority. Monitoring the effectiveness of the Plan modifications on reducing serious injuries and mortalities of right whales in U.S. waters and the impacts on fishermen and fishing communities is also required.

2.2 Purpose and Need for Action

Need	Purposes
To reduce North Atlantic right whale mortality and serious injury in Northeast trap/pot commercial fisheries to below PBR, by at least 60% of the level observed in 2017.	• Reduce risk of entanglement • Reduce the severity of entanglements
To inform future management actions	• Improve ability to identify entanglement gear source • Improve available data used to estimate entanglement risk
To monitor the impacts of management actions	• Monitor Compliance with regulatory actions • Monitor impacts of Plan measures for serious injuries and mortalities to right whales • Monitor social and economic impacts to fisheries
To reduce fin and humpback whale mortality and serious injury in Northeast Trap/Pot commercial fisheries.	• Reduce risk of entanglement • Reduce the severity of entanglements

The purpose of developing proposed changes to the Plan is to reduce North Atlantic Right Whale, as well as fin and humpback whale, serious injuries and mortalities:

1. Reducing the risk of entanglement in vertical line
2. Reducing the severity of any entanglement that does occur

To inform future management actions by:

1. Improving the ability to identify the source of entanglement gear
2. Improving the amount of data available to estimate entanglement risk

To monitor the impacts of the Plan and its modifications by:

1. Monitoring compliance with regulatory actions
2. Monitoring impacts of Plan measures for serious injuries and mortalities of U.S. fisheries to right whales
3. Monitoring the economic and social impacts of the Plan on fishermen

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3 REGULATORY ALTERNATIVES

The Atlantic Large Whale Take Reduction Plan (ALWTRP), last amended in 2015, includes a combination of fishing gear modifications and seasonal area closures aimed at reducing the risk that large whales will be killed or seriously injured as a result of entanglement in U.S. commercial fishing gear. Gear marking to improve our understanding of where entanglement incidents occur is also required. The nature and extent of the gear modification and seasonal closure requirements varies by jurisdiction (i.e. state waters, geographic regions, and within federal waters) such that risk reduction is distributed along the U.S. East Coast. NMFS recognizes that entanglement risks occur throughout the distribution of North Atlantic large whales, requiring continued collaboration with the Government of Canada toward the development of similar protective measures for large whales beyond the northern bounds of U.S. waters.

The scope of modifications analyzed with this Draft Environmental Impact Statement (DEIS) are confined to the Northeast Region Trap/Pot Management Area (hereinafter referred to as the Northeast Region) where large whales, and particularly North Atlantic right whales, occur nearly year round and where the vast majority of buoy lines are fished (see Chapter 2). Below, we describe the process that was followed in developing the initial alternatives (Section 3.1), a description of regulatory alternatives under consideration (Section 3.2), justification for the alternatives selected (section 3.3), and an overview of the alternatives that NMFS considered but rejected (Section 3.4).

3.1 Development of Alternatives

NMFS is considering two types of actions: 1) modifications to the existing Take Reduction Plan requirements and 2) small modifications to the federal regulations for American Lobster related to maximum trawl length. The alternatives being considered would reduce risk to all large whales but especially target ongoing right whale entanglements that result in serious injury or mortality. Additionally, NMFS is considering gear marking requirements that may improve our understanding of where entanglements occur.

The alternatives analyzed use the best available information about right whale distribution and co-occurrence with buoy lines as well as the relative threat of gear configurations across the Northeast Region. The alternatives attempt to scale gear modifications to relative risk, while recognizing that continuing ecosystem shifts require broad scale precautionary measures to protect the shifting distribution of right whales. In areas of low risk to right whales, such as where right whales have not predictably aggregated and where buoy lines are of lower strength, precautionary measures such as weak insertions in buoy lines are considered. Where risk is higher because lines are stronger and/or whales occur in higher abundance or seasonal aggregations, measures to reduce the number of buoy lines, close areas to buoy lines, or require half the buoy lines to be reconfigured to line that breaks at 1,700 lbs (771.1 kg) are analyzed. The measures under consideration aim to reduce entanglement risk posed by Northeast Region trap/pot fisheries gear by 60 percent or greater to achieve the Potential Biological Removal (PBR) level of less than one right whale per year (see section 2.1.5 for further explanation of these calculations).

To evaluate and compare risk reduction alternatives to estimate the extent to which regulatory changes would achieve the risk reduction target, a Decision Support Tool (DST) was developed by the Northeast Fisheries Science Center. The DST attempts to quantify entanglement risk for North Atlantic right whales in Jonah crab and lobster trap/pot fisheries in the northeast region. The following sections describe the data and associated tools that were considered and how these were incorporated into the DST, as well as how the tool was used in the development of a near-consensus suite of alternatives recommended by the Take Reduction Team, and further, how the DST was used, often in consultation with New England state managers and offshore lobster fishery Team members, to create the alternatives considered in this DEIS.

3.1.1 Relevant Meetings

3.1.1.1 Take Reduction Team Input

Since the inception of the Atlantic Large Whale Take Reduction Plan, risk reduction measures recommended by the Team and implemented through regulations have been directed at:

- reducing line in the water column,
- reconfiguring buoy lines and gillnet panels, including weak links, to allow large whales to break free of the lines, and
- protecting predictable aggregations of whales through restricted areas.

The 1997 regulations implementing the Plan included: the use of negatively buoyant buoy lines to fixed gear fisheries to reduce line floating at the surface; configuration options to reduce strength of connections between surface systems with buoy lines in lobster or gillnet gear and between panels of sink gillnet gear seasonally; and closures of predictable aggregation areas in Cape Cod Bay and the Great South Channel, (62 FR 39157, July 22, 1997). Information on these early Team meetings, through the present, as well as Plan regulatory actions can be found on the NMFS website at https://archive.fisheries.noaa.gov/garfo/protected/whaletrp/trt/.

After the initial rulemaking, the Team focused on considering how to further reduce the amount of line in the water column. The Plan was modified to reduce the profile of groundline, replacing floating line with sinking groundline between traps in U.S trap/pot fisheries and on sink gillnets, with some seasonal and area exemptions, along the Atlantic Coast, effective April 5, 2009 (73 FR 51228, September 2, 2008). The Team then turned efforts toward reducing the risk of entanglement in vertical buoy lines, culminating with 2014 and 2015 measures that expanded the Massachusetts Restricted Area (MRA; 50 CFR 229.32(c)(3), a closure area that largely results in the removal of gear to shore storage, and by establishing “trawling up” areas that increased the number of traps between buoy lines to reduce the number of buoy lines overall.

Confirmation that the North Atlantic right whale population had been in decline since 2010 was published in 2017 (Pace et al 2017), identifying a decrease in calving and increased mortality. Also in 2017, unprecedented right whale mortalities were documented, including 12 mortalities seen in Canada and five in U.S. waters, prompting NMFS to declare an Unusual Mortality Event, which continues through 2020. Cause of mortality was only determined for six of the twelve dead right whales discovered in Canada, including two that were attributed to entanglement and four to blunt force trauma associated with vessel strikes. Cause was determined for three of the five mortalities first seen in U.S. waters: two showed signs of entanglement trauma, and one young right whale was killed by a vessel strike. In addition, zero births were observed in the subsequent 2017/2018 calving season. As a result of evidence of a declining population exacerbated by 2017's high mortalities, in February 2018, NMFS established two subgroups of the Atlantic Large Whale Take Reduction Team. One subgroup was charged with investigating the feasibility of using weak rope (1,700 lbs/771.1 kg maximum breaking strength) and gear marking, and the other was tasked with investigating the feasibility of fishing without buoy lines (ropeless fishing). As discussed in Section 2.1.3, over 95 percent of buoy lines fished along the U.S. East Coast in waters not exempt from Plan requirements are fished by the lobster trap/pot fishery, 93 percent within the Northeast Region. For this reason NMFS focused the scope of the Team meetings on developing recommendations for the northeast region lobster and crab trap/pot fisheries.

The subgroups concurred that expanded gear marking requirements were feasible, though if expensive approaches such as micro-chips or transponders were required, they suggested that the cost of marking all buoy lines would exceed the benefit since no gear is retrieved from approximately 60 percent of all right whale entanglement-related serious injuries and mortalities. Weak rope was considered by the subgroup to be feasible nearshore but concerns were expressed about use in deeper water fisheries as well as about the economic impacts of a wholesale change over in buoy lines. The subgroup findings were shared with the Team in support of an October 2018 in-person meeting.

Also prior to the October 2018 in-person meeting, team members were invited to submit risk reduction proposals. Eight proposals were submitted and an additional proposal was crafted and provided to Team members at the meeting. The goal was to develop Team recommendations regarding acceptable risk reduction elements for further evaluation. The lack of agreement on whether or how much risk reduction was necessary, or any mechanism to compare the wide range of proposal elements, challenged the Team's ability to develop consensus recommendations. In anticipation of a spring 2019 meeting, the Team created work plans for NMFS identifying data needs for decision making. Priority was given to common themes including development of a risk reduction target, a tool to allow comparison of alternatives, and a focus on elements with the greatest potential to reduce mortality and serious injury quickly.

Following up on the work plans provided to NMFS at the October 2018 meeting, NMFS conducted two "work group" teleconferences for the Team: one to discuss gear marking alternatives and the other to discuss methods for developing and evaluating closed areas. NMFS also shared results from a New England Aquarium rope workshop results and hosted a teleconference so Aquarium staff and participating Team members could recount the discussion of operational challenges and weak rope relative to use in Northeast Region trap/pot fisheries.

Maine Department of Marine Resources rope research was also reviewed on the rope teleconference. Also included on the October 2018 agenda was discussion of the NMFS Advance Notice of Proposed Rulemaking (ANPR) to modify existing seasonal closures to instead be vertical line closures. Under a revised closure definition, trap/pot fishermen could fish with trap/pot gear using “ropeless” methods, although exempted fishing permits would be required to exempt fishermen from surface marking requirements under other laws. The gear would still require rope in the groundline between pots in the trawls on the ocean floor. Most designs also include rope buoy lines, but they are stored on the bottom until retrieved by a vessel operator when hauling the lobster trawl. Team members disagreed about further consideration of “ropeless fishing” for multiple reasons, including: costs of the technology, concerns about gear conflicts, lack of testing under commercial fishing conditions, questions about impacts on trawlers and other mobile gear fishermen, ability of enforcement agents to retrieve, inspect, and reset the gear, and the belief that it could not be rapidly adapted for commercial use. Some Team members recognized that ropeless fishing could provide an alternative to seasonal closures and many strongly supported the need for commercial fishermen to be involved in the further development and design of ropeless gear. Because the overall sense was that the Team would not provide a consensus recommendation on the ANPR, NMFS did not move the action further in 2018.

Between the October 2018 and April 2019 in-person Take Reduction Team meetings, NMFS identified the need for a 60 percent to 80 percent risk reduction in U.S. entanglement-related serious injury and mortality to a potential biological removal level of 0.9 right whales, or about four serious injury or mortality events in a five-year period (see Section 2.1.5). Additionally, the NMFS Northeast Fisheries Science Center created a preliminary DST (see Section 3.1.4 and Appendix 3.1), a model for use during the in-person April 2019 Take Reduction Team meeting to analyze the contribution of various proposal elements (whale density, gear density, etc.) towards the target risk reduction. The draft DST was presented to the Team a week before the meeting.

Many Team members did not agree with the risk reduction target established by NMFS. Fishermen in particular believed that too many entanglements of unknown origin were assigned as serious injuries and mortalities due to U.S. commercial fisheries. There were particular concerns expressed about the uncertainties within the upper bound of the target, which considered estimated mortalities generated by a new population model (Hayes et al 2019). Because all observed mortalities that can be attributed to a source are caused by either entanglements or vessel strikes (except for some natural neonate mortalities), estimated non-observed mortalities are likely to be caused by the same human interactions. However, there is no way to definitively apportion unseen but estimated mortality across causes (fishery interactions vs. vessel strike) or country of origin (U.S. vs. Canada). For the purposes of developing a conservative target, NMFS assumed that half of the undocumented incidents occurred in U.S. waters and were caused primarily by incidental entanglements. However, given the many sources of uncertainty in the 80 percent target, as well as the challenges achieving such a target without large economic impacts to the fishery, the Take Reduction Team focused on recommendations to achieve the lower 60 percent target.

Table 3.1: TEAM NEAR-CONSENSUS RECOMMENDATIONS, April 2019
(Vote on support to move forward with these measures: 44 out of 45 Team members)

General Recommendations

- Given the high variability around gear severity rankings included in the tool, re-do the poll using expert elicitation methods to converge on improved severity/risk reduction estimates
- Develop a monitoring plan, including whale and gear surveys, to monitor efficacy over time, as well as track implementation approaches and innovations.
- Revisit the need for weak links if weak lines are required.
- Put in place safety exemptions for young fishermen, nearshore fisheries, shallow waters, etc.

Specific Recommendations by Area

- For Maine, Lobster Management Area (LMA) One
  - 50 percent buoy line reduction
  - The top ¾ length of buoy lines made of weakened rope (toppers) on all gear outside of 3 miles; expected to generate an 11.6 percent risk reduction
  - Assessment and monitoring should include assessment of unintended consequences; develop best practices to avoid issues such as increasing rope diameter/strength
- For Massachusetts, LMA One
  - 30 percent buoy line reduction (excluding the approximately 100 fishermen already closed out of the Massachusetts Restricted Area); results in annual net risk reduction of roughly 25 percent.
  - Sleeves or their equivalent everywhere; expected to generate an 11 percent risk reduction
  - 24 percent credit for the previously implemented Massachusetts Restricted Area
  - Note: Some source data for this calculation needs confirming
- For Rhode Island, LMA Two
  - Buoy lines expected to be reduced by 18 percent in the next three years
  - Willing to use 1,700 lbs (771.1 kg) sleeves or equivalent everywhere; expected to generate a 43 percent risk reduction or equivalent
  - Additionally, Rhode Island to trawl up from 20 to 30 pots in 2/3 overlap as a component of its 30 percent buoy line reduction
- For New Hampshire, LMA One (aggregate risk reduction of 58.5 percent)
  - 30 percent vertical line reduction
  - 11,700 lbs (771.1 kg) or sleeves or equivalent throughout fishery; expected to generate a 28-29 percent risk reduction
- For Offshore, LMA Three
  - Fishermen in principle agree to reducing risk through a combination of buoy line reductions (already underway) and other measures; LMA Three responsible (like other LMAs) for meeting the 60 percent risk reduction goal
  - Ongoing LMA Three risk reduction of 18 percent anticipated due to already planned buoy line reductions from 2018-2020
  - Through 50 fathoms (91.4 m) depth, fishermen agree to use 1,700 lbs (771.1 kg) breaking strength or equivalent
  - Five-year rapid research commitment to address lower rope weight breaking strength and other risk reduction measures
  - Work with industry to identify the specifics of risk reduction; present approaches to Team

Note: The risk reduction estimates provided here represent old calculations based on the original version of the tool. The tool has since been updated and the current version is discussed below. One notable difference here is where the Team noted a discrepancy in risk reduction anticipated by using sleeves versus 1,700 lbs (771.1 kg) rope. Although the Team believes these conservation measures are equivalent, according to the tool, the sleeves were projected to provide a 43 percent reduction. This has since been altered in the most current iteration of the tool to consider these two configurations as equivalent.

Team members were also uncomfortable with the preliminary nature of the DST, particularly the threat index component that models risk associated with line strength and gear configurations.

However, all present Team members worked within and across caucuses to run various alternatives through the DST. Both the target risk reduction and the DST generated an understanding of the scope of measures NMFS was proposing to achieve the necessary potential biological removal level for right whales. After some discussion there was general agreement that risk reduction should be shared across jurisdictions so no one state or fishing area would have to bear the bulk of reductions, and so that different jurisdictions could choose an approach that best fit their fishery, rather than a “one size fits all” approach. This also allowed consideration of area-wide measures that would be resilient to changes in North Atlantic right whale distribution. By the final morning of the meeting, all but one Team member agreed that NMFS should move forward on the recommendations listed on Table 3.1 toward a 60 percent risk reduction. The dissenter believed that the measures did not go far enough to prevent the extinction of the North Atlantic right whale.

New England states were given the lead in scoping with stakeholders in their states and developing measures and implementation details related to the Team’s near-consensus recommendation. Maine, New Hampshire, Massachusetts, and Rhode Island conducted scoping before and after drafting measures. Lacking a state jurisdictional counterpart, NMFS also worked closely with the Atlantic Offshore Lobstermen’s Association on measures for the offshore federal Lobster Management Area (LMA) Three. NMFS conducted Scoping in August 2019, receiving over 89,000 written comments and including eight public meetings attended by over 800 stakeholders.

Proposals submitted to NMFS by the states can be found in Appendix 3.2. As described in the list of measures for Alternative Two (Preferred), nearly all of the measures in the preferred alternative were proposed by the states. One measure, an area seasonally closed to buoy lines along the edge of LMA One about 30 miles (48.3 km) off shore of Maine, was included by NMFS though not in Maine’s proposal to ensure LMA One achieved sufficient risk reduction. Another measure, proposed by Rhode Island, to require one weak buoy line for Area 2 vessels, was not included in the preferred alternative. Instead, a closure south of Nantucket proposed by Massachusetts is included in the risk reduction measures of Alternative Two. Measures discussed with LMA Three participants including the American Offshore Lobster Association are analyzed in both Alternatives Two and Three. In sum, the alternatives analyzed in this DEIS were adapted from state proposals for risk reduction alternatives, where possible. Neither the alternatives proposed by the States nor the regulatory alternatives detailed in Table 3.2 are identical to the framework recommendations provided by the Team. However, Alternatives Two and Three align with the basic principles within that framework: they were estimated by the DST to achieve at least 60 percent risk reduction in the northeast lobster and Jonah crab trap/pot fisheries in the Northeast Region, distributed across jurisdictions, primarily using line reductions through trawling up, and requiring weak rope or weak inserts. Additionally, alternatives Two and Three also include seasonal closures to crab and lobster buoy lines in areas where there North Atlantic right whales are known to aggregate.

3.1.1.2 Atlantic States Marine Fisheries Commission Consideration of Take Reduction Team Target

The large majority of buoy lines along the Atlantic coast occur in the American lobster trap/pot fishery. The Atlantic States Marine Fishery Commission (ASMFC) is the management authority for the American Lobster Fishery Management Plan, coordinating interstate management of the American lobster (*Homarus americanus*) fishery in state waters (0 to 3 miles/ 0-5.56 km offshore). NMFS has management authority for the fishery in Federal waters (3-200 miles/5.56-370.4 km) in close coordination with ASMFC.

At the ASMFCs October 2018 American Lobster Board Meeting, the Board was briefed on proposals considered by the Atlantic Large Whale Take Reduction Team, including what are traditionally considered fishery management measures such as establishment of trap caps toward reducing buoy line numbers. The Lobster Board recognized that many of the right whale conservation proposals considered could impact the economic and cultural future of the lobster fishing industry. They created a Lobster/Whale Work Group to evaluate measures under consideration by the Team and to create recommendations for the Board. After discussing measures including consideration of up to a 50 percent line reduction requirement, the Work Group recommendations, presented at the February 2019 Lobster Board meeting, included initiation of an Addendum to ASMFC's American Lobster Fishery Management Plan to consider: reducing traps and/or buoy lines); vessel tracking requirement for federal permit holders; and reporting requirements. The Board initiated the drafting of an Addendum to the American Lobster Fishery Management Plan (Addendum XXVIII) to reduce the number of buoy lines in the lobster fishery by 20 to 40 percent in each LMA (except LMA Six) taking into consideration ongoing effort reduction measures - and to the extent possible maintaining the viability and culture of the lobster fishery.

A Plan Development Team (PDT) was created and met regularly beginning in March 2019. Like the Take Reduction Team, the PDT struggled with the difficulty in assessing the effectiveness of buoy line reduction in different areas towards reducing risk to right whales. The draft Decision Support Tool was presented in April and was not sufficiently finalized at that time to inform the Addendum. The PDT also shared concerns about the challenge determining buoy line numbers given the variety of data collection requirements and standards used by each state. For states that do not have 100 percent vessel trip reporting that includes buoy line data, the Team agreed to use the NMFS Co-occurrence model developed by Industrial Economics, Inc. (IEc) to provide the 2017 monthly buoy line estimates as the baseline against which line reduction would be considered. Consideration for 2015 and 2016 effort reduction actions was also promoted. Finally, the PDT was concerned about the ability to provide states with flexibility to develop measures suited to their lobster management areas with the need for consistency in federal waters, as well as concerns about the ability to evaluate the effectiveness of line reduction measures with inconsistent reporting requirements.

No draft addendum was put forward by the PDT at the August 2019 Annual meeting, citing challenges in the buoy line count data, analysis, and evaluation challenges. However, the Lobster Board did establish a fishery control date of April 30, 2019. Control dates alert fishery permit holders that their eligibility to participate in a commercial fishery in the future might be affected by their past participation as that is documented through landings data, vessel trip reports and gear configuration from records prior to the control date. However discussions by the ASMFC's Lobster/Whale Work Group and PDT informed the development of measures included in the alternatives analyzed within this DEIS.

3.2 Alternatives Considered

NMFS has identified a suite of regulatory alternatives for consideration and has identified preferred alternatives from those considered. This section delineates new risk reduction alternatives and gear marking alternatives for Jonah crab and lobster trap/pot fisheries already included under the Plan within New England waters. NMFS also proposes adding additional precautionary and monitoring requirements that would apply across all the alternatives, with the exception of the No Action Alternative (Alternative 1). The requirements under these alternatives supplement existing Plan requirements, unless otherwise noted (see Appendix 2.1 for description of current regulations).

Consistent with the recommendations of the Atlantic Large Whale Take Reduction Team, as delineated in Table 3.1, the suites of measures developed for Alternative 2 and Alternatives 3 recognize and include the risk reduction contribution of regulatory measures that will not be included in federal rulemaking to modify the Take Reduction Plan, including:

- American lobster and Jonah crab fishery management measures that are being phased-in or are imminent, including ongoing changes to trap allocations phased in through 2021, and in-development regulations to further modify the trap allocation and trap transfer program to address the poor condition of southern New England lobster stock per Addenda 21, 22 and 26 to Amendment 3 of the Interstate Fishery Management Plan for American Lobster
- Measures in Alternative Two that will be implemented by states, including gear marking and weak insertions in lobster buoy lines in Maine exempt waters, extension of state waters of the Massachusetts Restricted Area into May until surveys show that right whales have left the area, Massachusetts cap on buoy line diameter in state waters, and phase out of single traps for vessels 29 feet or greater upon state permit transfer.
- “Credit” for the Massachusetts Restricted Area.

Although these existing or anticipated regulatory measures would not be included in the proposed rule associated with this DEIS, the risk reduction analysis considers the risk reduction contributed by these measures toward achieving the lobster and crab trap/pot fishery’s risk reduction target of more than 60 percent. These measures are listed but shaded in Table 3.2.

Table 3.2: A summary of the regulatory elements of the proposed risk reduction alternatives, arranging the requirements by LMA and geographic region (where appropriate). Shaded rows represent risk reduction elements that already exist or are reasonably foreseeable under other federal or state regulations and that contribute to the risk reduction goal but would not be implemented by Federal rulemaking to amend the Take Reduction Plan.

Component	Area	Alternative Two	Alternative Three
Line	**Reduction**		
Trawl up/ Line Reduction	ME exempt area – 3 nm (5.56 km)	3 traps/trawl	-
	ME 3 (5.56 km) – 6 nm*	8 traps/trawl	Line allocations capped at 50 percent of average monthly lines in federal waters
	LMA 1, 6* – 12 nm (22.22 km)	15 traps/trawl	Same as above
	LMA 2, OCC 3 – 12 nm (5.56 – 22.22 km)	15 traps/trawl	Same as above
	LMA 1, 2 over 12 nm (22.22 km)	25 traps/trawl	Same as above
	MA State waters, all zones	No singles on vessels longer than 29’ (8.84 m) permits after 1/1/2020	-
	LMA3	Year-round: 45 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	May - August: 45 trap trawls; Year-round increase of maximum trawl length from 1.5 nm (2.78 km) to 1.75nm (3.24 km)
Seasonal Buoy Line Restricted Areas	Existing closures become closed to buoy lines	Allow trap/pot fishing without buoy lines. Will require exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would likely include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.	Allow trap/pot fishing without buoy lines. Requires exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.
	LMA1 Restricted Area, Offshore ME LMA1/3 border, zones C/D/E	Oct-Jan. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Oct – Feb. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts South Island Restricted Area	Feb-April: State of Massachusetts proposed buoy line restriction areas South of Nantucket Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Closed to buoy lines Feb – May: A. Large rectangular area, edited yearly B. L-shaped area Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts Restricted Area	Credit for Feb-Apr, State water closed through May until no more than 3 whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA unless surveys confirm that right whales have left the area. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)

Component	Area	Alternative Two	Alternative Three
Seasonal Buoy Line Restricted Areas-cont'd	Georges Basin Restricted Area	-	Closed to buoy lines May through August. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	Existing 18% reduction in the number of buoy lines
	LMA 3	Existing and anticipated fishery management resulting in an estimated 12% reduction in buoy lines	Existing and anticipated fishery management resulting in an estimated 12% reduction in buoy lines
Weak Line			
Weak Link Modification	Northeast Region	Retain current weak link/line requirement at surface system but allow it to be at base of surface system or, as currently required, at buoy	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system
Weak Line	ME exempt area	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exempt area – 3 nm (5.56 km)	2 weak insertions, at 25% and 50% down line	Same as above
	NH/MA/RI Coast – 3 nm (5.56 km)	1 weak insertion 50% down the line	Same as above
	All areas 3 – 12 nm (5.56 – 22.22 km)	2 weak insertions, at 25% and 50% down line	Same as above
	LMA 1, 2, OCC over 12 nm (22.22 km)	1 weak insertion 35% down the line	Same as above
	LMA 2	Same weak insertions as above based on distance from shore	Same as above
	LMA 3	One buoy line weak year round to 75%	One weak line to 75% year round OR
	LMA 3	Same as above	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" to 20%

*Note that the 6 mile line refers to an approximation, described in 50 CFR 229.32 (a)(2)(ii).

The alternatives examined in this DEIS are the product of extensive collaboration with the New England states and outreach by both the states and by NMFS in response to the continued risk of serious injury or mortality of large whales from entanglement in commercial fishing gear. Particular emphasis was placed on those options designed to reduce the potential for entanglements and minimize adverse impacts if entanglements occur. Regulatory options were combined based on a variety of factors including the spatial risk landscape, regional fishery characteristics, safety concerns, and known areas of increased whale presence. The proposed rule with two notable exceptions combines risk reduction measures as proposed by the New England states or as discussed with the Atlantic Offshore Lobstermen's Association (see Appendix 3.2 for additional details on state proposals). The exceptions include the addition of a closed area about 30 miles (55.6 km) offshore of Maine. Not included was a proposal from Rhode Island that did not support a closure south of Nantucket proposed by Massachusetts, but instead recommended a requirement that LMA Two vessels fish with one weak buoy line. The minimum trawl lengths proposed for both alternatives in LMA Three will also require associated modifications to the regulations at 50 CFR 697.21 (b)(3) implementing the Atlantic Coastal Fisheries Cooperative Management Act, increasing the allowable length of the trawl and groundline between the buoy lines from 1.5 nm (2.78km) to 1.75 nm (3.24km) in length.

During the scoping process, NMFS received numerous comments from diverse interested parties. The comments included both formal written comments as well as oral comments offered at public hearings. Appendix 3.3 summarizes the comments received during the initial stages of rulemaking at the public scoping meetings.

3.2.1 Risk Reduction Alternatives

3.2.1.1 Alternative 1: No Action Alternative

Under Alternative 1, NMFS would continue with the status quo, i.e., the baseline set of Plan requirements currently in place. A description of the current requirements can be found in Chapter 2, Appendix 2.1.

3.2.1.2 Alternative 2: Preferred Alternative

Alternative 2 would modify the ALWTRP requirements for lobster and Jonah crap trap/pot fisheries in the Northeast Region in a number of ways varying by lobster management areas or distance from shore. These measures largely represent measures proposed by each state or lobster management area with a few modifications if required for risk reduction or equity among fishing areas (see Appendix 3.2 for additional details on state proposals).

Trawling Up Modifications

Increase the number of traps per trawl according to distance from shore:
Lobster Management Area One

- Maine, exempt line to three nmi (5.56 km): minimum 3 traps per trawl
- Maine, three (5.56 km) to the six nmi line: minimum 8 traps per trawl

- Outside of Maine, three (5.56 km) to the six nmi line: retain minimum 10 traps per trawl (status quo)
- Outside of Maine, the six nmi line to twelve nmi (22.2 km): minimum 15 traps per trawl

Lobster Management Area Two & Outer Cape

- Three to twelve nmi (22.2 km): minimum 15 traps per trawl

Lobster Management Area 1 & 2

- Over twelve nmi (22.2 km): minimum 25 traps per trawl

All Massachusetts Waters

- No single trap trawls on vessels over 29 feet (8.8 m) in length in state waters for permits transferred after 1/1/2020

Lobster Management Area Three

- Trawl up to minimum 45 traps/trawl.- Increase the number of traps per trawl seasonally in LMA Three and increase length of trawl: To accommodate this modification, increase allowable length of lobster trawl from 1.5 nautical miles (2.78km) to 1.75 miles (3.24 km).

Seasonal Restricted Areas (Open to ropeless, closed to persistent buoy lines) (Figure 3.1)

- Modify current closures to allow fishing without persistent buoy lines; allow conditional EFPs for ropeless fishing in Massachusetts and Great South Channel Restricted Areas.
- The LMA One Restricted Area in offshore waters (approximately 30 nmi/55.6 km offshore) spanning Maine zones C, D, and E from Oct through January.
- Maintain the MRA in state waters within Cape Cod Bay and within Outer Cape state waters (within 3 nmi/5.56 km) through May or until surveys detect that whales have left the area and no more than 3 whales remain. Risk reduction credit for existing MRA closure.
- Establish a new seasonal restricted area closed to persistent buoy lines in an area contiguous with the MRA and south of Nantucket from February through April.

Weak Link Modification, Weak Line and Weak Insertion Modifications

Add weak inserts (break at less than 1,700 lbs (771.1 kg)) at depths based on distance from shore or add full weak rope to same depth on line for added risk reduction:

Lobster Management Area 1, 2, & Outer Cape

- Coast to three nmi (5.56 km): one insert halfway down the buoy line
- Three to twelve nmi (22.2 km): two inserts, one halfway and one a quarter of the way down the buoy line
- Over 12 nmi (22.2 km): one insert thirty-five percent of the way down the buoy line

Lobster Management Area 3

- Year round require one buoy line on each trawl to be weak rope on the top seventy five percent of the buoy line.
- Retain weak link or weak rope connection of surface system but allow placement at base of surface system rather than requiring it at buoy.

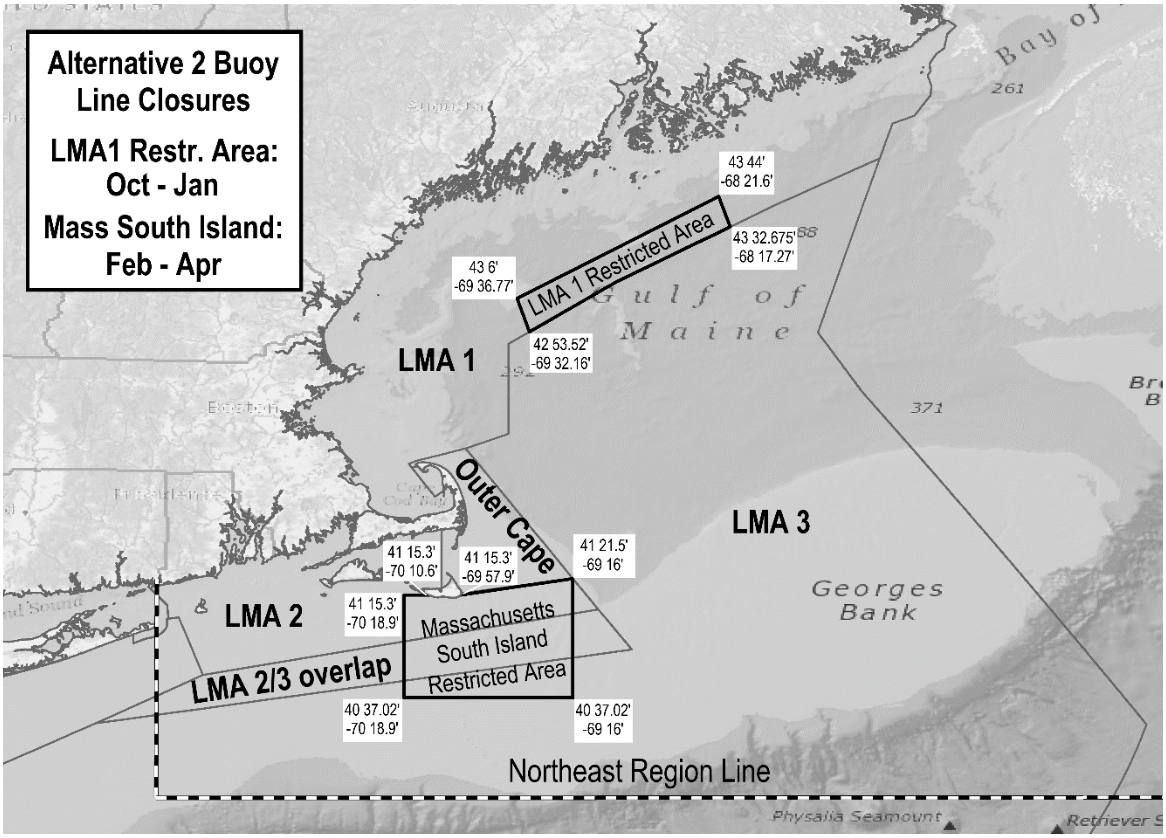

Figure 3.1: The trap/pot buoy line closure areas proposed in Alternative Two (Preferred). LMAs are delineated by the grey lines. The Massachusetts South Island Restricted Area is proposed as closed to trap/pot buoy lines from February through April and the LMA One Restricted area is proposed from October through January.

3.2.1.3 Alternative 3: Non-Preferred Alternative

Alternative 3 takes an alternate approach to achieving risk reduction across the proposed areas, making use of more buoy line closures and buoy line allocations rather than trawling up measures.

Gear Modifications

Cap the total number of lines available for trap/pot fishing outside of state waters:
Throughout federal waters of the Northeast Region

- Cap the number of buoy lines to 50 percent of the average baseline number of lines (2017) outside of state waters.

Increase the number of traps per trawl seasonally in LMA Three and increase length of trawl:
Lobster Management Area Three

45 traps per trawl, May through August. To accommodate this modification, increase allowable length of lobster trawl from 1.5 nautical miles (2.78km) to 1.75 miles (3.24 km

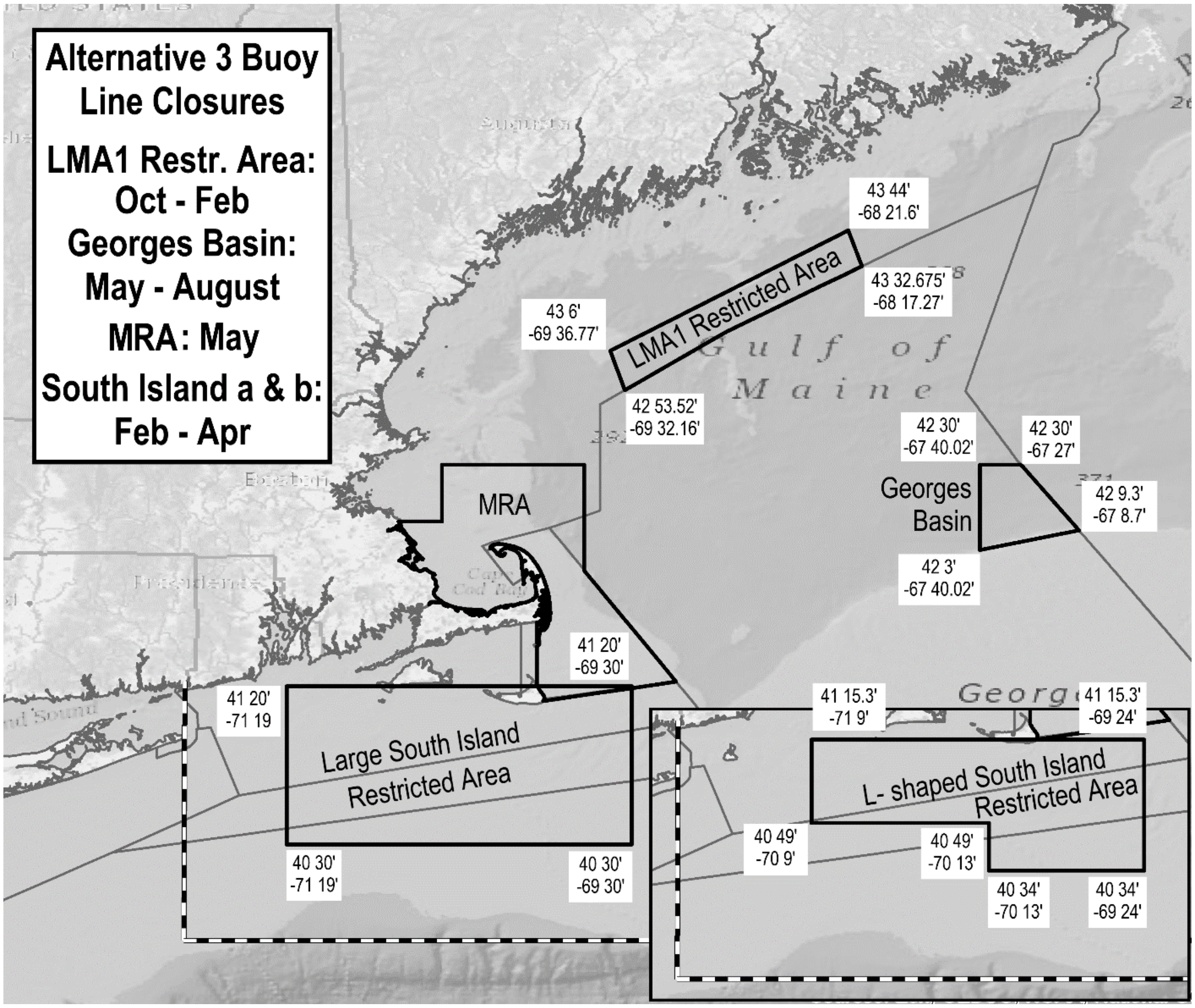

Figure 3.2: The restricted area options proposed in Alternative Three (Non-preferred). There are two different options for a restricted area south of Cape Cod from February through April, the Large South Island Restricted area (3a) and the L-shaped South Island Restricted Area (3b). The LMA One Restricted Area is proposed from October through February. The Georges Basin Restricted Area is proposed from May through August. An extension of the MRA through May, with a potential opening if whales are no longer present, is also included.

Seasonal Restricted Areas (Open to ropeless, closed to persistent buoy lines) (Figure 3.2)

- Modify current closures to areas closed to buoy lines; allow conditional EFPs for ropeless fishing in Massachusetts and Great South Channel Restricted Areas.
- The LMA One Restricted Area in offshore waters (approximately 30 nmi/55.6 km offshore) spanning Maine zones C, D, and E from Oct through February
- Extend the entire MRA closure to buoy lines through May with the potential to open it early when surveys indicate that the whales have left the area.
- A buoy line closure in the core Georges Basin Restricted Area from May through August.
- Two options for seasonal Restricted Areas from February through May (see Fig 3.2):
  - A large area encompassing a large portion of areas where north Atlantic right whales have been observed that may be reduced annually based on sightings.

- An “L” shaped buoy line closure that encompasses the greatest density of whale sightings during February through April, primarily based on data collected between 2017 through March 2020.

Weak Line

Throughout Northeast Region

- Year round require one buoy line on each trawl to be weak rope (breaks at less than 1,700 lbs/771.1 kg) on the top seventy-five percent of both buoy lines, except in lobster management area three

Lobster Management Area Three

- Two options for weak line in this area:
  - Seasonally, May through August, one buoy line on each trawl would consist of a full weak rope on the top seventy-five percent of the line. The second buoy line would have a weak topper in the top twenty percent of the buoy line. The rest of the year both buoy lines will have a weak topper in the top twenty percent of the buoy line. OR:
  - Year round require one buoy line on each trawl to be weak rope on the top seventy five percent of the buoy line.

3.2.2 Gear Marking Alternatives

As discussed in Section 3.1.6, the Atlantic Large Whale Take Reduction Team supported efforts to expand gear marking to further improve efforts to determine entanglement location. The current gear marking strategy does not support observation of marks from platforms such as boats and planes, and the expansion of gear marking in 2014/2015 did not substantially increase the ability to determine original entanglement locations. The Maine Department of Marine Resources has regulations, effective September 1, 2020, to require gear marking throughout Maine waters using purple as their unique color (DMR Chapter 75.02).

3.2.2.1 Alternative 1: No Action Alternative

Under Alternative 1, NMFS would continue with the status quo, i.e., the baseline set of Plan requirements currently in place. A description of the current requirements can be found in Chapter 2, Appendix 2.1.

3.2.2.2 Alternative 2: Preferred Alternative

Under Alternative Two (Preferred), NMFS would mirror the Maine regulations in all non-exempted waters, and implement analogous marking for the other New England states (one state-specific three-foot (30.5 cm) colored mark within two fathoms of the buoy, two additional marks in top and bottom half of gear in state waters, three in Federal waters including a green six inch (15.24 cm) mark in top two fathoms of line within one foot of long mark. This proposal would continue to allow multiple methods for marking line (paint, tape, rope, etc.). Table 3.3 outlines the proposed gear marking colors.

Table 3.3: The proposed gear marking alternatives by state and/or management area. The color designations are the same for both alternatives. The shaded portion represents an area that will be managed by a state agency rather than NMFS.

Area	Alternative 2	Alternative 3
Entire Northeast Region	Three-foot long state-specific (see color below) mark within two fathoms (60.96 cm) of the buoy. In Federal waters, and additional six-inch (15.25 cm) green mark within one foot (30.5 cm) long mark.	Three-foot long state-specific (see color in Alt 2) mark within two fathoms of the buoy & ID tape throughout buoy line denoting home state and trap/pot fishery
Maine Exempt	**Purple**. One or two additional one-foot marks (by depth) through state regulation only	See above
Maine Non-Exempt	**Purple**. Three one-foot marks: at top, middle and bottom of line. In Federal waters, an additional six-inch green buoy line mark within two fathoms of buoy	See above
New Hampshire	**Yellow.** In state waters: two one-foot marks in top half and bottom half of buoy line. Beyond state waters, three one-foot marks: at top, middle and bottom of line. In Federal waters, and additional six-inch green mark within one foot of long mark within two fathoms of buoy	See above
Massachusetts	**Red.** In state waters: two one-foot marks in top half and bottom half of buoy line. Beyond state waters three one-foot marks: at top, middle and bottom of line. . In Federal waters, and additional six-inch green mark within one foot of long mark within two fathoms of buoy	See above
Rhode Island	**Silvery/Gray.** In state waters: two one-foot marks in top half and bottom half of buoy line. Beyond state waters 3 one-foot marks at top, middle and bottom of line. . In Federal waters, and additional six-inch green mark within one foot of long mark within two fathoms of buoy	See above
LMA 3	**Black.** In Federal waters add a three-foot long mark within two fathoms of the buoy, and an additional six-inch green mark within one foot of long mark within two fathoms of buoy	See above

3.2.2.3 Alternative 3: Non-Preferred Alternative

Under Alternative Three (Non-preferred) a state specific color would be marked on the buoy line within two fathom of the buoy, as in the preferred, but the entire line would also have to be replaced with a line woven with identification tape with the home state and fishery (for example Maine, lobster/crab trap/pot) repeated in writing along the length of the buoy line.

3.3 Justification for Regulatory Options Considered

3.3.1 Buoy Line Reduction

There are multiple approaches to accomplish line reduction, including increasing trap/trawl requirements so that fewer buoy lines are used to fish the same number of traps and restricted areas that eliminate buoy lines during predictable seasons when whales aggregate. The 2014/2015 rulemakings used both of these approaches. Assuming that the co-occurrence (overlap in seasonal distribution and abundance) of buoy lines and whales is a proxy for risk due to relative opportunity for encounters and entanglements, those rulemakings intended to reduce co-occurrence to reduce risk. Similar measures are considered for the proposed alternatives in this DEIS.

Ongoing and imminent (RIN 0648-BF01) Lobster Plan fishery management modifications that result in line reductions relative to the 2017 baseline would provide risk reduction in the lobster fishery that would be counted towards the 60 percent goal. Phased in lobster management measures as well as ongoing independent rulemaking being developed concurrently with this Plan modification will restrict aggregate trap limits. Discussed in Chapter 5 and in the proposal analysis from Massachusetts and Rhode Island (Appendix 3.2), declines in the southern New England lobster stocks as well as lobster management measures have modified the fishery to reduce the number pf permitted traps that could be fished in the fishery, known as latent effort. In LMA Two, actively fished traps and buoy lines have declined annually since measures were implemented in 2015. Buoy line numbers did not decline in LMA Three but with fewer latent traps available for transfer, measures currently in development are anticipated to reduce the number of lines fished in LMA Three (discussed further in section 3.3.5, Appendix 3.2, and in Chapter 5.2.1.1.1). Inclusion of risk reduction as a result of fishery management actions towards the risk reduction target was supported by the Team in their April 2019 recommendation.

Reviewers are asked to comment on the trawling up requirements in the Alternatives. We invite ideas that provide “conservation equivalency”, that is options that can be demonstrated to result in the same overall buoy line reductions while providing flexibility for vessels with less deck space or other capacity challenges.

3.3.2 Ropeless Fishing

In an effort to provide new options to reduce large whale entanglements in buoy lines, scientists, fishermen, conservationists, and resource managers are increasingly looking to new gear and technological options that may provide an alternative to complete area closures and other risk reduction measures that attempt to separate whales from rope in the water column. Ropeless systems allow fishermen to retrieve the gear from the bottom using methods such as: remotely releasing a buoy line stored on the bottom, by an inflation bag that brings the trap to the surface, by using galvanized releases that decay over time to release a buoy line, or by grappling the ground line from the surface - often done when buoys have been parted from fishing gear. Ropeless designs are usually not fully rope-free. Buoy lines are often deployed for retrieval, and groundlines would continue to connect traps in a “trawl” along the sea floor. However, “ropeless” fishing would allow fishermen to operate around whales with a greatly reduced risk of entanglement.

A number of technological, regulatory, financial, and operational barriers must be addressed before this type of fishing gear can be considered operationally feasible on a broad scale. Only small scale use of remote buoy line retrieval in U.S. commercial lobster fisheries has been done to date. Gear manufacturers are continuing to adapt the gear to meet the rigors of commercial conditions. An additional major area of concern is gear conflict. In current trap/pot operations, persistent buoy lines are required both to connect a buoy at the surface to bottom gear including trawls of pots to allow retrieval of pots. Surface systems including buoys and radar reflectors are also required to alert other mariners of gear. The surface systems help bottom fishing vessels which drag nets along the bottom, as well as gillnet and trap/pot fishermen, avoid trawling up or overlaying gear over the lobster and Jonah crab trawls.

Once technology is readily available and affordable to allow mariners to locate fishing gear on the sea floor, all fishermen (including mobile gear fishermen) would need to have this technology to avoid gear conflicts. Technology and regulations requiring vessel operators to use that technology to detect gear set on the bottom could replace current surface system regulations. Until then, fishermen harvesting lobster and crabs without surface system are required to obtain state or federal authorization exempting them from requirments to mark the ends of their trawls with visible surface systems.

Recognizing the current hurdles, the 2020 Appropriations Bill covering the Department of Commerce (Senate Report 116-127) directed funds toward the development of a program to develop and test "innovative fishing gear technologies designed to reduce North Atlantic right whale entanglements in partnership with relevant stakeholder. . ." NMFS has begun piloting a cooperative research program with fishermen, scientists, and environmental organizations to address the current challenges to ropeless fishing to maximize the potential for a ropeless fishing option that would allow trap/pot fisheries to continue while also preventing North Atlantic right whale entanglements.

Prior to piloting ropeless research, NMFS convened a subgroup of the Atlantic Large Whale Take Reduction Team members in 2018 to investigate the feasibility of ropeless fishing. The subgroup evaluated the existing barriers and considered that while there might be a ropeless fishing opportunity in the future, short-term risk reduction was a greater priority for the Team. NMFS published an Advance Notice of Proposed Rulemaking (ANPR) investigating changing existing seasonal closure areas to closures to trap/pot buoy lines (83 FR 49046, September 28, 2018). Team members at the October 2018 in-person Team meeting, as well as fishermen responding to the ANPR and to NMFS during scoping for this DEIS expressed skepticism that ropeless fishing would replace traditional and successful fishing methods and focused discussions instead on immediately available risk reduction solutions. If the right whale population continues to decline, broad implementation of seasonal closures may be required. Further testing of ropeless retrieval and bottom gear detection is needed to resolve operational barriers and to develop ropeless fishing methods as an alternative to broad closures. While testing can and is being done outside of restricted areas, controlled experiments in areas closed to the majority of lobster and crap traps and pots could accelerate ropeless testing and demonstrate efficacy. NOAA has invested a substantial amount of funding in the industry's development of ropeless gear, in specific geographic areas and in general. We anticipate that these efforts to facilitate and support the industry's development of ropeless gear will continue, pending further appropriations.

Some Team members representing environmental organizations considered seasonal closures in areas of high whale occurrence, such as Cape Cod Bay, to be more protective than ropeless fishing, and necessary to provide sufficient protection to right whales. NMFS believes experimentation by fishermen during commercial fishery operations is essential to any future operational success of ropeless fishing technology. Complete fishing closures may provide marginally more conservation benefit in the near-term by reducing vessel traffic and removing ground line and bottom-stored buoy line from closed areas. However, remotely retrieved buoy lines would only be present in the water column upon command. As described below, amendments to other fishery regulations with surface gear requirements would be required to allow large scale ropeless fishing. Currently, fishing in an area that is closed to trap/pot buoy lines would require exemptions through authorizations or permits that would be conditioned to minimize impacts on right whales and to include monitoring and reporting requirements. Exempted fishing effort would be conditioned to minimize the likelihood of entanglement or vessel strike (e.g. it could include requirements to post observers to look for whales, require vessel speed restrictions, or specify areas to avoid), interest is not expected to be substantial, and participation can be limited. For these reasons, the alternatives consider modifying current seasonal restricted areas and defining new restricted areas as closures to trap/pot fishing that use persistent vertical buoy lines.

3.3.2.1 Seasonal Restricted Areas Open to "Ropeless" Fishing

Seasonal closures of predictable right whale aggregation areas have been in place to reduce right whale exposures to buoy lines since the earliest Plan measures, when Cape Cod Bay and the Great South Channel were seasonally closed to trap/pot fisheries (62FR 39157, July 22, 1997). Modified in 2015, there are currently two large seasonal trap/pot fishery closure areas, the MRA (50 CFR 229.32(c)(3)) and the Great South Channel Trap/Pot Restricted Area (50 CFR 229.32(c)(4)). The MRA prohibits fishing with, setting, or possessing trap/pot gear in this area unless stowed in accordance with § 229.2 from February 1 to April 30. The Great South Channel Restricted Area prohibits fishing with, setting, or possessing trap/pot gear in this area unless stowed in accordance with § 229.2 from April 1 through June 30. Under both Alternatives Two and Three, additional seasonal restricted areas are identified; however, rather than prohibiting commercial fishing, the alternatives would modify existing closed areas and require the new seasonal restricted areas to be open to ropeless fishing, and closed to the use of persistent buoy lines. Under this modification, commercial fishing would be allowed using pots or trawls that can be retrieved remotely, releasing a buoy line or the first trap on a line of trawls, using what has become known as ropeless fishing technology.

Reviewers that believe these additional restricted areas are not warranted to achieve PBR should provide specific information or analysis in support of recommended removal of restricted areas from the preferred alternative. If NOAA receives information indicating that we can achieve the 60% risk reduction without the restricted area, we would consider eliminating the restricted area from rulemaking. Additionally, if commenters believe that information will be available after issuance of the final rule on this topic, commenters should articulate the nature of that information, how the information might affect the decision, and propose a mechanism for evaluating that information in determining whether or not to continue with the restricted area(s).

3.3.2.2 Requirements for Exemption from Surface System Regulations

Regulations implemented under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA), at 50 CFR Part 697.21 requires buoys (with identification marking) and for larger trawls, radar reflections on each end of trawls of lobster pots. Similar regulations for bottom tending fixed gear have been implemented under the MSA at 50 CFR 648.84. These surface systems allow all mariners to know that there is gear on the ocean bottom between the buoys.

Modifications to surface system regulations could be made once other methods to detect bottom gear are required. Modifications of these regulations will be considered along with the other challenges to ropeless fishing that will be evaluated in the pilot program discussed above. Until those regulations are revised, ropeless fishing will require authorization or exempted fishing permission from states or NMFS. Applicants will likely be required to provide details on their operations, including objectives, reporting and monitoring plans, approach to minimize gear conflict, and a description of possible environmental impacts including anticipated impacts on marine mammals or endangered species. NMFS will particularly solicit Team and public input on conditions for authorizations and exemptions in areas with seasonal buoy line closures to protect right whales. As required for other exempted fishing permits, conditions will likely govern trip reporting, monitoring requirements, and conditions on number of participants or traps. Review under the Endangered Species Act (Section 7) and NEPA will also be required for federally issued exempted fishing permits.

3.3.3 Weak Links, Weak Inserts, and Weak Rope

3.3.3.1 Weak Links

Weak links attaching the buoy to the rope have been required for trap/pot fisheries in some areas since the first Take Reduction Plan regulations were implemented, modified over time to include more areas and to lower breaking strength (for a summary, see Borggaard et al 2017). Weak links were one of the earliest gear modifications under the take reduction plan, believed to allow the buoy to break away and the rope to pull through the baleen if an entanglement occurs near the surface. It is difficult to assess how well the weak link connecting the buoy to the rope line reduces serious injury and mortality. Comments from readers may provide additional information to inform final rulemaking.

Alternative Two would maintain the current weak link requirement but would add an option to place the weak link at the junction between the bottom of the surface system and the rest of the buoy line. This would be an alternative to the current requirement for the link to be at the buoy itself. This alternative was requested particularly by offshore fishermen who believe that it would reduce the loss of gear caused by vessel or gear conflicts or by storms. This alternative would increase the likelihood that the entire surface system, often made up of two or more lines holding buoys and radar reflectors, would break away and reduce the complexity of an entanglement. While surface systems may be lost, if the surface systems break away quickly the gear will remain near the area where it was set, making location and grappling easier.

Alternative Three would remove the weak link requirement for lobster/crab trap buoy lines that would be required to use weak rope or weak insertions where weak rope or insertions are required further down on the buoy line. A lower weak rope or insertion would presumably allow a whale to break free of entangling gear below the surface system. Fishermen in these areas could still use a weak link at the buoy but it would not be required. This measure was recommended by Team members involved in disentanglements for three reasons:

- First, a buoy provides resistance through the water as a whale moves forward, pulling the line away from the whale and in a simple entanglement possibly pulling line out of baleen or off of a whale.
- The buoy, especially if it is pulling line away from the whale, provides the disentanglement team with an opportunity to grapple the line and pull it from the whale and/or attach tracking buoys to help monitor an entanglement.
- And finally, commercial fishery regulations require fishermen to include identification information on buoys. Identification of last known set location of the gear retrieved from large whales is often only possible when a buoy has been retrieved.

3.3.3.2 Weak Inserts and Weak Rope

The Team recommended risk reduction measures that included comprehensive weak rope (engineered rope that breaks at 1,700 lbs (771.1 kg) or less) or weak insertions (e.g. sleeves, generally discussed by the Team as insertions every 40 ft (12.2 m) along the buoy lines, although that was not explicit in the recommendations). A full buoy line of 1,700 lb (771.1 kg) breaking strength would allow a whale to break free no matter where the whale encounters the line. Insertion of weak sleeves or other weak configurations at regular intervals would reduce the amount or likelihood of trailing line and gear involved in an entanglement.

The Team's consideration of weak line was largely based on Knowlton et al. (2016) findings that no ropes retrieved from entangled right whales of all ages had breaking strengths that were below 7.56 kN (1,700 lbs) and suggests they can break free from these weaker ropes and thereby avoid a life threatening entanglement. This is consistent with estimates of the force that large whales are capable of applying, based on axial locomotor muscle morphology study conducted by Arthur et al. (2015). The authors suggested that the maximum force output for a large right whale is likely sufficient to break line at that breaking strength. That study and others recognized that a whale's ability to break free from an entanglement is also somewhat dependent on the complexity of the gear configuration (van der Hoop et al. 2017).

There may be added risk reduction to whales depending on how weak insertions are configured. The greater the number of weak points on a line, the greater the likelihood that a weak point will be located outside of the mouth where the whale has a better chance of breaking free from the entanglement. Configurations that are knot-free may also pose less risk. Currently, the Plan recommends the use of gear that is knot-free, and/or free of attachments due to the belief that smooth line may be more likely to slide through the whale's baleen without becoming lodged in the mouth or elsewhere, decreasing the risk of serious injury or mortality. Insertions that have large knots could potentially get caught in baleen if an entanglement occurs. Note that, while lacking the 'slide-through' benefits of smooth line, there is evidence that splices and knots introduce weaknesses into buoy lines. Lines undergoing breaking strength testing broke on the smaller side of a knot or splice (MEDMR 2020).

Knowlton et al. (2016) suggested that this breaking strength should also be strong enough to allow successful retrieval of pots in commercial trap/pot fisheries, depending on the gear configuration, set location, and hauling behavior (for example, less force is needed to haul while traveling over the trawl than to drag the trawl to the boat). Preliminary studies of hauling forces encountered during commercial lobster fishing suggest that most hauls in waters within 50 fathoms do not approach or exceed 1,700 lb (771.1 kg) (Knowlton et al. 2018, Maine DMR 2020, Maine DMR Proposal to NMFS 2019, Appendix 3.2 see Figure 8). In deeper waters, additional force occurs on the lines once multiple pots have been pulled up off the bottom and are in the water column. Uncontrollable conditions can also cause additional force on the line, including gear conflict (such as a trawl overlaid on the fished trawl); high seas, tides or currents; and trawls set in deeper water with more pots per trawl resulting in multiple pots hanging from the buoy line during the haul. As measured during commercial operations, while forces greater than 1,700 lb (771.1 kg) breaking strength were required to retrieve gear, particularly for gear of 35 traps and more in waters greater than 50 fathoms (91.4 m) (ME DMR 2020), timed haul data indicated those higher forces were not detected on the line until well past halfway through hauling the buoy line (for example, Figure 7 in ME proposal, Appendix 3.2). This suggests that under most operational conditions, weak rope or a weak insertion within the top half of a buoy line would not be subjected to forces approaching or greater than 1,700 lb (771.1 kg) during haul. It is important to avoid putting a weak point in areas where forces may exceed the breaking strength of the rope to minimize safety risks to fishermen and occurrence of gear loss. The proposed regulation would only require weak insertions or full weak rope for buoy lines, not sinking groundlines, to a depth where it is operationally safe.

NMFS and fishing industry organizations are working with fishing rope manufacturers and distributors to identify or develop commercially available line of appropriate diameters that break at 1,700 lb (771.1 kg) or less. Other options that would allow fishermen to use their existing gear include using weak insertions (e.g. a braided sleeve or configurations employing spliced in weaker line) that reduces the breaking strength of the line in several locations along the length of the rope. NMFS considers insertions placed close enough together to minimize wrapping of a whale in full strength rope without a weak point present (estimated to be approximately 40 ft (12.2 m), determined by the average whale length), to be equivalent to an engineered weak rope.

3.3.4 Decision Support Tool

The Decision Support Tool (DST), a model to assess and compare the mortality risk reduction that may be achieved by various management measures, was developed by the Northeast Fisheries Science Center to aid in the comparison of spatial management measures toward the development of alternatives that meet a 60 to 80 percent risk reduction target. This model calculates North Atlantic right whale entanglement risk based on three components: the density of lines in the water, the distribution of whales (as indicated by either a habitat density model predicting north Atlantic right whale distribution through 2017 or, in Southern New England where a large proportion of the population has been documented seasonally in recent years, North Atlantic Right Whale Consortium’s Sighting per Unit Effort data from 2014-2018), and a gear threat model to determine the relative threat of gear based on gear strength. Both line density and whale distributions are resolved monthly. Together, these components roughly estimate the approximate risk of an entanglement that will result in serious injury or mortality, where a higher density of lines or predicted whales, and/or high line strength increase risk. This enables a semi-quantitative comparison of how different management scenarios and gear modifications are predicted to change entanglements that result in serious injury or mortality. The DST was used in this DEIS to help select risk reduction scenarios for the preferred and non-preferred alternatives that sufficiently reduce right whale significant injury and mortality risk and that distribute risk across the proposed area as equitably as possible. This section includes a brief summary of the model and how it was used in this DEIS. More thorough documentation of the model and its components are available in appendix 3.1.

The line density component of the DST is based on the peer-reviewed NMFS Vertical Line Model and Co-occurrence model developed by IEC. It estimates the number of vertical lines associated with trap/pot configurations within a given spatial area. The main vertical line model uses line estimates from 2017, the latest data available and considered representative of current fishery management measures and associated effort. The DST evaluates all changes against the 2017 baseline, chosen because it was the year the NMFS determined that the population was in decline, an Unusual Mortality Event was ongoing, used the most recent data available, and when the ALWTRT process was reinitiated. An additional model was included that uses older fishing effort data prior to the MRA to determine the value of that closure, which became effective only 1.5 years before 2017, and specifically to identify how much risk reduction the closure likely accomplished and an associated estimate of the relative risk reduction credit.

A second layer in the model assesses the risk associated with different gear configurations, accounting for the use of line with different breaking strengths. Gear with higher breaking strength is more risky to whales because it is harder to break out of and therefore more likely to result in serious injury or mortality. An empirical gear threat model was built using information on the strength of ropes involved in serious whale entanglements and how the strength of the ropes observed in entanglements compares to the strength of ropes that whales would be expected to encounter. See Figure 4.7.3a in Appendix 3.1 for the resulting curve relating line strength to injury.

The final layer is a whale distribution layer. For most analyses, the DST employs the habitat density model built by researchers at Duke University that predicts the spatiotemporal distribution and density of right whales throughout the proposed area (Roberts et al. 2016). The primary model used oceanographic and habitat variables to create a map of likely whale presence using whale data from 1998 through 2017. Because this model did not provide estimated whale density in areas close to shore (e.g. state waters),), nearshore densities, which are expected to be low, were extrapolated into these inshore areas when risk in these habitats were being assessed. An alternative whale distribution model was added with more recent whale data in southern New England where a large proportion of the population has been documented seasonally in recent years. The sightings per unit effort (SPUE) model uses observational data from the North Atlantic Right Whale Consortium rather than a habitat density model. This was built primarily to address recent survey effort and right whale sightings in the area south of Nantucket and Martha's Vineyard that occurred after the habitat density model's time frame. The SPUE whale model in particular is vulnerable to changes in sighting effort throughout the proposed area but offered better data on current whale presence in the area south of Massachusetts and Rhode Island and thus was useful to evaluate the relative risk reduction of potential restricted areas in this region.

Each model run allows selection of a variety of spatially explicit management measures on a monthly basis with a focus on measures that reduce the number or strength of lines in the water column, such as changes in the number of traps per trawl, the proportion of traps fished, line strength, restricted areas, and number of lines per trawl. The output provides the mean reduction in risk throughout an entire fishing year as well as reduction in co-occurrence. Suites of measures can be run in tandem to best estimate overall changes in risk while taking into account how different management measures may interact with one another to alter the risk landscape.

3.3.4.1 Center for Independent Experts Peer Review

The Center for Independent Experts managed a review of the DST by three independent experts through a public panel process conducted in November, 2019. The experts' summary and individual reports can be found online: https://www.st.nmfs.noaa.gov/science-quality-assurance/cie-peer-reviews/cie-review-2019 and https://www.fisheries.noaa.gov/event/peer-review-right-whale-decision-support-tool. To summarize briefly, the reviewers concluded that the decision support tool provides a useful and open way for industry and managers to compare relative changes in entanglement risk for right whales under various risk management scenarios. The reviewers advised caution in interpreting decision tool results and advised on modification to improve the tool but, given the urgent need to reduce entanglement mortalities as soon as possible, indicated that decision- making should proceed while the tool is further refined. The final versions of the DST used to estimate risk reduction in the Alternatives included a number of changes informed by the reviewer input. Documentation of the DST version used to assemble Alternatives estimated to achieve a 60 percent or greater risk reduction can be found in Appendix 3.1.

3.3.4.2 Selecting the Risk Reduction Alternatives

Generally, the alternatives were selected based on the combination of risk reduction measures that, when combined, met the target of a minimum of 60 percent risk reduction from northeast region crab and lobster trap/pot fisheries within each alternative package (Table 3.4 and 3.5). The target of 60 to 80 percent was proposed to the Team, as described in section 3.1.1.1, to reduce all U.S. fishery mortalities and serious injuries to below the PBR. To expedite rulemaking, NMFS asked the Team to first focus on the northeast lobster and Jonah crab fisehries because they fish 93% of the endlines used in areas where right whales occur. Regulating multiple fisheries coastwide has been a much lengthier process. Given the many sources of uncertainty in the 80 percent target, as well as the challenges of achieving such a target without large economic impacts to the fishery, the Take Reduction Team focused on recommendations to achieve the lower 60 percent target for lobster and Jonah crab fisheries in the Northeast Trap/Pot Management Area (northeast). The ALWTRT near-consensus agreement presented a framework aimed at achieving a 60 percent risk reduction target in those fisheries. The dissenting opinion that prevented consensus did so because they thought the proposed measures were not sufficient for population recovery.

Table 3.4: A) The risk reduction measures that were selected for the preferred alternative (Alternative Two) and the associated risk reduction scores for separate measures as well as combinations of components (when possible). For line reduction, the upper and lower bounds provided by the DST were included. Given the uncertainty in risk reduction for the insert intervals proposed by the states, upper and lower bounds were also provided, as described in section 3.3.4.4 and highlighted in gray below. The lower bound compares the proposed insert intervals relative to insert intervals every 40 ft and provides the percentage of rope within buoy lines that would be considered weak by that metric. The upper bound recognizes that the depth of the lowest insert is important; a whale hitting the line above the lowest weak insert could break away, preventing attachment to the bottom gear and an acute drowning event, and possibly before a serious entanglement injury can be incurred. That upper bound is the estimated percent of line above the lowest weak insert. The percent risk reduction used to evaluate weak insert proposals is the average of these two estimates (in gray). B) The risk reduction measures in the non-preferred alternative (Alternative Three), the associated risk reduction scores for separate and combined measures, and the upper and lower bounds provided by the DST. Elements that do not result in significant risk reduction (e.g. weak link and gear marking modifications) are not included.

	A: Alternative Two			
Area	**Line Reduction Measure**	**% Risk Reduction**	**Lower Bound**	**Upper Bound**
ME, MA and RI for LMA1 and 2, OCC	Trawl ups proposed by states by distance from shore	12.1%	9.4%	15.6%
Existing line reduction in LMA 2 and 3	18% within LMA 2, 12% within LMA3	4.7%	3.7%	5.8%
No singles on MA vessels over 29 ft	About 36 vessels, primarily in the Outer Cape	Not calculable		
LMA1	Restricted area, October - January	10.8%	9%	11.7%
CCB, OCC	State waters stay closed in May if whales remain	4.7%	3.5%	6.2%
	Total for above line reduction when modeled together in DST	**28.9%**	**24%**	**31.7%**
MRA Credit	MRA is closed from February - April	9.9%	9.40%	10.60%
South Island Restricted Area	Proposed by Massachusetts, Closed February-April	3.8%	2.2%	5.6%
Area	**Weak Line Measure**			
State waters and other exemption areas	1 weak insertion at 50%	6.2%	5.3%	7.1%
3 to 12 nm (5.56 – 22.2 km)	2 weak insertions 25% and 50%	4.7%	2.6%	6.7%
12 nm/22.2 km to LMA3 border (all states)	1 weak insertion in topper at 35%	3.3%	0.8%	5.7%
	Average weak line measures:	**14.1%**	8.7%	19.5%
LMA3	Year round 45 traps/trawl and one buoy line weak (to 75%)	7.6%	2.8%	12%
	TOTAL risk reduction estimate:	**64.3%**	**47.1%**	**79.4%**

Area	Line Reduction Measure	% Risk Reduction 1A	Lower 1A	Bound 1A	% Risk Reduction 2A	Lower A	Upper 2A	% Risk Reduction 1B	Lower 1B	Upper 1B	% Risk Reduction 2B	Lower 2B	Upper 2B
	B: Alternative Three												
Federal waters	50% (of monthly average) line cap	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%	44.5%
MRA	Restricted area extension through May, possible May opening	5.1%	4.1%	6.5%	5.1%	4.1%	6.5%	5.1%	4.1%	6.5%	5.1%	4.1%	6.5%
LMA1	Restricted area October – February, possible February opening	11.5%	9.6%	12.5%	11.5%	9.6%	12.5%	11.5%	9.6%	12.5%	11.5%	9.6%	12.5%
LMA3	Restricted area Georges Basin, May – August	6.5%	3.6%	9.6%	6.5%	3.6%	9.6%	6.5%	3.6%	9.6%	6.5%	3.6%	9.6%
LMA3	45 traps/trawl, May – August	2.6%	1.5%	3.8%	2.6%	1.5%	3.8%	2.6%	1.5%	3.8%	2.6%	1.5%	3.8%
Area	**Weak Line Measure**												
All but LMA3	Weak Rope down to chafing gear (75% buoy line)	30.3%			30.3%			30.3%			30.3%		
Pick One:	**LMA3 Weak Line Options**												
Option 1	**Year round, one buoy line weak to 75%, one to 20%**	4.9%	0.6%	8.6%				4.9%	0.6%	8.6%			
Option 2	May – August, one line weak to 75% and one to 20%. Sept – Apr, two 20% toppers				5.3%	0.8%	9.4%				5.3%	0.8%	9.4%
	Subtotal (a single model run):	**62.5%**	**41.5%**	**74.3%**	**62.1%**	**41.5%**	**73.7%**	**62.5%**	**41.5%**	**74.3%**	**62.1%**	**41.5%**	**73.7%**
And Pick One:	**South Island Restricted Area Scenarios**												
Scenario A	Large South Islands – February – May	10.1%	6.0%	14.6%	10.1%	6.0%	14.6%						
Scenario B	L-shaped South Islands –February – May							7.5%	4.0%	11.4%	7.5%	4.0%	11.4%
	TOTAL Risk Reduction	**72.6%**	**47.5%**	**88.9%**	**72.2%**	**47.5%**	**88.3%**	**70.0%**	**45.5%**	**85.7%**	**69.6%**	**45.5%**	**85.1%**

In addition to 60 percent or greater risk reduction target, the guiding principles applied in assembling the alternatives includes:

- As recommended by the Team, spread risk reduction across jurisdictions and include broad application of reduced line and weak rope.
- For jurisdictional approach: incorporate the proposals submitted by the New England states and collaborate with the American Offshore Lobster Association for LMA Three.
- Direct the most protection to areas of predictable high seasonal aggregations of right whales, substantial risk reduction across areas of likely occurrence, precautionary measures in other areas to be resilient to ecosystem changes and associated changing whale distribution.

3.3.4.3 Identifying Areas for Seasonal Restrictions to Buoy Lines

Broad scale reduction in buoy lines across the proposed area is robust to changes in whale distribution. However, NMFS further identified areas and seasons where persistent aggregations of North Atlantic right whales appear to be seasonally predictable and to afford opportunity for additional risk reduction through seasonal closures to persistent buoy lines. Effective areas would not cause predictable relocation of lines to areas of high co-occurrence with right whales, inadvertently displacing risk. In considering areas, the primary goal was to find areas and seasons where there was an increased likelihood of right whale presence while minimizing undesirable consequences. For optimal conservation, the area needs to be sufficiently large to provide protection for whales despite annual variation in whale presence, but not designed such that large numbers of lines would relocate to other areas of high risk or to create a fencing effect along the borders of the restricted area. Hot spots of high buoy line and right whale co-occurrence were identified and tested with the DST to look for overall risk reduction. The approach for selecting hot spot areas is discussed below:

3.3.4.3.1 South of Martha’s Vineyard and Nantucket

Several proposals from Team members and during the scoping process included the need for a restricted area south of Cape Cod and several areas were considered in this analysis (Figures 3.1 and 3.2). This area was also predicted as viable right whale habitat based on oceanographic models showing suitable habitat and prey availability (Pendleton et al. 2012). Right, humpback, fin, minke, and sei whales were all sighted throughout the proposed restricted areas from spring of 2011 through spring of 2015, extending from the area south of Nantucket to the west past Martha’s Vineyard (Stone et al. 2017). During this period, all demographic classes were seen, within the 196 individuals identified. Thirty-five of the whales identified during the 2011 – 2015 time period were not seen in other right whale habitats during this period. Right whale sightings occurred primarily from December through April, but were highest in February and March (Leiter et al. 2017).

When considering a restricted area in this region, we compared a number of options to consider the relative protection offered by different sizes and shapes towards achieving 60 percent risk reduction for LMA2. Ultimately, three different shapes were selected for analysis based on the most recent five year NARWC sightings data (data downloaded in 2019, see Figure 3.3). The NARWC data were used in lieu of the Duke Habitat model for this area because it included sightings data through 2017 and better captured the recent right whale aggregations in that area. This represents a new right whale aggregation area. Additionally it has been subject to increased aerial survey effort conducted as part of the environmental review for windfarm lease areas south of Martha's Vineyard and Nantucket. These newer data were not available in the 2017 Duke Habitat Model.

The restricted area that was included in the preferred alternative was proposed by Massachusetts because it encompassed most of the sightings in the most recent two years and bolstered the risk reduction that they were proposing for southern New England. Two additional restricted areas were included in the non-preferred alternative. The largest encompasses most of the recent right whales sightings since 2014. A large area was selected because it encompasses most of the smaller restricted areas that were tested using various data sources and proposals. The other restricted area option in the non-preferred alternative is an L-shaped restricted area that encompasses the area with the most sightings over the most recent three years of data (2017 through March 3, 2020), slightly adjusted to capture areas of high right whale density since 2014. This area also reasonably encompasses the areas where right whales have been frequently spotted most often over the last ten years and may be semi-robust to annual changes in aggregations in this area. If one of the larger restricted areas was included, a "soft" restricted area option could be implemented, allowing the Regional Administrator in consultation with the Take Reduction Team to close a smaller portion of the area (up to 50 percent) in consideration of updated most recent three years' observations if sufficient data are available.

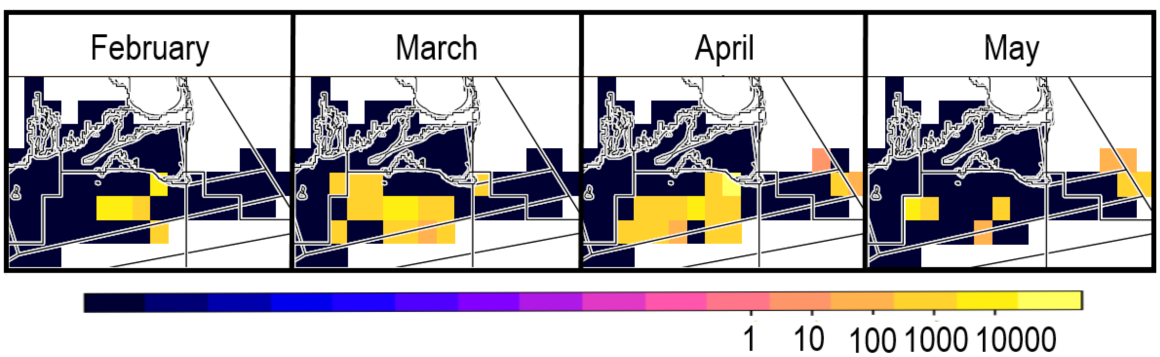

Figure 3.3: Right whale SPUE density on a log scale from 2014 through 2018.

3.3.4.3.2 Offshore Hot Spot Analyses

A hot spot analysis was conducted in the offshore fishing habitats in LMA One and LMA Three to see if there were any regions where whales and buoy lines co-occurred more frequently and where measures might be targeted to achieve the target risk reduction. The offshore fishery uses stronger and longer buoy lines to retrieve trawls with more trap/pots in deeper waters. As described by Knowlton et al. 2017, stronger gear is likely more lethal. As a caveat, in recent years, surveys are rare in this area, occasionally conducted in response to reports of sightings. In order to identify offshore areas that could benefit from a restricted area, we used the Duke Habitat Model within the DST to identify the individual pixels that represent forty to fifty percent of the cumulative risk in LMA One (assuming MRA is closed through May, see below identified as a "hot spot") and in LMA3 within the Northeast Region. Two areas were identified as having higher than average risk: one about 30 miles (55.6 km) offshore of Maine during fall and winter months (Figure 3.4) which has been proposed for a seasonal buoy line closure in Alternatives Two and Three, and one in Georges Basin within the Northeast Channel out to the Exclusive Economic Zone (EEZ) boundary beginning in late spring through late summer (Figure 3.5), proposed as a buoy line closure in Alternative Three. The final borders around these areas were drawn through an iterative process, testing the risk reduction offered in each version with the Decision Support Tool and selecting an area that is robust to annual shifts in predicted whale distribution without being larger than is necessary. For the LMA One restricted area, we also considered Maine's fishing zone boundaries, and truncated the borders to align with the edges of the outermost two zones to support future potential to create equivalencies by fishing zone. Independent observations, as well as the physical and biological features of these "hotspots" identified by the DST confirm their relative importance.

The Duke Habitat model is being updated through 2018. A recent review of the draft updated model confirmed the 2017 Model was suitable for use in the rest of the Northeast Region, demonstrating that while there is a reduction in magnitude of use in the Gulf of Maine, the distribution of right whales has remained consistent and therefore is somewhat predictable (Burton Shank, personal communication, August 19, 2020).

LMA One: Data from recent gliders operating in offshore Maine waters during December and January in 2018 and 2019 detected the presence of right whales, with positive detections within an area in the season and within nearly identical to the boundaries selected with the DST. Humpback, fin, and sei whales were also detected (real time data available at dcs.whoi.edu, Baumgartner et al. 2019, Baumgartner 2020). Although aerial surveys in recent years have been sparse for this area, Baumgartner's recent detections coincide with the area that had been identified as a potential winter breeding ground from 2002 to 2008 (Cole et al. 2013). Sound traps placed along the Maine Coast this year may provide further information regarding the value of a seasonal closure to buoy lines in this area.

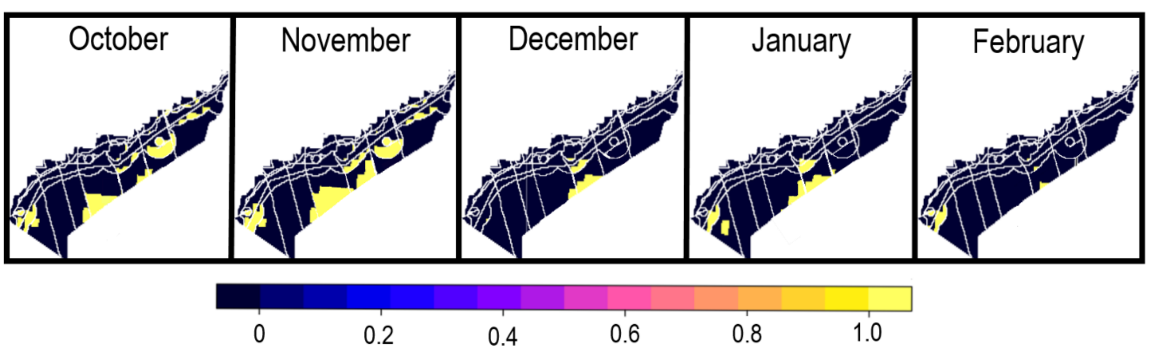

Figure 3.4: A hot spot analysis of the first 50 percent of risk characterized in the Duke Habitat Model for LMA One

Georges Basin: There is some evidence that this area could serve as a right whale foraging area. Historical data from Gulf of Maine show high densities of *C. finmarchicus*, in this area in May and June, particularly in areas sampled on the edge of Georges Bank in Georges Basin (Grieve et al. 2017). The area north of Georges Bank in the Gulf of Maine typically have higher percentages of stage five *C. finmarchicus*, one of the more lipid-rich stages that make up a part of the right whale diet (Mayo et al. 2001), starting in May and extending through summer (Harvey Walsh, NEFSC, Pers. Comm.). High *C. finmarchicus* densities are known to be present in summer months through fall just across the EEZ from the area in question, which could be connected to densities the proposed restricted area (Plourde et al. 2019). Right whales also begin appearing in Canada in April and May (DFO 2019), potentially transiting through Georges' Basin area in search of food on their way north.

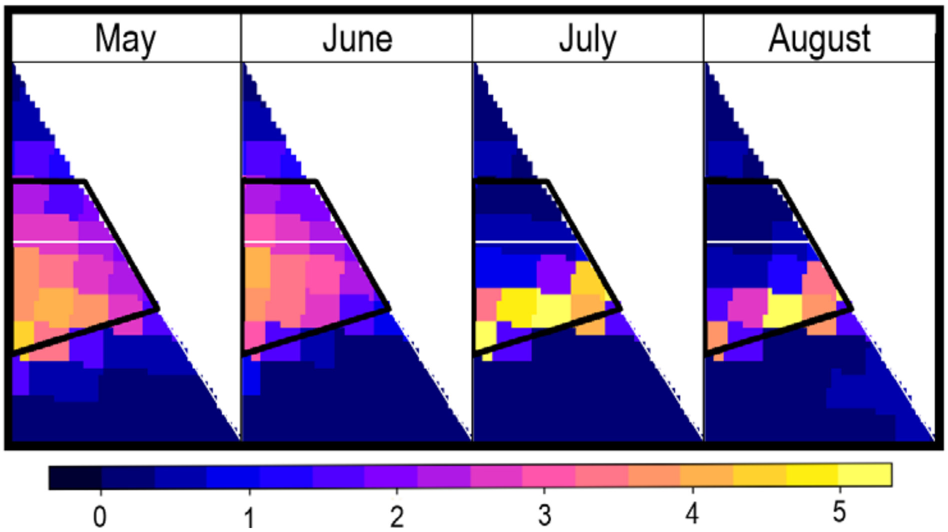

Figure 3.5: A hot spot analysis of the first 40 percent of risk characterized in the Duke Habitat Model for LMA Three

3.3.4.3.3 Massachusetts Restricted Area Extensions

Though the time period selected for the original MRA from February through April was based on the months where whales were known to consistently aggregate, optimal habitat conditions in Cape Cod Bay, Massachusetts Bay, and surrounding areas often extend well into May (Morano et al. 2012, Pendleton et al. 2012). Thus, several options were selected that would allow flexibility in reopening dates in certain areas at the end of the restricted period in case large aggregations are still present.

3.3.4.4 Decision Support Tool Analyses

Over one hundred risk reduction elements and compiled scenarios were tested, in an iterative process primarily sourced from feedback provided by the Take Reduction Team, state officials, scientists, trap/pot industry officials, NGOs, public scoping meetings, and written comments. Each individual regulation and regulation package were run through the decision support tool to identify the estimated contribution to risk reduction by state, LMA, and/or the entire Northeast Region. The model has several options to customize each run according to the assumptions being made, such as different whale models with different power to detect whale presence within three nautical miles from shore. The following delineates how scenarios were run based on the different underlying assumptions of the different model options available.

- All final estimates were run in high resolution
- All risk reduction estimates used the same gear threat model and assumed line strength would not increase for the trawl up scenarios selected.

- The majority of models were assessed with the primary whale habitat density model provided by Duke University and the main line model provided by IEc, unless otherwise specified.
- When a scenario was concentrated within three nautical miles, an expanded habitat model was used to get a better estimate of risk reduction in these areas.
- The most updated trap map was used for each region. Most areas were updated in version 2.2.1 and used for the majority of analyses. Updates to the trap map were made for LMA Three in versions 2.2.2 and 2.2.3 that were used for trawling up scenarios in this region with traps aggregated.
- Weak insertions in fewer intervals (i.e., more than 40 feet between insertions, where 40 feet is the interval assumed to be equivalent to full weak rope) were not built into the decision support tool because there is not enough quantitative data to inform this type of analysis. These scenarios were estimated in two ways to provide an upper and lower bound of estimated risk reduction and utilized the average of these two numbers. The lower bound represented how close rope in buoy lines using the proposed number of insertions was to rope with 40 foot (12.2 m) intervals, considered equivalent to full weak rope. The number of insertions needed for full weak rope equivalent was estimated using average depth in the area, which was calculated according to distance from shore and LMA, and adjusted for estimated scope ratio of the buoy lines in the area based on consultation with state managers or fishermen. The risk reduction estimate of full weak rope provided by the DST in the area being considered was then adjusted based on the proportion of rope considered weak based on the insertions proposed relative to those required to be full weak rope equivalent. The upper bound estimate was the risk reduction estimated for full weak rope times the percent of rope above the lowest weak insertion point since the lower the insertion, the more likelihood a whale will encounter and breakaway from above the insertion. Below the lowest insertion, no risk reduction value is given.
- The MRA credit was estimated using a model of line density and trap configurations prior to its implementation in 2015. The most recent version of this trap map was used.
- When possible, the final elements of a scenario were run together to assess potential interactive effects of altering multiple elements concurrently.
- Closure proposals in LMA Two, south of Massachusetts, were assessed with the most recent data available from 2014 through 2018 that were only available in sightings per unit effort provided by the North Atlantic Right Whale Consortium (2019).

3.3.5 Considering Existing Risk Reduction Credits

Overall the goal of this DEIS is to evaluate new regulations to reduce entanglement risk to North Atlantic right whales by 60 to 80 percent in the northeast lobster and Jonah crab trap/pot fisheries. However, the take reduction team agreed at the April 2019 meeting that there are a few areas where existing regulations or current effort reduction since 2017 should contribute toward the overall risk reduction analyzed here. Note that the economic analysis within this DEIS considers only the economic impacts of measures that would be implemented by NMFS to modify the Take Reduction Plan by federal rulemaking.

3.3.5.1 Massachusetts Restricted Area Credit

Given the large scale of the current MRA and the importance of the area for right whales, the take reduction team agreed that Massachusetts fishermen should get equivalent credit for maintaining the closure from February through April. This closure was implemented effective June 2015 through modifications to the Atlantic Large Whale Take Reduction Plan, impacting a portion of LMA One and the outer cape LMA. As summarized in the Massachusetts DMF proposal (MADMF 2020, Appendix 3.2), up to 65 percent of the known North Atlantic right whale population forages each spring in the Mass Bay Restricted Area, especially within Cape Cod Bay. In a single day in April 2017, 179 individual right whales were documented. A number of studies document the increase in importance of Cape Cod Bay in recent years, with the largest proportion of right whales observed in the Bay than anywhere else in right whales' range (Mayo et al. 2018, Ganley et al. 2019). MADMF estimates up to 10 right whales per square mile of water have been in Cape Cod Bay in a peak foraging season. The Take Reduction Team recognized the high and increasing value of this recently expanded area, and recognizes its disproportionate impact on Massachusetts fishermen when they recommended inclusion of the closure area risk reduction towards the 60 percent risk reduction target.

3.3.5.2 Existing Effort Reduction

As described below, lobster fishery management efforts in LMA Two and Three have or will soon reduce the estimated buoy lines fished relative to 2017 buoy line estimates due to ongoing trap reductions. As recommended by the Take Reduction Team, because this line reduction has reduced entanglement risk to right whales relative to the 2017 baseline year, or will reduce the number of lines within the timeline of the rulemaking associated with the Plan modifications, estimated reductions are applied toward the 60 percent risk reduction targets. As detailed below, LMA Two has observed annual effort reduction that is expected to continue through 2021. Since 2017, the baseline year, Massachusetts and Rhode Island demonstrate that the 18 percent line reduction for vessels fishing in LMA Two identified within the Team recommendations will be achieved by 2021. LMA Three is anticipated to achieve a 12 percent line reduction in the Northeast Region by May 2021 as a result of previous trap consolidation and ongoing trap aggregation efforts being developed in Addendum XXII to the Amendment 3 of the American Lobster Fishery Management Plan.

3.3.5.3 Planned Weak Insertion Risk Reduction

Maine intends to implement precautionary measures in exempt waters to aid in efforts to reduce the severity of potential entanglements. All lines in exempt waters within the state of Maine will be required to have one weak insert placed halfway down the buoy line. Given the depth of the water column in this area, the risk reduction this offers is close to but slightly under the equivalent of weak rope (an insert every 40 feet/12.2 m) when accounting for the scope ratio of the buoy line (estimated at 1.5 times depth in this areas, further analysis is presented in Chapter Five). As North Atlantic right whales are rare in this area, this offers a reasonably precautionary measure to reduce entanglement severity in the chance that a whale gets entangled in this area and therefore was counted towards risk reduction in the preferred Alternative.

3.3.5.4 Vessel Size Restrictions & Maximum Line Diameter

Massachusetts is planning to enforce new regulations that likely reduce entanglement risk but the level of risk reduction is not calculable at this time. One of these bans fishing single traps on all vessels larger than 29 feet (8.8 m) for all permits after January 1, 2020. This is likely to reduce the number of buoy lines in this area, and therefore entanglement risk, but there is not enough information on vessel size in the Decision Support Tool or the Co-occurrence Model to analyze changes that impact only vessels of a certain size. This regulation is likely to minimize the addition of new risk in the future and will potentially contribute to risk reduction alongside the proposed rule. Additionally, this will be implemented by the state and not by NMFS. The other measure to be implemented by Massachusetts is a maximum line diameter of three eighths of an inch. This will likely reduce the strength of line used by Massachusetts fishermen but it is unclear how this will relate to the maximum breaking strength requirements of 1,700 lbs (771 kg). Maximum breaking strength is associated with line diameter but also with line material (Knowlton et al. 2016), so the risk reduction of a maximum line diameter alone is difficult to calculate without additional information on line material. However, smaller diameter line generally has a lower breakings strength than thicker line and is therefore considered a precautionary measure that could reduce the severity of an entanglement.

3.3.6 Selecting Gear Marking and Other Information Gathering Elements

3.3.6.1 Gear Marking

The Atlantic Large Whale Take Reduction Team supported efforts to expand gear marking to further improve efforts to determine entanglement location. Morin et al. (2018) summarized gear characteristics from 2013 to 2017 right whale entanglement incidents. During those five years NMFS evaluated 62 documented right whale entanglements. No gear was present in 32 of those incidents. Only 17 cases in which gear was present included sufficient information to identify country of origin, including 12 that had the easy-to-identify Canadian snow crab gear, one incident involving marked gear indicative of US lobster gear, one incident with gear from a Canadian weir, one unknown Canadian case, and two cases of unknown U.S. gear. As this summary demonstrates, gear is not present on more than half of all right whale entanglement injuries investigated. Although disentanglement efforts attempt to retrieve gear when present, their primary focus is on saving the animal and therefore gear is not always retrieved (for more on disentanglement efforts, see NMFS, 2020). When gear is retrieved, it cannot always be identified to fishery or location. The Team discussed measures to increase visibility of marks from vessels and airplanes as well as requiring marks in all waters including those currently exempt. The gear marking schemes in Alternatives Two (Preferred) and Three (Non-preferred) would include the entire Northeast Region from coast through the EEZ, including waters currently exempted from gear marking requirements, and would add state-specific color markings or identification tape to lobster and crab trap/pot fisheries in the Northeast Region.

Effective September 1, 2020, Maine requires fishermen landing fish in Maine to include state-specific buoy line marking (ME DMR Regulations 13 188 Chapter 75, as amended by a modification proposed February 19, 2020) consistent with the measures proposed in Alternative Two. Under their revised measures, Maine will require purple markings on lobster pot/trap buoy lines fished by all state permitted fishermen from the coast to the LMA One/LMA Three boundary. Buoy lines in Maine exempted water would be required to have one three-foot mark within two fathoms of the buoy. For buoy lines less than 100 feet (30.5 m) in length one additional mark one-foot long would be required about half way down the line. Longer buoy lines in the exemption area would be required to have the three-foot mark and two additional one-foot marks, one midway along the buoy line and one at the bottom of the buoy line. In the sliver area (between the Maine Exemption Line and the three nautical mile line) and offshore throughout LMA One, Maine permitted fishermen will be required to mark buoy lines with a three-foot mark within the top two fathoms and three additional one-foot marks at the top third, middle and bottom third. In Federal waters, an additional 6 inch (15.24 cm) long mark would also be required within the first two fathoms for buoys set in Federal waters. And as discussed in Section 3.1.6.1, if weak links at the buoy are no longer required on buoy lines that are weak or have weak inserts, buoys with their identifying marks may be retained on an entangled whale more often, providing information that can help NMFS determine the original location of entanglements.

3.3.6.2 Non-regulatory Components

Monitoring requirements are a non-regulatory but important part of the Atlantic Large Whale Take Reduction Plan. Four non-regulatory monitoring components are proposed to align with recommendations from the Team in April 2019:

1. **Compliance monitoring:** compliance support and monitoring is achieved through outreach and enforcement efforts that inform fishermen of the regulatory requirements to support their ability to comply, as well as through active inspection of gear and associated enforcement actions. In state waters, NMFS supports enforcement related to marine mammal protection through funding for joint enforcement agreements in Maine, New Hampshire, Massachusetts and Rhode Island. NMFS, in coordination with the Coast Guard and state enforcement personnel, is also developing an offshore enforcement plan that combines traditional enforcement practices with the use of new technologies such as drones and electronic monitoring to support enforcement throughout the EEZ. The enforcement plan will be presented to the Atlantic Large Whale Take Reduction Team at their next in- person meeting in early 2021.

2. **North Atlantic right whale population monitoring:** In 2019, NMFS convened an Expert Working Group to develop recommendations to (1) improve right whale population status by identifying and tracking essential population metrics and (2) improve our understanding of distribution and habitat use. Recommendations from the Working Group (Oleson et al. 2020) will be used to modify surveys on a three-year monitoring cycle that includes a report to the Team every three years to evaluate and reconsider restricted management areas. Results may be used by the Team to recommend changes, openings, or further area management. The data included in monitoring plans will include whale abundance and distribution as well as other environmental characteristics that impact whale habitat use and population health, including copepod abundance and oceanographic parameters.

3. **Fishery monitoring**: Northeast Fisheries Science Center has initiated a program to monitor both the economic and social impacts of Take Reduction Plan measures on trap/pot fisheries and to monitor indicators of the effectiveness of those measures including: a review every three years of economic impact of Plan measures on trap/pot fisheries; changes in co-occurrence caused by line reduction and closures, and an evaluation of predicted vs. actual line reduction by distance from shore.

4. **Fishery Reporting:** Lobster trap/pot gear makes up the vast majority of buoy lines fished in the Northeast Region. The ASMFC adopted Addendum XXVI in February 2018 to improve harvester reporting and biological data collection in both state and federal waters to improve the spatial resolution of harvesting data, improve and expand fishery effort data, and obtain better data on the offshore fishery and lobster stock through biological sampling. NMFS is working on a proposed rule at this time that would require 100 percent harvester reporting by federal permit holders as early as 2021. Maine, currently the only New England State that does not require 100 percent harvester reporting, has committed to 100 percent reporting by no later than 2023 and is actively seeking funding to support harvester reporting efforts. Additionally, ASMFC has piloted a vessel tracking study with the intention of requiring vessel tracking in Federal waters. Pilot study results are anticipated in the summer of 2020 and will be used to inform future rulemaking to require vessel tracking on vessels with lobster permits operating in Federal waters.

3.4 Alternatives Considered but Rejected

In the scoping efforts conducted for this rulemaking, stakeholders recommended a variety of approaches for reducing entanglement risk to large whales. Scoping discussions included the meeting of the full Take Reduction Team as well as a series of public meetings held at key locations on the Atlantic coast.

While NMFS solicited and considered all input from stakeholders, a number of approaches were rejected in the formulation of alternatives. Table 3.6 summarizes these approaches and briefly explains why NMFS chose not to integrate the approach into the regulatory alternatives under consideration. The rejected approaches are organized by topic. Stakeholders identified many approaches that would apply to more than one fishery or region; hence, many of the concepts are repeated in the table. The alternatives described are not mutually exclusive; i.e., some were recommended in combination, despite the fact that they are listed and addressed separately in the table. The rejected alternatives are wide-ranging in content. Concepts that recur frequently in the alternatives include the following:

Table 3.6: A list of the primary alternative components that were considered but rejected, with the reason for the rejection.

Topic	*Alternative Considered but Rejected*	*Rationale for Rejection*
	LMA3: In Georges Basin, trawl up to 70 traps per trawl, year round or seasonally	Less preferable to broader scale measures, insufficient risk-reduction
	LMA1 Maine: Trap reductions	Unpopular with stakeholders
	LMA1 Mass: 30 percent line reduction	Unpopular with stakeholders
	LMA1 NH: 30 percent line reduction	Unpopular with stakeholders

Topic	*Alternative Considered but Rejected*	*Rationale for Rejection*
Line Reduction	Only use one endline in LMA3 year round	Unpopular with stakeholders, Safety concern
	Outside 12 nm 1/2 of endlines ropeless	Unpopular with stakeholders, potential increased gear conflict
	Reduce all traps 50 percent	Prefer fishery management to be done by Commission/Council
	3-4 year phase-in of 400 traps/fisherman trap limit with commensurate reduced end	Prefer fishery management to be done by Commission/Council
	Reduce trap tag limits by 50 percent commensurate with vertical line reduction.	Prefer fishery management to be done by Commission/Council
	Reduced trap limits if fishing in modified Mass Restricted Area	Prefer fishery management to be done by Commission/Council
	Do not change gear configurations in state waters	Insufficient risk reduction
	Trap or line cap to include all fisheries including EFPs, gillnet, trap/pot, aquaculture, includes seines	Prefer fishery management to be done by Commission/Council
Closures	Close statistical area 529	Too large, unpopular with stakeholders
	LMA3 above 40.3 degrees Oct - Dec	Too large, unpopular with stakeholders
	LMA1 Feb - May 15	Too large, unpopular with stakeholders
	Everywhere Jan - Apr	Too large, unpopular with stakeholders
	Extension of Massachusetts Restricted Area to May 15	Unpopular with stakeholders
	Extension of Massachusetts Restricted Area to the New Hampshire border	Unpopular with stakeholders
	Extension of Massachusetts Restricted Area to Cape Anne	Unpopular with stakeholders
	Cape Cod Bay Closure January	Unpopular with stakeholders, little additional risk reduction
	Close Area 537, Nov 1 – May 14	Too large and too long, unpopular with stakeholders
	Closure West GOM- April	Unpopular with stakeholders, little additional risk reduction
	South of Nantucket/Martha's Vineyard March - May	Not sufficient risk reduction
	Closure south of Nantucket bounded by 30-minute squares capturing 80 percent of sightings in the last three years Dec-May	Length of closure not necessarily supported by data available, unpopularity with stakeholders
	Emergency action to close area south of Martha's Vineyard and Nantucket until ruling	Not a part of this DEIS, potentially under a different authority
	Emergency action to close area in offshore Maine in summer and fall (LMA 1 and 3)	Unpopularity with stakeholders
	Create dynamic closures	Not currently feasible with regulatory process
	vertical line trap/pot closures during the summer and fall in offshore waters East of Maine in LMA1 and LMA3	Data supported slightly different seasons for closures in each area
	NEAQ proposed area closure south of Nantucket for Feb-May 15	Unpopular with stakeholders and/or did not achieve sufficient risk reduction
	Modify opening and closures of Mass. Bay Restricted Area via MA Dynamic Seasonal Extension	Not feasible
	Buoyless everywhere >100m	Needs more testing
	Mass Area B- Buoyless fishing Feb-Apr	Eliminates closure and increases risk
	Mass Area C Buoyless in April	Eliminates closure and increases risk

Topic	*Alternative Considered but Rejected*	*Rationale for Rejection*
Ropeless Fishing	Limit new and transferred federal trap/pot permits to ropeless-only fishing (only 25 percent by grapple). All trap/pot ropeless by 1/1/20.	Needs more testing
	Experimental and operational support for a 5 year transition to ropeless fishing in waters greater than 300 feet in depth	Needs more testing
	Ropeless in all of LMA3	Needs more testing
	Where weak rope is not feasible, 5-yr phase in of ropeless	Needs more testing
	Require ropeless for new fixed gear operations or fisheries, emerging gear such as aquaculture or experimental fisheries	Needs more testing
	Within finite sections of closed area, allow/fund ropeless experimentation	May occur under alternatives that require EFP but opportunity for broader options
Weak Line	Weak line at top 50 percent both buoy lines, everywhere	Safety concerns in deeper waters with more and heavier traps/trawl
	LMA3 Northeast (outside of N of George's Management Area), on remaining strong buoy line, weak insertion at 35 percent of scope	Safety concerns, unpopular with stakeholders, needs more testing
	Mass waters: sleeves	Unpopular with stakeholders
	ME 12+ 1,700 lbs (771.1 kg) on 3/4 toppers	Unpopular with stakeholders
	1,700 lbs rope in top 2/3	Unpopular with stakeholders
	LMA3: Sleeves top 500m	Unpopular with stakeholders
	Outside of 100m Toppers	Unpopular with stakeholders
	Inside of 100m 1,700 lbs (771.1 kg) rope	Unpopular with stakeholders
	Inside 100 ft isobaths, 1,700 lbs rope, outside use add-ons	Unpopular with stakeholders
	Sleeves everywhere	Unpopular with stakeholders
	1,700 lbs (771.1 kg) tag line everywhere >100m	Unpopular with stakeholders
	Area 537 full weak rope or equivalent	Unpopular with stakeholders
	Sub Area 537- 1,700 lbs (771.1 kg) or sleeves	Unpopular with stakeholders
	Reduce breaking strength in all ropes used in depths of less than 300 feet to 1,700 lbs (771.1 kg) or sleeves every 40 feet	Unpopular with stakeholders
	Tiered buoy line strength: 1,700 lbs (771.1 kg) breaking strength as standard where safely feasible. Where not safe, consider using taglines. If neither is an option, ropeless within 5 years	Unpopular with stakeholders
	Require 1,700 lbs (771.1 kg) breaking strength line for all fixed gear fisheries in Area 537	Unpopular with stakeholders
	Try 1,900-2,000 lbs breaking strength	Insufficient risk reduction
	Use predetermined bleach soak time to weaken rope	Difficult to standardize
	Test reduced breaking strength gear beyond 300 feet	Does not reduce risk
	Cap buoy line diameter in non-exempt ME state waters, and federal waters out to the Area 1 line varied by distance from shore, to reduce breaking strength and prevent its escalation	Unclear risk reduction
	Individual fishermen/permit numbers specific ID tape throughout buoy line	Unpopular with stakeholders
	Distinctively marked 1,700 lbs (771.1 kg) breaking strength rope	Manufacturing challenges
	In Maine, only add a single tracer to existing markings	Does not add additional info when gear is not collected.
	Existing marking is sufficient	Does not meet needs
	Different marks for different fisheries, area fished, subregion, etc	Limited color options

Topic	Alternative Considered but Rejected	Rationale for Rejection
Gear Marking	Mark all fixed gear fisheries	Not all included in this ruling
	Increase marking frequency	Unpopular with stakeholders
	Marking lengthener	Unpopular with stakeholders
	Mark to ID line type (groundline and buoy lines)	Unpopular with stakeholders
	Mark ropeless gear	Unpopular with stakeholders
	Mark gear every 40 feet	Unpopular with stakeholders
	Red sleeves as gear marking	Unpopular with stakeholders
	Use high visibility rope	Unpopular with stakeholders
	Replace and mark 20 percent of lines each year for a 5 year phase in	Too slow
	Include unique country of origin tracer in line to identify as US gear	Increased marking should help distinguish US gear
	Unique for exempted areas	Limited color options
	Unique mark for sinking line in vertical systems	Unpopular with stakeholders
	Include unique marks closure areas (when open) and certain other key areas.	Limited color options
Reporting	Require VMS/AIS on all buoy line fisheries	Cost burden
	Require mandatory lost gear reporting for all trap/pot and gillnet gear not already required to report.	Unpopular with stakeholders
Monitoring	Effort along the US east coast with increased effort south of the islands and in the mid-Atlantic more than once per month. Year-round throughout US east coast with increased effort in the mid-Atlantic region.	Unpopular with stakeholders
	Year round throughout US east coast with increased effort in the mid-Atlantic region	Logistical challenges
	Train lobstermen as whale observers and disentangle teams	Funding and logistical challenges
	VMS and AIS use in fishery at 100 percent	VMS implemented by a different authority, AIS costly
	Require VMS and VTR	VMS implemented by a different authority, VTR will be implemented in a separate monitoring plan.
	Annually review and amend, high density right whale closure areas	Logistical challenges
Weak Links	Weak link alternatives in northern Area 537: 600 lbs weak-link or 1,100 lbs weak-link for pot gear buoy lines	Unpopular with stakeholders
	In statistical area 537 lower the breakaway requirement for all fixed gear from a maximum of 1,500 lbs to a lower level. Analyze options for a 600 lbs breakaway and another for a 1,100 lb breakaway.	Unpopular with stakeholders
Other	Allow participating fishermen to fish reduced number of traps with SSL installed every 40 feet in line in January and in green sections of the Mass Bay Restricted Area February - April (PSSLA)	Increases entanglement risk
	Mass Feb-Apr, sleeves, some traps go back in	Increases entanglement risk
	Adopt all provisions agreed upon at the TRT	Does not take into account additional information/data available since
	Only implement new measures in Maine over 30 mi from shore	Insufficient risk reduction
	Remove exemption line	Unpopular with stakeholders
	Establish triggers in advance which would result in prescribed management actions for example reduced buoy lines in a region	Logistical challenges
	Reduce line in surface systems in Maine	Unpopular with stakeholders

Topic	Alternative Considered but Rejected	Rationale for Rejection
	Oppose any experimentation with grappling for gear that would allow any type of floating or buoyant groundline	Not risk reduction
	Implement measures that apply equally to all fishermen in federal waters	Doesn't take into account operation size.
	No aquaculture in any closed areas at any time of year	Beyond the scope of the DEIS
	Require all trap/pot fisheries to use sinking groundlines with no exemptions	Unpopular with stakeholders
	5 year transition to red/orange buoy lines to increase visibility	Unpopular with stakeholders
	Colored lines throughout Area 537	Unpopular with stakeholders

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4 AFFECTED ENVIRONMENT

This chapter describes the valued ecosystem components that may be affected by the Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan) modifications. Four major valued ecosystem components are examined in detail:

- **Atlantic Large Whales**: The large whale valued ecosystem component includes the three large whale species that are the focus of the ALWTRP, the North Atlantic right whale, the humpback whale, and the fin whale, as well as the minke whale, which also benefits from the plan.

- **Other Protected Species**: Other protected species are included in a separate valued ecosystem component from the four large whales above and includes all other protected species that may be impacted by the proposed regulations (i.e., marine mammals and sea turtles; Table 4.1).

- **Habitat**: The habitat valued ecosystem component represents marine habitats, with a focus on Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC). This includes the physical environment and benthic organisms that provide important ecological functions.

- **Human Communities**: This valued ecosystem component encompasses potentially affected fisheries with an emphasis on the economic effects of the proposed alternatives. The proposed actions are not expected to have significant impacts on the biological aspects of the fisheries and therefore fish biology is not included in this analysis.

This chapter is broken down as follows:

- Section 4.1 discusses the status of protected species that may be impacted by elements of the Atlantic Large Whale Take Reduction Plan. This has two sections: one focusing on large whales and another on all other protected species.

- Section 4.2 provides information on potentially impacted habitats and their physical characteristics.

- Section 4.3 considers the economic and social aspects of the potentially impacted fisheries.

4.1 Protected Species

The following discussion examines the potential impact of management actions on protected species. Table 4.1 shows the protected species that were considered and identifies which of those may be impacted by the proposed action.

Table 4.1: The species that were considered, their current status, and which ones are likely to be impacted by the proposed regulations.

Potential Effect	*Category*	*Species*	*Status*
Potentially Impacted	**Whales**	North Atlantic Right Whale	Endangered
		Humpback Whale	Protected
		Fin Whale	Endangered
		Minke Whale	Protected
		Blue Whale	Endangered
		Sei Whale	Endangered
		Sperm Whale	Endangered
	Turtles	Loggerhead Sea Turtle (North Atlantic DPS)	Threatened
		Leatherback Sea Turtle	Endangered
Not Likely to Be Impacted	**Fish**	Giant Manta Ray	Endangered
		Oceanic Whitetip Shark	Endangered
		Atlantic Salmon	Endangered
		Shortnose Sturgeon	Endangered
		Atlantic Sturgeon	New York, Chesapeake Bay, Carolina, and South Atlantic DPSs - endangered, Gulf of Maine DPS as threatened
	Marine Mammals	Brydes Whale	Protected
		Harbor Porpoise	Protected
		WNA Coastal Bottlenose Dolphin	Protected
		Atlantic White-Sided Dolphin	Protected
		Risso's Dolphin	Protected
		Spotted Dolphin	Protected
		Striped Dolphin	Protected
		Pilot Whale	Protected
		Offshore Bottlenose Dolphin	Protected
		Common Dolphin	Protected
	Seals	Harbor Seal	Protected
		Gray Seal	Protected
		Harp Seal	Protected
	Turtles	Kemp's Ridley Sea Turtle	Endangered
		Green Sea Turtle (North Atlantic DPS)	Endangered
		Hawksbill Sea Turtle	Endangered
		Olive Ridley Sea Turtle	Threatened

The information here was compiled from a variety of sources including published literature and official reports. The abundances, potential biological removal (PBR) levels, and serious injury and mortality rates for all marine mammals were taken from the annual NMFS stock assessments and, if possible, supplemented by additional data from the Northeast Fisheries Science Center that has yet to be published. Sea turtle abundance and trends were available from government and non-government reports. It should be noted that annual mortality rates for protected species that were calculated from the detected mortalities should be considered a biased representation estimate of human-caused mortality. Detections are arbitrary and not the result of a systematic survey of mortality. As such, they represent a minimum estimate of human-caused mortality which is almost certainly biased low (Waring et al. 2012).

4.1.1 Large Whales

North Atlantic Right Whale

The North Atlantic Right Whale (*Eubalaena glacialis*) is a baleen whale found in temperate and sub-polar latitudes in the North Atlantic Ocean. Today they are mainly found in the Western North Atlantic, but were historically recorded south of Greenland and in the Denmark strait, as well as in Eastern North Atlantic waters (Kraus and Rolland 2007, Monsarrat et al. 2016), and with possible historic calving grounds in the Mediterranean Sea (Rodrigues et al. 2018). Although some individuals are occasionally sighted off of Europe and in the Gulf of Mexico, the current geographic range is primarily from Florida, Georgia, and South Carolina in the south, where calving occurs, through the mid-Atlantic to the north along the east coast of North America and further extending north and west to the waters of Greenland and Iceland (Lien et al. 1989, Mate et al. 1997, Morano et al. 2012, NMFS 2013, Wikgren et al. 2014, Oedekoven et al. 2015, Davis et al. 2017, Krzystan et al. 2018, Davies et al. 2019). Other than right whales that aggregate in small numbers on the calving grounds in the winter, aggregations are most frequently observed in the Mid-Atlantic and New England throughout Cape Cod Bay and the Gulf of Maine (Mate et al. 1997, Wikgren et al. 2014, Davis et al. 2017, Mayo et al.2018) as well as in Canadian waters, such as the Bay of Fundy, Scotian Shelf, and Gulf of Saint Lawrence (Davies et al. 2019, Plourde et al. 2019) likely in search of food.

Right whales feed primarily on copepods, in particular *Calanus finmarchicus*, where they occur in high abundance (Watkins and Schevill 1976, Wishner et al. 1988, Mayo and Marx 1990, Wishner et al. 1995, Woodley and Gaskin 1996, Kenney 2001, Baumgartner et al. 2003, Baumgartner and Mate 2003). Right whale foraging occurs commonly at the surface in the spring in Cape Cod Bay (Mayo and Marx 1990) but at depth in the summer, fall, and early winter where high densities of copepods occur (Kenney et al. 1995, Baumgartner and Mate 2003, Baumgartner et al. 2017). Baumgartner et al. (2017) observed right whales using all depth strata, including surface feeding on *C. finmarchicus* coincident with spring phytoplankton blooms and feeding at depth spring through late fall. The high lipid content of diapausing copepods that occur in late summer and early fall at depth, from 300 m (83 fm) to 1500 m (250 fm), in the Gulf of Maine Basins may be of particular importance to right whales (Baumgartner et al. 2017, Krumhansl et al. 2018). By mid-winter, there is a decline in *C. finmarchicus* availability and right whales are required to target other prey. Seasonal patterns in *C. finmarchicus* aggregations and phenology have been changing (Pershing and Stamieszkin 2020), shifting distributions throughout the Gulf of Maine (Record et al. 2019) making it more challenging to predict aggregations in known hot spots. In Canada, whales in the Bay of Fundy were observed less often and earlier in the season in recent years in line with shifting prey overlap (Davies et al. 2019) and foraging habitat was recently identified on the Scotian Shelf and in the Gulf of Saint Lawrence (Plourde et al. 2019).

From 1990 to 2010, the North Atlantic right whale population grew at a rate of 2.8% from an estimated 270 in 1990 to high of 483, but has declined since 2010 (Pace et al. 2017) and experienced an unusual mortality event beginning in 2017 that was likely related to both vessel strikes and entanglement in fishing gear (Daoust et al. 2018), particularly in the Canadian Gulf of St. Lawrence. Serious injury and mortalities were attributed to entanglements for 63% of all serious injuries and mortalities documented between 2010 and 2018 (see Chapter 2). During this time frame, there were 165 documented incidents in the US and Canada. The following is a broad overview of the incident data:

- Of all 165 incidents reported, 139 of those showed injuries confirmed as caused by entanglements or vessel strikes, 56 of which resulted in serious injury or mortality (Table 4.2).
- Seven of these entanglements would have resulted in serious injury or mortality but were disentangled.
- The vast majority of incidents cannot be identified to a known gear type. Of those with gear retrieved and identified, more were confirmed as trap/pot gear incidents than incidents caused by netting (see Chapter 2).
- Among all entanglement incidents by country, while there appears to be a spike in Canada, there are also a large proportion that do not have a country of origin identified.
- Yearly trends demonstrate a particular increase in serious injury and mortality of right whales since 2014.
- Seventeen mortalities occurred in 2017, including 12 in Canada and 5 in the U.S. Entanglement was identified as the cause of four of the mortalities, two in Canada's Gulf of St. Lawrence, and two in the U.S. Two serious injuries, one in each country, were also documented as caused by entanglement
- Three mortalities showing signs of acute entanglement were documented in 2018, all in US waters and including one in January 2018 from which snow crab gear was removed.

During 2019, another 10 mortalities were documented, including 9 in the Gulf of St. Lawrence (three of the four examined were caused by injuries compatible with blunt force trauma) and one last seen with a new entanglement in the Gulf of St. Lawrence shortly before stranding dead in New York (necropsy results pending). A number of entanglement-related serious injuries were also documented in 2019, including a right whale disentangled from Canadian snow crab gear east of Provincetown, Massachusetts.

Between 1990 and 2015, survival rates appeared relatively stable, but differed between the sexes, with males having higher survivorship than females (males: 0.985 ± 0.0038; females: 0.968 ± 0.0073) leading to a male-biased sex ratio (approximately 1.46 males per female, Figure 2.4)(Pace et al. 2017). The most recent published population estimate for the North Atlantic

Right Whale is 409 at the end of 2018 with 10 subsequent mortalities in 2019 and seventeen births, since 2018, including one that is likely dead after a vessel collision (Pettis et al. 2020, S. Hayes Pers. Com 2020).

Table 4.2: The number of entanglement and vessel strike cases, 2010 – 2018, by country, that resulted in serious injury or mortality

Country	Cause	# of Cases
US	Entanglement	3
	Vessel Strike	7
First Seen US	Entanglement	26
	Vessel Strike	1
Canada	Entanglement	11
	Vessel Strike	4
First Seen Canada	Entanglement	16
	Vessel Strike	1
Total	Entanglement	56
	Vessel Strike	13

Anthropogenic mortality has limited the recovery of North Atlantic Right Whale (Corkeron et al. 2018). With whaling prohibited, the two major known human causes of mortality are vessel strikes and entanglement in fishing gear (Hayes et al. 2018b). Vessel strikes declined after vessel speed regulations were implemented (78 FR 73726) (Conn and Silber 2013), but entanglement in fishing gear remains a significant threat (Kraus et al. 2016, Sharp et al. 2019) and appears to be worsening (Hayes et al. 2018b). Other potential threats to recovery include low genetic diversity, pollution, nutritional stress, and other sublethal stressors (Best et al. 2001, Kraus et al. 2001, Rolland et al. 2012, Rolland et al. 2016, Meyer-Gutbrod and Greene 2018).

There is evidence of declining physiological health in the population since the early 1990s, which was also linked to several periods of poor reproduction (Rolland et al. 2016, Christiansen et al. 2020). Calving rates have varied substantially, with low calving rates coinciding with all three periods of decline or no growth, with low female survival further reducing the number of birthing females (Pace et al. 2017). This has been acute in recent years, when calf production has decreased and the time between births has nearly doubled. Between 2009 and 2017, Pettis et al. (2018a) observed an increased calving interval from an average of 4 to 10 years. Only five new calves were documented in 2017 (Pettis et al. 2018b), no new calves in 2018 (Pettis et al. 2018a), and only 7 new calves in 2019 (Pettis et al. 2020), which is too low to compensate for estimated mortalities (Pace et al. 2017). Many factors could explain the low birth rate, including poor female health (Rolland et al. 2016) and reduced prey availability (Meyer-Gutbrod et al. 2015, Johnson et al. 2018, Meyer-Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018). Entanglement in fishing gear also can have substantial health and energetic costs that affect both survival and reproduction (Robbins et al. 2015, Pettis et al. 2017, Rolland et al.2017, van der Hoop et al. 2017, Hayes et al. 2018a, Hunt et al. 2018, Lysiak et al. 2018).

The resilience of the North Atlantic Right Whale to future stressors is considered very low given the existing threats (Hayes et al. 2018a) and would be more so in the absence of human-caused serious injury and mortality (Kenney 2018). Hayes et al. (2018a) estimates that by 2029 the population will decline to the 1990 estimate of 123 females if the current rate of decline is not mitigated. Recent modelling efforts by Meyer-Gutbrod et al. (2018) further indicate that because right whales feed primarily on dense aggregations of *Calanus* spp copepods, the population may decline towards extinction if prey conditions worsen as predicted under future climate scenarios (Grieve et al. 2017, Johnson et al. 2018, Krumhansl et al. 2018), and anthropogenic mortalities are not reduced (Meyer-Gutbrod et al. 2018). Recent data from the Gulf of Maine and Gulf of St. Lawrence indicate prey densities may already be declining (Johnson et al. 2018, Meyer-Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018, Record et al. 2019). Additionally, changes in prey distribution has shifted right whales into new areas with nascent mitigation measures so they are at additional risk of anthropogenic mortality (Plourde et al. 2019, Record et al. 2019)

The North Atlantic right whale is listed as endangered under the Endangered Species Act (ESA). NMFS believes that the western population of North Atlantic right whales is well below the optimum sustainable population level. NMFS determines a population's PBR level as the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks or stocks of unknown status relative to an optimum sustainable population. The recovery factor for right whales is 0.10 because this species is listed as endangered under the ESA. The abundance estimate in the 2018 stock assessment report (Hayes et al. 2019) suggests minimum population size is 445 and the maximum productivity rate is 0.04. The PBR level for the North Atlantic Right Whale has been less than one serious injury or mortality each year, and although PBR will likely go down in the next stock assessment, it was identified as 0.9 per year for the stock assessment for 2012-2016 (Hayes et al. 2019). During that same time frame, the minimum estimated annual mortality and serious injury of right whales between 2012 and 2016 was 5.56, including 5.15 attributed to fishery interactions (Hayes et al. 2019, Henry et al. 2019), well above PBR.

Humpback Whale

The Gulf of Maine humpback whale (formerly Western North Atlantic, *Megaptera novaeangliae*) was previously listed as endangered under the ESA. In 2016, several distinct population segments were removed from listing, including the West Indies distinct population segment. The Gulf of Maine stock is largely composed of whales that reproduce in the West Indies (81 FR 62259, September 2016). The Gulf of Maine stock is still protected under the Marine Mammal Protection Act.

In the western North Atlantic, humpback whales calve and mate in the West Indies during the winter and migrate to northern feeding areas during the summer months. They occur along the entire U.S. east coast and north and east across Greenland, Iceland and the Norwegian Sea (Christensen et al. 1992, Palsbøll et al. 1997). Although not clearly delineated, matrilineally determined stock separation between feeding grounds is evident, with a northern boundary for the Gulf of Maine stock somewhere along the Scotian Shelf (Hayes et al. 2019)

Since the early 1990s, humpbacks, particularly juveniles, have been observed stranded dead with increasing frequency in the Mid Atlantic (Swingle et al. 1993, Wiley et al. 1995) and have been sighted in wintertime survey in the Southeast and Mid-Atlantic (Hayes et al. 2019). In the Gulf of Maine, sightings are most frequent from mid-March through November, with a peak in May and August, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffreys Ledge (CETAP 1982). Small numbers of individuals may be present in New England waters year-round, including the waters of Stellwagen Bank (Clapham 1993). Distribution in these waters appears to be correlated with prey species, including herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes as well as euphausiids (Paquet et al. 1997). More recent surveys conducted in recent years, summarized in the 2019 Stock Assessment Report (Hayes et al. 2019) confirm similar seasonal humpback distribution trends.

Current data suggest that the Gulf of Maine humpback whale stock is increasing (Hayes et al. 2019). The most recent population estimate calculated an abundance of 896 animals in this stock and a minimum population estimate of the same number (Hayes et al. 2019). The maximum productivity rate is 0.065 and the "recovery" factor is assumed to be 0.50, the default for stocks of unknown status, because the listing for the distinct population segment was removed in 2016. Thus, the PBR level for the Gulf of Maine humpback whale stock is 14.6 whales per year (Hayes et al. 2019).

The primary known sources of anthropogenic mortality and injury of humpback whales are commercial fishing gear entanglements and ship strikes. Robbins et al. (2009) found that 64.9% of the North Atlantic population had entanglement scarring in 2003, encountering new scarring at an annual rate of 12.1 percent. From 2010 to 2018, thirty-four percent of all observed serious injury and mortalities were attributed to entanglements from interactions with trap/pot, monofilament line, netting, and unidentified gear (see Chapter 2). From 2012 through 2016, human-caused mortality averaged 9.8 animals per year (under the PBR level), with 7.1 incidental fishery interactions and 2.7 vessel collisions (Henry et al. 2019). An unusual mortality event was declared in 2016 after a spike in strandings along the East coast of the U.S. and fifty percent of the cases where cause of death was examined had evidence of ship strike or entanglement.

Humpback whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources attributable to commercial fishing, coastal development, vessel traffic, and other influences. Changes in humpback distribution in the Gulf of Maine have been found to be associated with changes in herring, mackerel, and sand lance abundance associated with local fishing pressures (Payne et al. 1986). Likewise, there are strong indications that a mass mortality of humpback whales in the southern Gulf of Maine in 1987/1988 was the result of the consumption of mackerel whose livers contained high levels of a red-tide toxin (Geraci et al. 1989).

Fin Whale

The fin whale is found in all major oceans and was composed of three subspecies until recently: *Balaenoptera physalus physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere. New genetic data suggest that fin whales in the North Atlantic and North Pacific oceans represent two different subspecies (Archer et al. 2019). The International Whaling Commission defines a single stock of the North Atlantic fin whale off the eastern coast of the U.S., north to Nova Scotia, and east to the southeastern coast of Newfoundland (Donovan 1991). Fin whales are common in the waters of the U.S.

Exclusive Economic Zone principally from Cape Hatteras northward (Hayes et al. 2019).

The fin whale was originally listed as endangered on December 2, 1970 because of commercial whaling. Of the three to seven stocks thought to occur in the North Atlantic Ocean (approximately 50,000 individuals), one occurs in U.S. waters, where National Marine Fisheries Service' best estimate of abundance is 1,618 individuals but this may be an underrepresentation as the entire range of the stock was not surveyed (Hayes et al. 2019, Palka 2012). The species' overall large population size may provide some resilience to current threats, but trends are largely unknown. The minimum population size of the North Atlantic fin whale stock is 1,234, and the maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor is assumed to be 0.10 because the fin whale is listed as endangered under the ESA. Thus, PBR for the western North Atlantic fin whale is 2.5 (Hayes et al. 2019).

Like right whales and humpback whales, documented sources of anthropogenic mortality of fin whales include entanglement in commercial fishing gear and ship strikes. Additional threats include reduced prey availability and sound. Experts believe that fin whales are struck by large vessels more frequently than any other cetaceans (Laist et al. 2001). Twenty-two percent of all observed serious injury and mortalities were attributed to entanglements between 2010 and 2018, with most interactions occurring with trap/pot and unidentified gear (see Chapter 2). The minimum annual rate of anthropogenic mortality and serious injury to fin whales, between 2012 and 2016, was 2.5 per year (at PBR), 1.1 of those from fishing entanglement (unknown but first reported in U.S. waters) and 1.4 per year from ship strikes (Hayes et al. 2019, Henry et al. 2019).

Minke Whale

The minke whale (*Balaenoptera acutorostrata*) is not listed as endangered or threatened under the ESA but is protected under the Marine Mammal Protection Act. Minke whales off the eastern coast of the United States are considered to be part of the Canadian east coast population, which inhabits the area from the eastern half of Davis Strait south to the Gulf of Mexico. Spring and summer are times of relatively widespread and common occurrence on the continental shelf and when minke whales are most abundant in New England waters. There are fewer minke whales in New England waters in fall and they are largely absent by winter (Hayes et al. 2019, Waring et al., 2012). There is evidence of high acoustic occurrence during September through April in deep-ocean waters in the Western North Atlantic (Risch 2013, Risch et al. 2014).Records hint at a possible winter distribution in the West Indies and in mid-ocean southeast of Bermuda (Mitchell 1991); this suggestion has been confirmed by research conducted by Clark and Gagnon (2002) and Rish et al. (2014).

Data are insufficient for determining a population trend for this species. A summer survey in 2011 estimated 2,591 (CV=0.81) minke whales (Palka 2012) and the minimum population size is calculated at 1,425 (Hayes et al. 2019). This estimate does not account for those animals in Canadian waters but previous estimates in this area are too old to be considered reliable estimates. The maximum productivity rate is 0.04, the default value for cetaceans and the recovery factor is assumed to be 0.5 because the stock is of unknown status. Thus, PBR for this stock of minke whales is 14 (Hayes et al. 2019).

Minke whales have been entangled in a variety of fishing gear, including unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. Between 2010 and 2018, twenty-eight percent of all observed serious injury and mortalities were attributed to entanglements, most of which resulted from interactions with trap/pot, netting, and unidentified gear (see Chapter 2). An unusual mortality event was declared in 2017 following an uptick in strandings along the East coast of the U.S. Though the specific cause of the high mortality has not been determined, several stranded whales have shown evidence of human interaction. From 2012 to 2016, the average annual human-caused mortality and serious injury was 7.9 minke whales per year (below PBR), including 7.1 from U.S. and Canadian fisheries using stranding and entanglement data (1.9 U.S./2.55 Canada/Canada/2.65 unassigned) and 0.8 from ship strikes (0.6 U.S./0.2 Canada; Henry et al. 2019).

4.1.2 Other Protected Species

4.1.2.1 Marine Mammals

Blue Whale

Blue whales (*Balaenoptera musculus*) occur worldwide and are believed to follow a migration pattern from northern summering grounds to more southern wintering areas (Perry et al., 1999). Three subspecies have been identified: *B. m. musculus*, *B.m. intermedia*, and *B.m. brevicauda* (Reeves et al. 1998). Only *B.m. musculus* occurs in the northern hemisphere. Blue whales range in the North Atlantic from the subtropics to Baffin Bay and the Greenland Sea and are considered to be part of one stock (Perry et al. 1999).

Blue whales are occasional visitors to east coast U.S. waters. They are more commonly found in Canadian waters, particularly the Gulf of St. Lawrence, where they are present for most of the year, and in other areas of the North Atlantic. It is assumed that blue whale distribution is governed largely by food requirements (Reeves et al. 1998). In the Gulf of St. Lawrence, blue whales seem to feed on a variety of copepod species (Reeves et al. 1998). The best minimum population estimate available for the Northeast Atlantic is 440 blue whales, as identified via photo-identification (Ramp and Sears 2013) and PBR is estimated at 0.9 (Waring et al. 2010).

Threats for North Atlantic blue whales are unclear, but may include ship strikes, pollution, entanglement in fishing gear, and long-term changes in climate (which could affect the abundance of their zooplankton prey (Waring et al. 2010). Ice entrapment is known to kill and seriously injure some blue whales during late winter and early spring, particularly along the southwest coast of Newfoundland (Sears and Calambokidis 2002). Acoustic and chemical habitat degradation may be stressors for blue whales in the Gulf of St. Lawrence. However, there are no data to confirm that blue whales have been affected by such habitat changes (Perry et al. 1999). In 1987, concurrent with an unusual influx of blue whales into the Gulf of Maine, one report was received from a whale watch boat that spotted a blue whale in the southern Gulf of Maine entangled in gear described as probable lobster pot gear. A second animal found in the Gulf of St. Lawrence apparently died from the effects of an entanglement. In March 1998, a juvenile male blue whale was carried into Rhode Island waters on the bow of a tanker. The cause of death was determined to be due to a ship strike that may have occurred outside the U.S. Exclusive

Economic Zone (Waring et al. 2010).

Sei Whale

Sei whales are distributed worldwide, occurring in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere. The range of sei whales (*Balaenoptera borealis*) extends from subpolar to subtropical and even tropical marine waters but is most commonly found in temperate areas (Perry et al. 1999). Two genetically distinct sub-species of sei whale are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere (Baker and Clapham 2004, Huijser et al. 2018). Based on past whaling operations, the International Whaling Commission recognized three stocks in the North Atlantic: (1) Nova Scotia; (2) Iceland-Denmark Strait; and (3) Northeast Atlantic (Donovan 1991). Mitchell and Chapman (1977) suggested that the sei whale population in the western North Atlantic consists of two stocks, a Nova Scotian Shelf stock and a Labrador Sea stock. The Nova Scotian Shelf stock is the only sei whale stock within Atlantic Large Whale Take Reduction Plan boundaries and range from the U.S. east coast to Cape Breton, Nova Scotia and east to 42°00'W longitude (Hayes et al. 2019).

The sei whale was originally listed as endangered on December 2, 1970 as a result of past commercial whaling. The Nova Scotia stock in the North Atlantic is estimated at 357 individuals with a minimum population size of 236 individuals (Hayes et al. 2019). Population growth rates for sei whales are not available at this time as there are little to no systematic survey efforts to study sei whales.

Current threats include vessel strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and anthropogenic sound. Between 2010 and 2018 fourteen serious injuries and mortalities were observed: 6 with unknown causes, 5 vessel strikes (all confirmed US), two entanglements, and one non-human caused mortality. Based on Henry et al. (2019), the average annual rate of confirmed human-caused mortality and serious injury to sei whales, between 2012 and 2016, is 0.8 incidents per year, all of which were vessel collisions. Possible causes of natural mortality, particularly for compromised individuals, are shark attacks, killer whale attacks, and endoparasitic helminthes (Perry et al. 1999).

Sperm Whale

Sperm whales (*Physeter macrocephalus*) inhabit all ocean basins, from the equator to the polar regions (Perry et al. 1999). In the western North Atlantic they range from Greenland to the Gulf of Mexico and the Caribbean. The International Whaling Commission recognizes one stock for the entire North Atlantic (Waring et al. 2002). The sperm whales that occur in the western North Atlantic are believed to represent only a portion of the total stock (Blaylock et al. 1995).Waring et al. (2015) suggests sperm whale distribution shifts north in spring to the central mid- Atlantic bight and southern end of George's Bank and into the Northern end of Georges Bank, the continental shelf, and the Northeast Channel in summer. Sperm whale presence on the continental shelf south of New England is highest in the fall (Waring et al. 2015).

Total numbers of sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. The most recent abundance estimate for sperm whales is the sum of 2011 U.S. Atlantic surveys: 2,288 (CV=0.28) (Waring et al. 2015). However, this is likely an underestimate given the data were not corrected for dive-time, which can be long for sperm whales.

Few instances of injury or mortality of sperm whales due to human impacts have been recorded in U.S. waters. Recently, there were 14 sperm whale strandings counted between 2008 and 2014. Human interaction was confirmed in four of the cases, only one that was found in US waters (with no confirmed country of origin) and the other three were related to Canadian pelagic longline or trap/pot fisheries. Between 2008 and 2012 average annual serious injury and mortality to sperm whales was at 0.8 whales per year, all of which were attributed to fishery interactions (Waring et al. 2015). This is well below the PBR level for sperm whales (i.e., PBR level= 3.6; Waring et al. 2015) Ships can also strike sperm whales, but the offshore distribution of this species reduces the likelihood of interactions (both ship strikes and entanglements) being reported compared to those involving right, humpback, and fin whales, which are more often found in nearshore areas.

Another potential human-caused source of mortality for sperm whales may be the exposure to contaminants, such as polychlorinated biphenyls (PCBs), chlorinated pesticides, polycyclic aromatic hydrocarbons, and heavy metals. Though not conclusive, tissue samples from 21 sperm whales that mass stranded in the North Sea in 1994/95 showed cadmium levels twice as high as those found in North Pacific sperm whales and possibly affected the stranded animals' health and behavior (Holsbeek et al. 1999). Sperm whales in the North Atlantic also have higher levels of DDT and PCBs than baleen whales (Borrell 1993).

4.1.2.2 Sea Turtles

Loggerhead and leatherback sea turtles spend all or part of the year in the waters potentially affected by new Atlantic Large Whale Take Reduction Plan regulations and have interacted with trap/pot fisheries. Sea turtles continue to be affected by many of the original threats that prompted their ESA listing, including interactions with fishing gear, degradation of nesting beach sites, poaching, nesting predation, vessel strikes, channel dredging, and marine pollution (including ingestion of marine debris) (Lutcavage et al. 1997).

Loggerhead Sea Turtle

Loggerhead turtles (*Caretta caretta*) are circumglobal and are found in temperate and tropical regions of the Pacific, Indian, and Atlantic Oceans. The species was first listed as threatened under the ESA in 1978 (43 FR 32800). On September 22, 2011, the National Marine Fisheries Service designated nine distinct population segments (DPSs) of loggerhead turtles, with the Northwest Atlantic Ocean DPSs listed as threatened. The Northwest Atlantic Ocean DPS of loggerhead turtles are found along eastern North America, Central America, and northern South America.In the U.S. Atlantic, loggerhead sea turtles occur from Florida north to Canadian waters, though they more commonly occur from Massachusetts south. They arrive at foraging areas in the mid-Atlantic as early as mid-April and on in the Gulf of Maine in June. In fall, the trend is reversed with most turtles leaving the region's waters by the end of November.

In 2010, NMFS preliminarily estimated approximately 588,000 individuals (greater than 30 cm in size, approximate inter-quartile range of 382,000 to 817,000) from Cape Canaveral, FL to the mouth of the Gulf of St. Lawrence. When a portion of the unidentified turtles were considered loggerheads, the number increased to 801,000 (inter-quartile range of approximately 521,000–1,111,000) (NMFS 2011).

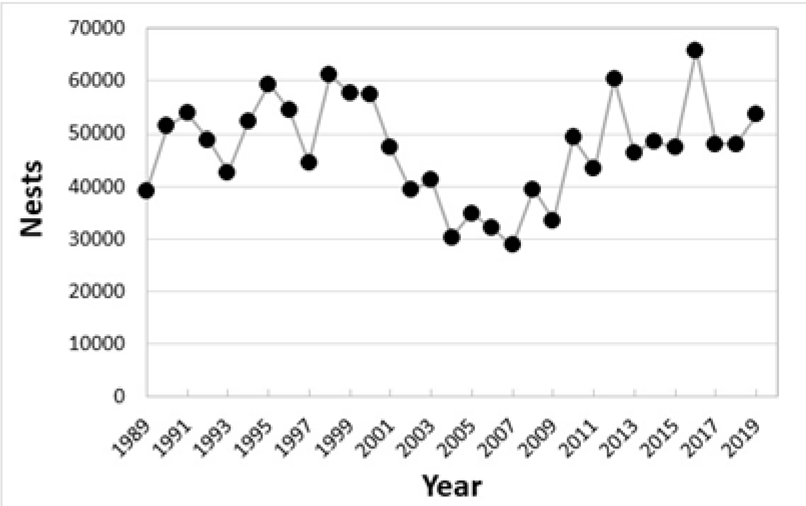

Figure 4.1: Annual nest counts for loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2018. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

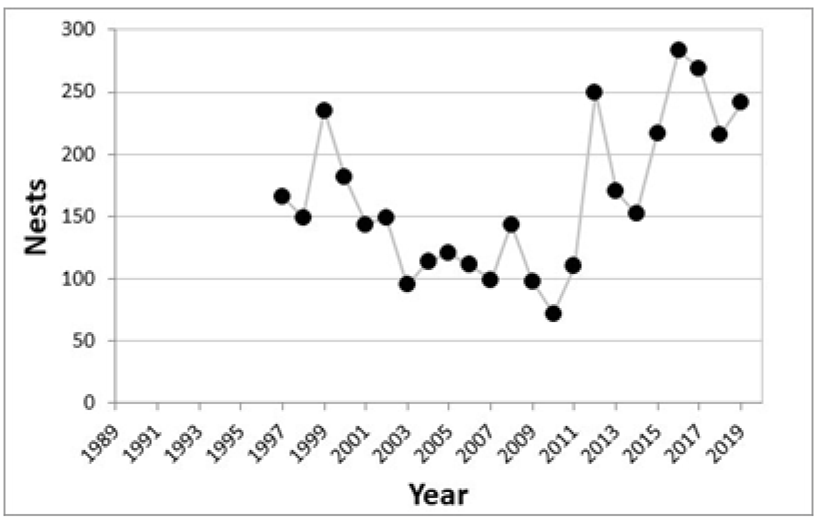

Figure 4.2: Annual nest counts on index beaches in the Florida Panhandle, 1989-2019. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. Ceriani and Meylan (2017) reported a 5-year average (2009- 2013) of more than 83,717 nests per year in the southeast United States and Mexico (excluding Cancun, Quintana Roo, Mexico). Based on genetic information, the Northwest Atlantic Ocean DPS of loggerhead turtles is further categorized into five recovery units (Conant et al. 2009). The annual nest counts on Florida's index beaches fluctuate widely, and we do not fully understand what drives these fluctuations. In assessing the population, Ceriani and Meylan (2017) looked at trends by recovery unit. While overall the Northwest Atlantic loggerhead population trend has been positive (+2%), (Ceriani and Meylan 2017) trends by recovery unit were variable (Ceriani and Meylan 2017, Bolten et al. 2019) and several recovery criteria delineated in the 2008 recovery plan have not yet been met (Bolten et al. 2019). At core index beaches in Florida, nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (Figure 4.1). In 2019, more than 53,000 nests were documented. There have been three intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2019) https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/. Nest counts at Florida Panhandle index beaches, which are not part of the set of core beaches, has an upward trend since 2010 (Figure 4.2). The DPS is stable over the long-term, although the shorter-term trend is increasing.

Significant threats to loggerhead populations in the Atlantic include commercial fisheries, coastal development, erosion of nesting beaches, pollution (including ingestion of marine debris), marine habitat degradation, and vessel strikes. Loggerhead turtles interact with a variety of fishing gear, including pots, gillnets, pelagic longlines, trawls, pound nets, and scallop dredges (NMFS and USFWS 2008). Stranding reports indicate that from 2008-2011, an average of approximately 1,100 loggerhead turtles stranded annually along the Eastern U.S. coast from a variety of causes, most of which are unknown (NMFS STSSN database).

Leatherback Sea Turtle

The leatherback turtle (*Dermochelys coriacea*) is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. Leatherback sea turtles are found worldwide from tropical to sub-polar latitudes. In the northwestern Atlantic, the leatherback turtle's range extends throughout the North Atlantic Ocean from Canada south, including the Caribbean Sea and Gulf of Mexico. Leatherbacks occur in the Gulf of Maine from June to November and in mid-Atlantic waters south of Massachusetts from May through November. By late fall, they have migrated out of the region.

In the North Atlantic, previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari et al. 2013). However, more recent analyses indicate that the overall regional, abundance-weighted trends are negative (The Northwest Atlantic Leatherback Working Group 2018, 2019). The Northwest Atlantic Working Group formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the NW Atlantic Ocean subpopulation estimated 20,000 mature individuals in 2019 and pproximately 23,000 nests per year (estimate to 2017) (The Northwest Atlantic Leatherback Working Group 2019). Leatherback nesting in the Northwest Atlantic showed an overall negative trend through 2017, with the most notable decrease occurring during the most recent period of 2008-2017 (The Northwest Atlantic Leatherback Working Group 2018).

Table 4.3: Leatherback entanglements by gear type and permit between 2009 and 2018.

	State	Federal	Recreational	Unknown	Total
Lobster	52.5	11	4	18	**85.5**
Fish	10.5	3	-	5	**18.5**
Crab	5	-	-	-	**5**
Conch	17	-	-	-	**17**
Unknown	1	1	-	-	**126**
Total	**86**	**15**	**4**	**147**	**252**

Threats to leatherback turtles on nesting beaches include harvest of nesting females and eggs, loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. As with the other sea turtle species, mortality due to fisheries interactions (including trawl, gillnet, pelagic longline, and trap/pot gear) accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Other marine threats include pollution (including ingesting marine debris), habitat destruction, and vessel strikes. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Furthermore, climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise). The species' resilience to additional perturbation is low. Of the 252 leatherback entanglements from 2009-2018, lobster, fish, crab, and conch were identified as gears involved (Table 4.3).

4.1.3 Species and Critical Habitat Not Likely to be Impacted

This action is not likely to impact dwarf sperm whales, pygmy sperm whales, pilot whales, beaked whales, Brydes whales, Risso's dolphins, Western North Atlantic coastal bottlenose dolphins, offshore bottlenose dolphins, Atlantic white-sided dolphins, common dolphins, harbor porpoise, Atlantic spotted dolphins, striped dolphins, hawksbill sea turtles, Kemp's ridley sea turtles, olive ridley sea turtles, green sea turtles, shortnose sturgeon, Atlantic sturgeon, Atlantic salmon, harbor seals, gray seals, harp seals, hooded seals, oceanic white tip sharks, or manta rays. This was determined based on the low entanglement threat of these species in trap/pot gear in the action area. The proposed actions are also not likely to impact critical habitat for North Atlantic right whale, the Northwest Atlantic distinct population segment of Loggerhead Sea Turtle, or salmon critical habitat because they are unlikely to significantly alter the physical or biological characteristics that support these species within these habitats.

4.2 Habitat

Modification of the Atlantic Large Whale Take Reduction Plan may affect essential fish habitat. Under the Magnuson-Stevens Act (MSA) (16 U.S.C. 1801), essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 U.S.C. 1802(10)). To help guide regional Fisheries Management Councils (Councils) in the implementation of essential fish habitat provisions, regulations developed by the National Marine Fisheries Service encourage Councils to identify Habitat Areas of Particular Concern (50 CFR 600 Subpart J; 62 FR 66531; 67 FR 2343). Habitat Areas of Particular Concern are subsets of essential fish habitat which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated Habitat Areas of Particular Concern are not afforded any additional regulatory protection under the Magnuson-Stevens Act. However, federal projects with potential adverse impacts to Habitat Areas of Particular Concern must be more carefully scrutinized.

This section has three basic objectives:

- First, it defines the essential fish habitat and Habitat Areas of Particular Concern associated with the Atlantic trap/pot fisheries regulated by the Atlantic Large Whale Take Reduction Plan.

- Second, it describes key components of lobster habitat in detail.

- Finally, it discusses how the Atlantic Large Whale Take Reduction Plan can influence habitat, with a particular focus on potential disturbances to benthic habitat.

4.2.1 Identification of Essential Fish Habitat

The 1996 re-authorization of the Magnuson-Stevens Act requires that the National Marine Fisheries Service and the regional Fisheries Management Councils (Councils) specifically describe and identify essential fish habitat. In addition, the Magnuson-Stevens Act requires that fisheries management plans minimize, to the extent practicable, adverse effects on essential fish habitat caused by fishing activities. According to the essential fish habitat regulations found at 50 CFR 600, information necessary to identify essential fish habitat for each managed species includes its geographic range and habitat requirements by life stage, the distribution and characteristics of those habitats, and current and historic stock size as it affects occurrence in available habitats (50 CFR 600.815(a)(1)(ii)(A)). Information on the temporal and spatial distribution of each life history stage is needed to understand each species' relationship to, or dependence on, its various habitats.

Atlantic trap/pot fisheries are geographically widespread on the Atlantic coast and target a diverse array of fish and shellfish species. In the context of this Environmental Impact Statement, essential fish habitat includes the habitat for all non-target species during relevant life history stages that take place within the proposed area (Table 4.4). When viewed in the aggregate, across all species, essential fish habitat is all benthic habitat in the Atlantic Exclusive Economic Zone. It is important to note that corals are currently not listed as essential fish habitat in the Northeast Region Trap/Pot Management Area (Northeast Region). However, they have been included as a component of essential fish habitat for managed species in the region that rely on complex hard bottom habitats where corals and other types of structure-forming organisms are found.

Table 4.4: A list of essential fish habitat for different species and life history stages that are within the proposed area.

Species	Life Stage	Depth (meters)	Habitat Type and Description
Acadian redfish	Juveniles	50-200 in Gulf of Maine, to 600 on slope	Sub-tidal coastal and offshore rocky reef substrates with associated structure-forming epifauna (e.g., sponges, corals), and soft sediments with cerianthid anemones
Acadian redfish	Adults	140-300 in Gulf of Maine, to 600 on slope	Offshore benthic habitats on finer grained sediments and on variable deposits of gravel, silt, clay, and boulders
American plaice	Juveniles	40-180	Sub-tidal benthic habitats on mud and sand, also found on gravel and sandy substrates bordering bedrock
American plaice	Adults	40-300	Sub-tidal benthic habitats on mud and sand, also gravel and sandy substrates bordering bedrock
Atlantic cod	Juveniles	Mean high water-120	Structurally-complex intertidal and sub-tidal habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna
Atlantic cod	Adults	30-160	Structurally complex sub-tidal hard bottom habitats with gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae, also sandy substrates and along deeper slopes of ledges
Atlantic halibut	Juveniles & Adults	60-140 and 400-700 on slope	Benthic habitats on sand, gravel, or clay substrates
Atlantic herring	Eggs	May-90	Sub-tidal benthic habitats on coarse sand, pebbles, cobbles, and boulders and/or macroalgae
Atlantic sea scallop	Eggs	18-110	Inshore and offshore benthic habitats (see adults)
Atlantic sea scallop	Larvae	No information	Inshore and offshore pelagic and benthic habitats: pelagic larvae (“spat”), settle on variety of hard surfaces, including shells, pebbles, and gravel and to macroalgae and other benthic organisms such as hydroids
Atlantic sea scallop	Juveniles	18-110	Benthic habitats initially attached to shells, gravel, and small rocks (pebble, cobble), later free-swimming juveniles found in same habitats as adults
Atlantic sea scallop	Adults	18-110	Benthic habitats with sand and gravel substrates
Atlantic surfclams	Juveniles and adults	Surf zone to about 61, abundance low >38	In substrate to depth of 3 ft
Atlantic wolffish	Eggs	<100	Sub-tidal benthic habitats under rocks and boulders in nests
Atlantic wolffish	Juveniles	70-184	Sub-tidal benthic habitats
Atlantic wolffish	Adults	<173	A wide variety of sub-tidal sand and gravel substrates once they leave rocky spawning habitats, but not on muddy bottom
Barndoor skate	Juveniles and adults	40-400 on shelf and to 750 on slope	Sub-tidal benthic habitats on mud, sand, and gravel substrates
Black sea bass	Juveniles and adults	Inshore in summer and spring	Benthic habitats with rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas, also offshore clam beds and shell patches in winter

Species	Life Stage	Depth (meters)	Habitat Type and Description
Clearnose skate	Juveniles	0-30	Sub-tidal benthic habitats on mud and sand, but also on gravelly and rocky bottom
Clearnose skate	Adults	0-40	Sub-tidal benthic habitats on mud and sand, but also on gravelly and rocky bottom
Deep-sea red crab	Eggs	320-640	Benthic habitats attached to female crabs
Deep-sea red crab	Juveniles	320-1300 on slope and to 2000 on seamounts	Benthic habitats with unconsolidated and consolidated silt-clay sediments
Deep-sea red crab	Adults	320-900 on slope and up to 2000 on seamounts	Benthic habitats with unconsolidated and consolidated silt-clay sediments
Golden tilefish	Juveniles and adults	100-300	Burrows in semi-lithified clay substrate, may also utilize rocks, boulders, scour depressions beneath boulders, and exposed rock ledges as shelter
Haddock	Juveniles	40-140 and as shallow as 20 in coastal Gulf of Maine	Sub-tidal benthic habitats on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel
Haddock	Adults	50-160	Sub-tidal benthic habitats on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel and adjacent to boulders and cobbles along the margins of rocky reefs
Little skate	Juveniles	Mean high water-80	Intertidal and sub-tidal benthic habitats on sand and gravel, also found on mud
Little skate	Adults	Mean high water-100	Intertidal and sub-tidal benthic habitats on sand and gravel, also found on mud
Monkfish	Juveniles	50-400 in the Mid-Atlantic, 20-400 in the Gulf of Maine, and to 1000 on the slope	Sub-tidal benthic habitats on a variety of habitats, including hard sand, pebbles, gravel, broken shells, and soft mud, also seek shelter among rocks with attached algae
Monkfish	Adults	50-400 in the Mid-Atlantic, 20-400 in the Gulf of Maine, and to 1000 on the slope	Sub-tidal benthic habitats on hard sand, pebbles, gravel, broken shells, and soft mud, but seem to prefer soft sediments, and, like juveniles, utilize the edges of rocky areas for feeding
Ocean pout	Eggs	<100	Sub-tidal hard bottom habitats in sheltered nests, holes, or rocky crevices
Ocean pout	Juveniles	Mean high water-120	Intertidal and sub-tidal benthic habitats on a wide variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel
Ocean pout	Adults	20-140	Sub-tidal benthic habitats on mud and sand, particularly in association with structure forming habitat types; i.e. shells, gravel, or boulders
Ocean quahogs	Juveniles and adults	9-244	In substrate to depth of 3 ft
Offshore hake	Juveniles	160-750	Pelagic and benthic habitats
Offshore hake	Adults	200-750	Pelagic and benthic habitats
Pollock	Juveniles	Mean high water-180 in Gulf of Maine, Long Island Sound, and Narragansett Bay; 40-180 on Georges Bank	Intertidal and sub-tidal pelagic and benthic rocky bottom habitats with attached macroalgae, small juveniles in eelgrass beds, older juveniles move into deeper water habitats also occupied by adults

Species	Life Stage	Depth (meters)	Habitat Type and Description
Pollock	Adults	80-300 in Gulf of Maine and on Georges Bank; <80 in Long Island Sound, Cape Cod Bay, and Narragansett Bay	Pelagic and benthic habitats on the tops and edges of offshore banks and shoals with mixed rocky substrates, often with attached macro algae
Red hake	Juveniles	Mean high water-80	Intertidal and sub-tidal soft bottom habitats, esp those that that provide shelter, such as depressions in muddy substrates, eelgrass, macroalgae, shells, anemone and polychaete tubes, on artificial reefs, and in live bivalves (e.g., scallops)
Red hake	Adults	50-750 on shelf and slope, as shallow as 20 inshore	Sub-tidal benthic habitats in shell beds, on soft sediments (usually in depressions), also found on gravel and hard bottom and artificial reefs
Rosette skate	Juveniles and adults	80-400	Benthic habitats with mud and sand substrates
Scup	Juveniles	No information	Benthic habitats, in association with inshore sand and mud substrates, mussel and eelgrass beds
Scup	Adults	No information, generally overwinter offshore	Benthic habitats
Silver hake	Juveniles	40-400 in Gulf of Maine, >10 in Mid-Atlantic	Pelagic and sandy sub-tidal benthic habitats in association with sand-waves, flat sand with amphipod tubes, shells, and in biogenic depressions
Silver hake	Adults	>35 in Gulf of Maine, 70-400 on Georges Bank and in the Mid-Atlantic	Pelagic and sandy sub-tidal benthic habitats, often in bottom depressions or in association with sand waves and shell fragments, also in mud habitats bordering deep boulder reefs, on over deep boulder reefs in the southwest Gulf of Maine
Smooth skate	Juveniles	100-400 offshore Gulf of Maine, <100 inshore Gulf of Maine, to 900 on slope	Benthic habitats, mostly on soft mud in deeper areas, but also on sand, broken shells, gravel, and pebbles on offshore banks in the Gulf of Maine
Smooth skate	Adults	100-400 offshore Gulf of Maine, to 900 on slope	Benthic habitats, mostly on soft mud in deeper areas, but also on sand, broken shells, gravel, and pebbles on offshore banks in the Gulf of Maine
Summer flounder	Juveniles	To maximum 152	Benthic habitats, including inshore estuaries, salt marsh creeks, seagrass beds, mudflats, and open bay areas
Summer flounder	Adults	To maximum 152 in colder months	Benthic habitats
Spiny dogfish	Juveniles	Deep water	Pelagic and epibenthic habitats
Spiny dogfish	Female sub-adults	Wide depth range	Pelagic and epibenthic habitats
Spiny dogfish	Male sub-adults	Wide depth range	Pelagic and epibenthic habitats
Spiny dogfish	Female adults	Wide depth range	Pelagic and epibenthic habitats
Spiny dogfish	Male adults	Wide depth range	Pelagic and epibenthic habitats
Thorny skate	Juveniles	35-400 offshore Gulf of Maine, <35 inshore Gulf of Maine, to 900 om slope	Benthic habitats on a wide variety of bottom types, including sand, gravel, broken shells, pebbles, and soft mud

Species	Life Stage	Depth (meters)	Habitat Type and Description
Thorny skate	Adults	35-400 offshore Gulf of Maine, <35 inshore Gulf of Maine, to 900 om slope	Benthic habitats on a wide variety of bottom types, including sand, gravel, broken shells, pebbles, and soft mud
White hake	Juveniles	Mean high water - 300	Intertidal and sub-tidal estuarine and marine habitats on fine-grained, sandy substrates in eelgrass, macroalgae, and un-vegetated habitats
White hake	Adults	100-400 offshore Gulf of Maine, >25 inshore Gulf of Maine, to 900 on slope	Sub-tidal benthic habitats on fine-grained, muddy substrates and in mixed soft and rocky habitats
Windowpane flounder	Juveniles	Mean high water - 60	Intertidal and sub-tidal benthic habitats on mud and sand substrates
Windowpane flounder	Adults	Mean high water - 70	Intertidal and sub-tidal benthic habitats on mud and sand substrates
Winter flounder	Eggs	0-5 south of Cape Cod, 0-70 Gulf of Maine and Georges Bank	Sub-tidal estuarine and coastal benthic habitats on mud, muddy sand, sand, gravel, submerged aquatic vegetation, and macroalgae
Winter flounder	Juveniles	Mean high water - 60	Intertidal and sub-tidal benthic habitats on a variety of bottom types, such as mud, sand, rocky substrates with attached macro algae, tidal wetlands, and eelgrass; young-of-the-year juveniles on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks
Winter flounder	Adults	Mean high water - 70	Intertidal and sub-tidal benthic habitats on muddy and sandy substrates, and on hard bottom on offshore banks; for spawning adults, also see eggs
Winter skate	Juveniles	0-90	Sub-tidal benthic habitats on sand and gravel substrates, are also found on mud
Winter skate	Adults	0-80	Sub-tidal benthic habitats on sand and gravel substrates, are also found on mud
Witch flounder	Juveniles	50-400 and to 1500 on slope	Sub-tidal benthic habitats with mud and muddy sand substrates
Witch flounder	Adults	35-400 and to 1500 on slope	Sub-tidal benthic habitats with mud and muddy sand substrates
Yellowtail flounder	Juveniles	20-80	Sub-tidal benthic habitats on sand and muddy sand
Yellowtail flounder	Adults	25-90	Sub-tidal benthic habitats on sand and sand with mud, shell hash, gravel, and rocks

4.2.2 Identification of Habitat Areas of Particular Concern

The essential fish habitat regulations developed by the National Marine Fisheries Service encourage regional Fisheries Management Councils to identify Habitat Areas of Particular Concern (HAPCs) and essential fish habitat areas (EFHAs) within areas designated as essential fish habitat (Figure 4.3). In New England, these HAPCs were created for juvenile cod and multi-species Fishery Management Plans (FMPs) and EFHAs for monkfish and multispecies FMPs. A few mid-Atlantic HAPCs for golden tilefish and EFHAs for tilefish, mackerel, squid, and butterfish FMPs overlap with the proposed area as well. The intent of this action is to help focus conservation priorities on specific habitat areas that play a particularly important role in the life cycles of federally managed fish species (Dobrzynski and Johnson 2001).

Habitat Areas of Particular Concern are defined based on the following criteria:

- The importance of the ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether and to what extent development activities are or will be stressing the habitat
- The rarity of the habitat type

The designation of Habitat Areas of Particular Concern has been approached in various ways according to the discretion of the different Councils. The following sections summarize the Habitat Areas of Particular Concern designated by the Councils for essential fish habitat in the geographic area that could be affected by this action. Several of these HAPCs are also EFH areas closed to mobile, bottom-tending gear (trawls and dredges).

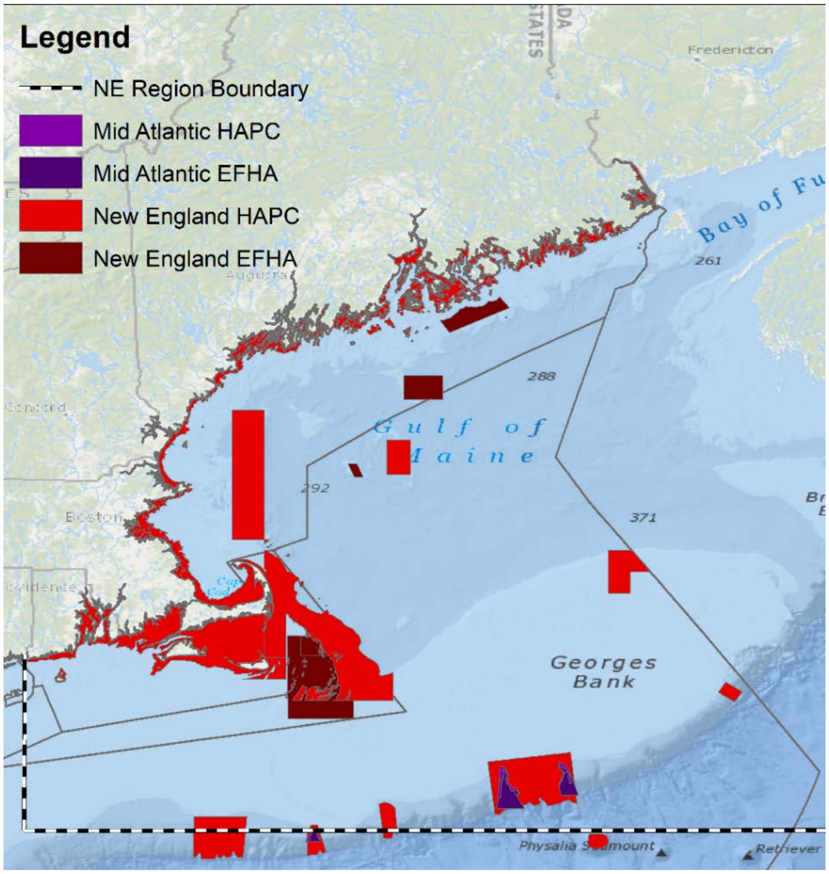

Figure 4.3: The Habitat Areas of Particular Concern (HAPC) and essential fish habitat currently protected from fishing (EFHA) within the proposed area, including those overseen by the Mid-Atlantic and New England Fishery Management Councils.

4.2.2.1 New England Fishery Management Council

The New England Fishery Management Council previously designated discrete geographic areas as Habitat Areas of Particular Concern for two of its managed species (NEFMC 1998): Atlantic cod and Atlantic salmon. In 2018, the National Marine Fisheries Service approved the New England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2, which revised essential fish habitat and Habitat Areas of Particular Concern in the region.

Atlantic Cod

For juvenile Atlantic cod, the New England Fishery Management Council has designated a gravel/cobble bottom area on the northern edge of Georges Bank as Habitat Areas of Particular Concern. This area meets the first criterion for Habitat Areas of Particular Concern of providing an important ecological function, in that the gravel/cobble substrate provides a place for newly settled juvenile cod to find shelter from predation, helping to decrease typically high mortality rates associated with the juvenile life stage. In addition, these areas are typically rich in important prey items. This habitat also meets the second Habitat Areas of Particular Concerncriterion of sensitivity to human-induced environmental degradation, in that it is vulnerable to fishing practices that use mobile fishing gear.

Atlantic Salmon

The New England Fishery Management Council has designated eleven rivers in Maine as Habitat Areas of Particular Concern for juvenile Atlantic salmon: the Dennys, Machias, East Machias, Pleasant, Narraguagus, Ducktrap, Kennebec, Penobscot. St. Croix, Tunk Stream, and Sheepscot Rivers provide habitat for the distinct population segment of Atlantic salmon. These rivers are also extremely vulnerable to anthropogenic threats, thus fulfilling the first two criteria for designation of Habitat Area of Particular Concern: provision of an important ecological function and sensitivity to human-induced environmental degradation.

Inshore Juvenile Cod

This area includes waters between 0-20 meters within the Gulf of Maine and Southern New England and recognizes inshore areas that are thought to be important for juvenile cod. This area consists of complex rocky-bottom habitat and meets the first two criteria for designation of Habitat Area of Particular Concern: provision of an important ecological function and sensitivity to human-induced environmental degradation.

Great South Channel Juvenile Cod

Important habitat for juvenile cod was identified near the Great South Channel and extends the shallow inshore juvenile cod Habitat Areas of Particular Concern with waters from 30 and 120 meters. It is characterized by structurally complex gravel, cobble, and boulder habitat and supports a highly productive benthic habitat. It also meets the first two criteria for designation of Habitat Areas of Particular Concern: provision of an important ecological function and sensitivity to human-induced environmental degradation.

Cashes Ledge

Cashes Ledge provides a unique and productive habitat characterized by rocky pinnacles. It provides areas of refuge from predators and supports several managed species. As such, it provides an important ecological function and is also sensitive to anthropogenic degradation.

Jeffreys Ledge/Stellwagen Bank

This area is shallow and has a variety of habitat types, such as gravel/cobble, boulder reefs, sand plains, and deep mud basins. It is not only known as a productive area for fishing but is also frequented by marine mammal species (CETAP 1982, Clapham 1993, Weinrich 2000). The area is sensitive to development and fishing activities and is currently closed to certain types of fishing.

Canyon/canyon complexes

Eleven canyons and canyon complexes located near Georges Bank and within the offshore of the Mid-Atlantic Bight were also designated as Habitat Areas of Particular Concern because they support a variety of species and habitats. Five of these HAPCs (Heezen, Lydonia, Gilbert, Oceanographer, and Hydrographer) occur within the geographic area included in this action.

4.2.2.2 Mid-Atlantic Fishery Management Council

The Mid-Atlantic Fishery Management Council has designated Habitat Areas of Particular Concern for summer flounder and tilefish. Habitat Areas of Particular Concern have not been designated for other species under the Mid-Atlantic Fishery Management Council's jurisdiction due to a lack of information linking habitat type with recruitment success.

Summer Flounder

Aggregations of submerged aquatic vegetation, defined as rooted, vascular, flowering plants that, except for some flowering structures, live and grow beneath the surface, have been identified as Habitat Areas of Particular Concern for summer flounder. More specifically, this designation includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations used by adults and juveniles. These Habitat Areas of Particular Concern meet the first criterion of an important ecological function, in that they provide both shelter from predators and sources of prey for the juvenile and larval stages of summer flounder (MAFMC 1998).

Tilefish

Clay outcrop habitats in four submarine canyons on the outer continental shelf at depths between 100 and 300 meters (MAFMC 2008). This habitat type is also referred to as a "pueblo village" – see Offshore Lobster Habitat, section 4.4.3.2. Five of these canyons (Lydonia, and Oceanographer) are located within the geographic range of the habitat VEC for this action

(Figure 4.3). These Habitat Areas of Particular Concern meet three of the criteria required for designation: 1) they provide shelters for tilefish, which live in burrows that they dig in the clay; 2) this habitat type is rare, occurring only in areas on the outer continental shelf like the canyons where Pleistocene clay deposits are exposed; and 3) they are highly susceptible to damage and loss from any type of disturbance, such as that caused by mobile, bottom-tending fishing gear. In addition, three of these canyons have been added to the National System of Marine Protected Areas (see Section 12.13).

4.2.3 American Lobster Habitats

The American lobster fishery accounts for the majority of affected vessels and gear regulated by the Atlantic Large Whale Take Reduction Plan. Because lobster habitat may be influenced by the proposed Atlantic Large Whale Take Reduction Plan modifications, this section examines the unique aspects of lobster habitat in greater detail.

Bottom dwelling American lobster (*Homarus americanus*) is distributed throughout the Northwest Atlantic Ocean from Newfoundland to Cape Hatteras, North Carolina. Juvenile and adult American lobsters occupy a wide variety of benthic habitats from the intertidal zone to depths of 700 meters. They are most abundant in relatively shallow coastal waters, Temperature and salinity along with other characteristics of water, as well as substrate and diet, are critical habitat components (ASMFC 2015). They feed on a variety of plants and animals according to seasonal availability, and bait in lobster traps is believed to be an important food sources in areas of intense fishing pressure ((Lawton and Lavalli 1995, Grabowski et al. 2010) cited in ASMFC 2015).

The following description of lobster habitats in the Northeast of the U.S. (Maine to North Carolina) is based primarily on a report prepared by Lincoln (1998) from a variety of primary source documents. Table 4.5 provides a summary of lobster densities by habitat type. This information has been supplemented by the addition of some more recent research results.

4.2.3.1 Inshore Lobster Habitats

Estuaries represent one key component of inshore lobster habitat, and encompass the following environments:

- **Mud Base with Burrows**: These habitats occur primarily in harbors and quiet estuaries with low currents. Lobster shelters are formed from excavations in soft substrate. This is an important habitat for juveniles and densities can be very high, reaching 20 animals per square meter.

- **Rock, Cobble and Gravel**: Juveniles and adolescents have been reported on shallow bottom with gravel and gravelly sand substrates in the Great Bay Estuary, New Hampshire; on gravel/cobble substrates in outer Penobscot Bay, Maine (Steneck and Wilson 1998); and in rocky habitats in Narragansett Bay, Rhode Island (Lawton and Lavalli 1985). Densities in Penobscot Bay exceeded 0.5 juveniles and 0.75 adolescents/m2. According to unpublished information cited by Lincoln (1998) juvenile lobsters in Great Bay prefer shallow bottoms with gravelly sand substrates.

- **Rock/Shell**: Adult lobsters in the Great Bay Estuary utilize sand and gravel habitats in the channels, but appear to prefer a rock/shell habitat more characteristic of the high temperature, low salinity regimes of the central bay.

Table 4.5: A summary of American lobster habitats and densities

Habitat Category	***Habitat Subtypes***	***Lobster Densities (per sq. meter)***	***Lobster Sizes***	***Source***
Estuaries	Mud base with burrows	Up to 20	Small juveniles	Cooper and Uzmann, 1980
		< 0.01	Adults	Cooper and Uzmann, 1980
	Rock, cobble & gravel	> 0.5	Juveniles	Steneck and Wilson, 1998
		> 0.75	Adolescents	Steneck and Wilson, 1998
	Rock/shell	N.A.		
Inshore Rock Types	Sand base with rock	3.2	Avg. 40 mm carapace length	Cooper and Uzmann, 1980
	Boulders overlaying sand	0.09-0.13		Cooper and Uzmann, 1980
	Cobbles	Up to 16		Cooper and Uzmann, 1980
	Bedrock base with rock and boulder overlay	0.1-0.3		Cooper and Uzmann, 1980
	Mud-shell/rock substrate	0.15		Cooper and Uzmann, 1980
Submarine Canyons	Canyon rim and walls	0-0.0002	Adolescents and adults	Cooper et al., 1987
	Canyon walls	Up to 0.001	Adolescents and adults	Cooper et al., 1987
	Rim and head of canyons and at base of walls	0.0005-0.126	Adolescents and adults	Cooper et al., 1987
	Pueblo villages	0.0005-0.126	Adolescents and adults	Cooper et al., 1987
Other	Peat	Up to 5.7		Barshaw and Lavalli, 1988
	Kelp beds	1.2-1.68	Adolescents	Bologna and Steneck, 1993
	Eel grass	<0.04	Juveniles and adolescents	Barshaw and Lavalli, 1988
		0.1	80% adolescents	Short et al., 2001
	Sand base with rock	N.A.		
	Clay base with burrows and depressions	Minimum 0.001		Cooper and Uzmann, 1980
	Mud-clay base with anemones	Minimum 0.001	50-80 mm carapace length in depressions	Cooper and Uzmann, 1980

Inshore rock areas make up another important category of lobster habitat. These include the following:

- **Sand Base with Rock**: This is the most common inshore rock type in depths greater than 40 meters. It consists of sandy substrate overlain by flattened rocks, cobbles, and boulders. Lobsters are associated with abundant sponges, Jonah crabs, and rock crabs.

Shelters are formed by excavating sand under a rock to form U-shaped, shallow tunnels. Densities of sub-adult lobsters are fairly high in these areas.

- **Boulders Overlaying Sand**: This habitat type is relatively rare in inshore New England waters. Compared to other inshore rocky habitats, lobster densities are low.

- **Cobbles**: Lobsters occupy shelters of varying size in the spaces between rocks, pebbles, and boulders. Densities as high as 16 lobsters/m^2 have been observed, making this the most densely populated inshore rock habitat for lobsters in New England.

- **Bedrock Base with Rock and Boulder Overlay**: This rock type is relatively common inshore, from low tide to depths of 15 to 45 meters. Shelters are formed by rock overhangs or crevices. Encrusting coralline algae and attached organisms such as anemones, sponges, and mollusks cover exposed surfaces. Green sea urchins and starfish are common. Cunner, tautog, sculpin, sea raven, and redfish are the most abundant fish. Lobster densities generally are low.

- **Mud-Shell/Rock Substrate**: This habitat type is usually found where sediment discharge is low and shells make up the majority of the bottom. It is best described off the Rhode Island coast. Lobster densities generally are low.

Other lobster habitat types are significant. For example, kelp beds represent another form of lobster habitat. Kelp beds in New England consist primarily of *Laminaria longicruris* and *L. saccharina*. Lobsters were attracted to transplanted kelp beds at a nearshore study site in the mid-coast region of Maine, reaching densities almost ten times higher than in nearby control areas (Bologna and Steneck 1993). Lobsters did not burrow into the sediment, but sought shelter beneath the kelp. Only large kelp (greater than 50 cm in length) was observed sheltering lobsters and was used in the transplant experiments.

Lobster shelters also are formed from excavations cut into peat. Reefs form from blocks of salt marsh peat that break and fall into adjacent marsh creeks and channels and appear to provide moderate protection for small lobsters from predators (Barshaw and Lavalli 1988). Densities are high (up to 5.7/m^2) in these areas.

Lobsters have been associated with eelgrass beds in the lower portion of the Great Bay Estuary in New Hampshire (Short et al. 2001). Eighty percent of the lobsters collected from eelgrass beds were adolescents. Average density was 0.1/m^2, higher than reported by Barshaw and Lavalli (1988). In mesocosm experiments, Short et al. reported that lobsters showed a clear preference for eelgrass over bare mud. This research showed that adolescent lobsters burrow in eelgrass beds, utilize eelgrass as an overwintering habitat, and prefer eelgrass to bare mud.

Finally, research in Maine has demonstrated the presence of early settlement, postlarval, and juvenile lobsters in the lower intertidal zone (Cowan 1999). Two distinct size classes were consistently present: three to 15 mm and 16 to 40 mm. Monthly mean densities during a five-year period ranged from zero to 8.6 individuals/m^2 at 0.4 meters below mean low water. Preliminary results indicate that areas of the lower intertidal zone serve as nursery grounds for juvenile lobster.

4.2.3.2 Offshore Lobster Habitats

Offshore areas supply several types of lobster habitat. First, more than 15 submarine canyons cut into the shelf edge on the south side of Georges Bank. These canyons were first surveyed in the 1930s, but were not fully explored until manned submersibles were used extensively in the 1980s. Detailed information on canyon habitats for American lobster are available primarily for Oceanographer Canyon, but this information is generally applicable to other major canyons on Georges Bank. Concentrations of adolescents and adult lobsters are substantially greater in submarine canyons than in nearby areas that are occupied mostly by adults (Cooper and Uzmann 1980, Cooper et al. 1987). These canyons present a diverse group of habitat types:

- **Canyon Rim and Walls**: Sediments consist of sand or semi-consolidated silt with less than five percent overlay of gravel. The bottom is relatively featureless. Burrowing mud anemones are common but lobster densities are low.

- **Canyon Walls**: Sediments consist of gravelly sand, sand, or semi-consolidated silt with more than five percent gravel. The bottom is relatively featureless. Burrowing mud anemones are common, as are Jonah crabs, ocean pout, starfish, rosefish, and red hake. Lobster densities are somewhat higher than in substrates that contain less gravel (see above).

- **Rim and Head of Canyons at Base of Walls**: Sand or semi-consolidated silt substrate is overlain by siltstone outcrops and talus up to boulder size. The bottom is very rough and is eroded by animals and current scouring. Lobsters are associated with rock anemones, Jonah crabs, ocean pout, tilefish, starfish, conger eels, and white hake. Densities are highly variable, but reach as high as 0.13 lobsters/m^2.

- **Pueblo Villages**: This habitat type exists in the clay canyon walls and extends from the heads of canyons to middle canyon walls. It is heavily burrowed and excavated. Slopes range from five to 70 degrees, but are generally between 20 and 50 degrees. Juvenile and adult lobsters and associated fauna create borings up to 1.5 meters in width, one meter in height, and two meters or more in depth. Lobsters are associated with Jonah crabs, tilefish, hermit crabs, ocean pout, starfish, and conger eels. This habitat may well contain the highest densities of lobsters found offshore.

In addition to canyons, lobster are associated with several other offshore habitat types, including the following:

- **Sand Base with Rocks**: Although common inshore (see above), this habitat is rather restricted in the offshore region except along the north flank of Georges Bank.

- **Clay Base with Burrows and Depressions**: This habitat is common on the outer continental shelf and slope. Lobsters excavate burrows up to 1.5 meters long. There are also large, bowl-like depressions that range in size from one to five meters in diameter and may shelter several lobsters at a time. Minimum densities of 0.001 lobsters/m^2 have been observed in summer.

- **Mud-Clay Base with Anemones**: This is a common habitat for lobsters on the outer shelf or upper slope. Forests of mud anemones (*Cerianthus borealis*) may reach densities of three or four per square meter. Depressions serve as shelter for relatively small lobsters at minimum densities of $0.001/m^2$.

- **Mud Base with Burrows**: This habitat occurs offshore mainly in the deep basins, in depths up to 250 meters. This environment is extremely common offshore. Lobsters occupy this habitat, but no density estimates are available.

4.2.4 Impact of Fishing on Essential Fish Habitat

The environmental impact analysis presented in Chapter 5 of this Draft Environmental Impact Statement includes a discussion of how the Atlantic Large Whale Take Reduction Plan (ALWTRP) may affect fishing gear and fishing practices, and subsequently influence marine habitat. Experts believe that fixed fishing gear (e.g. pots/traps) has a more direct impact on benthic habitat than on non-benthic (water column) habitat because it generally comes in contact with the sea floor. Therefore, the sections below review how fishing can affect marine habitat, with a primary focus on benthic habitat and on the potential effects of towed gear (bottom trawls and dredges) which cause more widespread disturbance to seafloor habitats than fixed gear (Stevenson et al. 2004). The potential effects examined include:

- Alteration of physical structure;
- Mortality of benthic organisms;
- Changes to the benthic community and ecosystem;
- Sediment suspension; and
- Chemical modifications.

4.2.4.1 Alteration of Physical Structure

Any type of fishing gear that is towed, dragged, or dropped on the seabed will disturb the sediment and the resident community to varying degrees. The intensity of disturbance is dependent on the type of gear, how long the gear is in contact with the bottom, sediment type, sensitivity of habitat features in contact with the gear, and frequency of disturbance. Physical effects of fishing gear, such as ploughing, smoothing of sand ripples, removal of stones, and turning of boulders, can act to reduce the heterogeneity of the sediment surface. For example, boulder piles, crevices, and sand ripples can provide fish and invertebrates hiding areas and a respite from currents and tides. Removal of taxa, such as worm tubes, corals, and gorgonians that provide relief, and the removal or shredding of submerged vegetation, can also occur, thereby reducing the number of structures available to biota as habitat.

Most studies on habitat damage due to fishing gear focus on the effects of bottom trawls and dredges. It has been noted by Rogers et al. (1998) that the reason there are few accounts of static gear (e.g. traps/pots) having measurable effects on benthic biota may be because the area of seabed affected by such gear is almost insignificant when compared to the widespread effects of mobile gear. It is possible that benthic structures (both living and non-living) could be affected as traps/pots are dropped or dragged along the bottom. Most studies investigating small numbers of trap or pots per buoy line (1-3) have found minimal, short-term impacts on physical structures (Eno et al. 2001, Chuenpagdee et al. 2003, Stephenson et al. 2017), Similarly, a panel of experts that evaluated the habitat impacts of commercial fishing gears used in the Northeast of the U.S. (Maine to North Carolina) found bottom-tending static gear (e.g. traps/pots) to have a minimal effect on benthic habitats when compared to the physical and biological impacts caused by bottom trawls and dredges (NMFS 2002). The vulnerability of benthic essential fish habitat for all managed species in the region to the impacts of pots/traps and bottom gill nets is considered to be low (NMFS 2004). However, less is known about longer trap/pot trawls and there is limited information that trawls with 20 or more pots may have impacts more similar to mobile gear, though at a smaller spatial scale (Schweitzer et al. 2018).

4.2.4.2 Mortality of Benthic Organisms

In addition to effects on physical habitat, fishing gear can cause direct mortality to emergent epifauna. In particular, erect, foliose fauna or fauna that build reef-like structures have the potential to be destroyed by towed gear, longlines, or traps/pots (Hall 1999). Physical structure of the biota sometimes determines their ability to withstand and recover from the physical impacts of fishing gear. For example, thinner shelled bi-valves and sea stars often suffer higher damage than solid shelled bi-valves (Rumohr and Krost 1991). Animals that can retract below the penetration depth of the fishing gear and those that are more elastic and can bend upon contact with the gear also fare much better than those that are hard and inflexible (Eno et al. 2001). Longer trap/pot trawls likely pose a greater threat to benthic organisms than individual trap/pots or short trap/pot trawls (Schweitzer et al. 2018).

4.2.4.3 Changes to Benthic Communities and Ecosystems

The mortality of benthic organisms as a result of interaction with fishing gear can alter the structure of the benthic community, potentially causing a shift in the community from low-productive long-lived species (k-selected species) to highly-productive, short-lived, rapidly-colonizing species (r-selected species). For example, motile species that exhibit high fecundity and rapid generation times will recover more quickly from fishery-induced disturbances than non-mobile, slow-growing organisms, which may lead to a community shift in chronically fished areas (Levin 1984).

Increased fishing pressure in a certain area may also lead to changes in species distribution. Changes (e.g., localized depletion) could be evident in benthic, demersal, and even pelagic species. Scientists have also speculated that mobile fishing may lead to increased populations of opportunistic feeders in chronically fished areas.

4.2.4.4 Sediment Suspension

Resuspension of sediment can occur as fishing gear is pulled or dragged along or immediately above the seafloor (NMFS 2002). Although resuspension of sediment is typically associated with mobile fishing gear, it also can occur with gear such as traps/pots.

Chronic suspension of sediments and resulting turbidity can affect aquatic habitat by reducing available light for photosynthesis, burying benthic biota, smothering spawning areas, and causing negative effects on feeding and metabolic rates. If it occurs over large areas, resuspension can redistribute sediments, which has implications for nutrient budgets (Mayer et al. 1991, Messieh et al. 1991, Black and Parry 1994, Pilskaln et al. 1998).

Species' reaction to turbidity depends on the particular life history characteristics of the organism. Effects are likely to be more significant in waters that are normally clear as compared to areas that typically experience high naturally induced turbidity (Kaiser 2000). Mobile organisms can move out of the affected area and quickly return once the turbidity dissipates (Coen 1995). Even if species experience high mortality within the affected area, those with high levels of recruitment or high mobility can re-populate the affected area rapidly. However, sessile or slow-moving species would likely be buried and could experience high mortality. Furthermore, if effects are protracted and occur over a large area, recovery through recruitment or immigration will be hampered. Additionally, chronic resuspension of sediments may lead to shifts in species composition by favoring those species that are better suited to recover or those that can take advantage of the additional nutrient supply as the nutrients are released from the seafloor to the euphotic zone (Churchill 1989).

4.2.4.5 Chemical Modifications

Disturbances associated with fishing gear also can cause changes in the chemical composition of the water column overlying affected sediments. In shallow water, the impacts may not be noticeable relative to the mixing effects caused by tidal surges, storm surges, and wave action. However, in deeper, calmer areas with more stable waters, the changes in chemistry may be more evident (NMFS 2002). Increases in ammonia content, decreases in oxygen, and pulses of phosphate have been observed in North Sea waters, although it is not clear how these changes affect fish populations. Increased incidence of phytoplankton blooms could occur during seasons when nutrients are typically low. The increase in primary productivity could have a positive effect on zooplankton communities and on organisms up the food chain.

Eutrophication, often considered a negative effect, could also occur. However, it is important to note that these releases of nutrients to the water act to recycle existing nutrients and, thereby, make them available to benthic organisms rather than add new nutrients to the system (ICES 1992). This recycling is thought to be less influential in the eutrophication process than the input of new nutrients from rivers and land runoff.

4.3 Human Communities

The following discussion examines the economic and social environment that would be impacted by modifications to the Atlantic Large Whale Take Reduction Plan (Plan). The human communities that may be affected are discussed, particularly communities whose social and economic fabric depends in part upon commercial fishing operations that must comply with Plan requirements. The fisheries that may be affected under modifications considered within the scope of this Environmental Impact Statement are the Northeast Region U.S. lobster and Jonah crab trap/pot fisheries. These affected fisheries include:

After describing the sources of data used, the sections below provide a baseline socio- economic characterization of these fisheries, discussing fishery management regulations, numbers of permitted vessels, landings, revenue, and key ports. The final section references the communities potentially affected by modifications to the Plan.

4.3.1 Data Sources

The analyses presented in this section are based primarily on data collected and maintained by NMFS' Greater Atlantic Regional Fisheries Office (GARFO), Northeast Fisheries Science Center (NEFSC), and Atlantic Coastal Cooperative Statistics Program (ACCSP). The data represent the best available information on the Northeast Coast fishing activity. Below, we describe the databases used and highlight key sources of uncertainty in the analyses.

4.3.1.1 NMFS NEFSC/ACCSP Dealer Data

In the Northeast, all seafood dealers handling the catch of federally-permitted vessels are required to hold dealer permits. While there is no fee for the permit, NMFS requires that dealers submit reports on the catch that they purchase. Specifically, a dealer must submit a report to NMFS for each fishing trip from which it purchased catch. Each dealer report includes information on:

- date of purchase;
- dealer name and address;
- dealer number;
- vessel name and permit number;
- pounds of each species, by market category, if applicable;
- value of each species, by market category, if applicable; and
- port landed

Field office staff enter data into a coded form and send the data to the NEFSC to be incorporated into NMFS' larger Oracle database.

Analyses based on the dealer data warrant the following caveats:

- The purchase reports that seafood dealers submit to NMFS are not required to provide information on the gear used to land the catch reported. This information is deduced by each individual NMFS Field Office based on personal knowledge of the vessel's primary gear, the predominant species caught on the trip, or firsthand information from the fisherman. Therefore, breakouts of catch by gear type are subject to uncertainty.
- NMFS records only one gear type per dealer report. Thus, if two or more types of gear were used to catch different species during a trip listed on the same dealer report, only the primary gear used on the trip will be noted and gear used to catch secondary species maybe mischaracterized. This creates further uncertainty regarding gear types.

4.3.1.2 Permit Data

Fishermen are required to hold permits to fish for all federally managed species.[13] Permit requirements are included as part of the Fishery Management Plans developed by the Regional Fishery Management Councils and/or the Atlantic States Marine Fisheries Commission (ASMFC) and implemented by NMFS. Permit data are collected when fishermen apply to renew their fishing permits.

The characterization of affected fisheries relies on permit data to identify the number of vessels that may target a particular species. The analysis distinguishes between commercial and charter/party permits using permit category data. Because fishermen may not actually target all species for which they hold permits, this approach may lead to an overestimate of the number of vessels actively involved in a fishery.

The analysis also relies on permit data to identify the number of vessels likely to fish with gear regulated under the Atlantic Large Whale Take Reduction Plan. When applying for permits in the Northeast Region, fishermen are required to indicate what gear they are likely to use, although they are not restricted to the use of this gear (unless stipulated in the American Lobster FMP). As a result, the permit database indicates the gear the permit holder intended to use when the permit application was filed, not necessarily the gear currently used. The degree of inaccuracy that stems from this data limitation is unknown, but is likely minor. In addition to the caveat above, it is important to note that permit applications can designate multiple types of gear (ranked by likelihood of use). For the purpose of characterizing affected fisheries, the analysis examines the distribution of permits by both primary gear (i.e., the gear that the permit holder is most likely to use) and all gear noted on the permit application. This approach provides a more accurate indication of the number of vessels that may be affected by PLAN requirements.

4.3.2 Affected Fisheries

The American lobster and Jonah crab fisheries are the trap/pot fisheries in the Northeast Region that would be affected by the risk reduction measures identified in Alternatives Two and Three and are described in detail below. Other trap/pot fisheries have been regulated by the Plan and occur in the affected area; however, regulation of those fisheries is not analyzed. The Team will be asked to develop recommendations to reduce risk by 60 to 80 percent for U.S. fisheries along the entire Atlantic coast, including other trap/pot fisheries and fixed gear gillnet fisheries. Other trap/pot fisheries as well as gillnet fisheries are described because although they represent a very small percentage of buoy lines, they are fished in the affected area.

American Lobster

The American lobster, *Homarus americanus*, is a bottom-dwelling, marine crustacean characterized by a large shrimp-like body and ten legs, two of which are enlarged to serve as crushing and gripping appendages. American lobster range extends from Newfoundland south to the Mid-Atlantic region. In U.S. waters, the species is most abundant from the inshore waters of

[3] Fisheries may be managed by NMFS or by cooperative agreement between NMFS and the individual states

Maine to Cape Cod, Massachusetts, and the abundance declines from north to south (ASMFC 2015). In the Gulf of Maine, the inshore fishery dominates the industry, accounting for the highest percentage of lobster harvest. The offshore fishery dominates in the Georges Bank stock unit; however, in recent years the landings of catch from the inshore portion of Georges Bank (Statistical Area 521) has increased substantially. While historically the inshore fishery dominated in Southern New England, since the late 1990s the offshore fishery has accounted for the largest portion of the total landed catch (ASMFC 2015).

Lobster growth and reproduction are linked to the molting cycle. Lobsters are encased in a hard external skeleton that provides body support and protection. Periodically, this skeleton is cast off to allow body size to increase and mating to take place. Eggs (7,000 to 80,000) are extruded and carried under the female's abdomen during a 9 to 11 month incubation period. The eggs hatch during late spring or early summer and the pelagic larvae undergo four molts before attaining adult characteristics and settling to the bottom. Lobsters typically reach legal, commercial size after five to seven growing seasons, or approximately 20 molting cycles.

Several types of gear are used in the American lobster fishery, but the majority of landings are associated with traps/pots. In 2018, 144 out of 147 million pounds (65.3 to 66.7 million kilograms, about 98 percent) of lobsters were landed using traps/pots. Traps/pots may be set singly, each having its own buoy line and buoy, or in multiple-trap/pot "trawls" where the traps/pots are linked together by groundlines, with buoy lines and buoys (or high flyers) at the first and/or last trap/pot. Traps/pots are further divided into general categories: inshore and offshore traps/pots. Inshore fleet is comprised mainly of small vessels (22 to 42 feet/6.7 to 12.8 meters) that make day trips in nearshore waters (< 12 nmi/22.2 km), while offshore fishery has larger boats (55+ ft/16.8 m) that make multi-day trips to the edge of the continental shelf (ASMFC 2015).

Harvest levels of American lobster first prompted concern in the 1970s, resulting in the first Fishery Management Plan (FMP) for the American lobster, adopted in 1983. This first FMP called for fishing effort limits, minimum carapace size requirements, a prohibition on the possession of egg-bearing (or "berried") lobsters, and a prohibition on landing lobster parts. Since that time, a number of plan amendments have been developed for both state and federal waters. In December 1999, NMFS issued a Final Rule (64 FR 68228) transferring the federal lobster fishery regulations created under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (50 CFR Part 649) to the state-oriented Atlantic Coastal Fisheries Cooperative Management Act (Atlantic Coastal Act) (50 CFR Part 697). This decision recognized that the federal FMP, which covered only federal waters, was insufficient to address overfishing.

Currently, the American lobster fishery is managed under Amendment 3 of the Atlantic States Marine Fisheries Commission's American Lobster Management Plan, as well as Addenda I through XXVI to the plan. Adopted in December 1997, primary regulatory measures under Amendment 3 include carapace size limits, protection of ovigerous females, gear restrictions, and nominal effort control measures. In addition, Amendment Three created seven lobster management areas (LMAs; Figure 4.4). These include the Inshore Gulf of Maine (LMA One), Inshore Southern New England (LMA Two), Offshore Waters (LMA Three), Inshore Northern

Mid-Atlantic (LMA Four), Inshore Southern Mid-Atlantic (LMA Five), New York and Connecticut State Waters (LMA Six), and Outer Cape Cod (OCC). Lobster Conservation Management Teams (LCMTs), composed of industry representatives, were formed for each management area. They advise the American Lobster Management Board and recommend changes to the management plan within their area.

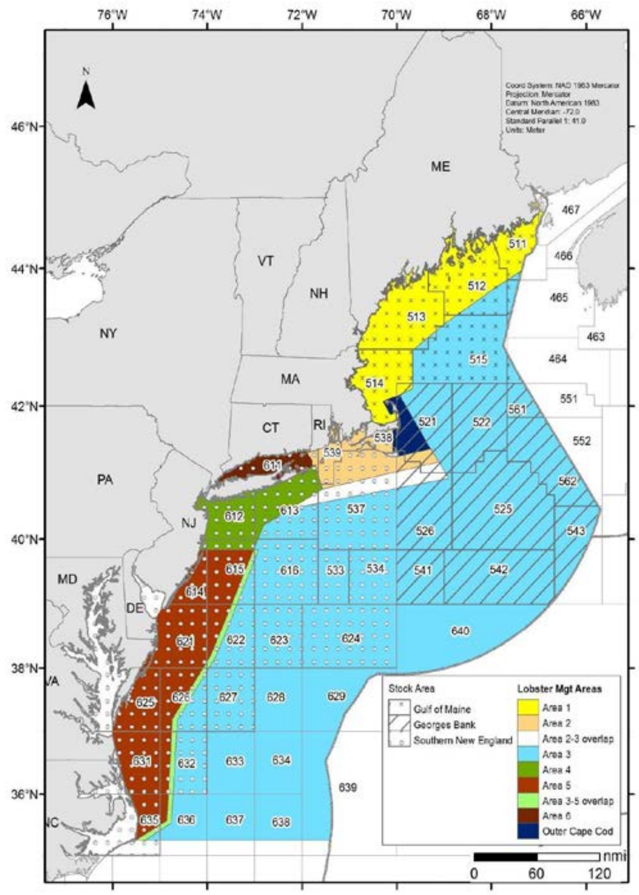

Figure 4.4: American lobster management areas and stock boundaries

Under federal regulations for the American lobster fishery outside of state waters, only limited access federal permits are issued. No new entrants are allowed, although in some LMAs, permits may be bought, sold, and transferred to another vessel. GARFO permit data indicate that 1,918 federal lobster permits were issued to vessels using trap/pot gear in 2018. The number of commercial trap/pot vessels that hold federal permits for each LMA is presented in Table 4.6. Each state sets its own requirements for trapping/potting lobsters in state waters. State-permitted operators who wish to fish in federal waters must also hold a federal permit and abide by the more restrictive of the two (federal or state) regulations.

Lobster has consistently ranked among the Atlantic coast's most commercially important species. In 2018, dealer data shows total revenue of more than $630 million up from approximately $404 million in 2010. Additional detail on annual lobster landings and average ex-vessel revenue between 2010 and 2018 is presented in Table 4.7.

The greater abundance of lobster in northern waters is reflected in the distribution of landings by state. Maine consistently accounts for the greatest share of the lobster catch, with landings in 2018 of approximately 121 million pounds (54.9 million kg). Massachusetts, the second leading producer, had landings in 2018 of 17.7 million pounds (8 million kg). Together, Maine and Massachusetts accounted for about 94 percent of total national landings. Lobster landings by state for 2010 to 2018 are presented in Table 4.8.

Table 4.6: Federal commercial lobster trap/pot permits by LMA in fishing years 2010 – 2018. A single permit could be issued for more than one LMA. Permits that were issued by fishing year 2018 extend from May 1, 2018 to April 30, 2019 (GARFO permit data).

Year	Total	LMA1	LMA2	LMA3	LMA4	LMA5	LMA6	OCC
2010	2,460	1,946	405	106	68	47	60	153
2011	2,455	1,964	382	105	71	44	62	139
2012	2,394	1,900	376	110	67	45	56	136
2013	2,297	1,746	356	105	62	42	52	126
2014	2,313	1,779	343	105	61	41	51	120
2015	2,136	1,758	166	100	56	41	46	20
2016	2,124	1,745	165	98	57	40	43	22
2017	1,932	1,578	150	94	59	38	42	17
2018	1,918	1,569	147	91	60	40	38	16

Table 4.7: American lobster landings in pounds, value, and price per pound from 2010 to 2018. All values and prices are nominal (ACCSP Data Warehouse, 2019)

Year	Landings (pounds)	Value	Price per Pound
2010	117,592,066	$404,109,047	$3.44
2011	126,319,733	$422,880,865	$3.35
2012	150,419,199	$431,532,022	$2.87
2013	150,279,705	$460,768,813	$3.07
2014	148,034,278	$567,193,136	$3.83
2015	147,033,005	$622,146,981	$4.23
2016	159,364,676	$670,132,176	$4.21
2017	136,866,879	$567,029,896	$4.14
2018	147,536,073	$630,362,791	$4.27

Table 4.8: Lobster landings in pounds by state from 2010 to 2018.

	2010	2011	2012	2013	2014	2015	2016	2017	2018
ME	96,244,296	104,957,200	127,464,328	128,015,528	124,952,432	122,685,832	132,661,464	112,073,280	121,344,936
NH	3,648,005	3,919,195	4,229,227	3,817,707	4,374,657	4,721,827	5,782,056	5,513,999	6,082,882
MA	12,772,159	13,385,393	14,486,344	15,158,509	15,322,852	16,450,414	17,787,436	16,495,767	17,690,692
RI	2,928,689	2,754,067	2,706,384	2,155,763	2,412,875	2,315,708	2,260,335	2,031,143	1,905,689
CT-NC	1,998,918	1,303,878	1,532,915	1,132,198	971,463	859,225	873,386	752,691	511,874
Total	117,592,066	126,319,733	150,419,199	150,279,705	148,034,278	147,033,005	159,364,676	136,866,879	147,536,073

Table 4.9: The top ten lobster landing ports in 2018, in pounds. Ports are listed in descending order based on the weight of total landings (ACCSP Data Warehouse, 2019).

Port	County	State	Pounds	Value
Stonington	Hancock	ME	15,152,984	$57,674,407
Vinalhaven	Knox	ME	8,916,960	$39,207,878
Beals	Washington	ME	6,955,382	$21,700,970
Friendship	Knox	ME	5,027,178	$23,596,699
Newington	Rockingham	NH	4,233,958	$26,463,533
Gloucester	Essex	MA	4,148,414	$21,150,942
Portland	Cumberland	ME	3,987,340	$18,409,293
Spruce Head	Knox	ME	3,960,384	$15,914,903
Jonesport	Washington	ME	3,292,579	$9,967,077
Milbridge	Washington	ME	2,845,255	$10,081,280
Top 10 Total			58,520,534	$244,166,982
Industry Total			147,536,073	$630,362,791
Top 10 ports %			**40%**	**39%**

Table 4.9 provides additional data on the distribution of lobstering activity, highlighting the top 10 grossing ports for lobster in 2018. As shown, Maine ports account for a significant portion of the total lobster catch. However, most lobster were landed at smaller ports along the New England coast, rather than at a single dominant port. The total landing pounds of the top ten ports was 58.5 million, accounting for 40% of the industry total landings in 2018.

Jonah Crab

Jonah crab (*Cancer borealis*) is distributed in the waters of the Northwest Atlantic Ocean primarily from Newfoundland, Canada to Florida. The life cycle of Jonah crab is poorly described and what is known is largely compiled from a patchwork of studies. Female crabs are believed to move nearshore during the late spring and summer and then return offshore in the fall and winter. The reasons for this inshore migration are unknown, but maturation, spawning and molting have all been postulated. Due to the lack of a widespread and well-developed aging method for crustaceans, the age and growth of Jonah crab is poorly described. (ASMFC, 2018) Like other Cancer crab species, Jonah crab consumes a variety of prey including snails, arthropods, algae, mussels and polychaetes.

Jonah crab is managed under the Interstate Fishery Management Plan (FMP) for Jonah Crab (ASMFC, 2015) and its three addenda. The plan lays out specific management measures in the commercial fishery, including a 4.75 inch (12.07 cm) minimum size with zero tolerance and a prohibition on the retention of egg-bearing females, and requiring harvesters to have a lobster permit. Addendum I (May 2016), establishes a bycatch limit of 1,000 crabs per trip for non-trap gear (e.g., otter trawls, gillnets) and non-lobster trap gear (e.g., fish, crab, and whelk pots). Addendum II (February 2017) establishes a coastwide standard for claw harvest to respond to concerns regarding the equity of the claw provision established in the FMP. Specifically, the Addendum allows Jonah crab fishermen to detach and harvest claws at sea, with a required minimum claw length of 2.75 inches (6.99 cm) if the volume of claws landed is greater than five gallons. Addendum III (February 2018) addresses concerns regarding deficits in existing lobster and Jonah crab reporting requirements by expanding the mandatory harvester reporting data elements, improving the spatial resolution of harvester data, establishing a 5-year timeline for implementation of 100% harvester reporting, and prioritizing the development of electronic harvester reporting.

Jonah crabs are primarily caught in pots and traps and have long been taken as incidental catch in the lobster fishery, or more recently as a secondary target, in the lobster fishery. On average, less than 1% of the catch are identified to come from dredges and trawls (ASMFC 2015). Table 4.10 shows that in 2018, pots and traps are still the primary gears used to harvest Jonah crabs. Other gears include dredge, gill nets, hand line, trawls and long lines.

Table 4.10: 2018 Jonah crab landings in pounds by gear type (ACCSP 2010-2018)

Gear Type	Landing Pounds	Percentage
Pots and Traps	16,670,443	84.08%
Not Coded	2,806,209	14.15%
Hand Line	258,321	1.30%
Gill Nets	41,046	0.21%
Dredge	21,961	0.11%
Long Lines	15,307	0.08%
Trawls	12,490	0.06%
Other Gears	123	0.00%
Total	19,825,900	100%

Table 4.11: Jonah crab landings (in pounds) and the value by state from 2010 to 2018 (ACCSP 2010-2018)

Year	MA Pounds	MA Value	RI Pounds	RI Value	Other Pounds	Other Value	Total Pounds	Total Value
2010	5,689,431	$3,211,506	3,720,440	$1,919,555	2,279,096	$917,051	11,688,967	$6,048,111
2011	5,379,792	$3,648,497	3,213,119	$1,834,949	1,353,503	$553,926	9,946,414	$6,037,372
2012	7,540,510	$5,573,391	3,774,300	$2,573,616	1,245,373	$638,456	12,560,183	$8,785,463
2013	10,109,590	$9,123,248	4,651,796	$3,337,500	1,313,742	$823,211	16,075,128	$13,283,958
2014	11,904,611	$9,319,309	4,435,934	$3,310,347	1,072,921	$865,491	17,413,466	$13,495,148
2015	9,128,876	$6,918,416	4,298,894	$2,969,663	825,570	$539,923	14,253,340	$10,428,001
2016	10,668,039	$8,191,489	4,224,092	$3,268,894	1,200,973	$823,857	16,093,104	$12,284,240
2017	11,698,705	$11,451,564	4,111,281	$3,947,064	1,782,396	$1,284,013	17,592,381	$16,682,641
2018	13,307,160	$12,476,913	4,607,089	$4,295,861	2,151,667	$1,757,927	20,065,916	$18,530,700

The value of Jonah crab has increased recently, and along with declining lobster stocks in southern New England, has resulted in higher landings. Landings fluctuated between approximately two and three million pounds (0.9 to 1.4 million kg) throughout the 1990s (ASMFC 2015). By 2005, landings increased to over seven million pounds and then to over 20 million pounds in 2018. Landings in 2018 predominantly came from Massachusetts (66%), followed by Rhode Island (23%), New Hampshire and Maine (5%). Connecticut, New Jersey, and Maryland accounted for a combined 5% of landings. MA and RI together contribute more than 90% of Jonah crab landings and value throughout the years (Table 4.11).

Table 4.12 The top landing ports for the Jonah crab fishery in 2018 (ACCSP 2010-2018).

Rank	State	Port	Pounds	Dollars
1	MA	New Bedford	10,680,827	$10,035,262
2	RI	Point Judith	1,946,948	$1,759,347
3	RI	Newport	1,863,292	$1,801,081
4	MA	Sandwich	1,598,037	$1,562,624
5	NJ	Point Pleasant	554,950	$552,176

Top landing ports of Jonah crab are mostly located in Southern Massachusetts and Rhode Island. Using 2014 Massachusetts and Rhode Island landings data (accounting for approximately 95% of all 2014 landings), Jonah crabs are primarily harvested from Statistical Area 537 (71%), followed by 526 (10%) and 525 (10%) (Figure 4.5, ASMFC DEIS 2018). Table 4.12 shows the top five Jonah crab landing ports in 2017. New Bedford and Newport, Rhode Island located in Southern New England have been the leading landing ports for years.

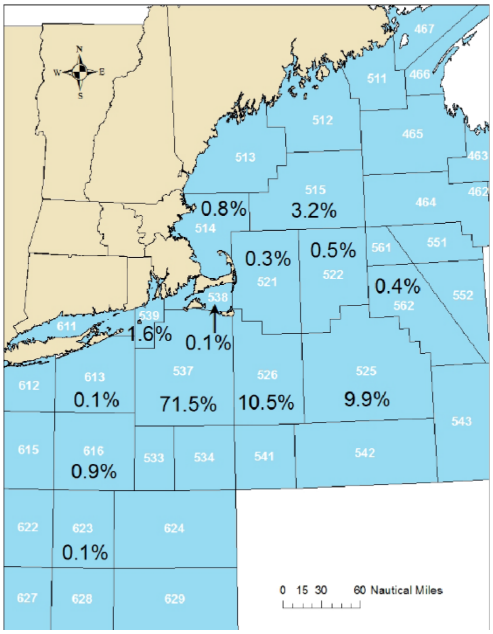

Figure 4.5: 2014 MA and RI Jonah Crab Landings by Statistical Area

4.4 *Affected Communities*

Appendix 4.4 describes the social and cultural setting of the communities potentially affected by the proposed modifications to the Atlantic Large Whale Take Reduction Plan.

Although rulemaking is being done under the Marine Mammal Protection Act, communities described are as defined by the Magnuson-Steven Act: “a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community.” Potentially affected communities were identified by identifying ports of landings, and by looking at the distribution of lobster and other trap/pot fishery harvesters across Maine, New Hampshire, Massachusetts, Rhode Island, and associated fishery management areas, then identifying the towns in which those harvesters reside. Geographically, the vast majority landings data from trap/pot fisheries that harvest lobster and crabs from LMAs One, Two, Three, and Outer Cape Cod are harvested by vessels fishing from ports in Maine, New Hampshire, Massachusetts, and Rhode Island. Social and cultural characteristics of the towns with the strongest participation in the affected trap/pot fisheries are described in Appendix 4-B. Social indicators considered here are divided into three categories: Social Vulnerability Indices, Gentrification Pressure Indices and Fishing Engagement and Reliance Indices. The explanation of social indicators used in Appendix 4.2 are listed in

Appendix 4.C.

Among all indicators, Commercial Engagement and Commercial Reliance are most relevant to our analysis. Commercial Engagement measures the presence of commercial fishing through fishing activity as shown through permits and vessel landings. A high rank indicates more engagement. Commercial Reliance measures the presence of commercial fishing in relation to the population of a community through fishing activity. A high rank indicates more reliance. Both indicators reveal the significance of fisheries to the community. The most engaged fishing community in Maine is Portland. However, Portland also has the least reliance on commercial fishing which means it has the most other working opportunities. While Stonington, the biggest lobster landing port in the US, has both high engagement and reliance on commercial fishing. Other heavily engaged fishing communities in the Northeast Region include Gloucester and New Bedford in Massachusetts, and Point Judith in Rhode Island. Beals in Maine and Newington in New Hampshire have high commercial fishing reliance.

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5 BIOLOGICAL IMPACTS

The National Environmental Policy Act (NEPA) requires an environmental impact statement (EIS) for a proposed Federal action to evaluate the impacts of the action with respect to its biological, economic, and social components. This Draft EIS (DEIS) analyzes the impacts of proposed modifications to the Atlantic Large Whale Take Reduction Plan (ALWTRP) on four valued ecosystem components (VECs): large whales, other protected species (i.e. other marine mammals and sea turtles), the physical environment and essential fish habitat, and human communities. As detailed in Chapter 3, the two action alternatives considered in this DEIS both were drawn largely from proposals provided to NMFS by New England states following some of the principles of the Atlantic Large Whale Take Reduction Team's (ALWTRT) April 2019 recommendations. The Alternatives were selected because, using the Decision Support Tool, these suites of measures which include ongoing and anticipated fishery management measures, measures that will be regulated by Maine and Massachusetts, and the benefits of the Massachusetts Restricted Area, achieve or exceed a 60% risk reduction necessary to reduce impacts to right whales to below the potential biological removal level of 0.9 serious injury or mortality per year. This chapter analyzes the alternatives' impacts on three of the VECs, evaluating the impact of potential modifications to the Plan on the biological and physical VECs. Human communities are evaluated in Chapter 6.

Of foremost concern to this evaluation is the direct effect of the potential regulations on reducing the likelihood that North Atlantic right whales will be killed, seriously injured, or experience sub-lethal impacts as a result of entanglement in crab and lobster trap/pot commercial fishing gear in the Northeast Region Trap/Pot Management Area (Northeast Region). It is also necessary to consider whether new regulations could indirectly affect this species by exposing it to different risks or by altering the habitat upon which it depends. In addition, it is important to examine the potential effect that changes in Plan regulations might have on other aspects of the marine environment.

The discussion that follows presents an evaluation of these impacts using a NMFS co-occurrence model, created by IEC Inc., which compares whale distribution and Northeast Region lobster and crab trap/pot buoy lines to help characterize baseline conditions and the impact of alternative management measures (Section 5.1). It then evaluates the direct and indirect effects of revised Plan regulations on Atlantic large whales/North Atlantic right whales, comparing the potential impacts of each of the regulatory alternatives under consideration, including NMFS' preferred alternative (Section 5.2.1) against the 2017 risk reduction baseline (representing status quo). Finally, the chapter discusses other potential impacts on marine resources − including impacts on other protected species (Section 5.2.2) and essential fish habitat (Section 5.2.3) − and compares the alternatives with respect to these impacts (Section 5.3).

As described in Chapter Three, the take reduction team agreed at the April 2019 meeting that there are a few areas where existing regulations or current effort reduction measures since 2017 should contribute toward the overall risk reduction analyzed here. However, the economic analysis in Chapter 6 considers the economic impacts of only those measures that would be implemented to modify the Take Reduction Plan by federal rulemaking.

5.1 Evaluating Impacts of the Alternatives

The discussion of the biological impacts of new Plan requirements on the biological VECs included in this analysis is largely qualitative. This approach is necessary because, although the Decision Support Tool (DST) was developed to aid decision makers in the selection and comparison of alternatives with sufficient risk reduction to decide on Plan modifications, several members of the ALWTRT expressed concern about relying solely on a relatively new model for analysis without sufficient peer review and testing. Furthermore, while the DST was designed to quantitatively assesses changes in entanglement risk as a result of different management actions, it was first formulated to help guide the decision making process rather than the full analysis of potential biological effects. It has yet to be validated against previously used metrics (e.g., co-occurrence between whale sightings and vertical lines in the IEC vertical line model). The DST is also limited in its capacity to assess the impact of the alternatives on other large whales and has yet to be used in any capacity for species other than the North Atlantic Right Whale. As such, the potential biological impacts of the alternatives on large whales were assessed primarily with IEC/NOAAs Vertical Line Model, described below, generating both qualitative and qualitative measures.

Table 5.1: A list of the criteria available to compare the impact of the proposed alternatives on large whales.

Type	***Measure***	***Criteria***
Buoy Line Reduction	Trawl up	• Change in co-occurrence
		• # of lines removed
	Planned fishery management trap reductions	• Change in co-occurrence
		• # of lines removed
	Time/area closures to buoy lines	• Change in co-occurrence
		• # of lines removed
		• Recent sightings data
	Line cap	• Change in co-occurrence
		• # of lines removed
Weak Rope	Weak insert	• Proportion of line that is weak or the equivalent (i.e. weakened insertion every 40 feet/12.2 meters)
		• % of line above weak point
		• Relative proportion of all lines that are converted to
	Full length weak rope	• Proportion of weak line or equivalent (i.e. mark every 40 feet/12.2 meters)
		• % of line above weak point
		• Relative proportion of all lines that are converted to
Gear Marking	New marking scheme	• % increase in new marks

In all cases, the following analysis measures the impacts of the action alternatives relative to Alternative 1, the no action alternative, against the 2017 baseline conditions. In some instances, and consistent with past practice, quantitative indicators of the impact of alternative regulations are provided, including changes in number or configuration of buoy lines and co-occurrence (for right, humpback, and fin whales only) as proxies for indicators of risk of entanglement. Quantitative measures that were possible for large whales are listed in Table 5.1 and described in more detail in sections 5.1.1 and 5.1.2. These indicators do not measure biological changes in entanglement risks, but offer useful information on factors that likely, based on expert opinion, correlate with such risks. Reduction in buoy line numbers and strength was also used to assess relative impact of the alternatives on other protected species, where no co-occurrence measure was available.

Qualitative analyses were used where quantitative data was not available or sufficient. The impacts of the risk reduction and gear marking alternatives are first examined for each VEC and the summary of impacts on all VECs is discussed in section 5.4.

5.1.1 Use of NMFS/IEC Co-Occurrence Model

NMFS has invested for a number of years in the development of a co-occurrence model designed to address the following types of questions:

- Where and how do the fisheries that are subject to the requirements of the ALWTRP operate?
- Where are concentrations of buoy line the greatest?
- Do whales frequent areas with high concentrations of fishing line?

Through the integration of information on fishing activity and gear configurations, this model characterizes geographic and temporal variations in fishing effort within the lobster, Jonah crab, and red crab fisheries and the distribution of fishing line in the Northeast Region subject to the Plan. The model also incorporates information on whale sightings per unit of survey effort (SPUE) from data compiled by the North Atlantic Right Whale Consortium, and identifies areas and times when whales and commercial fishing gear are likely to co-occur. The model’s final product is a set of indicators that provide information on factors that contribute to the risk of entanglement at various locations and at different points in time. These indicators, in particular the number of buoy lines in an area, whale SPUE and resultant co-occurrence score, are assumed to represent the relative risk of entanglement in different locations. They provide a basis for comparing the impact of alternative management measures on the potential for entanglements to occur. Readers interested in additional information on the model’s structure, data, assumptions, and methods should consult its documentation in appendix 5.1.

5.1.2 Evaluation of Weak Rope

Alternatives Two and Three propose large scale introductions of weak rope or weak inserts for crab and lobster buoy lines throughout the Northeast Region. This is consistent with ALWTRT recommendations for region-wide measures that would protect right whales while outside of known aggregation areas and would be precautionary as right whale distribution continues to shift.

Proposed measures that modify the strength of rope used for trap pot fisheries were primarily analyzed qualitatively. Lowering the strength of rope does not reduce the risk of interaction between whales and line nor does it change co-occurrence. The benefit of these measures is to reduce the potential health impact an entanglement has on a whale by increasing the chances that an entangled individual can break free of any constricting gear without resulting in a serious injury or mortality. Knowlton et al. (2016) documented the greatest frequency of serious injury and mortality of right whales in lines with breaking strength greater than 1700 lbs. (771.1 kg) and suggested that large scale introduction of weak rope across fisheries could reduce serious injuries and mortalities by up to 72%. This is consistent with estimates of the force that large whales are capable of applying, based on axial locomotor muscle morphology study conducted by Arthur et al. (2015). The authors suggested that the maximum force output for a large right whale is likely sufficient to break line at that breaking strength. That study and others recognized that success in breaking free is also somewhat dependent on the complexity of the entanglement (van der Hoop et al. 2017b). Although empirical evidence supports the theory that weakened line would reduce serious injury and mortality of right whales, without sufficient quantitative data to estimate how different forms of weak rope or weak inserts will impact the outcome of an entanglement, analysis of these measures is done qualitatively within the context of the empirical data that are available. Current research on fishing gear strength was primarily used as the standard against which the measures were evaluated, particularly evaluating how close the proposed measures compare to the types of weakened line recommended by current research (i.e., lines with breaking strength no greater than 1700 lbs).

5.2 Direct and Indirect Impacts of Risk Reduction Alternatives

5.2.1 Large Whales

As noted in Chapter Two, entanglements are a primary source of anthropogenic serious injury and mortality for the North Atlantic right whale. The primary threat that Northeast Region crab and lobster trap/pot commercial fishing poses to Atlantic large whales is the risk of serious injuries and mortalities due to incidental entanglement in buoy lines that mark the location of pots set singly or in trawls along the bottom. According to the NMFS/IEC line model, lobster and crab buoy lines make up an estimated 93% of the buoy lines offshore of the Northeast Region. Given the above, the regulatory changes under consideration are designed to reduce harm to large whales by reducing the likelihood of entanglement and/or reducing the severity of an entanglement should one occur. NMFS seeks to achieve these objectives primarily through gear modifications that reduces the number of buoy lines and line strength, and through time/area closures to commercial lobster and crab fishing with persistent buoy lines.

The discussion below examines the impact of these measures on whale entanglement risks, beginning with an evaluation of specific line reduction requirements and then turning to an assessment of other restrictions. It is important to note that the No Action Alternative (Alternative One; status quo) would not achieve the objectives listed above. If Alternative One were chosen, there would likely be continued incidents of serious injury and mortality to large whales due to entanglement in commercial fishing gear at rates that exceed potential biological removal (PBR) levels, rather than a reduction in these interactions. With no action, we would continue to have similar numbers of lethal and non-lethal takes of right, fin, and humpback whales.

5.2.1.1 Buoy Line Reduction

Buoy line (i.e., line that hangs vertically in the water column, connected from a surface flotation device to trap/pot gear set on the ocean floor) has been identified as an entanglement threat to Atlantic large whales. Reduction in buoy lines, therefore, has the potential to reduce entanglement risk to these species. As provided below, buoy line reduction can be taken by numerous means (e.g., seasonal restricted areas, trawling up, line caps). In the discussion to follow, the potential direct and indirect effects of buoy line reduction provisions that involve gear modifications (by trawling up or line caps), and those involving seasonal buoy line closure areas are examined.

Alternative One would maintain the status quo fishery. Under Alternative One there would not be a reduced risk of entanglement as the number of buoy lines in the water would remain the same (i.e. 2,125,588 annually outside of Maine exempt waters, summed monthly across the year). Relative to Alternative One, Alternatives Two and Three (Preferred and Non- preferred) include several vertical line reduction provisions to reduce the frequency of whale entanglements. Specifically, relative to baseline levels fished in 2017[4], these provisions would reduce the number of trap/pot buoy lines. As a result of public input during federal and state scoping, in some waters, including the exempt area in coastal Maine, those fishing closer to shore or around islands would not be subject to trawling up requirements and would be able to continue traditional fishing practices. Measures in exempt Maine waters are implemented by the state so, while line numbers are reported for both areas, the analysis of buoy line reduction relevant to these alternatives focuses on areas outside of the Maine exemption line.

Estimated 2017 buoy line numbers are evaluated within the lobster management area (LMA) in which they are fished as well as by distance from shore Alternatives Two (preferred) and Three (Non-preferred) reduce the number of buoy lines in the water through measures by: (1) specifying an increase in the minimum number of traps per trawls ("trawling up" requirements) by area and distance from shore, (2) implementing a total line allocation cap that is half the current average of lines fished, or (3) implementing time/area closures to buoy lines. Line reduction through existing or concurrent fishery management measures under the lobster Fisheries Management Plan (FMP) are also considered toward risk reduction, particularly including those measures that reduce latent effort and establish trap caps that reduce buoy lines in LMAs Two and Three.

All of these provisions would result in a decrease in the number of buoy lines in the water and therefore reduce the likelihood of an entanglement. Alternative Two (Preferred) line reduction requirements differ slightly from Alternative Three (Non-preferred). The former relies more on trawling up measures along with new buoy line closures, and the latter includes a universal line cap and more extensive restricted areas.

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[4] The baseline year in which risk reduction is being measured is 2017. Estimated 2017 buoy line numbers are evaluated within the lobster management area in which they are fished as well as by distance from shore.

5.2.1.1.1 Gear Modifications

Direct Effect of Trawling up and Line Caps on Large Whales

Trawling Up

The alternatives analyzed would in several cases institute restrictions designed to reduce the number of buoy lines that fishermen employ. Table 5.2 identifies the estimate line reductions under the Alternatives. Alternatives Two would limit the number of lines in the Northeast Region, and LMAs One, Two, and Outer Cape Cod, by enacting new minimum trap/trawl requirements based on area and distance to shore, with increasing traps/trawl with increasing distance from shore. Year-round (Alternative Two) and seasonal (Alternative Three) trawling up provisions are also proposed for all of LMA Three. Alternative Three would also institute a buoy line allocation in Federal waters of about half the buoy lines historically used by fishermen.

Maine developed the distance-from-shore trawling up scenarios in the preferred alternative based on public input and safety concerns, while recognizing that offshore of Maine whale co-occurrence and associated risk increases with distance from shore. Maine's proposed measures are adopted in Alternative Two (see proposal in Appendix 3.2), as they were also proposed by other New England states, across all the LMAs, after substantial state scoping with fishermen. Maine DMR indicated that fishermen identified these measures as operationally feasible with existing buoy lines and vessels. They include increases in traps/trawl requirements with increasing distance from shore, primarily in Federal and offshore waters where vessels are larger and capable of safely handling larger trawls. Fishermen in Maine identified these configurations as possible with their current vessel characteristics and buoy lines, so that costly and substantial operational changes would not be necessary.

In Massachusetts, an additional trawling up provision was proposed and is included in the preferred alternative. By not allowing vessels larger than 29 feet (8.8 m) with permits transferred after January 1, 2020 to fish singles, this measure is aligned with vessel size so will put less strain on small vessels.

Both the preferred (Two) and non-preferred (Three) Alternatives, include trawling up requirements in LMA Three as either year-round or seasonal. The analysis assumes a 45 trap/trawl for the trawling up alternatives in LMA Three. However, given the variety of vessel configurations that participate in LMA Three, options that achieve an average of 45 trap/trawls such as different traps/trawl options aligned with vessel length or according to permit categories, could be implemented if they are shown to achieve the same risk reduction as a simple 45 trap/trawl year-round or seasonal measure in LMA Three.

Table 5.2: Annual line numbers by area, summed across months, for each alternative, including Alternative One (i.e. Baseline). All changes in line numbers include the combined changes due to gear configurations and areas closed to persistent buoy lines. If a restricted area is proposed in a particular location, it is noted in parentheses. Two different scenarios were considered for buoy line closures: all lines are fully removed (the upper bound or largest number of lines removed) or all lines are relocated outside of a restricted area (lower bound/fewer buoy lines are removed). The extension of the Massachusetts Restricted Area in state waters is considered to be a lines-out closure because other LMAs are not available to those fishermen and it comes at the end of a long closure.

		Alternative 2		***Alternative 3a***		***Alternative 3b***	
Area	***Baseline***	***Lines Out***	***Relocation***	***Lines Out***	***Relocation***	***Lines Out***	***Relocation***
Maine Exempt Waters	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835
LMA 1 (Restricted Area & MBRA extensions)	1,943,950	1,565,653	1,573,130	958,872	966,208	958,872	966,208
LMA 2 (Restricted Area)	71,164	56,966	57,003	27,788	28,360	28,732	29,060
Outer Cape (MBRA extensions)	68,186	63,815	63,815	31,861	31,861	31,887	31,887
LMA 3 (Restricted Area in Alt. 3)	42,288	31,830	31,869	32,190	34,718	32,535	34,718
Total Lines (Outside ME Exempt)	**2,125,588**	**1,718,264**	**1,725,817**	**1,050,711**	**1,061,148**	**1,052,025**	**1,061,874**
Percent Reduction		**19.2%**	**18.8%**	**50.6%**	**50.1%**	**50.5%**	**50.0%**

Associated with the LMA Three trawling up requirement, NMFS would extend the allowable distance between buoy lines in LMA Three to 1.75 miles (3.24 km). Currently, lobster fishermen are restricted to fishing ground lines of no more than 1.5 miles (2.78km). While trawls with more than 45 traps are currently fished within this constraint, fishermen in some areas might want to increase groundline between end traps to reduce the number of pots hanging in the water upon hauling if weak line or weak inserts are implemented in buoy lines, or they may want to increase their total trawl length to hold fishing ground. To allow LMA Three vessels to optimize distance between traps, under both Alternative Two and Three, the maximum length between the buoy lines would be extended from 1.5 miles (2.78km) to 1.75 miles (3.24 km).

Also considered but not analyzed was a change to the current requirements to allow use of only one buoy line offshore, particularly in LMA Three. Ultimately, this alternative was not analyzed in favor of a weak buoy line and alternative trawling up considerations due to industry concerns about safety, increased possibility of gear conflicts with mobile gear, and the potential increase in gear loss.

All line reductions predicted for Alternatives Two and Three through trawling up and line caps, in addition to seasonal buoy line closure areas, will reduce the number of trap/pot buoy lines in the Northeast Region by between 18 to 50 percent of 2017 annual baseline numbers outside of Maine exempt waters (Table 5.2). In order to account for monthly variation in fishing effort, and therefore line numbers, monthly line numbers were summed to provide an annual total for the purpose comparing the alternatives and does not represent the number of lines in the water at a given time within the Northeast Region. The goal of these different buoy line reduction approaches is to reduce the number of lines and co-occurrence of vertical trap/pot buoy lines with large whales (e.g., North Atlantic right, humpback, and fin whales; see Tables 5.5 - 5.7 for co-occurrence).

Alternative Two, which includes the most trawling up measures and two additional restricted areas, would have a lower reduction in the number of buoy lines (18.8% - 19.2%) compared to the aggressive line cap in federal waters that would be set under Alternative Three (up to 50.5%). An option under Alternative Three also retains seasonal trawling up measures in LMA Three and more substantial restricted area options. Trawling up most substantially will likely result in some areas with longer, heavier trawls than baseline conditions. Heavier trawls, especially if buoy line strength also goes up (discussed in indirect effects), could increase potential entanglement severity to all whales, particularly calves that may be more likely to survive an interaction with a single trap than with a trawl made up of multiple traps. Small neonate calves are weak swimmers and lack the physical and behavioral developments that increase buoyancy (Thomas 1984) – all traits that likely contribute to a whale’s ability to survive an interaction with fishery gear. However, the decrease in buoy line decreases overall risk of entanglement, likely mitigating some of the possible increased risk. Trawling up measures are likely to reduce entanglement overall risk assuming the predicted line reduction occurs and mitigate potential increases in entanglement severity when implemented with weak line measures (see Section 5.2.1.3).

Potential for trawling up not impacting buoy line numbers:

As noted above, trawling up was required as a line reduction measure in the 2014 buoy line modifications to the Plan, effective June 2015. Hayes et al. (2018) reviewed data that indicated that draft buoy line estimates for 2016 prepared by IEC using the Co-occurrence Model were higher than the pre-regulation baseline line estimates provided in the FEIS developed for the 2014 rulemaking (NMFS. 2014). Hayes et al. (2018) suggested that the line reductions anticipated in the rule, effective in June 2015, were not achieved. However, the line estimate in the 2014 FEIS was based on fishery data from 2009 through 2011. Beginning in 2010, there was a steady increase in abundance in the Gulf of Maine and Georges Bank lobster stock. This is the stock fished in LMA One where the vast majority of buoy lines are fished. The values and landings of American lobster also rose steadily after 2010, peaking in 2016. Catch per unit effort was also higher during this time, so without line estimates it is difficult to draw conclusions about relative buoy line numbers, but it is likely that participation by permitted fishermen rose to near-capacity during these lucrative years.

However, without a constraint on the total number of lines that can be fished, such as that suggested in Alternative Three, there is no mechanism to prohibit latent effort from being activated. Many fishermen who hold lobster licenses do not actively fish at all, and many active fishermen do not fish all of the traps that have been allocated to them. Additionally, as discussed above, fishermen fish different numbers of pots and trawls in different months. This results in varying amounts of "latent effort"; permitted allocations that are not actively fished but are theoretically available to be deployed at any time. For the following reasons, we believe that trawling up under the present day fishery conditions would result in line reductions close to those calculated in our analysis (see Table 5.2).

1. Relative to 2017 effort in LMA Two and LMA Three, there is a low likelihood of future significant latent effort reactivation. Fishery management measures to reduce latent effort and consolidated trap allocations have been implemented in LMA Two and LMA Three, effective May, 2016, under Addendum XVII to Amendment 3 to the Interstate Fishery Management Plan for American Lobster (Lobster Plan). These changes were intended to match the size of the fishery to the size of the resource, including the declining southern New England lobster stock. As described in Chapter 3 section 3.1.4.3, and in the proposals submitted by Massachusetts and Rhode Island, (Appendix 3.2), latency in these two LMAs does appear to be greatly reduced. Massachusetts, in their proposal (MADMF 2020, Appendix 3.2) documents a reduction in fishermen actively fishing across their states, which includes LMA One and the Outer Cape Cod LMA.

2. The Gulf of Maine and Georges Bank lobster stock is at high abundance and recruitment, making direct management of latent effort less of a fishery management priority for LMA One. As indicated above, positive market and lobster stock conditions incentivize fishermen to increase fishing effort and may encourage inactive fishermen to reenter the fishery. For that reason, it is likely that fishermen in the Gulf of Maine have been fishing at a high capacity in recent years. Figure 1 in the proposal submitted by Maine DMR (Maine DMR proposal, 2019. Appendix 3.2) demonstrates the relative stability of latent licenses. As discussed in Maine's proposal (see Appendix 3.2) and above, these latent permits are unlikely to be activated if they were not used during recent lucrative fishing years.

3. The average age of New England crab and lobster fishermen is increasing. Massachusetts DMF (2020) provides documentation of their aging fisherman population. Similar demographics have been noted in the Maine fishery. A study conducted by the Gulf of Maine Research Institute (2014) showed the age of Maine lobster license holders increasing steadily from 1999 through 2013 (GMRI 2014) and suggested that at some point given the grueling nature of the work, fishermen reduce their fishing effort as they age.

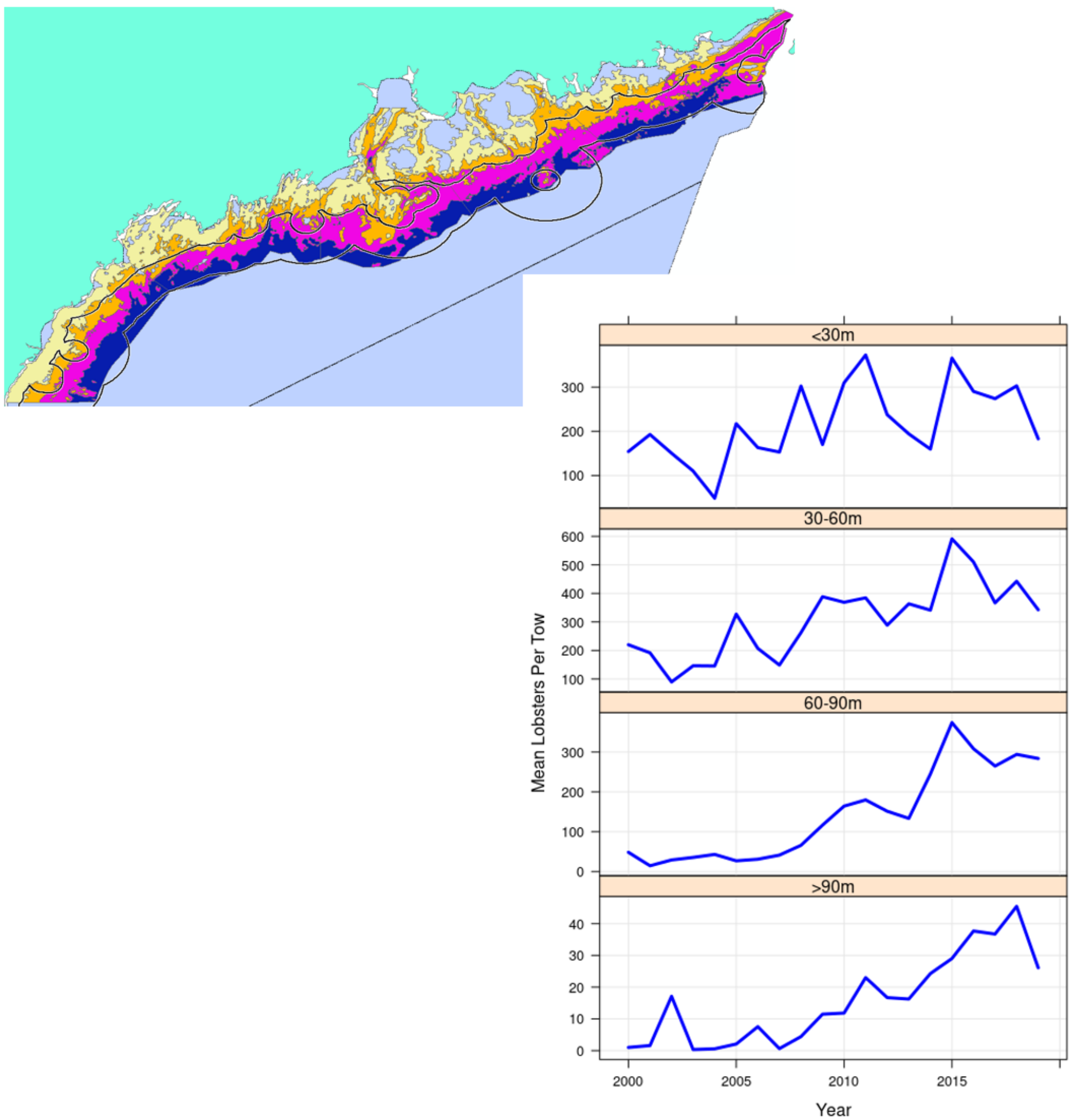


Figure 5.1: Mean lobster abundance in the Maine/NH trawl survey. Top left panel: map of coastal Maine with sampling strata with reference lines for 3 and 12 miles from shore and the LMA 1/3 boundary. Bottom right panel: survey indices by depth strata for the Fall survey.

For these reasons, we concur with Maine's, Massachusetts', and Rhode Island's conclusions that an increase in fishing effort from allowed, but inactive latent traps, above that documented in a strong fishing year like 2017, is unlikely to occur. Under these conditions, trawling up under Alternative Two would as estimated reduce the number of buoy lines fished relative to 2017 estimates, as detailed in Table 5.2.

Offshore of the Maine coast within LMA1, the likelihood of encountering a North Atlantic right whale increases with distance from shore (Roberts et al. 2016), as Maine DMR observed in their proposal (ME DMR, 2019, Appendix 3.2). For this reason, reducing buoy line numbers more substantially with increasing distance from shore provides better risk reduction for right whales.

Table 5.3: Trends in landings and fishing effort with distance from shore from Maine DMR.

Distance from shore (nmi)	2008	2009	2010	2011	2012	2013	2014	2015	2016
Proportion of	**landings**	**by**	**distance**	**from**	**shore**				
0-3	81.5%	69.8%	77.8%	75.5%	67.0%	72.8%	69.1%	64.1%	68.2%
3-12	14.9%	25.0%	19.3%	17.3%	25.8%	20.3%	24.7%	26.3%	23.3%
12+	3.6%	5.2%	2.9%	7.2%	7.2%	6.9%	6.2%	9.6%	8.6%
Proportion of	**trips by**	**distance**	**from**	**shore**					
0-3	87.7%	80.9%	84.2%	83.8%	77.5%	80.9%	80.3%	77.3%	80.8%
3-12	10.4%	16.3%	14.1%	12.4%	18.6%	15.5%	15.7%	17.7%	14.6%
12+	1.9%	2.8%	1.7%	3.8%	3.9%	3.7%	4.0%	5.0%	4.5%
Average	**catch**	**(lbs)**	**Per trap**						
0-3	1.17	1.31	1.46	1.62	1.86	1.96	1.87	1.82	1.81
3-12	1.45	1.77	1.74	2.05	2.33	2.24	2.67	2.27	2.43
12+	1.61	1.84	1.88	2.1	2.27	2.51	2.72	2.41	2.49
Total Average	1.41	1.64	1.69	1.93	2.15	2.24	2.42	2.17	2.24

The lobster resource is growing in federal nearshore waters, though lobster density is still highest in waters less than 90m deep, which is mostly inshore of about six miles (Figure 5.1). The proportions of landings and trips in the lobster fishery have increased in federal waters and industry catch-per-unit-effort has increased across the resource in Maine portion of LMA1 (Table 5.3). However, the potential for fishing effort to shift from state to federal waters is restricted by limited entry to the federal fishery. Additionally, spatial data is generally lacking on how fishing effort is distributed in federal waters either inside of 12 miles or outside of 12 miles within LMA1. Thus, it is unclear if changes in the distribution of lobsters or relative proportions of landings and trips are indicative of increased density of fishing gear further from shore. However, if current trends in lobster density continue, commercial lobstering may become more viable in deeper waters and further from shore in the future, a possibility that would be somewhat ameliorated by the proposed seasonal restricted area for offshore LMA1. This uncertainty in the current and changing spatial distribution of fishing effort complicates the assessment of entanglement risk in this region. Thus, going forward, there is a need for adequate characterization of the spatial distribution of fishing effort in this region, both through improved trip reporting and implementing vessel monitoring, to monitor how the lobster fishery responds to the changing distribution of lobsters and how this impacts risk of entanglements.

NMFS will monitor line numbers annually and associated co-occurrence with right whales to evaluate whether predicted line reduction occurs. This will be facilitated by improved data once NMFS and the state of Maine require 100% harvester reporting in the lobster fishery (Maine proposal 2019, see Appendix 3.2) and even more so once vessel tracking systems are deployed in Federal waters. While measures to implement vessel tracking have not yet been developed, Addendum XXVI to Amendment 3 to the Lobster Plan (2018) identified vessel monitoring as a long-term recommendation to improve lobster reporting (results from a lobster fishery vessel tracking pilot program are anticipated during the summer of 2020 and expected to inform future requirements within the next five years).

Endline Cap in Federal Waters

Because this is not the preferred alternative and therefore not in the proposed rule, the exact regulatory mechanism for implementing a line cap has not been identified. However, after doing the co-occurrence analysis, we modified this alternative further, limiting a 50 percent line cap option to federal waters, given the complexity of interstate fishery management. During the public comment period on this DEIS, we hope to get input from fishing industry stakeholders, particularly in federal waters, on how they would respond to a halving of their buoy lines. If ever implemented, NMFS would work with the Atlantic States Marine Fisheries Commission (ASMFC) and New England states to distribute allocations of line tags to fishermen; one tag to be affixed to buoy, one to the end trap of each buoy line. States and fishermen could use allocations according to their capacity, through trap reductions, trawling-up scenarios, or through other options that allow them to fish with half the lines that they have historically used. Allocation and histories would be based on vessel trip reports or, for Maine, other data sources such as dealer records for fishing prior to April 29, 2019. The ASMFC and NMFS established a control date of April 29, 2019, at the April 2019 ASMFC meeting, putting American lobster permit holders and new entrants on notice that future participation and eligibility could be affected by past participation data (84 FR 43785, August 22, 2019). A new control date would be established for red and Jonah crab fisheries.

To estimate the likely reduction in line numbers with a buoy line cap, NMFS used the 2017 baseline buoy line data to test how different approaches might shift buoy line numbers and selected likely scenarios. Using half the average monthly lines fished regionally throughout the year in federal waters resulted in an approximate 45 percent line reduction for the area outside of state waters. This takes into account three different line cap responses in areas where lines fished in certain months falls below the line cap. In months where line numbers fall below the cap, fishermen (1) continue fishing at the pre-cap level during low effort months, (2) fish an average number of lines between the lines they are allocated under a cap and the lines as fished during low effort months in 2017, or (3) fish the maximum allotment of lines under their line caps across all months (discussed further below). We estimate the actual result would be between the average and maximum allotment of line numbers. Without more detailed data on fishermen's likely response to a line cap, the data presented in Table 5.2 represent an ideal scenario with an actual fifty percent line reduction across all regions during each month; we applied this consistently across the Alternative Three scenarios. Other possible scenarios are discussed qualitatively below. Public comments on this DEIS may provide further information regarding implementation scenarios under the line cap option.

Although a 50 percent line cap does not explicitly include any trawling up restrictions, it is expected this measure would result in broad scale trawling up so fishermen could fish as many traps of their allocated traps as their individual operations would safely allow under a line allocation. Table 5.2 describes a 50 percent line cap on the average number of buoy lines currently being used across the Northeast Region with the exception of Maine exempt waters where line numbers are not expected to change in either alternative. Upon further consideration, we decided this would be difficult to implement in state waters. As a result, this measure would be restricted to lobster and crab fishermen when fishing in federal waters, leading to an increase in line numbers estimated in Table 5.2 (above) within exempted state waters outside of Maine. However, these State Waters would still achieve risk reduction in both alternatives due to targeted buoy line closures and other line measures that are not currently quantifiable (e.g. eliminating singles on vessels over 29ft). Additionally, Maine DMR (2019) considered a 50% line reduction for Maine permitted fishermen but it did not move forward with this consideration given that, although the large majority of Maine lobster buoy lines are fished in state waters, it is the area of least risk to whales causing an inverse relationship between fishermen impacted and risk reduction. A cap in federal waters to 50% of the average lines fished would likely result in a buoy line reduction closer to 44 to 45 percent given the current level of fluctuation in buoy lines used throughout a fishing year. Complementing restricted areas in areas of predictable whale aggregations, this line reduction would generally be in areas of greater risk to right whales. Furthermore, the most conservative scenario is analyzed in the risk reduction estimate provided from the Decision Support Tool (Chapter 2) with an estimated 44% reduction in line in Federal Waters still achieved well over the 60% risk reduction target.

Our estimate of a 44 to 45 percent reduction in buoy lines in federal waters under a 50 percent line cap is the result of regional variation and our anticipation of a complex response by fishermen to a line cap. Table 5.4 shows the monthly line data when a cap is implemented at a regional scale as well as across all federal fisheries. Implementing a line cap without accounting for variation across all fisheries achieves a near 50 percent reduction in line in federal waters. However, given variation between regions and months, if this was implemented on a regional level (a likely scenario) the actual average monthly line reduction is closer 44 to 45% due to areas with higher variation in monthly line numbers. For LMA Two in particular, where some months had lower line numbers than half of the monthly average, we considered three scenarios to capture a range in responses that could not be assessed through the co-occurrence model. Depending on how vessels respond to this line cap, during months where 2017 line numbers fall below the line cap, vessels could either:

1. Continue fishing at 2017 levels during months where line numbers typically fall below the line cap and only fish at their full halved line allocation level during months they previously fished at high effort.
2. Fish their entire line allocation each month even if they did not previously fish or fished fewer lines in some months. This could make up lost wages in other months.
3. Fish an average number of lines between the line cap and their 2017 line number in months where 2017 effort fell below the line cap, and fish their full allotment of lines.

Table 5.4: A breakdown of the monthly line numbers fished by region in 2017 and the number of lines would be allowed under a line cap in each area. Low, Mid, and High represent the scenarios describes above where, if monthly line numbers fall below the cap, they either remain as is (low), in between the cap and 2017 line numbers (mid), or at the line cap (high). Cells highlighted in dark grey represent possible increases in line numbers during these months. Cells in light grey are those where the number of lines allowed fall below 50 % of the 2017 monthly average. MA = Massachusetts, ME = Maine.

	LMA 2				LMA 2/3		LMA 3		MA LMA 1		ME LMA 1		All Federal Waters	
Month	**2017 Lines**	**Low**	**Mid**	**High**	**2017 Lines**	**50% of Avg**	**2017 Lines**	**50% of Avg**	**2017 Lines**	**50% of Avg**	**2017 Lines**	**50% of Avg**	**2017 Lines**	**50% of Avg**
January	1,061	961	961	961	201	**98**	3,036	1,713	3,261	**1341**	47,728	**22,927**	55,287	**27,040**
February	701	701	**831**	**961**	251	**98**	3,102	1,713	1,834	1341	31,811	22,927	37,699	27,040
March	733	701	**847**	**961**	116	98	2,791	1,713	1,628	1341	34,704	22,927	39,972	27,040
April	1,416	961	961	961	99	98	2,358	1,713	1,869	1341	42,232	22,927	47,974	27,040
May	2,146	**961**	**961**	**961**	135	98	3,029	1,713	2,269	1341	41,213	22,927	48,792	27,040
June	2,684	**961**	**961**	**961**	170	98	4,153	**1,713**	2,026	1341	44,820	22,927	53,853	27,040
July	2,915	**961**	**961**	**961**	167	98	3,913	**1,713**	1,797	1341	44,742	22,927	53,534	27,040
August	3,165	**961**	**961**	**961**	179	98	3,852	**1,713**	2,331	1341	47,366	**22,927**	56,893	**27,040**
September	2,931	**961**	**961**	**961**	244	**98**	3,807	**1,713**	3,277	**1341**	54,484	**22,927**	64,743	**27,040**
October	2,266	**961**	**961**	**961**	317	**98**	4,078	**1,713**	3,644	**1341**	56,454	**22,927**	66,759	**27,040**
November	1,596	961	961	961	228	**98**	3,307	1,713	4,206	**1341**	57,176	**22,927**	66,513	**27,040**
December	1,452	961	961	961	233	**98**	3,692	**1,713**	4,035	**1341**	47,529	**22,927**	56,941	**27,040**
Avg Lines	**1,922**				**195**		**3,427**		**2,681**		**45,855**		**54,080**	
Avg % Decrease		**41.3%**	**38.5%**	**35.6%**		**44.4%**		**48.6%**		**44.3%**		**48.5%**		**48.4%**

Since line caps result in a very large reduction of lines during high effort months, we anticipate the most likely scenario falls somewhere between scenarios two and three, with an increase in use of buoy lines during months that previously had lower fishing effort. This could increase risk in LMA Two when right whales are likely to be in the area. However, the line cap would only be implemented with one of two restricted area options in this area, which would likely help mitigate this potential risk. Where trawling up occurs, the effects are expected to be similar to those described above where heavier gear could be more likely to cause serious injury or mortality if an entanglement occurs but is likely offset somewhat given the overall decrease in risk of entanglement and full weak line or weak inserts are implemented.

Though overall co-occurrence, and associated entanglement risk, is expected to decrease substantially with the implementation of a line cap (Table 5.4), there is additional uncertainty over how the spatial and temporal entanglement risk will change as vertical line use adjusts to the new measures. Monitoring would be essential for tracking these changes. It is possible certain seasons and areas could experience an increase in co-occurrence, but that analysis is currently unavailable. Any increase in risk is expected to be offset somewhat in combination with seasonal buoy line closures.

Indirect

The indirect effects of the requirements described above depend upon whether they would result in an increase in unintended changes in gear lethality, gear conflict, or loss of trawls, with a resulting cost to fishermen and an increase in the risk that whales may become entangled in ghost gear.

Trawling up was required as a line reduction measure in the 2014 buoy line modifications to the Plan and some suggest that the trawling up requirements, effective in June 2015, caused fishermen to replace buoy lines with stronger line at strengths that have been associated more often with serious injuries and mortalities of all age classes (Knowlton et al. 2016, Hayes et al. 2018). If this occurred with these alternatives, it would reduce the benefit of trawling up measures. It is possible that trawling up poses a slightly higher risk of serious injury and mortality to calves moving through the area compared to adults, if one were to become entangled, but a reduction in the number of lines reduces the chances of an interaction occurring, mitigating some of this risk. However, Maine developed the proposed trawling up measures first, through extensive outreach with Maine fishermen to discuss what they could do with existing vessels and gear, including their existing buoy lines. For that reason, NMFS believes that these trawling up measures are not likely to result in changes in buoy line strength that would potentially reduce the effectiveness of line reduction. Note also that weak buoy line toppers and weak insertions, discussed in section 5.2.1.2, would mitigate some of the possible risk of heavier trawls as well.

Fishermen also voiced concerns that longer trawls make it more likely that lobster fishermen operating in close proximity will lay gear across each other’s trawls by mistake, or that mobile bottom trawl net fishermen will trawl their net through a lobster set, both resulting in safety hazards for fishermen. In 2010 and 2011, the Massachusetts DMF completed a comprehensive study of gear loss and “ghost” fishing (i.e., impacts from lost or derelict gear) (NMFS 2014). Their data indicate that rather than exacerbating gear loss, increased trawling requirements may reduce the amount of gear lost and thereby yield an economic benefit to affected fishermen. Furthermore, as mentioned above, the new trawling up measures were designed with input from fishermen regarding how many traps could be accommodated on one trawl using existing lines without overwhelming concern for additional gear loss. Available data assessing how trawling up requirements including increasing the distance between buoy lines in LMA Three could affect gear loss are inconclusive but suggest it is unlikely to increase substantially with the proposed measures.

LMA Three fishermen requested an extension of the distance between buoy lines to 1.75 miles (3.24 km) from 1.5 nautical miles (2.78km) to allow them options to trawl up to 45 pots or more, including an option to increase distance between traps near the ends of the trawl so that if fishing with a weakened buoy line, they will not have additional pots hanging in the water column and requiring more force for hauling. The 1.5 mile (2.78km) distance between buoy lines was originally instituted in 1986 gear marking requirements in Amendment One to the New England Fishery Management Council's Lobster Fishery Management Plan to "allow for visual identification of entire sets, under optimum sea conditions, by mobile gear operators" (NEFMC 1986). In making this request, offshore lobster fishermen did not identify any concerns about increased gear conflicts or gear loss. Radar technology has advanced since 1986. A recent report on gear marking best practices (FAO 2016) does not identify a standard for the distance between radar reflectors on lobster. However, it suggests that spar buoys can be seen by eye from three nautical miles (5.56 km) and further if fitted with a radar reflector. The report recommends that other line of sight position indicators are detectable from a distance of two nautical miles (3.7 km). Detection requires active searches and relies on factors such as sea conditions and the quality and settings of radar detectors. However, modifying the distance between radar reflectors from 1.5 (2.78km) to 1.75 miles (3.24 km) appears to be within standards acceptable with current technology and this measure is not anticipated to increase incidents of gear conflict or gear loss.

5.2.1.1.2 Seasonal Restricted Areas Changed To Buoy Line Closures

Currently, two areas in the Northeast Region are seasonally closed to trap/pot fishing: the Massachusetts Restricted Area and the Great South Channel Restricted Area. Alternative Two and Alternative Three would modify these management areas to allow ropeless fishing by changing the definition from a closure to fishing, to a closure to persistent trap/pot buoy lines. NMFS proposed and accepted comments on this change to the management areas through an Advanced Notice of Proposed Rulemaking (ANPR) published in September 2018 (83 FR 49046, September 28, 2018). This definition change would open up the potential use of these areas for ropeless fishing, and would incentivize fishermen that are currently unable to harvest lobster to participate in the development of methods to remotely retrieve buoys or buoy lines stored on the bottom in a manner feasible during commercial fishing operations. The ability to fish without buoy lines to retrieve gear and allow co-occurring fishermen to detect gear on the bottom to avoid gear conflicts requires testing and development under commercial conditions as well as solutions regarding limited manufacture and high production costs that keep the technology out of the reach of most lobster and crab fishermen. Testing and adaptation under commercial fishing conditions is necessary to accelerate development of ropeless solutions so that it becomes an alternative to broad seasonal area closures should additional risk reduction be needed. While the risk of ropeless fishing in areas of whale aggregations may be higher than the risk of closures in the short-term, there are long-term benefits to the accelerated development of gear that protects right whales and supports healthy lobster and Jonah crab fisheries.

To reduce potential risks in the short term, conditions can be placed on fishing. Interested fishermen would have to obtain authorization to fish without surface buoys and other surface gear. The federal lobster regulations promulgated pursuant to the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA), at 50 CFR Part 697.21 requires buoys (with identification marking) and for larger trawls, radar reflections on each end of trawls of lobster pots to insure other fishermen and mariners know that there is fishing gear on the bottom between the surface systems. Similar regulations for bottom tending fixed gear have been implemented for New England and Mid-Atlantic fisheries managed pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), at 50 CFR 648.84. Until remote surface detection technology is available and required on all fisheries that occur on the same fishing grounds, allowing revision of those regulations, they remain necessary to prevent gear conflicts and so ropeless fishing will require authorization or exempted fishing permission from states or NMFS. While surface marking is required, applicants for an exemption to those requirements will be required to provide details on their operations, including objectives, reporting and monitoring plans, and a description of possible environmental impacts including anticipated impacts on marine mammals or endangered species. A few fishermen from the South Shore of Massachusetts that have experimented with ropeless gear outside of the seasonal closure have continued to express interest in fishing with ropeless gear in the Mass Restricted Area under an exemption to the surface marking requirements. Other fishermen currently experimenting with ropeless fishing technology in offshore fisheries areas have not expressed interest in fishing within current seasonal restricted areas. We anticipate that this modification to the closed areas would likely result in very low level of lobster fishing during the seasonal restricted periods using ropeless retrieval or other ropeless systems under an exempted fishing permit or state authorization that includes risk reduction conditions.

Direct

Both Alternatives Two and Three propose additional seasonal management areas which would allow ropeless fishing but be closed to lobster and crab trap/pot fishing with persistent buoy lines; allowing fishing with ropeless gear under an exempted fishing permit. These closures to buoy lines would further reduce the amount of buoy line in the water during seasons that have been used by aggregations of North Atlantic right whales. The seasonal buoy line closure areas proposed in Alternative Three is more extensive in time and space than Alternative Two. As indicated in Table 5.5, the spatial and temporal risk reduction measures considered in the alternatives achieve co- occurrence scores with North Atlantic right whales of greater than 69.1%. Although co- occurrence scores are higher in Alternative Three, both Alternatives appear to reduce co- occurrence significantly in the months and areas where right whales and lines are most likely to overlap. Closures where buoy lines are fully removed offer slightly higher co-occurrence reduction, most notably in areas where right whales are likely to be aggregating. Humpback and fin whale co-occurrence scores are also provided in Tables 5.6 and 5.7, demonstrating some co-occurrence and resulting favorable protection, although to a lesser extent than for right whales.

Table 5.5: Right whale co-occurrence scores by month for each alternative scenario, including Alternative 1 (i.e. Baseline). All changes in co-occurrence include the combined changes due to gear configurations and areas closed to persistent buoy lines. Two different scenarios were considered for buoy line closures: all lines are fully removed (the upper bound or larger decrease in co-occurrence) or all lines are relocated outside of a restricted area (lower or larger decrease in co-occurrence). Numbers in bold represent predicted increases in co-occurrence.

		Alternative 2		**Alternative 3a**		**Alternative 3b**	
Month	**Baseline**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**
January	2,492	2,018	2,018	1,248	1,248	1,248	1,248
February	1,992	1,569	1,598	201	201	787	840
March	2,324	999	1,014	3	11	340	380
April	18,243	14,381	14,406	5,377	5,582	7,123	7,488
May	94,324	12,505	12,505	2,139	2,263	2,196	2,323
June	548	420	420	226	**3,284**	226	**3,284**
July	116	90	90	85	85	85	85
August	5,032	4,079	4,079	2,516	2,516	2,516	2,516
September	1,856	1,486	1,486	927	927	927	927
October	165	91	91	55	55	55	55
November	6,997	2,231	2,231	1,728	1,728	1,728	1,728
December	4,111	2,703	2,703	1,514	1,514	1,514	1,514
Total Co-Occurrence	**138,199**	**42,572**	**42,641**	**16,020**	**19,414**	**18,745**	**22,389**
% Decrease		**69.2%**	**69.1%**	**88.4%**	**86.0%**	**86.4%**	**83.8%**

Table 5.6: Humpback whale co-occurrence scores by month for each alternative scenario, including Alternative 1 (i.e. Baseline). All changes in co-occurrence include the combined changes due to gear configurations and areas closed to persistent buoy lines. Two different scenarios were considered for buoy line closures: all lines are fully removed (the upper bound or larger decrease in co-occurrence) or all lines are relocated outside of a restricted area (lower or larger decrease in co-occurrence). Numbers in bold represent predicted increases in co-occurrence.

		Alternative 2		Alternative 3a		Alternative 3b	
Month	**Baseline**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**
January	1,392	1,113	1,113	683	683	683	683
February	1,063	885	885	535	535	535	535
March	578	453	455	543	543	562	567
April	5,154	4,069	4,080	2,410	2,426	2,643	2,668
May	55,559	15,872	15,872	4,327	4,952	4,908	5,566
June	114,882	112,849	112,849	56,998	59,106	56,998	59,106
July	14,183	13,807	13,807	7,040	7,164	7,040	7,164
August	9,485	7,682	7,682	4,707	4,707	4,707	4,707
September	47,437	34,509	34,509	23,725	23,725	23,725	23,725
October	23,406	22,829	22,829	11,715	11,715	11,715	11,715
November	45,723	41,388	41,656	22,031	22,216	22,031	22,216
December	14,350	12,862	12,862	7,075	7,075	7,075	7,075
Total Co-Occurrence	**333,209**	**268,318**	**268,599**	**141,790**	**144,848**	**142,623**	**145,728**
% Decrease		**19.5%**	**19.4%**	**57.4%**	**56.5%**	**57.2%**	**56.3%**

Table 5.7: Fin whale co-occurrence scores by month for each alternative scenario, including Alternative 1 (i.e. Baseline). All changes in co-occurrence include the combined changes due to gear configurations and areas closed to persistent buoy lines. Two different scenarios were considered for buoy line closures: all lines are fully removed (the upper bound or larger decrease in co-occurrence) or all lines are relocated outside of a restricted area (lower or larger decrease in co-occurrence). Numbers in bold represent predicted increases in co-occurrence.

		Alternative 2		**Alternative 3a**		**Alternative 3b**	
Month	**Baseline**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**	**Lines Out**	**Relocation**
January	11,071	8,293	8,293	5,447	5,447	5,447	5,447
February	790	666	666	437	437	437	437
March	735	527	527	390	390	390	390
April	11,697	10,223	10,237	5,918	6,082	6,001	6,015
May	39,579	12,481	12,481	5,334	5,782	5,687	6,198
June	19,424	16,820	16,820	8,415	8,778	8,415	8,778
July	22,283	19,539	19,539	10,688	11,231	10,688	11,231
August	15,164	13,850	13,850	7,258	7,258	7,258	7,258
September	35,059	26,045	26,045	17,542	17,542	17,542	17,542
October	313	224	224	158	158	158	158
November	10,513	9,669	9,669	5,295	5,295	5,295	5,295
December	10,874	9,589	9,589	5,643	5,643	5,643	5,643
Total Co-Occurrence	**177,502**	**127,926**	**127,940**	**72,525**	**74,044**	**72,961**	**74,393**
% Decrease		**27.9%**	**27.9%**	**59.1%**	**58.3%**	**58.9%**	**58.1%**

Alternative Three would require more closures to fishing with persistent buoy lines and for longer periods of time and therefore, offers the greatest reduction of co-occurrence, assuming lines are not relocated. Alternative Two and Alternative Three both propose several new seasonal buoy line restricted areas. Both include an LMA One Restricted Area during fall and winter months (October through January) with a month-long extension in Alternative Three. Alternative Three would require an additional buoy line closure area in George's Basin core area (May through August). Alternative Two includes consideration of measures proposed by Massachusetts to continue monitoring and close state waters in Cape Cod Bay and the Outer Cape until the end of May or until no more than three whales remain in those areas. Alternative Three proposes an extension of the federal closure to buoy lines throughout the Massachusetts Restricted Area through May. The area could be opened by NMFS if monitoring confirmed that right whales had left the buoy line closure area. Similarly, the LMA One Restricted Area would be closed for an additional month as a soft restricted area that could be relieved by aerial or acoustic survey confirmation that there were no right whales within the buoy line closure areas.

Additionally, there are three options between the two action alternatives for a seasonal buoy line closure south of Cape Cod that extends the Massachusetts Restricted Area into the South of Nantucket Restricted Area from February through April. The option offered in Alternative Two was proposed by the state of Massachusetts and is the smallest of the three restricted areas. Alternative Three offers two larger, more substantial restricted areas that would likely offer additional protection to areas below Marthas' Vineyard where whales have frequently been sighted by Northeast Fisheries Science Center surveys between 2014 and 2018 (S. Hayes, Pers. Com.). Alternative Three A offers the larges option for restricted areas. This was created using sightings and habitat data available to encompass all of the likely hot spots based on whale presence as well as the presence of suitable right whale habitat. This area would include the option to be modified if data were available to reduce the size of the area according to recent data. This option offers the greatest protection to right whales because it has the potential to close a substantial area known to be used by right whales. The third option (Alternative Three B) is an L-shaped restricted area that encompasses the densest area of whales sighted between 2017 through March 3, 2020. This area was also mapped against data starting in 2020 to check for robustness to annual variation. This last restricted area option likely offers an intermediate to large protection for right whales because, though it is not as large as Alternative Three A, it did encompass the areas of high right whale density across several years and is somewhat robust to annual variation.

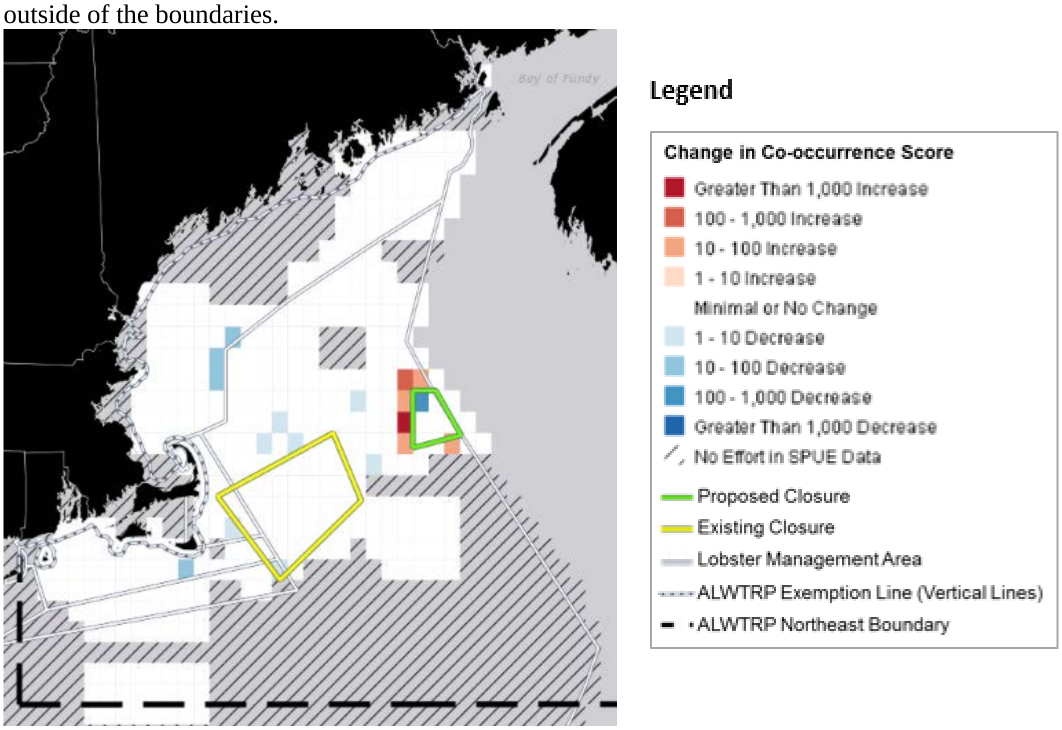
Impacts caused by modifying the definition of the existing seasonal restricted areas (Massachusetts and Great South Channel Restricted Areas) are anticipated to be very small because fishing under the new definition would be limited and conditional under exemptions to gear marking requirements. After the ANPR was published, a cost benefit analysis of a short term exempted fishery in the restricted areas was conducted (Black et al. 2019). The analysis considered primarily qualitative information gained from interviews with stakeholders in 2018. Interviewees included a lobster fisherman and representative that were targeted because they had expressed the most interest in developing alternatives to the fishery closures, particularly in Massachusetts Bay. At that time, industry representatives interviewed estimated that approximately eight to twelve fishermen from the South Shore of Massachusetts might consider applying for an authorization or an exempted fishing permit to explore ropeless fishing under commercial conditions in the closure area. In addition to operational challenges, the high cost of ropeless systems, at that time estimated to range from over $55,000 to over $240,000 per vessel, was identified as a constraint although support by ropeless developers, NMFS and NGOs was considered likely to defray costs during initial efforts. Additional constraints related to time, costs, and logistics associated with permitting, data collect, monitoring and reporting were also identified.

Ropeless research in the lobster fishery has occurred since that analysis was done. In 2019, the New England Aquarium initiated a study under an exempted fishing permit outside of the Take Reduction Plan closure areas. Additionally, NMFS has begun assembling ropeless gear to loan to fishermen and researchers, and is working with a handful of fishermen, with the support of environmental organizations, to test ropeless fishing under an exempted fishing permit. A few Massachusetts lobster fishermen have conducted trials with ropeless fishing technology outside closure areas and therefore have some understanding of operational issues associated with the technologies. In most of the work done to date, the high costs of the technology has not been borne by the individual fishermen. While these efforts demonstrate a growing interest in developing ropeless fishing, they also suggest that modifying the closure areas would not result in a large influx of fishermen into currently closed areas, especially if they are required to purchase ropeless systems themselves. Any increased testing of ropeless systems, though, could accelerate the timeline for feasibility of ropeless technologies, providing a long- term benefit to right whales and other large whales and to the trap/pot fisheries that operate in close proximity to them. NOAA has invested a substantial amount of funding in the industry's development of ropeless gear, in specific geographic areas and in general. We anticipate that these efforts to facilitate and support the industry's development of ropeless gear will continue, pending appropriations.

The effects of additional seasonal buoy line closure areas in Alternatives Two and Three vary, yet all would benefit right whales and may benefit fin whales and humpbacks. Restricted areas were analyzed two ways. First, it was assumed that 100% of the vessels would suspend fishing. We know from existing closures that this is more likely for nearshore restricted areas, when fishermen would have a long steam to open areas and some fishermen, without federal permits, are restricted in area choices. However, in offshore restricted areas or for fishermen with federal permits, some fishermen would be able to move their lines. Another co-occurrence analysis was done that assumed that some of the vessels would continue to fish and would relocate lines to nearby available areas. The percent change in co-occurrence varies by alternative based on the total estimated buoy line reduction due to trawling up or line caps, by estimated whale abundance, and, finally, by assumptions regarding displacement or suspension of fishing. The true effect of these restricted areas on the amount of vertical line in the area is most likely within the range of these two responses (e.g. lines out vs. relocation, Table 5.2, 5.5 – 5.7). The effects of each of these two scenarios differs slightly depending on how co-occurrence changes whale entanglement risk. When fishing is suspended or ropeless technologies are employed and lines are removed from the water entirely, there is a large decrease in co-occurrence and, as a result, a reduced risk of entanglement. If instead lines are moved to different areas, co-occurrence could decrease or increase depending on where lines are relocated. In some cases, restricted areas could increase risk if the restricted area leads to fencing of buoy lines around the area. As described in Chapter Three, restricted areas were picked based on scenarios that are more likely to result in a net decrease in north Atlantic right whale co-occurrence. Given recent changes in right whale distribution, continued monitoring is necessary to confirm how these measures change buoy line density and co-occurrence.

Though overall right whale co-occurrence decreased, there was a notable large increase in co-occurrence predicted in June when lines are relocated as a result of a restricted area (Figure 5.2, all monthly maps are available in Appendix 5.2). This is largely from relocated lines moving just outside the Georges Basin Restricted Area during summer months creating a fencing effect around this area. June is currently one of the months with the lowest monthly right whale co-occurrence estimate. The increased co-occurrence in June is still below the estimate for April (one of the highest risk months in US waters in terms of co-occurrence) in the same scenario and lower than most baseline months. Otherwise, north Atlantic right whale entanglement risk is expected to decrease, similar to co-occurrence, region wide throughout the year under the seasonal buoy line closure areas in Alternatives Two and Three.

Figure 5.2: The change in right whale co-occurrence in the month of June predicted with implementation of Alternative Three. The area outside of the proposed restricted area in green shows an increase in co-occurrence just outside of the boundaries.



The multiple restricted area proposed in Alternatives Two and Three could also result in local conservation benefits to other large whales, though to a lesser degree than north Atlantic right whales. All large whale species included in this VEC can occur within the proposed restricted areas at times (CETAP 1982), particularly the restricted areas proposed south of Cape Cod (Stone et al. 2017). As described in Chapter Three, the restricted areas were designed and selected using either estimates of right whale habitat density based on a long time series of sightings normalized over the area applying oceanographic characteristics (the "Duke" habitat model) or, in the case of the restricted area south of Nantucket, using more recent sightings per unit effort data between 2014 and 2018 (NARWC 2019) that was not captured in the habitat density model (the SPUE model). Despite the direct intention to focus on right whale hot spots, fin, humpback, and minke whales likely experience a slight benefit from these restricted areas as they are sometimes present in these areas during the restricted area times (CETAP 1982, Stone et al. 2017). Co-occurrence of humpback and fin whales is predicted to decrease throughout the year in Alternatives Two and Three (Table 5.5), with a larger reduction predicted with Alternative Three. Lines out restricted areas would likely have a beneficial impact on overall entanglement risk due to slightly larger decreases in co-occurrence in lines out scenarios within Alternative Three (the alternative with the most restricted areas). However, under the relocation scenarios, certain areas may experience an increase in co-occurrence where gear is expected to move to areas of higher whale density along the border of the restricted area, though the predicted increases are likely to be relatively small. Overall, co-occurrence of large whales with buoy lines and associated entanglement risk will likely decline substantially when paired with the other line reduction measures discussed above.

Indirect

Proposed seasonal restricted areas that are closed to persistent buoy lines could have indirect beneficial effects on large whales by tempering the possible expansion of trap/pot fisheries into areas of whale co- occurrence. Any vessels entering into these fisheries would be subject to the seasonal buoy line closure of the restricted areas or to obtaining conditional experimental fishing permits to allow them to fish with ropeless gear, such as remotely triggered buoys that bring line stored on the bottom to the surface at retrieval time. Further development of operational ropeless fishing systems would have indirect positive effects through the potential future conservation benefits of technology informed and accelerated by experienced commercial fishermen’s use under commercial fishing operations.

Testing of ropeless gear, particularly in test phases, could indirectly contribute to ghost gear that pose an entanglement risk. It is assumed that gear loss from ropeless equipment failure would be small given fishermen are more likely to test gear that have lower gear failure rates and gear loss has not yet been reported in testing conducted by the Northeast Fisheries Science Center. Additionally, most ropeless systems incorporate a transponder or other technology that provide fishermen with location information. Fishermen would be able to reclaim gear through grappling, further reducing the amount of abandoned gear in the environment and a collateral benefit to fishermen who already lose gear due to storms and gear conflicts.

The trap/pot buoy line closures could also have negative indirect effects if fishing effort is relocated just outside of the restricted areas adjacent to valuable whale habitats. This relocated effort may result in a wall of fishing gear, which would increase risk of entanglement risk as whales move in and out of these management areas.

Another potential indirect effect of an increase in ropeless fishing could be increased vessel traffic in areas with high whale densities. Right whales in the Massachusetts Restricted Area are vulnerable to vessel strikes. Vessels 65 feet (19.8 m) and larger operate under seasonal speed reductions of 10 knots or less in Cape Cod Bay from January 1 to May 15th, and along the Outer Cape from March 1 to April 30th. Despite these restrictions, since 2009 there have been eight known vessel strikes in or near Cape Cod Bay: two mortalities, one significant injury, and 5 additional injuries (Caroline Good, Pers. Comm.). It is unclear whether this was due to non-compliance of the speed restrictions or that the current restrictions are insufficient to protect north Atlantic right whales. Based on discussions with fishermen, we do not anticipate more than a few fishermen would operate in the buoy lineless area in Massachusetts Bay under exempted fishing permits until ropeless fishing gear becomes affordable and effective at marking buoyless gear for fixed and mobile gear fishermen and other mariners. Fishermen operating under an exemption will likely not increase vessel traffic above the current baseline during these months. However, to prevent an increased risk of vessel strikes, any ropeless fishing occurring under an exemption to the surface marking requirements during the seasonal closure to buoy lines and the seasonal speed reduction areas, regardless of vessels size, can be restricted under permit conditions to transit speeds of 10 knots or less, have a designated observer on board looking for whales, and be in contact with the Center for Coastal Studies or other contracted aerial survey teams to ensure knowledge of the most recent information about right whale distribution. Authorization may not be given for areas of particular high right whale abundance. Both Massachusetts DMF and NMFS may be involved in developing conditions for ropeless fishing in these areas and the Take Reduction Team will be apprised of outcomes at an annual monitoring meeting. Generally, indirect effects of seasonal buoy line closures are expected to be minimal.

Reviewers are asked to comment on the appropriateness of the seasonal restricted areas. Commenters that believe these additional restricted areas are not warranted to achieve PBR should provide specific information or analysis in support of recommended removal of restricted areas from the analyzed alternatives. If NOAA receives information indicating that we can achieve the 60% risk reduction without new restricted area(s), we would consider eliminating them from rulemaking. Additionally, if commenters believe that information will be available after issuance of the final rule on this topic, commenters should articulate the nature of that information, how the information might affect the decision, and propose a mechanism for evaluating that information in determining whether or not to continue with the restricted area(s).

5.2.1.2 Changes to Weak Link Requirements

Direct

As discussed in Section 3.1.2.2.1, ALWTRP measures include incorporation of weak links or weak rope to create breakaway buoy lines on fixed commercial fishing gear. Prescriptive breaking strengths by fishery and area were created after field testing to determine operational feasibility. The use of breakaway buoys or weak buoy lines were required because “. . . this measure would reduce the potential for a whale to become wrapped in the buoy line and sustain serious injury or mortality from either the buoy line itself or from dragging the whole lobster pot trawl (62 FR 16108, April 4, 1997).” This modification recognized the observation that line through the mouth of a baleen whale appeared to be one of the more frequent forms of entanglement (Knowlton & Kraus 2001). Entanglement involving baleen results in more complicated outcomes through persistent entanglements that can reduce feeding efficiency and increase the chance of a serious injury or mortality. Where an entanglement happens near the surface system of a buoy line, weak links may improve the outcome by allowing buoyless line to slip through the baleen in some cases. In gillnet gear, the placement of weak links in multiple places around gillnet panels appears to frequently allow right whales and other large whales to break through without serious injury but outcomes from trap/pot buoy lines are less clear.

For all large whale entanglement cases between 2010 and 2018 where a whale was entangled but the gear was not recovered, 38 percent had buoys still attached, suggesting a weak link was not present or the whale was not always able to break the weak link (Moise personal communication, April 9, 2020). There are a small number of cases including one observed in 2020 that demonstrate that buoys may complicate entanglements that involve the mouth or baleen. However, even where no buoys are involved, right whales and other large whales entangled at the mouth are often still left with constricting rope that can seriously impact their health and ability to feed. Disentanglement team members suggest that trailing gear that includes a buoy could aid disentanglement teams in grappling and pulling gear away from a whale or attaching a tracking buoy to facilitate tracking and further disentanglement attempts. Additionally, buoys could help whales shed gear by providing resistance against the water, pulling line away from a whale. Additionally, commercial fishing buoys are marked with identifying information that can help pinpoint the location of entanglement events if retrieved.

For these reasons, comments are invited on Alternative Three, an option to remove the weak link requirement for lobster/crab trap buoy lines that use weak rope or weak insertions further down on the buoy line. Discussed further below, a weak buoy line would likely do more than a weak link at the buoy to allow a whale to break away from a crab or lobster trawl and minimize entanglement severity and reduce serious injuries and mortalities. Additionally, Alternative Two, proposed by a Take Reduction Team member, would allow the currently authorized weak links to be placed at the bottom of the surface system as an alternative to the current requirement for the link to be at the buoy itself. Surface systems sometimes include two or more lines connecting buoys and radar reflector to the buoy line used to haul gear aboard. Public comments on these two alternatives would provide valuable insights on the disentanglement and fishing operational benefits to these potential modifications to the Plan.

Indirect

Weak link requirements have been implemented under previous ALWTRP initiatives, and the NMFS Gear Research Team reports that they have received few comments regarding problems with the failure of any of these devices. The NMFS Gear Research Team has conducted a series of research projects that measured the loads exerted on buoy systems when used in typical conditions at different locations (NMFS 2002a, 2003). Allowing an option to move the weak link to below the surface system (Alternative Two), or to remove the weak link at the buoy if weak rope or weak inserts are introduced to the buoy line lower down (Alternative Three) are not likely to indirectly affect large whales through gear loss but could provide fishermen with operational improvements. Input from fishermen and disentanglement responders from public comments would be useful on this element. Providing an option to move the weak link should minimize the amount of gear loss but it will be important to follow up after regulations are implemented to see whether gear loss rates have changed.

5.2.1.3 Weak Rope

Weak rope requirements are designed to increase the chance that a whale will quickly break free of gear, and reduce the number of interactions between whales and commercial fishing gear that result in a serious entanglement (i.e., results in serious injury or mortality). As previously noted, buoy lines have been identified as a source of entanglement risk. The requirement to weaken the strength of vertical lines is specifically designed to reduce serious injury or mortality as a result of interactions with buoy lines and surface systems. The theory is that the combination of the whale's momentum and the force it exerts against the weight of the gear, or the force exerted across a line entangled around the whale in particular entanglement scenarios (e.g. if the whale is entangled through its mouth and tail stock), will cause the force to increase until the rope or weak insertions break the line, allowing whale to break free of some gear. Replacing buoy lines with rope that breaks at less than 1700 lbs. (771.1 kg), a weak rope topper of 20 to 75 percent of the length of the buoy line, a weak buoy line or topper with weak inserts at 40 foot (12.2 m) intervals, or fewer weak inserts into full strength line all, to varying degrees, increase the likelihood that a whale will break away from a buoy line before sustaining more serious injuries or dying from the impacts of entanglement.

Alternatives Two and Three take different approaches to reducing line strength and our analysis considers how these differ in how they relate to research on the likely effectiveness of full weak rope. The theory behind weak rope is based on the observed strength of lines taken off of entangled whales associated with serious injuries and mortalities. Rope remaining on right and humpback whales included disproportionately (relative to availability in the environment) higher rope strengths, suggesting these species could break free from lighter line (Knowlton et al. 2016). During ALWTRT presentations and Team discussions, researchers suggested that, in lieu of fully manufactured weak rope, inserts of the same breaking strength at 40 foot (12.2 m) intervals would ensure sufficient breaking points to allow a whale to break free. The proposed distance of every 40 feet (12.2 m) is just less than the average length of an adult north Atlantic right whale, increasing the likelihood that a whale interacting with a line would encounter a weak spot. In the hope of being able to re-enter the Mass Bay Restricted Area, fishermen that belong to the South Shore Lobster Fishermen's Association developed a hollow braided sleeve that breaks at less than 1700 lbs. (771.1 kg) that they can rapidly splice into a buoy line, and proposed inserts at every 40 feet (12.2 m). A comparison of these lines to other buoy lines used by Massachusetts fishermen showed comparable performance during commercial fishing operations (Knowlton et al. 2018). Insertions every 40 feet (12.2 m) would be somewhat labor intensive for fishermen in deep waters, prompting New England states to propose fewer weak insertions. However, the broad regional use of weak rope in buoy lines, or frequent weak inserts increases the likelihood that an entanglement would include a point where a whale can exert sufficient force needed to break the line and potentially avoid more severe injuries.

Alternatives Two (Preferred) and Three (Non-preferred) would require the use of weak line or weak inserts with breaking strengths of 1700 lbs. (771.1 kg) or less. Engineered weak line that breaks at 1700 lbs. (771.1 kg) or less are available in commercial quantities at line diameters of 3/8ths (0.95 cm) and 5/16ths inches (2.1 cm), commonly used in lobster and crab trap/pot fisheries in nearshore waters. NMFS is working with gear manufacturers to determine if these lines can be produced with one strand of alternating color included to assist in the detection of engineered weak line since much stronger line is also available at these diameters. Weak insertions can be as simple as splicing in the South Shore Sleeve, or splicing in a length of this weak rope. Additional weak insertions are being proposed by lobster fishermen and tested, primarily by Maine DMR through a NMFS grant. Interim results show some solutions that use relatively inexpensive commercially available materials (MEDMR 2020). Offshore vessels are configured to use lines of larger diameters. The American Offshore Lobster Association is working with NMFS and gear manufacturers to find engineered line of 5/8ths or other larger diameters that breaks at 1700 lbs. (771.1 kg) and can work with their hauling block. Offshore fishermen are testing acquired line as weak inserts and toppers. NMFS will continue to work with gear manufacturers and distributors as well as the states and commercial fishermen to ensure that weak rope and insertion is available at commercial quantities well before the effective date of final regulations.

Compared to Alternative One (No Action), Alternatives Two and Three would reduce the maximum breaking strength of the equivalent of 31 to 75 percent of full weak buoy lines (i.e. manufactured weak line or an insert at least every 40 feet/12.2 m of the entire line) in Maine Exempt Waters (to be implemented and regulated by Maine MDR) and 26 to 73 percent in all other areas within the Northeast Region (to be included in the proposed rule, Table 5.8). This would introduce weak rope or weak spots in buoy lines to reduce the likelihood that interactions between whales and commercial fishing gear will result in entanglements that cause serious injury or mortality. Alternative One would maintain the status quo, and the potential for entanglements to result in serious injury and mortality would not be decreased. The primary difference between weak rope requirements in Alternative Two (Preferred) and Alternative Three (Non-preferred) is that Alternative Two relies primarily on weak inserts and at intervals that do not simulate full weak rope (except in shallow waters where inserts would be placed every 40 ft/12.2 m); whereas Alternative Three requires more weak insertions or the use of lengths of engineered weak rope.

There are two nearly equivalent weak line options of interest being analyzed for LMA Three within the non-preferred alternative (Alternative Three; Table 5.8). Option One is a year- round weak rope on the top 75 percent of the buoy line on one end of each trawl. Allowing the bottom 25 percent of the linbe to be composed of line that breaks above 1700 lbs recognizes that, at low tide and calm wave conditions, the lower portion of the line comes into contact with the ocean bottom causing wear and chafing that requires a heavier line. Option Two includes one weak end in the top 20 percent of the buoy line all year round and the other end weak in the top 75 percent of the line from May through August. The following discussion further explores the potential direct and indirect effects of these standards.

Table 5.8: The annual sum of lines fished across all months corrected to reflect the relative number of full length lines would be converted to full weak line or the equivalent (i.e. inserts every 40ft/12.2 m or less) for each alternative (e.g 100 ropes with weak line in the top 75% of the line weaken the equivalent of 75 full lines). Alternative One is not included because line strength is not explicitly managed at this time. There are two different scenarios provided regarding what happens to lines in the event of a restricted area: lines are fully removed or relocated. Alternative Three further includes two different options for weak line in LMA Three: option one is a year-round 75% topper made of full weak line on one end and option two is year-round 20% topper made of full weak line on one end, with a 75% topper on the other buoy line from May through August.

	Alternative:	***2***	***2***	***3a***	***3a***	***3b***	***3b***
Area	***Restricted Area Scenario:***	***Lines Out***	***Relocation***	***Lines Out***	***Relocation***	***Lines Out***	***Relocation***
Maine Exempt Waters	**Total Weakened Line**	1,276,741	1,276,741	3,022,376	3,022,376	3,022,376	3,022,376
	Total Lines	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835
	Proportion Weakened	**31.7%**	**31.7%**	**75.0%**	**75.0%**	**75.0%**	**75.0%**
Outside Maine Exempt Waters	**Area 3 Scenario**	**-**	**-**	**Option 1/ Option 2**	**Option 1/ Option 2**	**Option 1/ Option 2**	**Option 1/ Option 2**
	Total Weakened Line	457,779	458,077	776,123/ 770,747	783,028/ 777,814	776,995/ 771,571	783,573/ 778,358
	Total Lines	1,718,264	1,725,817	1,050,711/ 1,050,711	1,061,148/ 1,061,148	1,052,025/ 1,052,025	1,061,874/ 1,061,874
	Proportion Weakened	**26.6%**	**26.5%**	**73.9%/ 73.4%**	**73.8%/ 73.3%**	**73.9%/ 73.3%**	**73.8%/ 73.3%**

Direct

The alternatives included in this analysis were selected based on the approximate risk reduction estimated for weak line in the Decision Support Tool, which used an empirically-based gear threat model that compares an individual whales' likelihood of retaining gear of different strengths (see Appendix 3.1). The model predicts that whales are significantly more likely to be observed with gear attached as the breaking strength increases (Appendix 3.1). The probability of lethality also increases with breaking strength given the available data (Appendix 3.1, Figure 4.7.3a). These findings are in line with similar analyses showing no entangled adult right whales found in line that break at 1700 lbs. (771.1 kg) or below (Knowlton et al. 2016). Thus, broader use of line with a maximum breaking strength of 1700 lbs. (771.1 kg) should reduce the number of observed adult right whales entangled in heavy gear and the overall lethality of the gear in the Northeast Region trap/pot areas. Calves may not experience the same benefit given they may be less able to break line of the same breaking strength as adult whales.

The components of Alternatives Two and Three that would require full weak rope buoy line or the equivalent (weak insertions every 40 feet/12.2 meters) offer the most direct benefit to whales by reducing likely entanglement severity, e.g. one end of nearly full weak line or, for example, or two weak inserts in areas where the average depth is 40 feet (12.2 meters).

Weak buoy lines, particularly in areas with deep waters, waters with high currents, storm wavers, large tidal ranges, or high chance of gear conflicts, have a high likelihood of breaking upon retrieval or snapping due to other conditions, therefore requiring all buoy lines to be completely weak would result in increased lost gear and potential safety risks to fishermen.
Therefore, the alternatives, taken from proposals from New England state fishery management agencies, include other strategies that provide a few weak points. Generally, these requirements are for nearly all rope and would be required in areas or seasons of relatively low whale abundance. Such universal requirements would provide a precautionary measure to right whales outside of their predictable aggregation areas and would protect large whales across the Northeast Region.

However, whales that encounter buoy lines below weak rope or weak inserts are not likely to benefit from these modifications. Where the number of proposed inserts decreases as water depth increases (e.g. in Alternative Two in areas outside of 12 nmi/22.2 km), there is more risk reduction benefit than for a full-strength rope as whales encountering line above the break should be able to break free and would have an increased chance of shedding gear without serious injury/mortality, but the risk reduction benefit is not the equivalent of a full weak line. Although telemetry data are not available for North Atlantic right whales over deep waters off the continental shelf edge, current evidence suggests right whales use the entire water column to search for food and that they frequently interact with the seafloor (Baumgartner et al. 2017, Hamilton and Kraus 2019). That is, right whales can encounter buoy lines at all depths. The amount of protection a few inserts near the upper 35 to 50 percent of the buoy line offers is far less risk reduction than that of a full weak line or line with continuous 40 foot (12.2 m) interval inserts to the sea floor. A right whale or other large whale encountering rope above a weak point has a greater likelihood of breaking free from bottom gear as the whale exerts force against the weight of the trap/pots and anchor below. Depending on the length of time it takes for a whale to break free and the associated complexity of the entanglement, these weak inserts would reduce the risk of serious injury or mortality. However, if the whale encounters the rope below the lowest weak point, there would likely be no benefit given the lack of a weak point between a whale and the heaviest gear component. This scenario would still likely result in a whale dragging heavy gear or drowning below the surface. Drag can result in serious injury and mortality (van der Hoop et al. 2016, van der Hoop et al. 2017a, van der Hoop et al. 2017b). Serious entanglements can cause death in up to 6 months (Moore and van der Hoop 2012). Chronic entanglements with gear retained and dragging can also contribute to lower birth rates (Moore and Browman 2019). For some areas where fewer weak points are proposed or where weak inserts are not far down the buoy line (e.g. beyond 12 nautical miles/22.2), co-occurrence is higher between buoy lines and right whales relative to nearshore Maine waters, further reducing the risk reduction benefit in these areas.

There also may be reduced benefit depending on how weak insertions are configured and how a whale interacts with the line. The greater the number of weak points the greater the likelihood that a weak point will be located outside of the mouth, where the whale has a better chance of breaking free from the buoy line. Line through the mouth of a baleen whale is thought to be one of the more frequent forms of entanglement (Knowlton and Kraus. 2001) and involvement with baleen results in more complicated and persistent entanglements that can reduce feeding efficiency and increase the chance of a serious injury or mortality. Configurations that are knot-free may also pose less risk. Currently, the Plan recommends the use of gear that is knot-free, and/or free of attachments due to the belief that smooth line may be more likely to slide through the whale's baleen without becoming lodged in the mouth or elsewhere and increasing the possibility of serious injury or mortality risk. Weak insertions that depend on large knots could potentially get caught in baleen if an entanglement occurs. Note, however, that there is evidence that splices and knots introduce weaknesses into buoy lines. Lines undergoing breaking strength testing broke on the smaller side of knots and splices (MEDMR 2020). Configurations for weak insertions currently being developed by fishermen are likely to include some with knots. Further evaluation may be needed before adding knotted configurations to a list of approved weak insertions.

Both Alternatives Two and Three aim to reduce the severity (i.e. serious injury or mortality) of future entanglements while maintaining safe conditions for fishermen without increasing gear loss. The alternatives offer different approaches that are expected to reduce the risk of serious entanglement for large whales relative to the status quo (Alternative One), particularly for North Atlantic right whales and humpback whales (Knowlton et al. 2016) but also potentially for fin whales (Arthur et al. 2015). Knowlton et al. (2016) reported that age plays a role in a right whale's ability to break free of rope and that adults may be better able to break free from ropes of lower breaking strength than ropes of greater breaking strength so these measures may benefit adults more than calves or juveniles. Smaller species like minke whales and leatherback turtles are not expected to benefit from weak rope given they are frequently found entangled in rope of lower strengths and likely do not exert forces strong enough to allow disentanglement (Arthur et al. 2015, Knowlton et al. 2016). While Alternative Three may offer higher risk reduction from weak rope than Alternative Two (Table 5.6), they both offer some precautionary benefit to some large whales in some life stages in the event of an entanglement.

Indirect

The installation of weak rope could increase the rate of gear loss that could increase the risk that whales could become entangled in ghost gear. In a study of weak inserts conducted by New England Aquarium for the Massachusetts Office of Energy and Environmental Affairs, Knowlton et al. (2018) documented sleeves designed with reduced breaking strength breaking in only 11.8% of hauls relative to 8.5% of control buoy lines, which they did not find statistically significant. Information from Maine DMR studies of measured forces during gear hauling indicates that the proposed scenarios are appropriate for the areas and conditions where they are to be used (MEDMR 2020). While forces greater than 1700 lbs. (771.1 kg) breaking strength were required, particularly for trawls of 35 traps and more in waters greater than 50 fathoms (91.4m, (MEDMR 2020), timed haul data indicated those higher forces were not detected on the line until well past the halfway time during a haul (for example, Figure 7 in ME 2019 Proposal, Appendix 3.2). Both Alternatives propose a broader use of weak line or inserts in more shallow waters. In deeper offshore waters where there are increased forces needed for hauling, as well as added safety concerns and conditions that can inadvertently break a weak rope, the alternatives allow at least one buoy line either fully strong (LMA Three option 1), with a weak insert at 35% down (12 nm/22.2 km to LMA Three), or a weak topper at 20% down on one end (LMA Three option 2) on trap/pot trawls set in deeper waters. Alternative Two, with limited weak inserts half way or 35% of the way down the line, a smaller proportion of line is considered to be the equivalent of weak line and could have lower likelihood of contributing to gear loss, if weak rope is found to contribute to gear loss. Overall, weak rope elements considered in the Alternatives should minimize the amount of gear loss caused by reduced rope strength but it will be important to follow up after regulations are implemented to see whether gear loss rates have changed.

5.2.1.4 Comparison of Alternatives

The biological impacts described in the previous section focus on impacts to the North Atlantic right whale and vary across the regulatory alternatives. This section compares the direct and indirect biological impacts of each alternative. Where sufficient information is available, the alternatives are compared using quantitative criteria.

Table 5.9 compares the annual impacts of Alternatives Two and Three (Preferred and Non-preferred) using a variety of indicators that are likely to correlate with reduced large whale entanglement risk and severity. In order to account for monthly variation in fishing effort, and therefore line numbers, monthly line numbers and co-occurrence were summed to provide an annual total for the purpose comparing the alternatives and does not represent the number of lines in the water at a given time within the Northeast Region. This analysis evaluates the impact of alternatives to modify the ALWTRP requirements relative to the status quo Alternative One (the No Action baseline scenario that assumes no change in existing Plan requirements). As previously stated, it is important to note that the No Action Alternative (Alternative One) would not achieve the objective of reducing serious injury and mortality of North Atlantic right whales below PBR. If Alternative One were chosen, the current rate of serious injury and mortality to large whales due to U.S. entanglements in commercial fishing gear would continue to exceed PBR, rather than be reduced.

Table 5.9: The annual summary of all quantitative measures for each alternative, including the change in annual vertical line numbers (summed across months), co-occurrence, and total annual conversion to weak line. There are two different scenarios provided regarding what happens to lines in the event of a restricted area: lines are fully removed or relocated. Alternative Three further includes two different options for weak line in LMA Three: option one is a year-round 75% topper made of full weak line on one end and option two is year-round 20% topper made of full weak line on one end and an additional 75% topper on the other end from May through August.

	Alternative 1 (i.e. baseline)	Alternative 2 Lines Out	Alternative 2 Relocation	Alternative 3a Lines Out	Alternative 3a Relocation	Alternative 3b Lines Out	Alternative 3b Relocation
Vertical Lines							
Maine Exempt	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835	4,029,835
Outside ME EX	2,125,588	1,718,264	1,725,817	1,050,711	1,061,148	1,052,025	1,061,874
% Reduction		**19.2%**	**18.8%**	**50.6%**	**50.1%**	**50.5%**	**50.0%**
Co-Occurrence							
Right Whale	138,199	42,572	42,641	16,020	19,414	18,745	22,389
% Decrease		**69.2%**	**69.1%**	**88.4%**	**86.0%**	**86.4%**	**83.8%**
H-back Whale	333,209	268,318	268,599	141,790	144,848	142,623	145,728
% Decrease		**19.5%**	**19.4%**	**57.4%**	**56.5%**	**57.2%**	**56.3%**
Fin Whale	177,502	127,926	127,940	72,525	74,044	72,961	74,393
% Decrease		**27.9%**	**27.9%**	**59.1%**	**58.3%**	**58.9%**	**58.1%**
Weak Line							
Maine Exempt	**Total Weakened Line**	1,276,741	1,276,741	3,021,823	3,021,823	3,021,823	3,021,823
Waters	**Proportion Weakened**	**31.7%**	**31.7%**	**75.0%**	**75.0%**	**75.0%**	**75.0%**
Area 3	**Scenario**	**-**	**-**	**Option 1/2**	**Option 1/2**	**Option 1/2**	**Option 1/2**
Outside Maine	**Total Weakened Line**	457,779	458,077	776,123/ 770,747	783,02/ 777,814	776,995/ 771,571	783,573/ 778,358
Exempt Waters	**Proportion Weakened**	**26.6%**	**26.5%**	**73.9%/ 73.4%**	**73.8%/ 73.3%**	**73.9%/ 73.3%**	**73.8%/ 73.3%**

Alternatives Two and Three alternatives are similar in geographic range and requirements. As such, each alternative reduces co-occurrence and, by proxy, likely reduces entanglement risk. Each alternative also proposed gear modifications that would increase the likelihood that a whale could break free of gear before becoming seriously injured or killed. The substantial differences among the alternatives is the number of restricted areas and the different approaches taken to reduce the number and breaking strength of vertical buoy lines. Alternative Two (Preferred) would reduce co-occurrence with a minimal impact on fishing effort (e.g. the number of trap/pots fished or the number of restricted areas) and with less of an impact on line strength. Broad scale implementation of weak inserts or toppers with full weak line are also included in areas of lower co-occurrence and represent risk reduction that is also precautionary for right whales in the Northeast Region outside of high use areas and seasons. The highest degree of protection results from Alternative Three (Non-preferred) due to the combination of the strictest line reduction measures (via a 50% line cap), the most proposed closures to persistent buoy lines, and the broadest requirement for full weak rope.

Roughly 6,155,422 total trap/pot buoy lines are currently deployed annually (summed across months with an average of 512,952 occurring in a given month) in the Northeast Region, 4,029,835 (an average of 335,820 in a month) in Maine exempt waters and 2,125,588 (177,132 monthly average) outside of Maine Exempt waters (including exempt areas within other state waters). Maine Exempt Waters generally have lower levels of co-occurrence so this area is largely reducing risk via precautionary measures rather than line reduction. All of the risk reduction options analyzed here within Maine Exempt Waters will be implemented and regulated by Maine DMR so, while the risk reduction is included in this EIS, it reported separately from those that will be implemented by NMFS.

The restrictions on the number of buoy lines in the Northeast Region considered in the alternatives include minimum trap trawl requirements, line caps, and seasonal buoy line closures. These restrictions would result in an average reduction of around 19 percent of baseline buoy lines in Alternative Two to approximately 50 percent in Alternative Three outside of Maine Exempt Waters, depending on which restricted area scenario occurs (Table 5.9). This reduction in buoy lines will likely result in an equivalent reduction of the potential risk of entanglement by reducing the likelihood that whales and gear would co-occur in the same area at the same time.

Alternative Three also predicts greater reduction in large whale co-occurrence compared to Alternative Two. This is because of the more extensive reduction of lines with a line cap as well as a greater number of areas that would be closed to vertical buoy lines. Buoy line closures that relocate lines outside of the restricted area can increase risk near the restricted area, as is the case near Georges Basin in Alternative Three (Figure 5.3). Alternative Three could also have unintended consequences for all large whales if the line cap restriction results in increased effort in months where effort has been relatively low and potentially increase co-occurrence to a greater degree than is reflected in this analysis but this is less likely in combination with a restricted area in LMA Two. The line reduction and co-occurrence measures proposed in Alternative Two (Preferred) and Alternative Three both substantially reduce right whale co-occurrence. Alternative Three will likely reduce co-occurrence between large whales and buoy lines to a larger degree than Alternative Two, significantly decreasing entanglement risk for large whales. However, Alternative Two will be less likely to increase co-occurrence in the Northeast

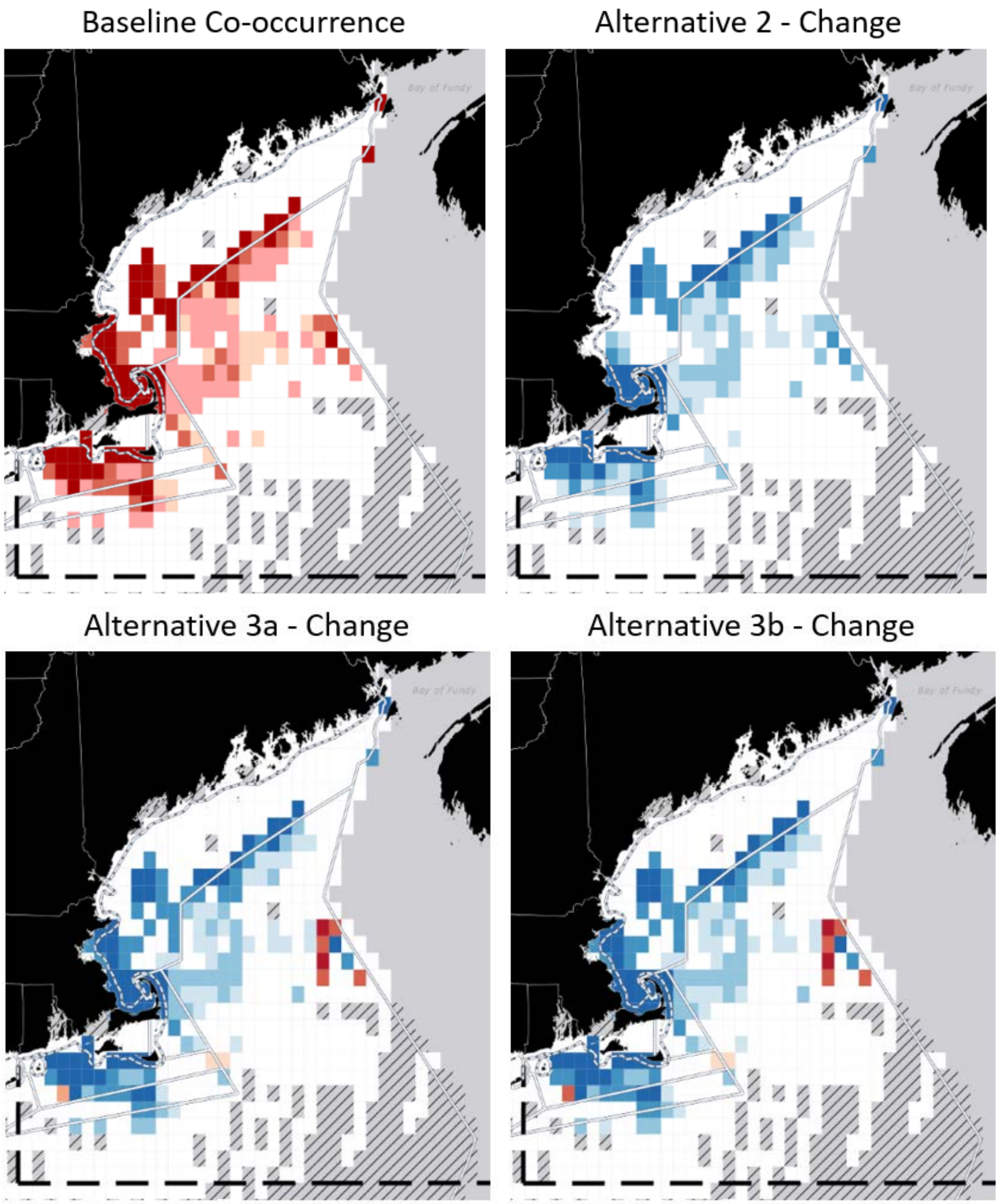
Region, better accommodates small scale fishing operations and traditional practices, considers fishing safety concerns, and requires less costly gear modifications and restricted area requirements.

The addition of weak line throughout the proposed area will not reduce co-occurrence but is predicted to reduce the likelihood that an entanglement will result in serious injury or mortality. Alternative Three proposes a larger percentage of full weak rope to be required on vertical buoy lines across the proposed areas. While Alternative Two similarly proposes broad scale use of weak rope, this alternative differs in that it relies upon weak inserts. Weak insertions may, in some ways, be optimal to full weak rope because insets provide a focused low breaking strength location when compared to a full weak line where breaking strengths often vary more widely across a line. However, the fewer insertions that are required in a full line and the deeper the water column, the less protection an insertion requirement will offer compared to full weak line or the equivalent. In Alternative Two, the proposed insertions within nearshore shallow waters are very close to a full weak line equivalent (an insertion every 40 ft). In deeper waters where fewer insertions are proposed within the top proportions of the buoy line, the risk reduction benefit of the weak insert is reduced. This may result in fewer weak rope benefits in offshore areas where right whales are more likely to occur but these areas would be subject to greater line reduction. The weak insertions in Alternative Two would provide some risk reduction benefit across the entire Northeast Region, providing a precautionary measure resilient to changes in right whale distribution. Expected line reduction measures in these areas will be far more effective at reducing overall entanglement risk than weak rope. Including weak inserts in areas with no line reduction and low right whale co-occurrence, such as exempt areas in Maine, provides an additional important precautionary measure.

Figure 5.3: The cumulative year-round baseline co-occurrence in Alternative One and predicted change in co-occurrence after implementation of Alternatives Two and Three for right (A), humpback (B), and fin whales (C).

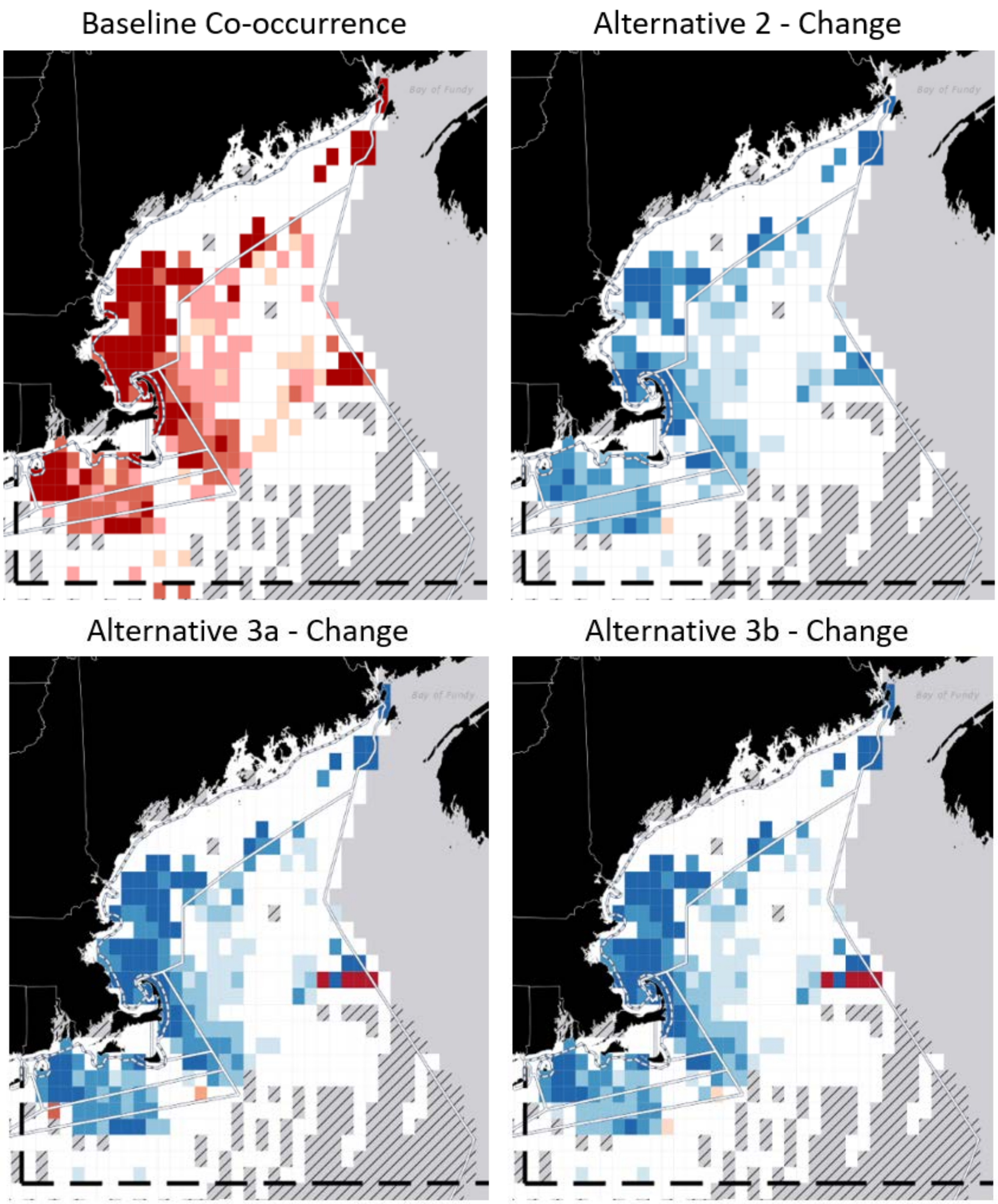
A

Co-occurrence Score | Buoy Lines and Right Whales
Cumulative January through December | Lobster Trap Pot Fishery

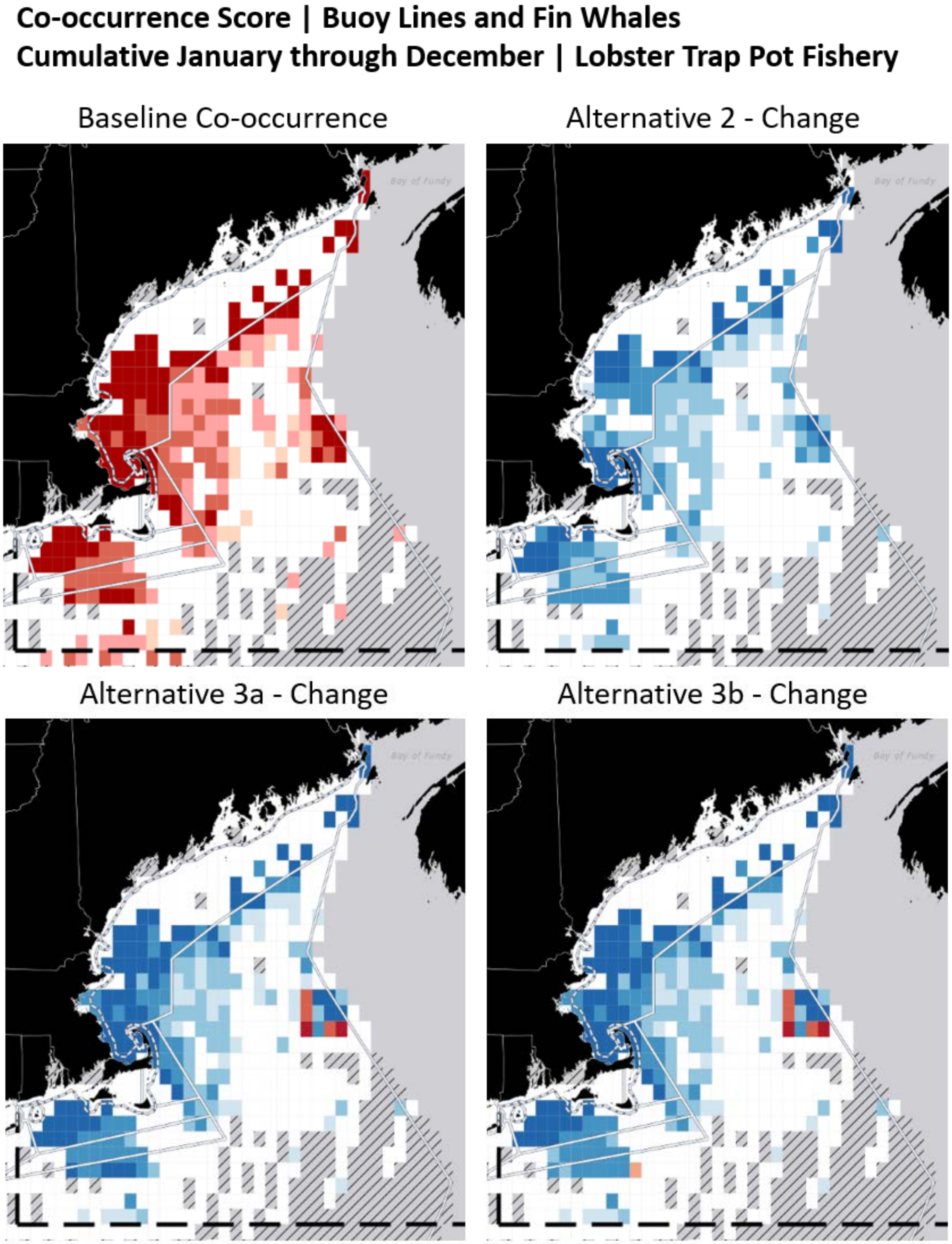


B

Co-occurrence Score | Buoy Lines and Humpback Whales
Cumulative January through December | Lobster Trap Pot Fishery



C



5.2.2 Other Protected Species

In addition to impacts on large whale species, other protected species occur in the Northeast Region that can be entangled in commercial fishing gear. This section assesses the potential impact of modifications in Alternatives Two and Three to the ALWTRP on other ESA listed species and non-ESA listed marine mammals, including blue, sei, and sperm whales as well as loggerhead and leatherback sea turtles (see Chapter 4 for more information). The alternatives differ with respect to the ancillary benefits they would afford other protected species. As the following discussion explains, these differences stem from differences in the extent to which the alternatives would mandate gear modification requirements that could prove beneficial to potentially affected species of whales and sea turtles.

5.2.2.1 Buoy Line Reduction

Similar to large whales, it is anticipated that proposed line reduction strategies will reduce overall risk of entanglement for other protected species, including other large whales and leatherback and to a lesser extent loggerhead sea turtles. The proposed changes would reduce the number of buoy lines in the water through measures specifying the minimum number of traps fished along lobster trawls by area and distance from shore, and/or through a buoy line allocation cap in federal waters. Alternative Two (Preferred) requirements differ slightly from Alternative Three (Non-preferred) where the former relies more on trawling up measures and the later includes a universal line cap and a greater number of restricted areas. The potential direct or indirect impacts are discussed below in two sections: gear modifications and seasonal area management.

5.2.2.1.1 Gear Modifications

In addition to the large whales discussed in Section 5.2.1, other protected species in the waters subject to regulation under the Plan are known to become entangled in lobster and other trap/pot lines (NMFS 2001c, a, b, d; STDN; 85 FR 21079, April 16, 2020; Henry et al. 2016; Henry et al. 2017; Henry et al. 2019). Alternative One (No Action) would not result in additional conservation gain for other protected species and this VEC would continue to sustain current levels of entanglement in trap/pot gear. Proposed gear modifications that aim to reduce buoy line are discussed in additional detail in section 5.2.1.1.1. As described previously, the regulatory changes proposed under Alternatives Two (Preferred) and Three include several provisions that reduce buoy line that could reduce protected species entanglement risks. The alternatives analyzed would impose restrictions on the number of buoy lines that trap/pot fishermen employ in the Northeast Region. In Alternative Two, fishermen would be required to use trawls of from 3 to 45 trap/pots, depending on area and season, contributing to an estimated 19 percent reduction of line. Alternative Three cuts the number of buoy lines nearly in half using a line cap contributing to a 50 percent reduction of line.

Direct

Absolute line reduction across the proposed area should benefit all protected species that use the areas where and when line is reduced. This comprehensive line reduction would likely benefit other protected species identified in Chapter 4, specifically large whales (i.e., blue, sei, sperm) and sea turtles, by also reducing the likelihood that individuals would encounter and become entangled in line.

Sea turtles would be best protected by line reductions that occur when waters are warm enough to support sea turtles in the Northeast Region (i.e., approximately May through the end of November; see Chapter 4). Thus, the implementation of a line cap that reduces line numbers more significantly in summer months, when effort is typically high, likely provides the most significant reduction in sea turtle entanglement risk. Changes in buoy line numbers during winter are not likely to impact sea turtle entanglement rates, given that they are typically only present in the Northeast Region when the water is sufficiently warm.

As provided in Chapter 4, blue, sei, and sperm whales have the potential to be impacted by the proposed regulations. Although the commercial fisheries regulated under the Plan may affect blue and sperm whales, there seems to be significant separation between the known feeding/or breeding range of these species and primary fishing areas. Therefore, the gear modifications in the commercial fisheries regulated under the Plan may be less beneficial for these species. Due to similarities in distribution, feeding behavior, and other characteristics, sei whales are believed to benefit from ALWTRP measures in much the same manner as the large whale species the plan is designed to protect.

Indirect

The indirect effects of reducing buoy lines are similar to those for large whales described above depend upon predicted changes in gear loss and gear movement. Increased gear loss, which generally appears unlikely across the alternatives, could cause an increase in the risk that whales and sea turtles may become entangled in ghost gear.

5.2.2.1.2 Seasonal Restricted Areas Closed to Persistent Buoy Lines

Alternatives Two and Three consider line reduction via seasonal closure of trap/pot fisheries to persistent buoy lines and are described in section 5.2.1.1.2. Under the No Action Alternative, the number of closures currently in place would remain the same but they would be closed to persistent buoy lines rather than to lobster fishing. Under exempted fishing permits, a low level of fishing with ropeless technology could occur that would have de minimis impact on protected species in the short term and that could result in an acceleration of the development of commercial ropeless fishing technology that reduce impacts to protected species in the future. There would be no additional conservation benefit to other protected species as a result of Alternative One.

Direct

Several of the proposed seasonal buoy line closures could have a beneficial impact on other protected species, but such benefits are likely to be limited. Leatherback and loggerhead sea turtles generally do not appear in the Cape Cod Bay Restricted Area or Gulf of Maine until June, when there are no current or proposed restricted areas. One restricted area is proposed during summer months in George’s Basin in the non-preferred alternative and is likely the only restricted area to potentially have any small positive effect, if any, on leatherbacks and loggerheads (James et al. 2006, Dodge et al. 2014, AMAPPS 2015, Dodge et al. 2015). Displacement of effort could negate benefits of the closed areas. The benefits of these restricted areas are likely to be minor but could potentially prevent the future expansion of trap/pot fisheries into this area.

The restricted areas described above could have a beneficial impact on blue, sei, and sperm whales, but such benefits are likely to be limited and may be negated by relocation of fishing lines. Given their offshore distribution, the only restricted area that is most likely to have a positive effect on blue and sperm whales is the George's Basin Restricted Area. The blue whale is considered an occasional visitor in the U.S. Atlantic EEZ, which may represent the southern limit of its feeding range. The waters in which it has been sighted are usually well north of the proposed area but can occur in the Gulf of Maine (CETAP 1982, Wenzel et al. 1988). Blue whales are the least likely species to substantially benefit from any proposed restricted area. The distribution of sperm whales in the U.S. Atlantic EEZ also typically occurs farther on the edge of the continental shelf, over the continental slope, and into mid-ocean (Waring et al., 2007), though have been spotted south of Massachusetts near proposed South Island Restricted Areas in spring (Stone et al. 2017) and near George's Bank in summer (CETAP 1982). Given the distinct offshore distribution of this species, sperm whales are also less likely to benefit from inshore fishery restricted areas particularly not the proposed LMA One Restricted Area.

Sei whales may also benefit from fishery restricted areas proposed closer to shore. Although sei whales are often found in the deeper waters that characterize the edge of the continental shelf (Hain et al. 1985), NMFS aerial surveys found substantial numbers of sei whales south of Nantucket in spring (when a restricted area is proposed in Alternative Three) and summer (Stone et al. 2017), and George's Bank in the spring and summer (CETAP 1982). Sei whales (like right whales) are largely planktivorous, primarily feeding on euphausiids and copepods, which has resulted in reports of sei whales in more inshore locations. Therefore, sei whales may benefit from the restricted area extensions in Cape Cod Bay, a restricted area south of Nantucket, and potentially a restricted area in George's Basin.

Indirect

The indirect effects of proposed restricted areas are similar to that of large whales and could have indirect beneficial effects on protected by tempering the possible expansion of trap/pot fisheries or negative indirect benefits if effort is relocated just outside the restricted area into more sensitive areas. This relocated effort may result in a wall of fishing gear, which would increase risk of entanglement in the area directly adjacent to the closed areas.

5.2.2.2 Changes to Weak Link Requirements

Direct

Changes in weak link requirements are not likely to have a significant direct impact on other protected species. Similar to large whales, sperm, blue or sei whales could potentially have a greater likelihood of breaking free if the weak link was in a different position on the line. However, the requirement to switch to some form of weakened line likely accomplishes this objective on a broader scale. Sea turtles will likely not be impacted from changes to current weak link requirements given they are unlikely to break line in an entanglement.

Indirect

Different weak link requirements could potentially increase the amount of ghost gear but, as discussed above, this is an unlikely outcome and this measure is not anticipated to have any substantial indirect effects on other protected species.

5.2.2.3 Weak Rope

Both proposed alternatives, with the exception of Alternative One (no action alternative), would require conversion of a certain proportion of line to weak rope or the equivalent (see section 5.2.1.2 for more details).

Direct

Regulations reducing the breaking strength of rope, or requiring weak inserts in rope, are more likely to benefit other protected large whales. Data from Arthur et al. (2015) suggest larger whale species, such as blue, sperm, and sei whales could be able to exert a high enough force to exceed 1700 lbs. (771.1 kg) line. Blue whales are capable of higher maximum forces than all large whales (Arthur et al. 2015), and therefore weaker breaking points are very likely to benefit this species. Other protected marine mammal species (e.g. sperm and sei whales) are estimated to exert lower maximum forces than north Atlantic right whales and blue whales (Arthur et al. 2015) and therefore the likelihood of these species breaking out of weak rope may be slightly lower. However, reduced breaking strength could benefit most other protected marine mammals analyzed here by reducing the likelihood of serious entanglements when an individual is able to exert enough force to break free. Similar to large whales, Alternative Three may provide slightly greater reduction in potential entanglement severity to other protected whale species compared to Alternative Two given the proposed use of more full weak line.

Sea turtles are unlikely to be able to free themselves at the proposed breaking strength of 1700 lbs. (771.1 kg). Given this, sea turtles are not expected to benefit from reduced rope strength proposed under Alternative 2 or Alternative 3 given their size and physiology limits their ability to break free of any entanglement regardless of rope strength.

Indirect

Indirect effects of the use of weak rope or inserts on other protected species are similar to that of large whales. There could be potential indirect effects from gear loss that could increase the risk of entanglement. However, the proposed measures aim to minimize the amount of gear that is potentially lost as a result of changes in rope strength and so the indirect effects are expected to be minimal.

5.2.2.4 Comparison of Alternatives

There were few quantitative criteria available to compare the biological effect of the alternatives on other protected species. Universal line reduction is likely the most beneficial for other protected species and, absent additional information on co-occurrence, Alternative Three is the most likely option that would benefit sea turtles, which inhabit the Northeast Region during warm months with higher fishing effort. However, it is unlikely that aggressive weak rope requirements will be beneficial to sea turtles.

Weak line requirements may benefit other large whales but the line reduction provisions are less likely to benefit other protected large whales that spend more time in deeper waters off of the continental shelf, with the exception of Sei whales. As such, Alternative Three offers slightly more protection to other protected large whales than Alternative Two.

5.2.3 Habitat

As noted in Chapter Four, traps/pots regulated under the ALWTRP can affect fish habitat primarily through the gear's impacts on the benthic environment. Such impacts generally arise as a result of contact between fishing gear and the sea floor, especially during the setting and retrieval of the gear. In some cases, bottom contact can alter the physical structure of the seabed, injure or kill benthic organisms, alter the structure and productivity of the benthic community, contribute to the suspension of sediments, and cause changes in the chemical composition of the water column overlying affected sediments. The habitat impacts attributed to fixed, bottom-tending gear are less severe than the impacts of mobile, bottom-tending gear. The regulatory alternatives under consideration are likely to have a temporary or minimally adverse impact on the benthic environment. The regulatory provisions with the greatest potential to affect benthic habitat are those that may influence contact between ALWTRP-regulated gear and the sea floor. As discussed below, the provisions of interest are those pertaining to trawling up measures and restricted areas.

5.2.3.1 Buoy Line Reduction

5.2.3.1.1 Gear Modifications

With the exception of Alternative One (No Action), all of the regulatory alternatives under consideration would require increasing the minimum number of traps per trawl fished in the Northeast Region. This increase in trawl length under Alternatives Two and Three (Preferred and Non-Preferred) may in turn increase the use of sinking groundline (see section 5.2.1.1.3 for more details on proposed changes). Alternative One would maintain the current levels of biological impact of trap/pot fishing on benthic habitats.

Direct

It is likely that in total, the amount of sinking groundline that may be used will not be substantially different. Fewer trawls will be fished with an increase to the minimum traps per trawl. Those trawls with more traps, however, may be longer so a reduction would not be equivalent to removing all groundline from the reduced trawls. A provision to allow trawls to be lengthened in LMA Three from 1.5 miles (2.78km) between buoy lines to 1.75 miles (3.24 km) is included that may result in some fishermen fishing disproportionately longer trawls if they think it will increase catch per unit effort by providing more space between traps on 45 trap trawls. Fishermen choose to add additional traps to their trawls to ensure that LMA Three fishermen can achieve an average of 45 trap trawls, compensating for vessels that cannot be configured to accommodate 45 trap trawls, or lengthen groundlines near the buoy line to reduce the number of pots hanging in the water column during haul-up so the forces do not break a weakened buoy line.

If these measures result in increased amount of sinking groundline along the bottom, there will be increased line contact with the sea floor, creating the potential for adverse impacts on benthic habitat. The expected impacts of sinking groundline on benthic habitat would occur primarily when the trawl lines of pots are hauled to the surface. During this process, the line may snag on bottom features and organisms as it is dragged across the bottom. Such impacts are not expected to be more than minimally greater than current impacts for shorter trawls and are likely temporary in nature. Most studies investigating small numbers of trap or pots per buoy line (1-3) have found minimal, short-term impacts on physical structures (Eno et al. 2001, Chuenpagdee et al. 2003, Stephenson et al. 2017). Similarly, a panel of experts that evaluated the habitat impacts of commercial fishing gears used in the Northeast Region of the U.S. (Maine to North Carolina) found bottom-tending static gear (e.g. traps/pots) to have a minimal effect on benthic habitats when compared to the physical and biological impacts caused by bottom trawls and dredges (NMFS 2002b). The vulnerability of benthic essential fish habitat for all managed species in the region to the impacts of trap/pots is considered to be low (NMFS 2004). However, less is known about longer trap/pot trawls and there is limited information that trawls with 20 or more pots may have impacts more similar to mobile gear, though at a smaller spatial scale (Schweitzer et al. 2018). Areas where trawl lengths reach 20 pots per trawl or more may have a greater impact of benthic habitats than areas with shorter trawls. In Alternative Two, longer trawls will primarily occur beyond 12 nmi (22.2 km) in deeper waters. In Alternative Three, this could impact inshore waters if longer trawls are used closer to the shore in response to the line cap.

Current knowledge suggests that trap/pot fishermen minimize the distance at which gear is drawn across the sea floor when hauling in their gear, as this contact causes abrasion of the protective coating on the traps themselves. Hence, fishermen try to position their vessels above their gear, pulling sets up through the water column instead of across the sea floor. This practice minimizes the adverse impact of long trap trawls and sinking groundline on benthic habitat. Furthermore, the amount of bottom area that would be disturbed by sinking groundline on long trap trawls, and the frequency of disturbance in the exact same area from repeated contact with sinking groundline, would be very small, allowing enough time for recovery of benthic communities that would potentially be affected. Therefore, any adverse impacts associated with longer trap/trawls or the increased use of sinking groundline would be temporary but slightly higher offshore where longer trawls are being fished.

Indirect

As with other VECs, an increase in ghost gear if trawling up led to the loss of more gear but this is not expected to occur in higher numbers than baseline given the trawl configurations proposed in Alternative Two. There is some uncertainty regarding the impact of a line cap on trawl configurations in Alternative Three but it is expected that fishers will continue configuring gear such that the risk of gear loss is minimized. Thus, indirect impacts from gear configurations are unlikely to have a measurable impact on habitat.

5.2.3.1.2 Seasonal Restricted Areas Closed to Persistent Buoy Lines

Both proposed alternatives, with the exception of Alternative One (no action alternative), include seasonal restricted areas that would further reduce the use of persistent buoy lines during times when north Atlantic right whales are more likely to aggregate (see section 5.2.1.1.2 for more details).

Direct

The seasonal restricted areas proposed in Alternatives Two and Three could lead to additional habitat protections where fewer lines and traps are coming into contact with the bottoms, leading to less structural damage or mortality of benthic organisms. However, there will be little benefit to the habitat if ropeless fishing expands in use within these areas, particularly with longer trawls that increase the amount of sinking groundline comes into contact with benthic habitats. If ropeless fishing expands widely in closed areas, habitat is expected to experience similar levels of disturbance as described in section 5.2.3.1.1 where longer trawls could potentially have an impact on benthic habitats.

Indirect

Seasonal restricted areas where no crab or lobster trap/pot trawls are fished are not likely to have many indirect impacts other than any potential cascading effects that result from protection of benthic habitats, though these are expected to be minimal given the scale of the restricted areas. If ropeless equipment is broadly used in seasonal management areas, it could indirectly impact the habitat in the event of equipment failure that could increase the presence of ghost gear. Using transponders to help fishermen locate their gear on the bottom in ropeless system could reduce the likelihood of gear lost compared with current gear losses after storm events or other incidents. Alternatively, expansion of ropeless gear in restricted areas could reduce bottom trawling in the region, preventing more invasive practices from harming benthic habitats and possibly leading to a positive impact on habitats. The loss of gear is not expected to be significantly higher than with traditional trap/trawl fishing practices so any impact is likely minimal. It is possible that an increase in grappling for lost gear could impact habitat quality given its known effect on the sea floor.

5.2.3.2 Changes to Weak Link Requirements

Direct

Changes in weak link requirements are not likely to have any impact on habitat quality because it will not come into direct contact with the benthic environment.

Indirect

Different weak link requirements could potentially increase the amount of ghost gear but, as discussed above, this is an unlikely outcome and this measure is not anticipated to have any substantial indirect effects on habitat.

5.2.3.3 Weak Rope

Both proposed alternatives, with the exception of Alternative One (no action alternative), would require conversion of a certain proportion of line to weak rope or the equivalent (see section

5.2.1.2 for more details).

Direct

The use of weak rope, as required by regulatory Alternatives Two and Three (Preferred and Non-preferred), is unlikely to have a significant direct impact on habitat. It largely will not come in direct contact with the seafloor and should not significantly result in any changes to the configuration of trap/pot trawls.

Indirect

Weak rope requirements could have minor indirect impacts on fish habitat or benthic organisms if there is any increase in lost gear. Ghost gear could impact habitat quality and benthic organisms if it comes in contact. It is possible that weak rope could benefit essential fish habitat by reducing the likelihood that an entangled whale would drag heavy gear over sensitive areas if gear is releasing more readily. If this occurs, potential direct damage to the marine environment could be avoided. Overall, weak rope requirements are not expected to create high amounts of ghost gear, as discussed in section 5.2.1.2 and therefore the indirect impacts to habitat are presumed to be minimal.

5.2.3.4 Comparison of Alternatives

No quantitative criteria are available to formally compare the biological effect of the alternatives on habitat. Alternative One will maintain baseline levels of biological impacts on benthic habitats. However, the direct and indirect impacts of Alternative Two and Three are both could have negligible to low negative impacts on the habitat compared to Alternative One (the no action alternative), aside from the potential increase in risk posed by long trap/pot trawls in contact with the sea floor. This possible impact is likely limited to offshore environments with Alternative Two and could impact offshore and nearshore environments with Alternative Three in the event that trap/pot trawls are expanded in these areas in response to a large cap in the number of lines allotted to each vessel. However, areas too close to shore, for example those within state waters, are unlikely to experience excessively long trap/pot trawls given the nature of the fishery and the vessels operating in these areas. Alternative One will maintain baseline levels of biological impacts on benthic habitats.

If ropeless fishing is implemented widely in closed areas, it is not expected that Alternative Two or Three will significantly change the amount of gear that comes into contact with the sea floor and therefore will not offer any habitat protection compared to Alternative One. Furthermore, weak rope is unlikely to have significant biological impacts on habitat in either Alternative. Overall, Alternative Three is less likely to increase negative impacts on benthic habitats.

5.3 Direct and Indirect Impacts of Gear Marking Alternatives

When compared to Alternative One (No Action), Alternatives Two and Three would both strengthen most of the Plan’s current gear marking requirements. Currently the marking system requires buoy lines to be marked three times (top, middle, bottom) with a mark equal to 12” in length, with exemptions in inshore waters in some areas.

Both alternatives would modify gear markings to add state-specific colors. Both alternatives include a three-foot (0.9 m) long colored mark within two fathoms of the buoy using the state-specific colors to increase the chance that it can be seen from platforms of opportunity, such as vessels or small planes, to distinguish gear from different states and/or management areas in the Northeast Region waters.

Maine has already added state specific gear marking requirement for state permitted fishermen, including a three-foot (0.9 m) mark within two fathoms of the buoy, effective September 2020. ALWTRP modifications will mirror Maine's regulations outside of the exemption area.

The goal of the long mark near the buoy is to increase mark visibility so that even if gear is not retrieved, it could be identified by state fishery from sighting platforms including boats and aerial survey planes. This color scheme would be continued on the three marks already required, and a six-inch alternative color would also be required for gear set in Federal waters. Additionally, New England waters that are currently exempt from the gear marking requirements would be required to follow the same marking regime or in some cases require the same surface marks but only one or two one-foot (0.3 m) marks lower on the buoy line. Alternative Three would include the same large surface system state-specific color marking to improve detectability, but would require the use of state and fishery specific tape along the entire buoy line excepting any small weak inserts required in the buoy line. The No Action alternative (One) would continue a gear marking system that uses marks specific to management areas rather than identifying gear to state level.

The gear marking provisions are designed to improve NMFS' ability to identify the gear involved in an entanglement. As discussed below, these provisions would have no immediate direct impact on entanglement risks. In the long run, however, they may help NMFS to target and improve its efforts to protect large whales.

5.3.1 Large Whales

Despite current efforts to mark gear, there is still a high proportion of entanglements that cannot be identified by the fishery or location of origin (as discussed in Chapter Two). No gear is retrieved and/or the fishery of origin or type of fishing gear are not identifiable for a majority of entanglements, including 76% of the right whale incidents. In many cases, this is because there was no gear present on right whales with clear signs of entanglement. Of all large whale entanglements between January 1, 2010 and March 16, 2020 where gear was still present, less than half of cases had gear available for analysis and less than 14 percent of all cases had gear marks that could be identified as originating in a US management area (Table 5.10; See Northeast Trap/pot gear guide for details regarding colors: https://www.fisheries.noaa.gov/webdam/download/94698537). Between five and 13 percent of all large whale cases with gear present had identifiable US marks and from 69 to 92 percent of all cases did not have US marks and could not be identified as Canadian gear. Only three of 62 right whale cases with gear present had gear with marks from US fisheries and all were red, representative of the large nearshore northeast lobster area. Thus, a large proportion of gear that is recovered does not have identifiable marks using the current marking scheme. These data suggest that the current gear marking scheme does not adequately increase our understanding of where entanglement gear is originating. Additionally, regulations that would add a large mark to the surface system will increase the number of cases where gear can be identified even if the gear are not retrievable.

The majority of large whale entanglement cases with gear present had marks that were red, representing a large portion of the nearshore Northeast Region trap/pot fishery. At present, all trap/pot fisheries in federal waters, outside of exempt areas, are required to mark their gear with red for most nearshore fisheries in the Northeast Region, and a separate color (black) for all offshore fisheries. A few management areas have added marks to aid in identification but most regions within the Northeast Region are indistinguishable from each other at the state level. A more fine scale spatial resolution marking scheme will help distinguish which regions are contributing most to large whale entanglements, allowing managers to implement more targeted measures in the future.

Direct

While existing gear marking requirements have increased the amount of retrieved gear with marks, it does not provide sufficient entanglement location information. Both Alternatives Two and Three include gear marking schemes expected to increase the number of marks present by approximately 65 percent, independent of line numbers. Counting for the number of lines in each scenario, both alternatives would result in the incorporation of approximately 56 percent in the Northeast Region trap/pot fisheries outside of Maine Exempt Waters, which will increase the chances that gear will be recovered with visible marks. Alternative Two (Preferred) would allow the use of inexpensive and commonly available materials and would result in the incorporation of two new marks per line in federal waters and three new marks in exempt waters. Alternative Three (Preferred) would require the addition of the same number of marks new marks in addition to an identification tape throughout buoy line denoting home state and trap/pot fishery. It is important to note that the difference in number of additional marks is largely related to changes in line numbers between scenarios and does not reflect a substantial difference in the prevalence in marks per line between the two scenarios. Alternative Two shows a higher number of marks than Alternative Three because a larger number of lines are expected to remain active in the region. However, Alternative Three further requires tape to be woven through the length of the line that contain state and fishery specific data, which would mean the majority of gear that is retrieved from a commercial trap/pot line would be identifiable to this level of information. The regulatory provisions described above would have neither direct impact on the probability of whales becoming entangled in commercial fishing gear nor would they affect the severity of an entanglement should one occur. As noted below, however, potential changes in gear marking requirements could have an indirect effect on whale entanglement risks.

Table 5.10: The number of incidents with retrieved gear analyzed from January 1, 2010 - March 16, 2020 that had marks of those where origin was identified.

Species	Total Cases with Origin ID	Total Analyzed	No marks/ not Canadian	Canadian Gear	Total with US Marks	Red	Red & Yellow	Red & Blue	Red & Blue or Black	Blue
Humpback	214	79	183	14	17	7	7	1	1	1
Fin	13	2	12	0	1	1	-	-	-	1
Minke	59	28	47	4	8	7	-	-	-	-
Right	62	25	43	16	3	3	-	-	-	-

Indirect

A primary barrier to understanding the nature of large whale entanglements is obtaining information on the type and origin of the gear involved. Gear removal from entangled animals still provides the only reliable information about the nature of entanglements (Johnson et al. 2005). However, it is often difficult to connect the gear in which a whale is entangled with a particular fishery, state, or country because even in those instances where line remains on a whale, entangled whales often carry only a portion of the gear they have encountered and that is not always retrieved. The gear marking requirements under consideration would help to generate more and more geographically specific information on the nature of the gear involved in an entanglement and the fishing vessel's state of origin. In addition, these provisions could increase the number of incidents in which the origin of the gear could be identified, allowing the agency to gather additional information on where, when, and how the gear was set. By increasing scientific understanding of the nature of large whale entanglements, gear marking measures would allow NMFS, over time, to improve the effectiveness of the Atlantic Large Whale Take Reduction Plan. Thus, these measures are expected to contribute indirectly to the preservation and restoration of whale stocks because bigger, more frequent marks would increase the chances of identifying the source of line that may be visible on whales observed from platforms or recovered from an entangled whale.

5.3.2 Other Protected Species

Direct

With the exception of Alternative One (No Action), all of the regulatory alternatives under consideration would impose new gear marking requirements. Alternative One would maintain the current gear marking scheme that is inadequate for identifying the gear related to many entanglements to the ideal specificity. Alternatives Two and Three would expand the current gear marking scheme for New England crab and lobster trap/pot fisheries and include state-specific gear marking. As with large whales, these requirements are intended to improve information about the source of gear seen on or retrieved from entangled whales. But these requirements would not have a direct impact on the probability of other protected species becoming entangled in commercial fishing gear. Nor would these requirements affect the severity of an entanglement if one occurs.

Indirect

The gear marking requirements under consideration would help to generate information on the nature of the gear involved in a well-documented entanglements of other protected species. Additional information on the source and type of fishing gear involved in entanglements could indirectly benefit other protected species if it leads to new regulations to mitigate entanglement risk. These provisions could, in some cases, allow NMFS to identify the origin of the gear, and thus, allow the agency to gather additional information on where, when, and how the gear was set. By increasing scientific understanding of the origin of entanglements, the gear marking measures would allow NMFS, over time, to improve the effectiveness of programs designed to reduce the entanglement risks faced by other species that experience high levels of entanglement. Thus, these measures could contribute indirectly to the preservation and restoration of the other potentially-affected protected species.

5.3.3 Habitat

Direct

The proposed gear marking requirements are unlikely to have any measurable direct impacts on fish habitat or benthic organisms given the gear markings will not change the amount or type of gear touching the seafloor nor will the markings interact with any characteristics of this valued ecosystem component.

Indirect

The proposed gear marking requirements are unlikely to have significant indirect impacts on fish habitat or benthic organisms unless the gear marking provided added information that informed a future restricted areas that was free of all buoy and groundlines. Given the increased interest in testing ropeless fishing in restricted areas, it is unlikely that future restricted areas would have any impacts on habitat.

5.3.4 Comparison of Alternatives

Alternative One would result in no changes to current rates of gear identification. Alternatives Two and Three could potentially result in a larger proportion of retrieved gear being identifiable to country of origin and, potentially, state of origin. Since the number of proposed marks are the same in both alternatives, the chances of visual identification of gear on large whales and other protected species are comparable between Alternatives Two and Three. However, it is notable that Alternative Three would have an additional marker throughout the length of the line, making this line identifiable no matter which portion of the gear was retained on the individual and which portion of the gear was retrieved by the gear team. While neither alternative would impact the risk of entanglement, Alternative Three provides the most opportunity to collect data that can be used to develop more effective regulations for minimizing entanglement risk in the future.

5.4 Summary of Impacts

To compare the biological impacts of all alternatives on all VECs, we used the impact designations outlined in table 5.9. This section only compares the action alternatives to the no action alternative for the biological VECs, large whales, other protected species, and habitat as defined in Chapter Four (Table 5.11). The economic VEC (Human Communities) is discussed in Chapter Six and integrated with the biological analysis in Chapter Seven.

Alternative One (No Action) would result maintain the current levels of impact trap/pot fishing currently has on the Valued Ecosystem Components. With this alternative, the impact of trap/pot fishing will remain at a high negative because the rate of serious injury and mortality of north Atlantic right whales is well above PBR and unsustainable for the population. The impact of trap/pot entanglement would remain negative for other protected species as well under this alternative. There are no additional impacts to the habitat as defined in Chapter Four since

Alternative One maintains the status quo; however, low negative impacts to habitat from the use of trawl and trap gear would continue. When assessed individually, Alternative Two and Alternative Three would each have a negative to low negative impact on large whales and other protected species and a negligible to low negative impact on the habitat.

Table 5.11: A key of the direction and magnitude of the actions being assessed in the biological effects analysis.

	Impact of Action		
VEC	***Positive***	***Negative***	***Negligible***
Large Whales	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or Actions that reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Other Protected Species	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Habitat	• Actions that increase habitat quality	• Actions that decrease habitat quality	• Actions that have little or no positive or negative impact on habitat quality
	Impact Qualifiers		
Low	To a lesser degree		
No qualifier	To a medium degree		
High	To a greater degree		
Likely	Some degree of uncertainty		
ND	Impacts could not be determined at time of this writing		

As the discussion above suggests, there are a few significant differences between Alternatives Two and Three (preferred and non-preferred, respectively), relative to Alternative One, with respect to impacts on large whales, other protected species, and habitat. The impacts are generally expected to be negligible to high positive when compared to the No Action Alternative. All of the Alternatives (with the exception of Alternative One) include some form of gear modifications and some level of increased traps per trawl. The main differences among these alternatives stem from differences in the approach and magnitude to reducing vertical lines, size or season of closures to persistent buoy lines, and the extent of the use of weak rope or weak insertions. Large whales are expected to positively benefit from the regulations proposed in both Alternatives Two and Three since they both effectively reduce co-occurrence between whales and buoy line as well as increase the proportion of lines with maximum breaking strength or weak inserts. Alternative Three likely reduces entanglement risk to a greater degree than Alternative Two with a larger decrease in the number and strength of lines. A greater decrease in line number and strength will likely offer more benefits but compliance is expected to be greater for Alternative Two rather than Three given that it was developed with the states and fishermen. Furthermore, Alternative Two likely contains fewer regulations that would lead to uncertain outcomes. Other protected species prone to entanglement in trap/pot gear would indirectly benefit from the Plan modifications being considered. Any additional indirect impacts of Alternatives Two and Three on habitat are expected to be extremely small and not measurable.

Table 5.12: The direct and indirect impacts of the Alternatives Two and Three on the four VECs relative to Alternative One (the no action alternative).

Alternatives	***Large Whales***	***Other Protected Species***	***Habitat***
Risk Reduction			
Alternative 1 (No Action)	**High Negative** – Serious injury and mortality would continue to occur and impact population health	**Negative** – Injury and mortality would continue to harm protected species	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact
Alternative 2 (Preferred)	**Positive** – Would reduce right whale co-occurrence by 69%	**Positive** – Would reduce likelihood of entanglement via 19% reduction in buoy lines	**Negligible to low negative** – Trawling up to trawls above 15 traps per trawl may have a short-term impact
Alternative 3 (Non-preferred)	**High Positive** – Would reduce right whale co-occurrence by 83-88%	**High Positive** – Would reduce likelihood of entanglement via 50% reduction in buoy lines	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact
Gear Marking			
Alternative 1 (No Action)	**Negligible**	**Negligible**	**Negligible**
Alternative 2 (Preferred)	**Negligible**	**Negligible**	**Negligible**
Alternative 3 (Non-preferred)	**Negligible**	**Negligible**	**Negligible**

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6 ECONOMIC AND SOCIAL IMPACTS

6.1 Introduction

The regulatory alternatives under consideration that would be implemented through proposed modifications to the Atlantic Large Whale Take Reduction Plan (Plan or ALWTRP) would subject commercial fishermen operating in fisheries covered by the ALWTRP to a number of new requirements. These include:

- Reducing buoy lines through minimum trap/trawl or trawl-length standards;
- Requirements to use weak "whale safe" ropes or weak insertions;
- Seasonal designated restricted areas to lobster and crab trap/pot buoy lines; and
- Gear marking requirements.

These requirements apply to lobster and Jonah crab fisheries in the Northeast Region Trap/Pot Management Area (Northeast Region).[5] Complying with these requirements is likely to impose additional costs to commercial fishermen and, in some instances, to have an adverse impact on their revenues. If these impacts are large, it is possible that some fishermen may switch their effort to other fisheries if opportunities exist, or cease fishing entirely.

For this analysis, we consider costs of only those measures that would be regulated under the Plan modifications. Costs of ongoing and anticipated lobster fishery management measures, Maine gear marking and weak insertion regulations within exempted waters, the extension into May of a buoy line closure for state waters in the Massachusetts Restricted Area, and other measures that Massachusetts proposed such as a line diameter cap and the phase out of single trap trawls upon trap transfers for Massachusetts permitted vessels larger than 29 feet are considered to be part of the baseline, and not analyzed here.

Fishermen would incur the costs associated with the change in equipment when new requirements go into effect, and may have additional maintenance and replacement costs on an ongoing basis thereafter. To appropriately reflect the costs associated with such investments, the analysis presents these costs on an accumulated (present value or PV) and annualized basis (annualized value or AV). The model develops a series of potential costs year by year within the effective time of this rulemaking, which is assumed to be six years. Six years represents an average replacement cycle for rope and is also the typical length of time between regulatory changes based on past actions. Then yearly costs are accumulated into 2017 the present value by using a discount rate of seven percent. Finally, an annualized cost is presented, which provides an estimate of costs as if they are constant for each year during the effective time of the new rules. We also apply a three percent discount rate to calculate the present value and annualized value in comparison to seven percent.

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[5] Existing or anticipated Maine regulations for Maine Exempt Waters and Massachusetts regulations for Massachusetts state waters measures, while considered for risk reduction, are not included in the economic analysis because they are not the result of the proposed rulemaking, rather are the result of the States' actions. . Existing gear marking and risk reduction measures are treated as part of the economic baseline.

All costs are reported in 2017 dollars. The year 2017 was selected because it is the baseline year for this action (year 0), against which risk reduction is being measures; 2017 was the year that the right whale population's decline was confirmed, mortalities were elevated, and the Team was notified of the need to modify the Plan. Economic impacts described represent the difference between the impacts of the proposed rule relative to the regulatory landscape in 2017. Data used in the analyses from different years are converted using the Gross Domestic Product deflator to convert them to 2017 dollars to ensure consistency across the document.

The following discussion describes the methods used to estimate the costs that commercial fishermen would incur in complying with potential modifications to the ALWTRP and presents the first year cost of each measure. These cost estimates represent the direct impact of new regulations on the commercial fishing industry at the beginning of rulemaking. They also provide a foundation for subsequent evaluation of the regulations' potential effect on commercial fishing activity, and of the implications of such effects on communities that depend on the commercial fishing industry. At the end, a summary of present value and annualized value of each measure will be provided. The discussion is organized as follows:

- Section 6.2 describes the data sources and methodology employed to estimate compliance costs associated with minimum trawl-length and weak rope requirements, including the Vertical Line Model;
- Section 6.3 describes the data sources and methodology employed to characterize the economic impact of the seasonal restricted area to trap/pot buoy lines;
- Section 6.4 describes the methods used to estimate the compliance costs associated with gear marking requirements;
- Section 6.5 describes the methods used to estimate the compliance costs associated with buoy line cap reduction;
- Section 6.6 presents the resulting estimates of compliance costs for each regulatory alternative;
- Section 6.7 describes the social impacts of the new requirements of the ALWTRP.

The analysis measures the cost of complying with the regulatory changes to the Plan relative to Alternative One, the no action alternative. The economic analysis is designed to measure costs on an incremental basis, i.e., to measure the change in costs associated with a change in regulatory requirements. If no change in regulatory requirements is imposed – as would be the case under Alternative 1 – the costs of complying with the ALWTRP would remain unchanged. Thus, the incremental cost of the no action alternative is zero.

Much of the analysis described in this chapter builds on the foundation provided by NMFS' Vertical Line Model created by Industrial Economics, Inc. which provides an estimate of the number and distribution of lines as they were fished in 2017 (see documentation in Appendix 5.1). As discussed earlier in this DEIS, the model integrates information on fishing activity, gear configurations, and large whale movements to provide indicators of the potential for entanglements to occur at various locations and at different points in time because of the co-occurrence of buoy lines and large whales, focusing especially on right whales. The costs of the management measures under consideration depend on the seasons and locations in which a vessel operates; the regulations to which it is already subject; and the current configuration of the vessel's gear. The Vertical Line Model specifies operating assumptions for groups of vessels that hold these key features in common, providing an important starting point for assessing economic impact. The role of the model in the analysis of economic impact is described in detail below.

6.2 Analytic Approach: Gear Configuration Requirements

A major component the federal Plan modifications in Alternative Two (Preferred) is the minimum trawl length requirement – i.e., prohibiting trawls of less than a specified number of traps or pots – for trap/pot fisheries in Northeast Region (referred as trawling up measure hereafter). The exact nature of this requirement varies by location (primarily distance from shore due to greater vessel capacity). Another important component of the alternatives is a requirement for using weakened, whale safe rope/weak rope, which limits the buoy line breaking strength at the depth of the weak rope or weak insertions to no more than 1,700 lb (771 kg) or introduce a weak insert into buoy line so that an adult right whale can break free after entanglements (Knowlton et al. 2016). The costs that fishermen are likely to incur in complying with such requirements fall into several categories:

Trawling up

- Gear conversion cost: Vessels fishing shorter trawls (e.g., singles, doubles) would need to reconfigure their gear to comply with trawling up requirements. These changes may require expenditures on new equipment as well as investments of fishermen's time.

- Catch/landings impact: The "catch" referred to in this analysis refers to the catch brought to land and sold, also known as "landings". Catch rates may decline for vessels that are required to convert from shorter sets to longer trawls, reducing the revenues of affected operations.

Weak rope cost: to comply with the new weak rope requirement, vessels in different areas need to add one or more weak insertions into their buoy lines, or replace their entire lengths of buoy lines with weak lines no greater than 1,700 lb (771 kg) strength. These changes will cost fishermen extra input in both materials and time.

Other Impacts: Some vessels that shift to longer trawls and/or weak ropes may experience changes in the rate at which gear is lost. In addition, some fishermen may need to modify their vessels or add crew to handle longer trawls.

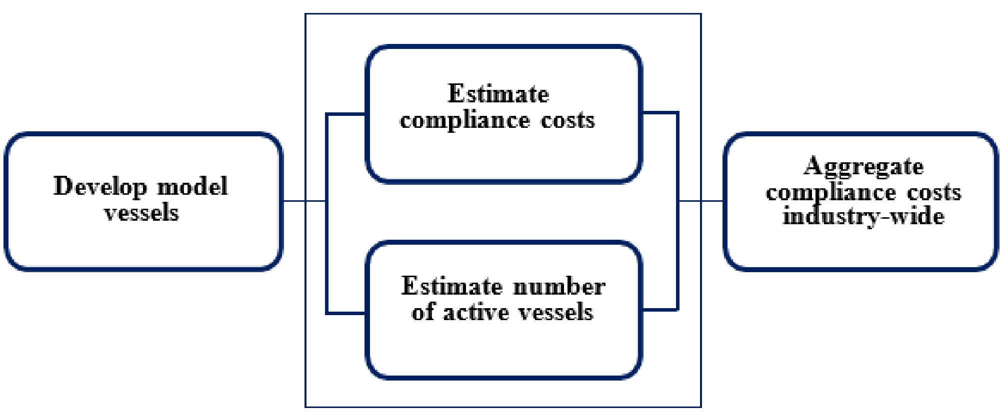
Given the broad scope of the ALWTRP, a vessel-by-vessel analysis of the costs of complying with these requirements is infeasible. Instead, the analysis is based upon the model vessels defined in the Vertical Line Model. Each model vessel represents a group of vessels that fish in the same area, share other operating characteristics, and would face similar requirements under a given regulatory alternative. As Figure 6.1 illustrates, the analysis estimates regulatory compliance costs for each model vessel. This cost estimate is then applied to the population of active vessels that the model represents, and aggregated across this population to estimate regulatory compliance costs for all vessels in a given category.[6] The sum of costs across all vessel categories provides an estimate of regulatory compliance costs for the commercial fishing industry as a whole (see Section 6.2.1 and appendix 5.1).

6.2.1 Development of Model Vessels

The first step in analyzing the impacts of trawling up requirements is to define the relevant suite of model vessels, i.e., groups of vessels that operate in a similar fashion and thus are likely to face similar compliance costs. Current regulations under the ALWTRP vary by fishery, location and season. Potential modifications to the ALWTRP, as embodied in the regulatory alternatives under consideration, would follow a similar approach. Thus, compliance costs are likely to vary depending upon the location in which it operates, and the seasons in which it is active. The model vessels employed in the cost analysis are designed to capture these differences.

In addition, the model vessels are designed to take into account differences in compliance costs that would result from the nature, configuration, and quantity of gear that vessels employ. For example, some lobster vessels fishing in a given region may configure their traps/pots in pairs, while others may already use longer trawls; since this difference could have a significant impact on the costs of complying with trawling requirements, it is important that the cost analysis differentiate between such vessels.

Figure 6.1: Economic Impact Assessment Methodology



Note: figure adapted from 2014 FEIS

Analysis of the economic impact of the trawling up requirements requires comparing the

[6] The cohort of active vessels that a model vessel represents is based in part on vessel trip reports that indicate the location of fishing activity. Some vessels report activity in multiple areas in a given month. To avoid double-counting in such cases, the analysis assigns the vessel's activity to each area in proportion to the distribution of trips it reports. For example, if over the course of a month a vessel reports seven trips to Area A and three trips to Area B, the analysis will assign 0.7 active vessels to Area A and 0.3 active vessels to Area B. Thus, all estimates of the number of vessels active in a given area are reported on a full-time equivalent basis; the number of vessels that fish a portion of their gear in the area each month may be higher.

baseline configuration of gear assigned to model vessels in the Vertical Line Model with the new configuration of gear that would be required under each regulatory alternative. This procedure allows assessment of compliance costs for the full suite of possible outcomes. For instance, for the set of lobster vessels fishing in exempt state waters in Maine Lobster Zone B, the Vertical Line Model identifies 35 possible gear configuration options, as defined by a matrix that specifies both the number of traps fished (five categories) and the number of traps per trawl (seven categories). The model relies on survey data to characterize the baseline distribution of gear configurations within this matrix. The cost analysis then identifies the gear configurations that would be prohibited under each regulatory alternative; vessels that currently fish sets shorter than the required minimum would need to reconfigure their gear. The difference between the baseline configuration and the new configuration of gear that each regulatory alternative would require (which varies by area and alternative) drives the analysis of gear conversion costs; thus, estimates of compliance costs for vessels that are subject to identical requirements will vary depending upon the configuration of gear they currently employ. As described below, the cost analysis takes into account a broad range of “with or without” gear configuration options.

6.2.2 Trawling up Gear Conversion Cost

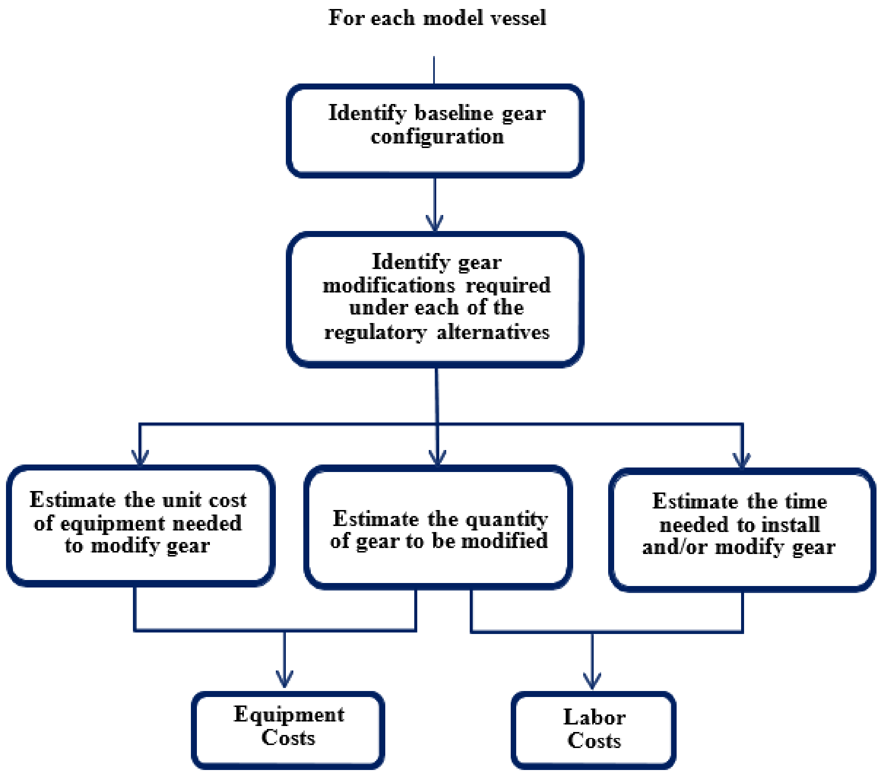
When vessels convert from shorter sets to longer trawls, one impact is the direct cost of converting gear to the new configuration. These costs include two major elements:

- **Equipment Cost**: Fishing traps in a new configuration may require the use of new equipment. For instance, the use of longer trawls is likely to require additional groundline. These costs may be offset, at least in part, by a reduction in the use of other types of equipment, such as a reduction in the use of buoy lines, buoys, etc.

- **Labor Cost**: The costs of converting gear include the implicit value of the time that fishermen spend reconfiguring their equipment.

Figure 6.2 illustrates the methodology employed to estimate these costs. As shown, the analysis identifies new gear conversion requirements (i.e., modifications that are not already specified under existing rules), estimates the material and labor required to bring all gear into compliance, and calculates the resulting cost. For each provision, equipment costs are a function of the quantity of gear to be converted and the unit cost of the materials needed to satisfy the trawling requirement. Labor costs are a function of the time required to implement a specific modification, the quantity of gear to be converted, and the implicit labor rate. All costs are calculated on an incremental basis, taking into account any savings in equipment costs that might result from efforts to comply with new ALWTRP regulations. The discussion below further describes how these costs are estimated.

Figure 6.2: Methodology Used to Calculate Gear Conversion Costs



Note: figure adapted from 2014 FEIS

6.2.2.1 Equipment Costs for Trawling up

Vessels that switch to longer trawls because of new ALWTRP requirements will incur costs for new equipment, but may also realize savings on components of gear that the new configuration would use less extensively or eliminate entirely. For example, under Alternative Two, the use of trawls shorter than eight in the three to six nautical miles (5.6 to 11.1 km) portion of Maine Lobster Zone B would be prohibited; trap/pot vessels that currently fish short trawls would need to switch to trawls of no fewer than eight traps. The analysis assumes that the affected vessels would switch to the minimum set length of the new requirements – in this case, eight traps per trawl. For vessels that previously fished triples, this implies an increase in the quantity of groundline and a decrease in the quantity of buoy lines. It also implies a decrease in the number of buoys and other surface marking elements associated with each set (surface systems). To capture this dynamic, the gear cost analysis compares “with” and without” new requirements for each category of affected vessels, identifying the impact of each regulatory alternative on the gear that vessels in that category would employ. The calculations also take into account regular replacement of surface systems, where an individual could use their cache of surface systems instead of replacement in the future; that credit was applied against the estimated costs.

The equipment cost that vessels would incur is also a function of the total number of traps that must be reconfigured. For each model vessel, the cost model itemizes changes in the quantity of all gear elements based on the maximum number of traps fished at any point during the year. In this way, the estimate of gear conversion costs for each model vessel reflects the cost of reconfiguring all of its gear, not just the subset of traps it may fish in a particular month.

Gear specifications for each model vessel are customized to the relevant fishing area. The specification of baseline gear use is consistent with typical practices and existing regulatory requirements, while the specification of gear use under each regulatory alternative is based on an assessment of the changes needed to comply with the new requirements. The factors considered in each case include:

- set configuration (i.e., the number of traps and number of buoy lines per trawl)
- the depth at which gear is typically set, combined with a buoy line slack factor (to define buoy line length);
- buoy line diameter;
- buoy system features (buoy size, number, and type);
- the number of anchors (if any) per set;
- the distance between traps on a trawl (to define groundline length); and
- groundline diameter.[7]

Appendix 6.1.1 details how these parameters vary by area. As explained in the appendix, many of these parameters are based on information provided in a lobster gear configuration report in Gulf of Maine (McCarron & Tetreault 2012). Additional specifications draw on data provided by state fisheries managers to support development of the Vertical Line Model.

To evaluate the net change in equipment cost associated with fishing longer trawls, the analysis incorporates unit cost information gathered from marine supply retailers. The unit cost estimates represent the average of prices quoted by three major marine supply retailers in the northeast, Friendship Trap, New England Marine and Brooks Trap Mill. This price information was gathered via searches of online catalogs as well as personal communication with company representatives. Supplementary information from other retailers provides prices for miscellaneous gear elements.

Appendix 6.1.2 summarizes the unit prices and useful life estimates compiled for all gear elements.

6.2.2.2 Labor for Gear Conversion and Associated Costs

In addition to equipment costs, converting trap/pot gear to longer trawls would require an investment of fishermen’s time. The following discussion summarizes the assumptions the analysis employs to estimate the amount of time fishermen are likely to spend reconfiguring their gear, as well as the method used to estimate the implicit value of their time.

[7] The analysis assumes that groundline employed in non-exempt waters is sinking line, consistent with the ALWTRP’s current requirements.

Labor for Gear Conversion

Numerous factors may influence the amount of time a fisherman is likely to spend on gear conversion, including:

- The individual's skill and experience;
- The complexity of the reconfiguration required;
- Whether gear is reconfigured on shore or at sea;
- For reconfiguration at sea, the distance between sets;
- The availability of a sternman to assist with the work; and
- The method (knots, splicing, etc.) used to string traps together into trawls.

In the absence of data to support characterization of all of these factors, the labor cost analysis applies a simplified method. Following the recommendation of NMFS gear specialists, the analysis assumes 15 minutes of labor for each trap that must be converted to a new configuration, based on the assumption that the reconfiguration will be performed at sea.[8] To determine the number of traps that must be converted, the analysis first calculates, for each model vessel, the number of sets that the new configuration will accommodate. Using the model vessel's baseline gear configuration as a starting point, it then calculates the number of traps that must be added to each set to reach the target set length. For example, assume as a starting point a model vessel that under baseline conditions fishes 400 sets of doubles (a total of 800 traps), but under a given regulatory alternative would be required to fish trawls of at least five traps. In this case:

- The regulatory alternative will accommodate 160 sets of 5-trap trawls (800/5 = 160);
- The analysis takes as a starting point 160 sets of doubles (320 traps);
- The remaining 480 traps must be added to these sets to create five-trap trawls;
- At 15 minutes per trap, the analysis estimates that 120 labor-hours would be required to reconfigure the 480 traps (480 traps times 0.25 hours per trap).

The formula for total reconfiguration labor hours is shown as below:

$$Total\ Labor\ Hours = 0.25 * \left(Total\ traps - \frac{Total\ traps}{New\ Traps\ per\ trawl} * Old\ traps\ per\ trawl\right)$$

While this approach is highly simplified, it incorporates a time estimated for the suite of considerations and steps (listed above) required to convert from current to proposed trawl configurations. In addition, because it is based upon an estimate of the time required to reconfigure gear at sea, it is designed to be more conservative (i.e., to yield a higher cost estimate) than would be the case if the analysis assumed that the reconfiguration of gear occurred on shore.

Labor Cost

[8] Personal communication with NMFS gear specialists, September 24, 2012.

The cost model assigns an implicit value to fishermen's time based on labor rates in professions they would pursue if not involved in fishing. This is the "opportunity cost" of time. To identify alternative professions, the analysis relies on responses provided to a survey administered by the Gulf of Maine Research Institute in 2005 (GMRI, 2006). The GMRI survey asked a sample of 1,158 randomly selected lobstermen a variety of questions regarding education, vessel characteristics, fishing effort, and other aspects of their work. Compiled and published in 2006, the survey findings guide a number of assumptions in the cost and socioeconomic analysis presented in this EIS.

When asked about alternative professions, the GMRI survey respondents most commonly indicated that they would be involved in carpentry, other trades, vessel maintenance, merchant marine activity, or another aspect of commercial fishing (i.e., harvesting other species, boat maintenance). Table 6.1 summarizes the responses.

The cost analysis uses the distribution of responses to develop a weighted average wage rate that reflects the opportunity cost of a fisherman's time. First, the analysis normalizes the survey responses, eliminating the indeterminate or non-relevant responses ("other", "don't know" and "retire"). The analysis then matches the alternative occupations with Bureau of Labor Statistics (BLS) occupational categories, developing a simple average wage rate for each occupation (or group of occupations) based on the May 2018 mean hourly wage rate reported by BLS. For instance, the survey response "carpentry/trades/mechanic" is assigned an average wage rate based on the rates that BLS reports for "Carpenters" and for "Automotive Service Technicians and Mechanics." Finally, the analysis weights the wage rates by the distribution of survey responses to estimate an average opportunity cost of $25.75 per hour (Table 6.1).

6.2.2.3 Caveats and Uncertainties

The discussion above highlights several key assumptions in the analysis of gear conversion costs. Chief among these are (1) the specific baseline configurations and gear elements used in each fishing area; (2) the cost and useful life of various gear elements; (3) the amount of labor needed to convert short sets to longer trawls; and (4) the implicit value of fishermen's time. There are uncertainties associated with each of these assumptions, but the overall direction of any potential bias in the resulting estimates of gear conversion costs is unclear.

It is noteworthy that the analysis of gear conversion costs results in some net cost savings in gear costs for some groups of vessels, as shown in Table 6.3. This occurs when trawling up implies lower expenditures on key gear elements. For instance, vessels fishing in the Federal waters of LMA 1 are likely to employ relatively sophisticated and expensive surface systems. If trawling up reduces the number of sets fished and the number of buoys used, the result is reflected as a net cost savings, even after accounting for investments of time needed to reconfigure gear. Table 6.3 also shows savings caused by trawling up for some Maine fishermen that fish singles. Even with some catch losses, these vessels have a net savings due to reduced gear costs when trawling up. While the analysis incorporates these impacts, for most vessels, it also recognizes the potential for other costs – in particular, adverse impacts on catch rates – to offset any savings implied by estimates of changes in gear costs. The following section discusses these impacts in greater detail.

Table 6.1: Calculation Of the Implicit Value of a Trap/Pot Fisherman's Time

Alternative Occupation	Percent of Respondents That Identified Alternative	Normalized Distribution of Responses	Average Wage Rate	BLS Occupational Categories Incorporated into Average Wage Rate
Carpentry/Trades/Mechanic	28%	41%	$23.59	Carpenters; Vehicle and Mobile Equipment Mechanics, Installers, and Repairers; Construction Trades Workers
Other Commercial Fishing/Merchant Marine/Boat Building and Maintenance	26%	38%	$24.16	Fishers and Related Fishing Workers; Motorboat Mechanics and Service Technicians; Sailors and Marine Oilers; Captains, Mates, and Pilots of Water Vessels
Other Business	8%	12%	$36.98	Business and Financial Operations Occupations
Truck Driver/Equipment Operator	3%	4%	$23.71	Heavy and Tractor-Trailer Truck Drivers; Operating Engineers and Other Construction Equipment Operators
Education	2%	3%	$27.22	Education, Training, and Library Occupations
Police/Firefighter/EMT/Military	1%	1%	$25.07	Police Officers; Firefighters; Emergency Medical Technicians and Paramedics
Engineering	1%	1%	$44.62	Mechanical Engineers
Other	10%	N.A.	Weighted Average: **$25.75**	
Retire	2%	N.A.		
Don't Know	**16%**	**N.A.**		

Notes: Because the survey permitted multiple responses, these figures do not sum to 100 percent. Sources: Alternative occupation choice data from GMRI survey 2006;
Wage rate data from BLS Occupational Employment Statistics, May 2018.
https://www.bls.gov/oes/current/oes_nat.htm#00-0000 . Data accessed on March 19, 2020

6.2.3 Catch Impacts Associated with Trawling Up Requirements

The analysis of compliance costs associated with trawling requirements recognizes the potential for impacts on landings under certain conditions. Fishermen use singles and other short sets for a variety of reasons. In some cases, short sets may allow fishermen to target especially productive bottom structure where longer trawls may be inefficient or difficult to haul (e.g., because of fouling on bottom structure). This advantage may be most prevalent in rocky habitats, including those around islands. Second, short sets can be distributed more widely than trawled traps. Wide distribution may aid in the search for the target species. Likewise, wide distribution may reduce competition between traps, increasing the catch per unit of effort.

Data to support a quantitative analysis of trawling up effects on catch are extremely limited. Because multiple factors influence catch rates (gear configuration, gear density, the abundance of the target species, bottom structure, soak time, individual skill, etc.), it is difficult to isolate the effect of trawl configuration on catch. The Maine Department of Marine Resources (DMR) developed and implemented a project designed, in part, to assess the impacts of longer trawls on catch in the lobster fishery (Maine DMR 2012). Participants hauled roughly 2,300 sets of gear in control configurations (singles and doubles) and 835 sets of gear in trawls ranging from triples to tens. The research found no statistically significant reduction in catch per trap when comparing the control configurations to the experimental configurations.

Despite this finding, industry experts believe it is possible, and in some instances likely, that changes in gear configuration could have an adverse impact on catch. Experts from the Massachusetts Division of Marine Fisheries (DMF), for example, have called attention to the potential for catch impacts in the inshore lobster fishery around Cape Cod, where single traps are routinely fished.[9] Research has demonstrated that the optimal spacing of lobster traps depends upon the abundance of lobster in an area; the greater the density of lobster, the greater the density of traps that can be fished without an adverse impact on catch per trap (Schreiber 2010). The use of singles in the Cape region is partly attributable to this dynamic. The density of lobsters in these waters is lower than it is off the Maine coast; under these conditions, traps that are placed relatively close together – as would be the case when fishing trawls – are more likely to compete with one another in attracting lobsters. As a result, traps fished in trawls around the Cape might be less productive than traps fished as singles.[10]

Gear configuration change may lead to change in fishing effectiveness and efforts, causing an initial reduction in landings and associated lower fishing mortality. However, this is a dynamic process: landings would drop in the first year that effort reductions are implemented, and then increase after a few years when fishermen adapt to the new regulations and when lobster not captured in earlier years are caught at larger and more valuable sizes. Baseline landings value would be reached between five and seven years after implementation and baseline value would be exceeded in subsequent years (Burton Shank, personal communication, May 9, 2020). Because the ALWTRP regulations are generally revised every five to six years, long-term benefits derived from this measure are not calculated. Lacking any systematic data linking gear configuration and catch rate, the analysis applies a simplified approach to characterize potential impacts. To recognize the potential for catch impacts to be greater when gear configurations change markedly, it first classifies affected vessels into two categories:

Category A – Those subject to relatively large increases in trawl length, defined as an increase of a factor of two or more in the number of traps in each set; and

Category B – Those subject to smaller increases in the number of traps trawled up in each set.

The analysis then incorporates two scenarios designed to provide a reasonable estimate of the range of potential catch impacts:

Lower Bound – In the lower bound scenario, the analysis assumes that vessels in Category A

[9] Personal communication with Massachusetts DMF, November 7, 2012.
[10] Personal communication with Massachusetts DMF, November 7, 2012. DMF also noted that several ports on the Outer Cape have sandbars that can only be cleared when the tide is high. Fishermen access and haul their traps in a relatively narrow window of time each day. While trawl fishermen tend to haul more gear to make up for lower catch rates, this may not be an option for those whose ability to exit and return to port is limited by the tides.

experience a five percent reduction in annual catch. The reduction in catch will also decrease by 20 percent per year, and reach zero at year six. The catch of vessels in Category B is assumed to be unaffected.

Upper Bound – In the upper bound scenario, the analysis assumes that all vessels in Category A experience a 10 percent reduction in annual catch, while those in Category B experience a five percent reduction. For both categories, the catch reduction will decrease by 10 percent in year two, then decrease by 20 percent per year, reaching 10 percent of the original reduction at year six.

The impact of the year one catch reduction is calculated as follows:

$$Baseline\ Catch\ per\ Trap\ (lb/trap)\ x\ Traps\ Fished\ (traps/year)\ x\ Catch\ Reduction\ (\%)$$

Similarly, the reduction in annual landings is converted to a loss in annual revenue using the following equation:

Reduction in Catch (lb/year) x Ex-Vessel Price ($/lb)

Table 6.2 summarizes the catch per trap and price data by state and LMA using NMFS Vessel Trip Report (VTR, 2010-2017) and dealer data (2015-2017). Vessels fishing in federal waters with any permit requiring VTR reporting are required to report their fishing location, gear configuration and catch amount, while prices are calculated from dealer reports using landed pounds and transaction value. We use more years of VTR data to compensate for the lower VTR reporting rate of 10 percent in Maine waters. The 10 percent sample for VTR reporting in Maine is stratified by state fishing zone (Zones A through G) and license class. More specifically, within each combination of zone and license class, a proportion of harvesters (i.e., 10 percent) is annually selected to complete trip reports. These practices make the multi-year data more likely to be representative for the area.

It is vital to note that the assumptions applied in estimating potential catch impacts are generalized, and the magnitude of such impacts is highly uncertain. A given vessel may experience catch changes greater or less than the impacts assumed in the analysis. These impacts may diminish over time, as fishermen adapt to new gear configurations and learn to fish longer trawls more efficiently. Nonetheless, it is important to recognize that changes in gear configurations could have an overall impact on catch rates. The analysis does so, applying a range of assumptions to illustrate the potential magnitude of this effect.

6.2.4 Summary of Trawling up Cost

Trawling up measures are mainly proposed in Alternative Two to reduce the number of buoy lines in state and federal waters. Under Alternative 3, the only trawling up proposal is for LMA 3 offshore waters to increase the trap per trawl to 45 from May to August although trawling up is also identified as a likely consequence of a line cap and reduction under Alternative 3. The total economic impact from trawling up consists of three parts: cost savings from surface systems and buoy lines; extra material and labor cost for groundlines; and lost revenue from catch impacts.

Table 6.3 summarizes the savings and costs for different areas.

Under Alternative Two, catch reduction impacts account for the biggest costs, ranging from $5 million to $13.5 million. After offsetting the cost saving from buoy lines and surface systems, the total cost is between $2.6 million and $11 million for the first year. For Alternative 3, the trawling up cost is around $1 million to $2 million. It is much lower than Alternative Two because the major buoy line reduction measure for Alternative 3 is not trawling up, but the buoy line cap reduction, which will be described later.

Table 6.2: Parameters for Assessing Yearly Landing Value Reduction for Vessels Converting to Longer Trawls

Fishery	Area	Annual Catch per Trap (kg)	Ex-Vessel Price ($/kg)	Gross Revenue per Trap ($)	5% Revenue Reduction per Trap ($)	10% Revenue Reduction per Trap ($)
Lobster	ME LMA1	19.26	11.09	213.62	10.68	21.36
	ME LMA3	2.00	11.09	22.18	1.11	2.22
	NH LMA1	14.53	12.57	182.63	9.13	18.26
	NH LMA3	11.96	12.57	150.31	7.52	15.03
	MA LMA1	16.63	11.90	197.97	9.90	19.80
	MA LMA2	8.19	11.90	97.47	4.87	9.75
	MA LMA3	8.41	11.90	100.04	5.00	10.00
	MA OCC	14.95	11.90	177.93	8.90	17.79
	RI LMA2	5.92	12.70	75.21	3.76	7.52
	RI LMA3	19.73	12.70	250.56	12.53	25.06
Jonah Crab	MA LMA2	6.11	1.85	11.31	0.57	1.13
	MA LMA3	66.32	1.85	122.80	6.14	12.28
	RI LMA 2	5.44	1.83	9.95	0.50	1.00
	RI LMA3	56.02	1.83	102.51	5.13	10.25

Notes: 1. Catch per trap data is the average value calculated by state and LMA using 2010-2017 VTR.
2. Ex-vessel price is calculated by state using 2015-2017 dealer reports.
3. All values adjusted to 2017 US dollars

Table 6.3: Savings and Costs Caused by Trawling up Measures in the First Year of the New Rules

Area	Surface System Savings ($)	Buoy line Savings ($)	Groundline Line Cost ($)	Groundline Labor Cost ($)	Catch Impact Lower Bound ($)	Catch Impact Upper Bound ($)	Total Cost Lower Bound ($)	Total Cost Upper Bound ($)
ME A	-1,219,554	-594,442	101,674	347,168	933,560	2,592,508	-431,594	1,227,354
ME B	-182,664	-381,900	77,925	279,060	666,523	1,657,372	458,944	1,449,793
ME C	-269,876	-531,202	95,439	289,710	620,682	1,995,643	204,753	1,579,714
ME D	-173,853	-481,199	98,285	326,987	860,757	2,394,299	630,977	2,164,519
ME E	-89,017	-176,377	29,278	117,270	335,335	904,739	216,489	785,893
ME F	-43,161	-161,464	11,049	73,558	447,925	1,017,105	327,907	897,087
ME G	-55,450	-118,870	24,399	89,839	333,035	830,875	272,953	770,793
MA	-5,837	-15,482	1,032	13,538	49,619	99,239	42,870	92,490
RI	-4,582	-2,062	469	6,894	15,025	30,051	15,744	30,770
LMA3 (Alt 2)	-39,961	-161,954	2,240	84,233	1,037,191	2,074,383	921,749	1,958,941
LMA3 (Alt 3)	-38,113	-154,822	2,136	77,090	942,716	1,885,432	829,007	1,771,723
Total (Alt 2)	**-2,083,955**	**-2,624,952**	**441,790**	**1,628,257**	**5,299,652**	**13,596,214**	**2,660,792**	**10,957,354**
Total (Alt 3)	**-38,113**	**-154,822**	**2,136**	**77,090**	**942,716**	**1,885,432**	**829,007**	**1,771,723**

Notes: 1. All values are adjusted to 2017 US dollars.

2. Fishermen would save some costs in buoy line and surface system under new gear configurations. The negative numbers are estimated savings.

6.2.5 Weak Rope Costs

The use of 1,700 lb (771 kg) test rope would be required under both alternatives to increase the probability of an adult right whale disentangling themselves if they get wrapped up by a buoy line. Weak inserts are considered equivalent if they are placed in the traditional rope every 40 feet. For example, a 90-foot buoy line would need two weak points to consider it a fully weak rope.

In Alternative Two (preferred), all buoy lines in state waters would be required to have one weak insertion at 50 percent down the rope; buoy lines in waters between 3 to 12 nm (5.6 to 22.2 km) would be required to have two weak insertions at the top 25 percent and 50 percent of the rope; buoy lines outside 12 nm (> 22km form shore) to the LMA 1 border are required to have one weak insertion at top 35 percent. For LMA 3, the preferred alternative would require fishermen to use fully engineered weak rope or equivalent in one of their buoy lines for the top 75 percent year round.

In Alternative Three (non-preferred), buoy lines in all but LMA 3 waters would be required to have a fully engineered weak line or equivalent in the top75 percent of the buoy lines. There are two options for LMA 3 lines: 1. Have one buoy line with 75 percent weak seasonally (May to Aug) and one line with 20 percent topper (top 20 percent of the buoy line) year round; 2. Have one buoy line with 75 percent weak year round.

Inshore or nearshore vessels usually use 3/8 inch (1 cm) diameter ropes, and for offshore vessels, 1/2 (1.3 cm) or 9/16 inch (1.4 cm) ropes are normally used. Fully engineered 3/8 inch (1 cm) diameter ropes that break at 1,700 lb (771 kg) or less (weak rope), according to a gear manufacturer,[11] would cost about 15 cents per foot, higher than the 11 cents per foot for traditional 3/8 inch (1 cm) diameter ropes. The price for offshore weak ropes are assumed to be 30 percent more expensive than original ropes at the same diameter. The life span of these ropes are assumed to be six years.[12]

There are a few other ways to make a buoy line weak, and the costs vary: The first one is to splice a piece of weaker rope into the original rope. Costs would include five minutes of labor for each insertion and the costs of the piece of rope. The life of this weak insertion is assumed to be the same as the original rope, about six years.

Another way is to introduce a 6-foot hollow sleeve, designed by South Shore fishermen, to the original rope. Two ends of the original rope meet in the middle of the sleeve, and the two ends of the sleeve are anchored into the original ropes in three tucks or splices. The estimated time to finish the work is around five minutes, and the cost of the sleeve is two dollars with an average life span of four years (Knowlton et. al. 2018).

In this analysis we adopt the costs of the South Shore sleeves as a proxy of weak insertion, and for LMA 3 where fully weak rope will be required, we use 3/4 inch (2 cm) weak rope as a proxy. The sleeves manufactured by Novatec Braid Ltd. have been tested by South Shore Lobster

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[11] Personal communication with Shippagan Ltd on March 17, 2020.
[12] Detailed gear price and life span can be found at Appendix.

Fishermen’s Association and the New England Aquarium in various locations and weather conditions (Knowlton et. al. 2018). Results indicate that these sleeves are consistent in maintaining integrity and breaking strength over time so they could be used for multiple seasons. The cost of one sleeve insertion is $6.1 including labor cost, and the cost of 3/8 weak rope is $0.15 per foot. The price for 3/4 fully engineered weak rope is not available, but with an estimate of 30 percent increase from regular rope, it is around $0.34 per foot.

The cost estimation for weak ropes is listed in the Table 6.4 below: The investment in weak ropes will generate costs only in the first year, and potentially last for six years without additional input. The total cost would be around $2 million for Alternative Two. For Alternative Three, the total cost would be $10 million due to the requirement of fully weak ropes.

Table 6.4: Affected Buoy Lines and Annual Costs of Weak Lines by Alternative in the First Year

	Affected Buoy Lines	**Weak Rope Cost Alternative Two ($)**	**Weak Rope Cost Alternative Three ($)**
ME A	50,674	279,515	2,101,559
ME B	24,336	135,362	872,347
ME C	50,768	259,823	1,978,356
ME D	42,573	217,389	1,228,861
ME E	15,148	83,608	526,789
ME F	16,378	104,720	1,039,877
ME G	15,170	91,990	763,639
NH	14,815	60,678	139,998
MA	100,454	435,695	1,076,352
RI	6,378	35,123	62,395
LMA 3	3,822	448,594	412,472
Total	**340,516**	**2,152,497**	**10,202,645**

Notes: 1. All dollar values are adjusted to 2017.
2. Weak lines and inserts are assumed to last for six years. Depending on fishing areas, some ropes might last shorter due to weather or bottom condition. Therefore, annual cost could be higher in some areas.

6.2.6 Other Potential Impacts Associated with Gear Configuration Requirements

The analysis does not attempt to quantify several other impacts potentially associated with changes in ALWTRP gear configuration requirements. These include:

- Costs associated with increased gear loss;
- The potential need for a larger crew to handle longer trawls;Vessel modification costs;

The analysis addresses these impacts qualitatively, either because data to develop reasonable estimates are lacking or because available information suggests the impacts will be relatively small. The subsections below address each of these costs in greater detail.

6.2.6.1 Gear Loss Costs

Some gear configuration requirements affecting fixed-gear fisheries have the potential to affect rates of gear loss. Substantial changes in equipment losses can have important cost implications, and should therefore be examined carefully.

The impact of minimum trawl length requirements on gear loss in trap/pot fisheries is difficult to predict with confidence. The uncertainty is largely attributable to the array of underlying factors responsible for gear loss. On the one hand, longer trawls may increase the likelihood that groundline will foul on bottom structure, increasing the potential for line to part while hauling traps. Longer trawls may also increase the potential for gear conflicts, particularly situations in which one fisherman's gear is laid across another's. In these cases, one party may inadvertently sever another's lines, making it impossible to retrieve all or some of the gear. A longer trawl also increases the consequences of such incidents; i.e., the more gear on a single trawl, the more gear is lost when that trawl is rendered irretrievable.

In other ways, trawling requirements may reduce the potential for gear loss. The fundamental objective of longer trawls is to limit the number of buoy lines in the water column and reduce encounters with large whales; such encounters are one possible source of gear loss. Likewise, a decrease in the number of buoy lines may reduce the frequency with which gear is entangled in ship propellers or certain types of fishing gear. Furthermore, in areas where trawling requirements necessitate addition of a second buoy line (e.g., for a vessel going from triples to ten-trap trawls), the second buoy line may make it easier to locate and retrieve gear when one buoy line is lost. Longer trawls are also heavier and may be less likely to be swept away during extreme storm or tidal events.

Available data assessing how trawling up requirements could affect gear loss are inconclusive. The Maine DMR trawling project (discussed above) asked participants to record whether they lost gear while hauling. An analysis of the raw data provided by DMR shows that of the roughly 3,100 sets of gear, 28 were lost. Of the lost sets, all but six were trawls of three traps or longer (Maine DMR 2012). While this outcome suggests a potential increase in gear loss when trawls are required, nine of the lost sets were seven- and 10-trap trawls fished with a single buoy line (an intentional feature of the project design). This gear configuration does not occur in normal practice and would not be required by any of the alternatives that NMFS is considering. Furthermore, in that study, the participants fished the trawls on an experimental basis; for example, they may have intentionally placed some trawls on bottom structure unsuited to the experimental configuration. Overall, the sample of gear loss incidents in the project is too small to draw reliable conclusions about how trawling influences gear loss.

In 2010 and 2011, the Massachusetts DMF completed a comprehensive study of gear loss and "ghost" fishing (i.e., impacts from lost or derelict gear). Roughly 520 Massachusetts lobstermen responded to the survey (about 59 percent of all the lobstermen permitted in the

Commonwealth); the responses were distributed across LMAs 1, 2, 3, and the Outer Cape in approximate proportion to lobstering activity. Respondents characterized the extent of their gear loss in different seasons and discussed the perceived causes of gear loss. Table 6.5 summarizes key information gathered in the survey. The findings demonstrate that gear loss is common and represents a significant cost for many lobstermen (MASS DMF 2011).

Table 6.5: Summary of Findings from Massachusetts DMF Gear Loss and Ghost Gear Survey

LMA	Average Number of Traps Lost per Vessel	Primary Causes of Gear Loss	Average Value of Gear Lost per Vessel
1	10 to 23	Storm events and vessel traffic	$640 to $1,570
Outer Cape	14 to 34	Storm events and vessel traffic	$1,410 to $2,950
2	8 to 21	Vessel traffic and bottom hang ups	$570 to $1,500
3	19 to 46	Gear conflicts, line wear, storm events	$3,860 to $7,140

Source: Massachusetts DMF, 2011

The survey also included questions about typical gear configurations, allowing DMF to examine how gear loss varies with trawl length. Table 6.6 summarizes the findings. The minimum gear loss rates reported for each configuration show slightly higher losses associated with singles. The maximum rates more strongly suggest that gear loss is greater when fishing singles and doubles than when trawls of three or more traps are used. Overall, these data indicate that rather than exacerbating gear loss, up to a point trawling up requirements may reduce the amount of gear lost and thereby yield an economic benefit to affected fishermen.

Table 6.6: Influence of Configuration on Gear Loss: Massachusetts DMF Gear Loss and Ghost Gear Survey

Configuration	Trap Loss Rate Minimum	Trap Loss Rate Maximum
Singles	2.70%	21.40%
Doubles	1.60%	19.30%
Trawls (three or more traps)	**2.10%**	**8.70%**

Source: Massachusetts DMF, 2011

Overall, the effect of trawling up on gear loss is unclear. While data from the Maine trawling project suggest some potential for increased gear loss during fishermen's transition to trawls, the more extensive data from the Massachusetts ghost gear survey suggest that trawls are less subject to gear loss in steady-state conditions. Gear loss is likely a function of numerous variables that extend well beyond the trawl configuration, including bottom structure, shipping traffic, gear density, gear conflicts, tides, currents, experience of adjacent fishermen, and weather events. The net effect of trawling up in the context of all these variables is difficult to characterize or quantify. Hence, the cost estimates discussed in this chapter do not explicitly incorporate the impact of gear loss changes.

6.2.6.2 Addition of Crew

Fishermen operating alone could potentially have difficulty handling the longer trawls required under some of the regulatory alternatives. The physical demands of hauling trawls may be challenging for fishermen who haul by hand rather than with a mechanized hauler. Even with a hauler, older fishermen may find it difficult to manage longer trawls. Addition of a sternman or other crew is one possible response for affected vessels. However, fishing alone is relatively uncommon on most vessels in ALWTRP-regulated waters. In addition, the cost of adding crew is prohibitive for most vessel operators. The subsections below present data suggesting that the addition of crew is unlikely as a response to the trawling requirements.

- **Crew on Affected Vessels**

Numerous inshore lobstermen choose to fish alone for a number of reasons: limited by permit type, limited by vessel size, or in consideration of vessel profitability. In Maine state waters, permit type LC1 holders are required to be operator only. Adding another crew to the vessel is not allowed. Maine DMR 2017-2019 permit data indicate that 24 percent of applicants hold LC1 permits.

Most other lobster fishermen in the Northeast Region fish with more than one crew onboard. According to the cost survey data collected by NMFS Northeast Fisheries Science Center (NEFSC) for fishing year 2011, 2012 and 2015, only 7 percent of survey respondents from New England states fish without any crewmembers, and 97 percent vessels longer than 25 feet have at least one crew. Table 6.7 displays the number of crew by vessel size using NMFS survey data.

Table 6.7: Number of Crew by Vessel Size

Crew	25-	26-35	36-45	46-55	55+	Sum
0	5	6	10	0	0	**21**
1	1	39	64	0	1	**105**
2	1	42	73	3	1	**120**
3	1	10	30	1	3	**45**
4	0	0	1	0	5	**6**
5	0	0	2	0	2	**4**
6	0	0	1	0	0	**1**
Total	**8**	**97**	**181**	**4**	**12**	**302**

- **Sternman Costs**

Vessel operators choose to work with crew primarily for economic reasons. For instance, a sternman may be cost-effective when lobster abundance is high, harvests are large, and fishing effort is high. Sternmen may also be hired for non-economic reasons, such as safety in offshore waters and for apprenticing purposes.

Sternmen are typically paid a percentage of the vessel's gross (or sometimes net) revenue. Table 6.8 summarizes data from NFMS cost survey for lobster vessels (Zou, Thunberg and Ardini 2020). As the exhibit indicates, payments to sternmen represent a substantial operating cost. A single sternman may be paid roughly 20 percent of gross revenue. On offshore vessels that typically operate with multiple crew members, sternmen may be paid a third of gross revenues.

Table 6.8: Crew Payment for Lobster Vessels by Size (in 2018 US Dollars)

Vessel Size	Vessel Number	Crew Payment ($)	Fishing Revenue ($)	Percentage
35-	13	20,208	107,793	**19%**
36-45	277	36,391	168,108	**22%**
46-55	11	51,986	255,200	**20%**
55+	1`5	275,800	752,497	**37%**

Source: NEFSC Cost Survey (Zou, Thunberg and Ardini, 2020)

- Conclusions

The information presented above demonstrates that the addition of a sternman is a major economic decision for a vessel operator, and is dependent upon many factors. If an operator fishes alone, trawling up requirements are not likely to alter that preference. Moreover, the available data suggest that vessel operators who work without a sternman are not necessarily limited to fishing singles. For example, of the Massachusetts lobster vessel operators who work alone, over two-thirds already fish trawls of three or more traps.[13] Anecdotal discussions with fisheries managers also indicate that trawls are routinely fished by vessel operators working alone.[14] Finally, the trawling-up configurations proposed in Alternative Two are based on measures proposed by Maine DMR after extensive scoping with Maine lobstermen and are believed to represent modifications that fishermen can accommodate within their current capacity and fishing practices.

Nonetheless, safety concerns and the physical demands of hauling trawls may prove to be a challenge to some lone operators. In Maine, these vessels may have the option of relocating to exempt waters. Beyond this option, it is possible that the trawling requirements may force some fishermen to fundamentally reconsider their operations, including crew choices. For instance, an operator fishing alone may choose to hire a sternman, fish more traps, and possibly move to a new location. NMFS does not believe such changes will be widespread, and the analysis does not reflect the cost of such major operational shifts.

6.2.6.3 Vessel Modification

For a variety of reasons, operators of smaller vessels may find it difficult to fish trawls. Some small vessels, for example, may lack the deck space to accommodate trawls. Experts with Maine DMR, however, note that in some cases, operators of smaller vessels have made it feasible to use trawls by affixing plywood sheeting to the stern or the rail of their vessels, thus extending the available deck space.[15] The proposed federal regulations would not include trawling up requirements in exempted waters; however, operators of small vessels affected by the proposed trawling up requirements may choose to make similar modifications.

Estimating the number of vessels that would need this type of modification would require data

[13] Based on analysis of MA DMF permit and 2009 Catch Report data.
[14] Personal communications with Maine DMR (August 30, 2012) and Massachusetts DMF (November 7, 2012)
[15] Personal communication with Maine DMR, August 30, 2012

on vessel size and other features that are not readily available; thus, the estimate of compliance costs does not specifically incorporate vessel modification costs. All else equal, the exclusion of these costs biases the estimate downward. In aggregate, however, these costs are likely to be relatively low; thus, the magnitude of any bias is likely to be minor.

6.3 Analytic Approach: Seasonal Restricted Area closed to Trap/Pot Buoy Lines

As described in Chapter 3, seasonal restricted areas that would allow ropeless fishing but be closed to fishing for lobster and Jonah crab with persistent buoy lines are proposed in Alternatives 2 (preferred) and 3 (non-preferred): Maine LMA 1 Offshore Restricted Area, across the Maine Lobster Management Zones C, D and E; Massachusetts Restricted Area; South of Nantucket and Martha's Vineyard Restricted Area options; and Georges Basin Restricted Area. Figure 6.3 and 6.4 depict the shape of these restricted areas, and Table 6.9 describes the details of the restricted areas and the number of affected vessels. Analysis of available data on vessel activity indicates that the practical impact of these proposals would be limited to the lobster and Jonah crab fishery, since vessels in other trap/pot fisheries do not appear to be active in the areas of interest when a restricted area would be in effect. How a lobster vessel is likely to respond to a given restricted area depends on the features of the restricted area as well as the type of permit that a vessel holds. In general, vessel operators will likely choose one of three responses:

Suspend Fishing – If alternative fishing grounds are not readily available, vessel operators may suspend fishing while their regular grounds are closed and resume fishing in the area when the restricted area ends. For example, if a vessel only holds a state permit, while during the closed time period, no other state waters is available, this vessel will suspend operation.

Relocate – It may be possible for vessel operators to fish for lobsters in other areas during the restricted period. The potential for relocation depends on many factors, including regulatory restrictions on access to alternative areas, the distance to those grounds, the productivity of the grounds, and the potential for competition with others to limit access to a new area.

Ropeless Retrieval - Use ropeless fishing technique such as remote retrieval of buoy line that is stored on the bottom.

These responses have different implications for economic welfare, and affected fishermen may respond differently, depending upon individual circumstances. The following discussion examines this issue, beginning with describing the general approach the analysis employs to analyze the costs associated with restricted areas. Then it examines each of the proposed buoy line restricted areas individually, and estimates the compliance costs.

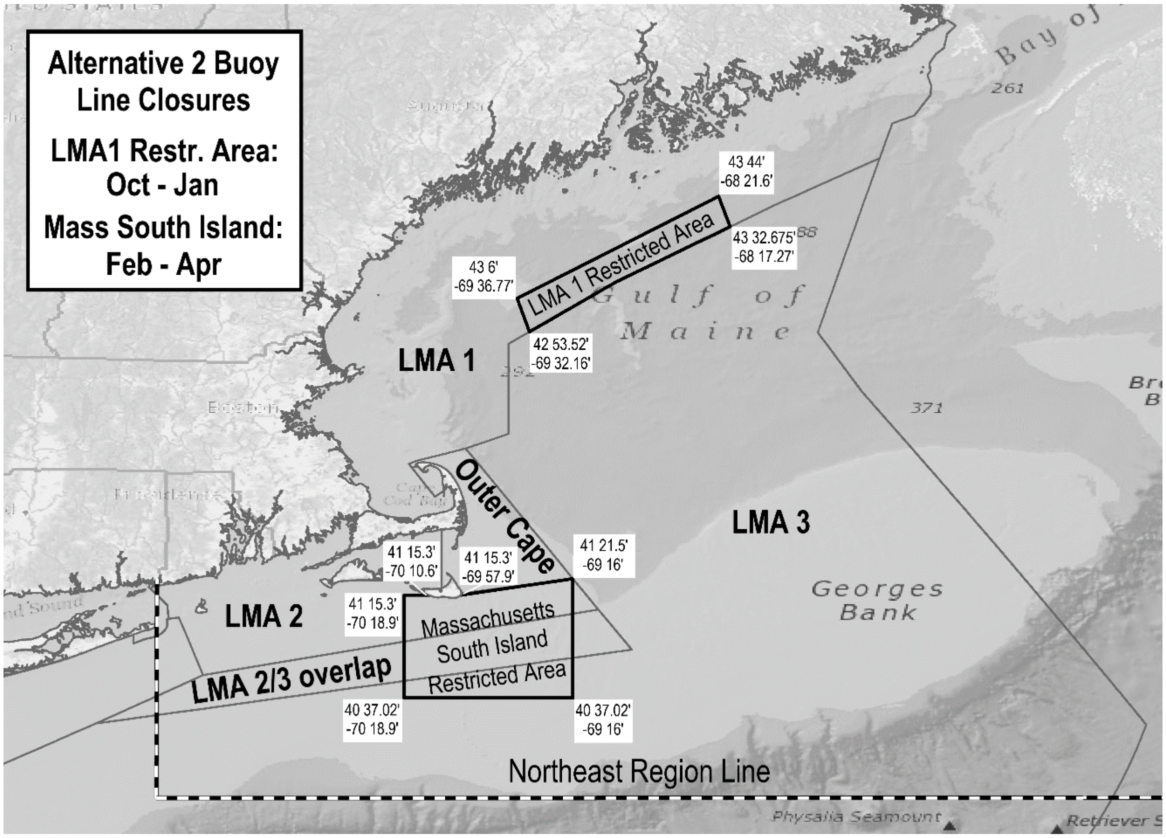

Figure 6.3: The trap/pot buoy line restricted area areas proposed in Alternative Two (Preferred). The Cape Cod Bay and Outer Cape State Water areas represent Massachusetts soft buoy line closures of state waters within the Massachusetts Restricted Area, retaining the restricted area in May until surveys confirm whales have left the area. The Massachusetts South Island Restricted Area is proposed as closed to trap/pot buoy lines from February through April and the LMA1 Restricted Area would be closed to buoy lines from October through January.

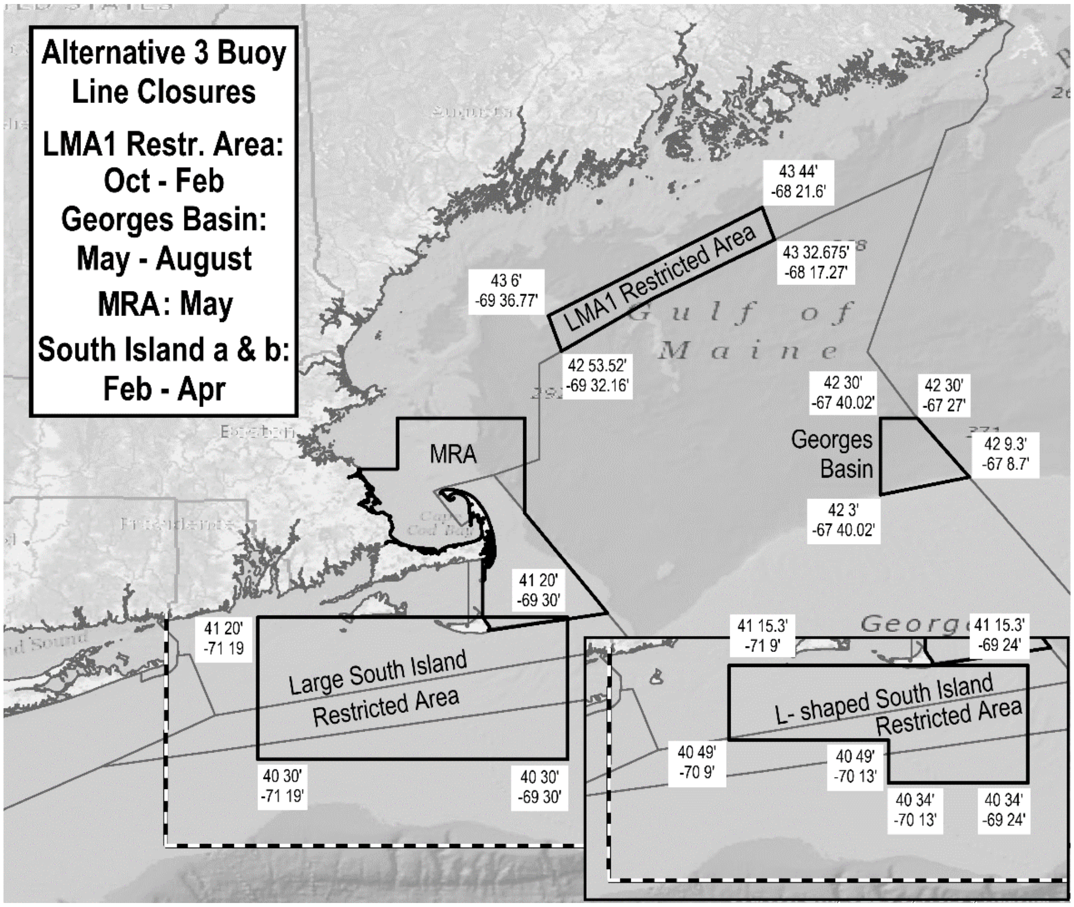

Figure 6.4: The seasonal trap/pot buoy line restricted area options proposed in Alternative Three (Non-preferred). There are two different options for a restricted area south of Cape Cod from February through April, a large restricted area (3a) and an L-shaped restricted area (3b). The LMA1 Restricted Area is proposed from October through February. The Georges Basin Core area is proposed from May through August. A Federal extension of the Massachusetts Bay Restricted Area through May, with a potential opening if whales are no longer present, is also included.

Table 6.9: Summary Table of Seasonal Buoy Line Restricted areas and the Number of Affected Vessels

Restricted Area	Alternative	Restricted Period	Size (Square miles)	Max vessels-lines out	Max vessels-relocation
ME LMA1	2	Oct - Jan	967 (2,504 km^2)		45
South Island_2	2	Feb - Apr	2,545 (6,592 km^2)	2	1
ME LMA1	3	Oct - Feb	967 (2,505 km^2)		45
MRA	3	May	2,161 (5,597 km^2)	138	21
Georges Basin	3	May - Aug	557 (1,443 km^2)		16
South Island_3a	3	Feb - May	5,468 (14,162 km^2)	16	11
South Island_3b	3	Feb - May	3,506 (9,080 km^2)	3	7

6.3.1 Costs of Suspending Fishing

6.3.1.1 Lost Revenue and Saved Operation Costs

Fishermen may respond to restricted areas by suspending fishing during the restricted period. The forgone revenue associated with inactivity would be the primary cost for fishermen who choose to sit out restricted areas. At the same time, fishermen would save operation costs by not fishing. The total cost variation will be the summation of these two parts. The sections below describe the general method used to estimate costs for trap/pot vessels that suspend fishing activity.

The analysis of the cost of suspending fishing is based on estimates of revenue per trap, which are then used to estimate forgone revenue based on the number of traps fished on affected vessels. The estimates of revenue impacts are tailored to the area and season each restricted area would affect. In each case, the analysis incorporates catch-per-trap estimates based on the best available data. As described in the gear configuration approach section, the catch per trap data are estimated using VTR data from 2010 to 2017.

Catch per trap is then combined with ex-vessel price data to estimate gross revenue per trap. To characterize typical market conditions, the analysis incorporates the average price data for the three most recent years available (2015 to 2017). To align prices with the area and season specific catch-per-trap data, the analysis uses ex-vessel price data from the states and months relevant to each restricted area.

Gross revenue per trap is the product of the catch per trap and the applicable ex-vessel price for each restricted area. A final adjustment is needed to convert gross revenue per trap to net revenue per trap. Fishermen who suspend fishing during restricted areas will forgo revenue but will save the operating costs associated with the effort (while continuing to pay fixed costs such as boat payments). Operating costs are the costs that vary with fishing effort, and primarily include bait, fuel, and payments to sternmen (when relevant). In this analysis, we adopt the operation costs from a recent economic research on lobster vessel profitability conducted by NFMS using cost survey data collected by the Social Science Branch of NMFS Northeast Science Center. On average, vessels below 35 feet have an annual operation cost of $68,858; the operation cost for medium-sized vessels (35-44 feet) is $120,704. For large (45-54 feet) and extra-large (55+ feet) vessels, the operation costs are $182,137 and $718,034 respectively.[16] .From VTR data, we calculate the percentage of trips that vessels take during the restricted months, and then we estimate the average operation costs during the restricted time.

As discussed further below, the analysis includes a restricted area-specific estimate of the number of traps fished per vessel. Thus, the impact of the restricted area on the net revenue of each affected vessel is the product of the number of traps the vessel would ordinarily fish in the closed area and the estimate of forgone revenue per trap, net of operating cost savings.

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[16] Zou, Thunberg and Ardini, 2020. Economic Profile for Lobster Fleets in the Northeastern U.S. Accepted as Center Reference Document at NEFSC.

6.3.1.2 Caveats

VTR data have been used extensively in the calculation of catch per trap and trip percentage during the closed period. We are aware of that VTR are self-reported data and the catch and location data are limited in accuracy and variation for some vessels. However, the geographic information and gear configuration data could not be found in any other data sources consistently for trap and pot fisheries. In addition, the data quality has been largely improved in recent years due to the use of new technology like electronic reporting. Therefore, we decided to use the recent years' data after carefully reviewing and the removal of outliers. (See Appendix 6.2 for documentation)

It is also important to note that the analysis of the revenue losses associated with suspending fishing assumes that fishermen lose all the catch they would ordinarily harvest during the restricted period. The loss in landings may actually be less, depending on lobster movements and behavior. Specifically, some of the lobsters not caught during the restricted area may simply be harvested once the closed area is reopened (i.e., catch rates may be higher than normal following the restricted area). To the extent that this occurs, the analysis may overstate the economic losses associated with suspending fishing.

6.3.2 Relocation Costs

When a vessel has the opportunity to relocate their traps during the closed period, it may to do so if the expected returns of fishing elsewhere exceed costs. Assuming restricted areas will not affect lobster prices and most operating costs such as bait will be unaffected, relocation has two major impacts on the vessel: change catch rate and fuel consumption. Some other factors like time and transition cost may also affect total costs, however, these costs could not be reliably estimated so we do not include them in the quantitative analysis in this section

6.3.2.1 Fuel Costs

One potential impact of relocating effort during restricted time is a change in operating costs associated with fuel consumption. This is a function of the change in distance that a vessel operator must steam in order to tend his or her gear, the number of trips taken during the period in question, the vessel's fuel efficiency, and the price of fuel.

The difference of travel distance before and after relocation is determined by the size of the restricted area. We assume vessels relocate their traps in areas adjacent to the restricted area where the difference in travel is measured from the center to the edge of the restricted area. Most restricted areas are in irregular shape, so we take the shortest route as the lower bound of relocation and the longest as the upper bound. Additional information on the areas to which vessels were assumed to relocate is provided in the detailed discussion of the analysis of each restricted area. In all cases, however, the method assumes that relocation to the substitute fishing area is temporary, and that the affected vessels will return to their preferred fishing grounds when the restricted area has ended.

Once the alternative fishing location is identified, the total change in distance traveled depends on the number of fishing trips made during the restricted period. In this analysis, only vessels in federal waters are assumed to relocate their traps, so we use multi-year VTR data to estimate the average number of trip each model vessel will take in a certain month.

Any change in fuel costs also depends on the fuel-efficiency of the affected vessels, which is a function of engine size (horsepower). Information on the engines with which affected vessels are equipped is not available; however, it is possible to estimate the horsepower of affected vessels based on the general correlation between horsepower and vessel length. The analysis employs an equation characterizing this relationship, using it, in combination with an estimate of the average length of affected vessels, to estimate the horsepower of vessels that may relocate their effort while a restricted area is in effect (Table 6.10).

Consistent with data from a recent study by the Maine Maritime Academy (MMA, 2011), the analysis assumes that marine engines burn 0.053 gallons of diesel fuel per hour for each unit of horsepower delivered. The analysis uses this figure to estimate total fuel use per hour for all affected vessels. Based on input from NMFS gear specialists, the analysis also assumes that vessels steam at an average speed of 14 knots. This figure, in combination with data on distances, provides a basis for estimating the change in steaming time to and from alternative fishing grounds. The analysis then multiplies this figure by the estimate of diesel use per hour to obtain an estimate of the change in fuel use per trip.

Multiplying fuel use per trip by the number of trips and price of diesel fuel yields the change in fuel costs. The analysis is based on a retail diesel price of $3.93 per gallon, the mean of the weekly prices recorded for New England from October 2010 through October 2012 (EIA, 2012). In calculating the change in costs attributable to each regulatory alternative, average diesel price data from 2017 to 2019 from American Petroleum Institute for the New England Area were used. The adjusted price for all area is $2.95 per gallon in 2017 US dollars.

Table 6.10: Summary of Fuel Use Parameters Used in Restricted Area Cost Assessment

Parameter	Value/Estimation Method	Source
Horsepower (Lobster Vessels)	HP = -16.3566 + 9.71*(Vessel Length in Feet)	NMFS Permit Data (2011)
Fuel Consumption at Cruising Speed	0.053 gallons/hour/HP	Maine Maritime Academy, 2011
Typical Cruising Speed (Lobster Vessels)	14 knots	NMFS Gear Specialists
Retail Price for Diesel Fuel (Tax included, New England Area)	$2.95 per gallon	Energy Information Administration, 2017-2019

6.3.2.2 Catch Impacts

It is also possible that relocating vessels will experience a reduction in catch relative to their preferred fishing location inside the closed area. Catch reductions could result because of crowding and heightened competition in the areas to which fishermen relocate; because fishermen are less familiar with the bottom structure or other determinants of catch in the new area; or simply because the available alternative fishing grounds are less productive than those inside the closed area.

The data required to develop a rigorous estimate of potential catch impacts are not available. Such an estimate would require a well-defined characterization of catch rates in the closed area and similar knowledge of conditions (e.g., lobster density) in a specific alternative fishing area. In practice, the potential impact is likely to vary significantly from individual to individual, depending upon the fisherman's expertise and ability to adapt to a new area. As a result, any catch reduction estimated for vessels that relocate their effort is subject to significant uncertainty.

Lacking more specific data, it was assumed that vessels which choose to relocate would experience reduction in catch during the restricted period. Using catch per trap and price data from previous analysis, then multiplying the total traps fished in each period, we can estimate the total value of each month. Five percent of total value is the lower bound of lost revenue and ten percent is the upper bound. Unlike catch reduction from trawling up measure, these reductions are assumed to happen every year.

6.3.2.3 Caveats

In addition to the assumptions noted above, the analysis of relocation costs is based on a number of other assumptions about fishermen behavior that are subject to considerable uncertainty. These include:

- The assumption that fishermen would reconfigure their gear, as necessary, to meet the minimum trawl length requirement in any area to which they relocate, but would incur no gear conversion costs beyond those associated with meeting these requirements;

- The assumption that fishermen who relocate their effort would continue to fish the same number of end lines and traps they used in the closed area.

- The assumption that fishermen will find productive ground to relocate to and would not have a reason to create dense gear fencing around the perimeter that could pose a risk to whales entering or leaving the buoy line closure area.

- The assumption that fishermen will continue to make the same number of fishing trips while using the alternate location.

Reviewers are asked to comment on these caveats and to provide evidence to support these or alternative assumptions. For example, reviewers are asked to comment on whether restricted areas to protect whales would cause a "curtain effect" resulting from fishermen lining up to surround a restricted area. This occurs when an area is closed to protect spawning areas or for other target species' conservation purposes. Target species become more productive within those closed areas and spill across the restricted area borders. This productivity prompts fishermen to fish around restricted area edges. Areas closed to protect whales would have some seasonal protection for lobster, but once opened, those lobsters would again be available for harvest. Rather than line up around the perimeter of an area that is not designed to increase target species production, to prevent conflict agile fishermen would be more likely to search for and relocate to productive bottom nearby. Responses would be dependent on other fishery practices, such as seasonal fishing habits nearshore, for example, in areas where most gear is removed seasonally, relative to offshore areas where gear is relocated.

The net effect of these assumptions on the cost estimates is unclear. The methodological discussion for each of the individual restricted areas highlights additional uncertainties associated with the selection of specific relocation sites for affected vessels.

6.3.3 Ropeless fishing

Under a revised restricted area definition, trap/pot fishermen could fish with trap/pot gear using “ropeless” methods, although exempted fishing permits would be required to exempt fishermen from surface marking requirements under other laws. The gear would still require rope in the groundline between pots in the trawls on the ocean floor. Most designs also include rope buoy lines, but they are stored on the bottom until retrieved acoustically by a vessel operator when present to haul-in the lobster trawl. Team members disagreed about further consideration of “ropeless fishing” for multiple reasons, including: costs of the technology; concerns about gear conflicts; lack of testing under commercial fishing conditions; questions about impacts on trawlers and other mobile gear fishermen; ability of enforcement agents to retrieve, inspect, and reset the gear; and the belief that it could not be rapidly adapted for commercial use. Some Team members recognized that ropeless fishing could provide an alternative to seasonal closures and many strongly supported the need for commercial fishermen to be involved in the further development and design of ropeless gear. Because the overall sense was that the Team would not provide a consensus recommendation on the ANPR, NMFS did not move the action further in 2018.

Since 2018, NOAA has invested a substantial amount of funding in the industry's development of ropeless gear, in specific geographic areas and in general. We anticipate that these efforts to facilitate and support the industry's development of ropeless gear would continue, pending appropriations, and would be essential to defray costs for early adapters.

6.3.4 Analysis of Specific Restricted Area Scenarios

Vessel operators are likely to respond to a particular restricted area in the way they believe would have the least adverse impact on their income, subject to financial, regulatory, and other constraints on the options available to them. Their responses will depend not only on the nature of their fishing operations (e.g., fishery, vessel type, quantity of affected gear) but also on the features of the restricted area itself (area and time period). The variety of possible outcomes and the large number of potentially affected fishermen precludes a vessel-by-vessel analysis of likely responses.

s noted above, this analysis examines three general response scenarios to evaluate the potential impact of restricted areas: relocation or suspension of fishing effort. Within that framework, however, the analysis of economic impact seeks to recognize key variables that may differ from case to case, such as the number of vessels a particular restricted area would affect, the scale of the fishing operations affected, regional differences in the prices that affected vessels may receive for their catch, and the availability of alternative fishing sites. The sections below discuss each restricted area individually, focusing on unique aspects of the approach to analyzing their potential impacts.

6.3.4.1 Offshore Waters of Maine Zone C, D, and E

The buoy line restricted area approximately 30 nm (55 km) offshore of Maine, across the Maine lobster management Zones C, D and E provide protection for right whales in an area of relatively high co-occurrence during the fall and winter according to both the Decision Support Tool and the NMFS/IEC co-occurrence model. In Alternative Two, the proposed season is from October to January, and in Alternative Three, one more month of restricted area in February is proposed.

As shown in Figure 6.3, the entire 967 square miles (2,505 km2) of closed area is located in federal waters of LMA 1. All vessels fishing in this area are required to have a federal permit with a designated fishing area of LMA 1. Based on estimates from the Vertical Line Model, 45 vessels will be affected by this restricted area. We assume these vessels would re-locate all their traps within the same zone but closer to shore for two reasons: firstly, vessels with LMA 1 permit are not able to get over the Eastern border of the closed area to fish in LMA 3. Secondly, even though vessels in Zone C and E could move their traps into adjacent zones, the trap numbers are limited. It is unlikely to be economically efficient to tend traps in two unconnected areas.

Based on the assumption above, fuel costs for affected vessel will go down due to shorter travelling distance, but may be counter-balanced by lost revenue from catch impacts by moving traps out of their premium fishing ground. Table 6.11 shows the details of affected vessels and the fuel cost changes. The average vessel horsepower in this area is 349, the lower bound of saved miles from relocation is 10 per round trip and the upper bound is 20.

Table 6.11: Cost Savings from Relocation in ME Closed Area by Month

Month	Average Trip	Affected Vessel	Fuel Cost Saving Lower Bound ($)	Fuel Cost Saving Upper Bound ($)
Oct	11.3	30.9	11,895	23,790
Nov	8.9	34.0	10,278	20,556
Dec	5.2	37.8	6,696	13,391
Jan	3.6	44.7	5,392	10,783
Feb	2.5	37.0	3,101	6,203
Oct-Jan (Alt 2)			**34,261**	**68,521**
Oct-Feb (Alt 3)			**37,362**	**74,724**

Offsetting fuel savings is reduced catch (Table 6.12). We assume vessels that fish in the closed area choose it as primary fishing ground based on their gear setup and. Therefore, it is reasonable to assume negative catch impacts if they have to relocate their gears to secondary ground. Using assumptions from the previous section we apply a 5 percent to 10 percent catch reduction on all traps fish in the closed area.

Table 6.12: Catch Impacts in ME Closed Area by Month

Month	Catch per Trap (kg)	Price ($/kg)	Total Traps	Total Catch (kg)	5% Value ($)	10% Value ($)
Oct	7.6	3.9	18,503	140,044	60,175	120,349
Nov	5.9	3.9	21,994	129,248	55,468	110,936
Dec	3.1	4.1	24,507	76,167	34,438	68,875
Jan	1.6	4.8	28,458	46,375	24,700	49,400
Feb	0.9	6.4	22,909	19,719	13,812	27,623
Oct-Jan (Alt 2)					**174,780**	**349,561**
Oct-Feb (Alt 3)					**188,592**	**377,184**

6.3.4.2 Massachusetts Restricted Areas

Massachusetts Restricted Areas (MRA) has been a traditionally closed area since 2014. The restricted areas are proposed in Alternative Three: the extended restricted area of MRA in May with possible reopening if surveys demonstrate that right whales have left the restricted area.

Table 6.13 summarizes key features of the restricted areas and associated costs. The general approach used to assess the impact on affected vessels is the same for all the Cape restricted areas. Cape Cod Bay and Outer Cape Cod are state waters; we assume all vessels will suspend fishing during the restricted area. MRA extends to the federal waters, both relocation and suspending fishing will happen.

Table 6.13: Cost for Affected Vessels in Massachusetts Restricted Area

	Alt 3	**Alt 3**	**Alt 3**	**Total (Alt 3)**
Area	**MRA**	**MRA**	**MRA**	**MRA**
Month	**May**	**May**	**May**	**May**
Action	Lines out	Relocation	Relocation	
Cost Type	Catch impacts	Catch impact	Extra Fuel	
Affected Vessels	137.6	20.5	20.5	**158.1**
Catch per Trap (kg)	1	1		
Average Trip per Month	8.1	8.1	8.1	
Price ($/kg)	13	13		
Total Traps	70,507	12,603		
5% Lost Revenue Lower Bound ($)	956,345	8,547		
10% Lost Revenue Upper Bound ($)		17,094		
Cost Saving($)	544,156			
Lower Total Cost ($)	**412,189**	**8,547**	**10,062**	**430,798**
Upper Total Cost ($)	**412,189**	**17,094**	**15,093**	**444,376**

6.3.4.3 Massachusetts South Island Restricted Area

In recent years, right aggregations have been demonstrated in the waters south of Martha's Vineyard and Nantucket. Three different seasonal restricted areas to buoy lines ares proposed in Alternative Two and Three as shown in Figure 6.3 and Figure 6.4. To complement the restricted area in MRA, the time period for the South Island Restricted Area would be from February to May with possible May opening.

Table 6.14: Number of Affected Vessels by Area and Month

Alternative	Month	Affected vessels (lines out only)	Affected vessels (relocated)	Total
3a	Feb	9.19	8.92	**18.11**
3a	Mar	9.02	8.16	**17.18**
3a	Apr	15.03	11.14	**26.17**
3a	May	16.35	10.68	**27.04**
3b	Feb	1.14	3.73	**4.87**
3b	Mar	1.14	3.76	**4.89**
3b	Apr	2.27	6.96	**9.23**
3b	May	2.92	7.25	**10.18**

The seasonal buoy line closed area in Alternative Two was proposed as a lobster/crab fishery restricted area by Mass DMF according to their understanding of fisheries in that area and calculation of risk reduction sufficient to achieve 60 percent for LMA2. The Vertical Line Model suggests that no more than two vessels fish in this area during the months it would be closed. Therefore, we assume there will be minimal economic impact by closing this area.

Table 6.15: Costs of Suspending Fishing in South Islands Restricted Area

	Total Traps	Catch per Trap LOB (kg)	Price LOB ($/kg)	Value LOB ($)	Catch per Trap CRJ (kg)	Price CRJ ($/kg)	Value CRJ ($)	Operation Cost Savings	Total Cost
	Alternative	3a							
Feb	13,389	0.27	13.7	52,762	4.90	1.8	116,289	24,017	
Mar	11,764	0.45	15.2	77,191	3.90	1.8	80,863	35,462	
Apr	15,618	0.86	16.3	221,002	1.22	1.8	35,357	142,427	
May	15,425	1.09	12.8	210,278	1.13	1.8	31,958	280,501	
Sum				561,232			264,466	482,407	**343,291**
	Alternative	3b							
Feb	3,679	0.27	13.7	14,499	4.90	1.8	31,955	2,973	
Mar	3,568	0.45	15.2	23,409	3.90	1.8	24,523	4,475	
Apr	5,894	0.86	16.3	83,399	1.22	1.8	13,343	21,548	
May	5,522	1.09	12.8	75,274	1.13	1.8	11,440	50,171	
Sum				**196,581**			**81,261**	**79,166**	**198,676**

Given the size and proximity to shore, for the two LMA2 seasonal buoy line closed areas in Alternative Three, some vessels may suspend fishing and some vessels may relocate their gears depending on the type of permits they are holding. Table 6.14 displays the number of vessels that are affected by these two restricted areas. Applying a similar analysis to that previously described when vessels suspend fishing, they will lose all the revenue they could normally generate during that time period, but they will also save that part of operation costs. For vessels that may relocate, they have to pay extra fuel costs to get to the new fishing grounds, and bear the assumed loss of 5 percent-10 percent of their catch due to the loss of their primary fishing location. For vessels that choose to fish without buoy lines in addition to lobster harvest, Jonah crab is another major contributor to revenue during the winter months for Southern New England fishermen. Jonah crabs are normally caught together with lobsters, so we add them to the total harvest of traps in these closed areas. Table 6.15 to 6.17 shows the details of all the costs incurred from the two restricted areas in Alternative Three.

Table 6.16: Costs of Relocation in South Islands Restricted Area

	5% LOB Value ($)	10% LOB Value ($)	5% CRJ Value ($)	10% CRJ Value ($)	5% Total Value ($)	10% Total Value ($)	Lower Fuel Cost ($)	Upper Fuel Cost ($)	Total Lower Cost ($)	Total Upper Cost ($)
	Alternative	3a								
Feb	1,545	3,090	3,405	6,810	4,950	9,900	2,653	3,537		
Mar	2,050	4,100	2,148	4,295	4,198	8,396	3,052	4,069		
Apr	5,304	10,607	848	1,697	6,152	12,304	6,384	8,513		
May	5,137	10,274	781	1,561	5,917	11,835	8,982	11,976		
Sum	14,035	28,071	7,182	14,364	21,217	42,434	21,072	28,095	42,289	**70,530**
	Alternative	3b								
Feb	664	1,329	1,464	2,929	2,129	4,257	740	1,111		
Mar	1,094	2,188	1,146	2,292	2,240	4,481	937	1,405		
Apr	3,677	7,354	588	1,177	4,265	8,530	2,657	3,985		
May	3,127	6,253	475	950	3,602	7,204	4,066	6,099		
Sum	**8,562**	**17,124**	**3,674**	**7,348**	**12,236**	**24,472**	**8,400**	**12,600**	**20,636**	**37,072**

Table 6.17: Cost Estimation of Vessels in South Islands Restricted Area

	Catch Impacts ($)		Fuel Impacts ($)		Lines Out ($)	Total ($)	Total ($)
	lower	upper	lower	upper		lower	upper
Alt 3a	21,217	42,434	21,072	28,095	343,291	385,580	413,821
Alt 3b	12,236	24,472	8,400	12,600	198,676	219,312	235,748

6.3.4.4 Georges Basin Restricted Area

Unlike the other restricted areas discussed earlier, the Georges Basin Restricted Area is located far offshore, on the EEZ border within LMA 3, and is mostly fished by lobster vessels from New Hampshire. Right whales have been sighted using the grounds during summer months while transiting from Southern waters to Northern feeding grounds.

The average distance from homeport to Georges Basin is more than 100 miles (160 km). Based on NMFS VTR and permit data, most vessels take multiple-day trips to fish this ground. The average vessel length exceeds 65 feet and most of them fish 35 traps per trawl. All vessels hold federal lobster permits and submit VTRs regularly.

The duration of the Georges Basin buoy line restricted area would be from May to August. Vessels would be required to remove gear during the restricted area and are most likely to relocate their traps to waters adjacent to the restricted area. Since the transit distance to adjacent areas is the same as to the restricted area, fuel costs would not change. However, catch rates may be lower. Following previous assumptions, all catch may be reduced by 5 percent-10 percent if vessels have to relocate their traps during May to August. Table 6.18 displays the catch impacts from this restricted area.

Table 6.18: Costs of Relocation in Georges Basin Restricted Area

Month	Catch per Trap (kg)	Price ($/kg)	Total Traps	Total Landings (kg)	5% Value ($)	10% Value ($)
May	7.5	12.6	10,410	172,975	49,538	99,077
June	9.9	12.3	17,487	381,969	106,489	212,979
July	7.3	12.1	14,956	239,072	66,112	132,224
August	15.4	11.9	11,549	391,387	105,879	211,758
Sum					**328,019**	**656,038**

6.3.4.5 Summary

Table 6.19 summarizes the economic impact of all proposed restricted areas in Alternative Two and Alternative Three. Alternative Two has a smaller number of vessels and the duration of the restricted areas are shorter. Therefore, the total costs range from $290,000 to $500,000. In Alternative 3a and 3b, the economic impacts range from $1.0 to $1.8 million because the proposed areas are larger and would be of longer duration.

Table 6.19: Summary of Economic Impact of Restricted areas

Restricted area	Alternative	Restricted period	Size (Square miles)	Max vessels-lines out	Max vessels-relocation	Lower Bound Cost ($)	Upper Bound Cost ($)
ME LMA1	2	Oct - Jan	967 (2,504 km^2)	0	45	106,259	315,300
South of Islands	2	Feb - Apr	2,545 (6,592 km^2)	2	1	N/A	N/A
Total	2		3,512 (9,096 km^2)	2	46	106,259	315,300
ME LMA1	3	Oct - Feb	967 (2,505 km^2)	0	45	113,868	339,822
MRA	3	May	2,161 (5,597 km^2)	138	21	430,798	444,376
Georges Basin	3	May - Aug	557 (1,443 km^2)	0	16	328,019	656,038
South of Islands	3a	Feb - May	5,468 (14,162 km^2)	16	11	385,580	413,821
South of Islands	3b	Feb - May	3,506 (9,080 km^2)	3	7	219,312	235,748
Total	**3a**		**9,153 (23,706 km^2)**	**154**	**93**	**1,258,265**	**1,854,057**
Total	**3b**		**7,191 (18,625 lm^2)**	**141**	**89**	**1,091,997**	**1,675,984**

Reviewers that believe additional restricted areas are not warranted to achieve PBR should provide specific information or analysis in support of recommended removal of restricted areas from the proposed rule. If NOAA receives information indicating that we can achieve the 60% risk reduction without the restricted area, we would consider eliminating the restricted area from the preferred alternative. Additionally, if commenters believe that information will be available after issuance of the final rule on this topic, commenters should articulate the nature of that information, how the information might affect the decision, and propose a mechanism for evaluating that information in determining whether or not to continue with the restricted area.

6.4 Analytic Approach: Gear Marking Requirements

The proposed action would implement additional gear marking requirements compared to no action. As explained in Chapter 3, under Alternative Two (Preferred), NMFS would mirror the Maine state regulations for all non-exempted waters, and would implement analogous marking for the other New England states. However, Maine state agency has already implemented the new gear marking requirements to all Maine state registered vessels, so we will not include Maine vessels in our economic impact analysis. In state waters, the gear marking requirement would include one state-specific three-foot (91cm) colored mark within two fathoms (3.7 m) of the buoy and two additional one-foot (30 cm) marks in the top and bottom half of gear. In Federal waters, in addition to the top three-foot (91 cm) mark, an additional green six inch (15 cm) mark would be required in the top two fathoms (3.7 m) of line, and three one-foot (30 cm) marks would be required in the top, middle, and bottom of the buoy line below the surface system. This proposal would continue to allow multiple methods for marking line (paint, tape, rope, etc). Under Alternative 3 (Non-preferred) a three-foot (91 cm) state specific color would be marked on the buoy line within two fathoms (3.7 m) of the buoy, as in the preferred, but the entire line would also have to be replaced with a line woven with identification tape with the home state and fishery (for example Maine, lobster/crab trap/pot) repeated in writing along the length of the buoy line.

The analysis relies on the Vertical Line Model to estimate the number of vertical lines it would be necessary to mark under Alternative Two and Three. In each case, the estimate of gear marking demands is consistent with the new trawling requirements the alternative specifies. Aggregate gear marking costs are based on numbers of active vessels estimated in the Vertical Line Model.

The estimate of gear marking costs considers both the cost of material/equipment and labor costs. A few assumptions are made here based on communication with our gear specialists[17]:

1. The NMFS gear specialist indicated that fishermen replace marks annually. . So the time and cost burden are the same for each year.

2. Time for marking: 20 min per line + 2 min per mark. For example: a five-mark line will cost 20+2*5=30 min; a three-mark line will cost 20+2*3=26 min. Note, that this is an increase from past estimates based on observations during 2020 marking conducted by

[17] Email correspondence with NFMS gear specialists from June 30, 2020 to July 9, 2020.

Maine fishermen in response to similar gear marking requirements.

3. Material cost for each foot marking is $0.04 per foot (see below for detail calculation); and labor cost per hour is $25.15 in 2017 dollars ($25.75 in 2018 dollars, see table 6.1 for details). Each foot of tape takes a minute to install. At an implicit value of $25.75 for an hour of a labor (see Table 6.1), this translates to a labor cost of $0.46 per foot. The endline is assumed to last for six years.

ID tape ropes are not available at this time, even suppliers could not provide an estimate of the price range. On a conservative basis, here we assume that cost of ID tape rope will be twice as much as 3/8 inch (1 cm) rope, which costs $0.22 per foot per year. Table 6.20 describes the gear marking cost for Alternative Two and Three.

Table 6.20: The First Year Gear Marking Cost for Alternative Two and Three

	Number of Endlines	**Total Cost Alt 2 ($)**	**Marking Cost Alt 3 ($)**	**ID Tape Cost Alt 3 ($)**	**Total Cost Alt 3 ($)**
NH	20,111	223,204	187,874	185,830	373,704
MA	149,479	1,672,717	1,396,383	1,402,422	2,798,805
RI	7,044	82,379	65,800	65,362	131,162
LMA3	3,822	38,983	35,702	914,780	950,482
Total	**395,503**	**2,017,283**	**1,685,760**	**2,568,393**	**4,254,153**

Notes: 1. All dollar values are adjusted to 2017.
2. Gear marking are assumed to last for six years. Depending on fishing areas, some marks might need replacement earlier due to weather or bottom condition. Therefore, annual costs could be higher in some areas.

6.5 Analytic Approach: Line Cap Reduction

Under Alternative Three, a 50 percent line cap reduction is proposed for federal waters to reduce the risk score by 45 percent in Federal waters. Line tags would likely be the implementation mechanism, with permitting entities distributing enough tags for 50 percent of the 2017 vertical line estimate fished under their permitting authority. No specific measures are proposed at this moment, so each state could identify distribution methods and each fishermen could choose their own line reduction measures to to fish under this limit. Vessels could keep fishing all their traps with twice as many traps per trawl, or maintain their gear configuration but reduce the total active fishing traps by half; or they can combine trawling up and trap reduction at the same time toward a 50 percent buoy line reduction goal. The estimation of economic impact of line cap reduction is difficult without knowing the exact measures of each area. Therefore, we estimate the more expensive and likely situation to get an estimate of economic impact, assuming all vessels comply by trawling up.

Similar to the trawling up measure in Section 6.2, the economic impact of a change in line cap reduction includes the change in gear configuration costs and impacts on total catch. Gear configuration costs would include cost savings from fewer surface systems and buoy lines, but increased costs for more groundlines and the associated labor cost of converting gear to meet the end line cap reduction goal. Table 6.21 describes the details of the cost estimation using a worst-case scenario of trawling up twice fishermen’s current traps per trawl on half the trawls.

Table 6.21: Estimation for 50 percent Line Cap Reduction in Federal Waters by Area at Year One

	5% Catch Impact Lower Bound ($)	10% Catch Impact Upper Bound ($)	Surface System Savings ($)	Buoy line Savings ($)	Groundline Material Cost ($)	Groundline Labor Cost ($)	Total Cost Lower Bound ($)	Total Cost Upper Bound ($)
ME A	-3,104,878	-1,164,559	175,962	866,709	2,817,580	5,635,160	-409,186	2,408,394
ME B	-272,181	-494,861	104,422	356,205	1,157,985	2,315,971	851,570	2,009,556
ME C	-583,259	-1,107,882	191,339	662,046	2,152,243	4,304,485	1,314,487	3,466,729
ME D	-375,910	-882,056	167,024	607,400	1,974,594	3,949,189	1,491,052	3,465,647
ME E	-181,441	-353,828	50,509	230,177	748,280	1,496,559	493,697	1,241,976
ME F	-212,378	-725,127	35,217	347,561	1,129,883	2,259,766	575,156	1,705,039
ME G	-138,921	-335,093	47,278	250,608	814,388	1,629,088	638,260	1,452,960
NH	0	-57,163	33,184	175,220	483,547	1,000,219		
MA	-401,389	-558,655	247,178	1,675,487	4,569,491	9,387,785	5,532,112	10,350,406
RI	-27,253	-31,293	11,866	139,029	178,721	359,776	271,070	452,125
LMA3	-133,456	-541,787	7,473	270,334	1,037,191	2,074,383	639,755	1,676,947
Total	**-5,431,066**	**-6,252,304**	**1,071,452**	**5,580,776**	**17,063,903**	**34,412,381**	**11,397,973**	**28,229,779**

Notes: All dollar values are adjusted to 2017.

6.5.1 Alternative Responses to Line Cap Reduction

The economic analysis above considers the first option described below; a fairly costly response that would cause safety challenges for some fishermen by doubling the number of traps per trawl. Other potential approaches that were not analyzed for costs are briefly described that would achieve a line cap reduction.

1) Double trap/trawl number and length, no trap reductions

A 50 percent line cap could result in broad scale trawling up in federal waters across the Northeast Region Trap/Pot Management Area (Northeast Region). In areas where two endlines are allowed on trap/trawls given current configurations, this would require double the number of traps per trawl. Vessels with higher capacity for longer trap trawls will likely have the ability to mitigate the impacts of a line cap and increase the number of traps per trawl, though this is anticipated to vary by distance to shore where those fishing farther offshore are most likely to double their trap trawl lengths and fish the same number of traps. This represents the lower bound of changes to fishing effort where the number of traps fished does not change.

2) Reduce traps

If a 50 percent line cap was implemented it is unlikely that all vessels would be capable of trawling up in order to fish the same number of traps. Anticipated trap reductions are likely to differ based on the location and size of fishing operations. In federal waters, outside of 3 nautical miles (5.6 km)), most areas have minimum trap trawl configurations, with the exception of small exempted areas outside of 3 nmi (5.6 km)offshore of Maine. Common configurations in this area start at 1 to 3 traps per trawl and increase with distance from shore. Elsewhere, there is a minimum of 10 traps per trawl outside of state waters and a minimum of 14 traps per trawl in offshore waters. Therefore it is likely that there will be some trap reductions as a result of a line cap, which could fall under a few different categories:

- Vessels constrained by vessel size, rope storage constraints, hauling block capacity, number of crew, or other operational constraints would have to either invest in major modifications to their vessel and capacity or reduce the number of traps fished by up to 50 percent of their current trap level. This is a more likely scenario with smaller vessels that are not capable of trawling up from their current capacity, especially those still fishing singles. A 50 percent trap reduction represents the upper bound of potential changes to fishing effort to achieve a 50 percent line reduction, likely limited to regional areas where no trawling up would be expected.

Some degree of trawling is most likely to occur in some nearshore and all offshore waters but in many cases doubling the traps/trawls would still be prohibitive. Given not all vessels will be able to adjust the scale of their vessel or current operations it is most likely that there will be a response somewhere in the middle where a combination of trawling up and trap reductions occurs. In federal waters outside of Maine lobster zones, most fishermen are already trawling up to at least ten traps per trawl so the capacity to trawl up further will be dependent on the size of the operation, the number of endlines currently use for each trawl, and safety concerns. A doubling of traps per trawl would strain smaller fishing operations, requiring a greater reduction in total traps fished than on larger vessels. Predicting how many allocated traps would be latent is difficult to estimate without additional details on vessel class and capacity.

3) Ropeless on one end

One additional scenario available is the use of only one tagged endline on trap/pot trawls with no buoy line or the incorporation of a ropeless fishing device on the other end. There are a number of manufacturers of devices to remotely retrieve buoy lines that are working with NMFS and commercial fishermen. Currently an authorization for exemption for surface marking requirements under the Atlantic Coastal and Magnuson-Steven Acts is required; however, in some areas where gear is more dispersed and gear conflicts may be of less concern, modifications to surface marking requirements could be developed to allow ropeless operations. Costs vary, but for some devices are as low as $5,000 per retrieval device. A buoy line on one end and a stored buoy line on the other end would achieve a 50 percent line cap without impacting the number of traps being fished in federal waters. Because ropeless devices transmit location information, increased gear loss would not be anticipated. As such, the primary costs would be those associated with purchasing and maintaining the equipment necessary to deploy, locate, and retrieve the buoy line on this end.

6.5.2 Potential Impacts:

As discussed above, if the first scenario is widely adopted, the cost of the line cap come primarily from catch impacts as a result of trawling up, estimated in the analysis as being from 5 to 10 percent. Additionally costs to reconfigure vessels to accommodate line or to hire additional crew may also be incurred. There could be some savings in the amount of buoy line that needs to be purchased and replaced. It is likely that this response is limited to larger, offshore vessels and it would not be feasible or safe to double or quadruple trawl lengths. Total costs would range from over $10 million to nearly $19 million, a range in costs that likely encompasses most of the alternative options discussed qualitatively below.

Areas closer to shore would likely experience either a mix of responses, ranging from a combination of trawling up and reduced traps fished, or a halving of traps fished with the same trap/trawl configuration to achieve the line cap (up to a 50 percent trap reduction). Cost impacts are difficult to estimate and are likely to be variable by area fished. Effort reduction could increase profits and salaries of lobster fishermen if operation costs decrease and the size, and subsequent value, of harvested lobster increases (Richardson and Gates 1986, Wang and Kellog 1988, Meyers et al 2007, Steinbeck et al. 2008, Holland et al 2011, Dayton et al 2018). Some indicate this level would have to be fairly high to have a measurable impact on profitability (Steinbeck et al. 2008, Holland et al 2011). There is evidence the industry is overcapitalized and that many vessels not operating at full efficiency, suggesting that effort reduction could help particularly if it resulted in a decline in operating costs (Dayton et al 2018). Previous research also suggests that reducing effort has a more measurable impact than solely relying on minimum size classes to maintain a healthy fishery (Richardson and Gates 1986).

Steinbeck et al. (2008) posits that personal income would increase with sharp decreases in trap numbers. Canadian lobster fisheries in Nova Scotia have maintained profitability despite only operating seasonally, indicating effort reduction does not necessarily correlate with a decline in profitability (Meyers et al 2007, GMRI 2014) while US profitability has decreased despite increases in landings and will need to reduce effort to maintain a profit (GMRI 2014). If effort is not sufficiently reduced, it is possible widespread trap reductions as a result of a line cap would not necessarily translate into a change in profitability.

The trap reduction necessary to increase profitability may be higher than what would be expected with the implementation of a 50 percent line cap. The maximum trap reduction would be around 50 percent but a mixed-response scenario is far more likely where some trawling up is used to recoup traps and some traps become latent. If effort reduction does not result in fewer trips and other adjustments that reduce operational costs, it is possible that the effort reduction would be less effective at increasing profitability. The proposed line cap does not require a change from year-round fishing, thus it would be left to the vessel operators whether or how to reduce operational costs in response to a reduction in traps. Take Reduction Plan modifications conducted under the MMPA are not normally done to control fishing effort, more commonly a goal of fishery management measures under the ACFCMA or MSCFMA, As a result, there is likely to be more variation in how vessel operators respond to trap reductions and effort reduction might not translate into an increase in the size and value of harvested lobster and overall profitability of fishing operations.

The last response scenario suggested is the use of ropeless devices on one end in the event of a line cap at 50 percent of 2017 buoy line estimates. Similar to scenario one where no trap reduction would be anticipated and current trawl configurations would be maintained, this alternative would allow vessels to continue operating at their current capacity. This scenario would likely have the smallest impact on landings. However, there would be at least a short term increase in the cost of operations with the need to purchase new equipment. The estimated initial per vessel investment for switching to full ropeless fishing is around a $56,000 to $243,000 depending on which technology is preferable (Black et al. 2019). Fishermen are likely to choose the more affordable technology and would likely only modify half of their buoy lines. Additional maintenance costs would include replacement and maintenance of gear. Increased gear conflict might occur, causing costs in lost gear or time to find and retrieve gear. Despite the costs, the benefits of this approach would be to maintain the current level of operation and minimize lost revenue. The more vessels that switch over to using ropeless devices, the more affordable the equipment will become in the future, minimizing the future costs of this approach.

This DEIS also proposed measures to allow ropeless fishing in areas that are seasonally closed to persistent buoy lines. Thus, an investment in ropeless equipment as a result of a line cap could also allow vessels with this capacity to access fishing areas that would be otherwise unavailable (though this would require an additional exempt fishing permit).

6.6 Estimated Compliance Costs By Alternative

As noted in the introduction to this chapter, the economic analysis is designed to measure regulatory compliance costs of the plan modifications that would be implemented by federal rulemaking on an incremental basis i.e., to measure the change in costs associated with a change in regulatory requirements. If no change in regulatory requirements is imposed as would be the case under Alternative one the economic burden attributable to the ALWTRP would be unaffected. Thus, Alternative 1 would impose no additional costs on the regulated community.

For this analysis, we consider costs of only those measures that would be regulated under the federal Plan modifications. Costs of ongoing and anticipated lobster fishery management measures, Maine gear marking and weak insertion regulations within exempted waters, the extension into May of a buoy line closure for state waters in the Massachusetts Restricted Area, and other measures that Massachusetts proposed such as a line diameter cap and the phase out of single trap trawls upon trap transfers for Massachusetts permitted vessels larger than 29 feet are considered to be part of the baselines, and are not analyzed.

The Cost changes in Alternative Two and two versions of Alternative 3 are displayed in Table 6.22. Three sets of values are presented using both three percent and seven percent discount rate: the first year costs, the present value and the annualized value. In general, the largest cost changes originate from the assumed catch impacts associated with the gear configuration change. In Alternative Two, using seven percent discount rate trawling up measures were estimated to cost between $2.8 million to $9.4 million annually, and in total $13 million to $45 million over six years. The full range of costs for the options under Alternative 3 (a and b), including primarily the 50 percent endline reduction in federal waters that would be required under both options, is estimated to be $9.6 million to $24 million annually, and $45.5 million to $114.3 million in total.

The total cost of all proposed measures for Alternative Two including gear marking, weak rope, restricted area and gear conversion costs range from $5.9 million to $12.8 million annually, $28 million to $61 million in total. It is much lower than the two versions of Alternative 3, which range from $17 million to $33 million annually, and $81 million to $157 million in total.

Table 6.22: Summary of Compliance Costs by Alternatives

	Discount Rate	Gear Marking	Weak Rope	Trawling up Lower	Trawling up Upper	Restricted Area Lower	Restricted Area Upper	Line Cap Lower	Line Cap Upper	Total Lower	Total Upper
Alt 2 Year 1		2,017,283	2,152,497	2,660,792	10,957,354	106,259	315,300			6,936,831	**15,442,434**
Alt 2 AV	3%	2,234,312	470,008	2,895,403	9,814,577	139,213	413,083			6,147,521	**13,340,566**
Alt 2 PV	3%	12,103,698	2,152,497	13,260,096	44,947,889	637,554	1,891,800			28,153,845	**61,095,884**
Alt 2 AV	7%	2,539,305	451,585	2,781,912	9,429,878	133,756	396,892			5,906,558	**12,817,660**
Alt 2 PV	7%	12,103,698	2,152,497	13,260,096	44,947,889	637,554	1,891,800			28,153,845	**61,095,884**
Alt 3a Year1		4,254,153	10,202,645	829,007	1,771,723	1,258,265	1,854,057	11,397,973	28,229,779	27,942,043	**46,312,357**
Alt 3a AV	3%	2,815,360	2,227,794	592,710	1,416,096	1,648,487	2,429,051	9,940,762	24,949,353	17,739,955	**34,352,495**
Alt 3a PV	3%	15,251,346	10,202,645	2,714,439	6,485,303	7,549,590	11,124,342	45,525,779	114,260,732	81,243,799	**157,324,368**
Alt 3a AV	7%	3,199,668	2,140,472	569,478	1,360,589	1,583,872	2,333,840	9,551,117	23,971,422	17,044,608	**33,005,992**
Alt 3a PV	7%	15,251,346	10,202,645	2,714,439	6,485,303	7,549,590	11,124,342	45,525,779	114,260,732	81,243,799	**157,324,368**
Alt 3b Year1		4,254,153	10,202,645	829,007	1,771,723	1,091,997	1,675,984	11,397,973	28,229,779	27,775,775	**46,134,284**
Alt 3b AV	3%	2,815,360	2,227,794	592,710	1,416,096	1,430,655	2,195,753	9,940,762	24,949,353	17,522,123	**34,119,197**
Alt 3b PV	3%	15,251,346	10,202,645	2,714,439	6,485,303	6,551,982	10,055,904	45,525,779	114,260,732	80,246,191	**156,255,930**
Alt 3b AV	7%	3,199,668	2,140,472	569,478	1,360,589	1,374,578	2,109,686	9,551,117	23,971,422	16,835,314	**32,781,838**
Alt 3b PV	7%	**15,251,346**	**10,202,645**	**2,714,439**	**6,485,303**	**6,551,982**	**10,055,904**	**45,525,779**	**114,260,732**	**80,246,191**	**156,255,930**

Notes:
1. Year 1 values are in 2017 dollars
2. PV represents net present value of year 1 to year 6, in 2017 dollars. It does not change with the discounting rates.
3. AV represents annualized value of the net present value. It is an equalized yearly cost during the 6-year time period with 3% and 7% discount rate.

6.7 Social Impact

The social impact assessment examines the social consequences of the potential changes to the ALWTRP that are under consideration. In this section, we will identify the groups of vessels that may be affected; then we provide a detailed socioeconomic characterization of the communities that may be affected by modifications to the ALWTRP, and assesses the vulnerability of these communities to adverse impacts. The analysis involves two basic elements:

First, based on the results of the economic impact assessment, the social impact analysis (SIA) identifies the number of affected vessels by each proposed measure, characterizes the changes in fishing practices and fishing activity that may occur.

Second, the analysis uses county-level socioeconomic data and fishery- dependent data to assess the vulnerability of communities (i.e., counties) to adverse social impacts stemming from promulgation of commercial fishing regulations under the ALWTRP. The analysis is primarily built on data from NMFS VTR, dealer reports and social indicator databases, as well as demographic and socioeconomic data from the U.S. Census and the U.S. Department of Labor.

This analysis also qualitatively considers various other social impacts – both negative and positive – that may result from modification of the ALWTRP. In all cases, the analysis measures these impacts relative to Alternative One, the no action alternative.

6.7.1 Characterization of Affected Vessels under ALWTRP

According to the estimation in the Vertical Line Model, there are 3,970 vessels in trap/pot fisheries in Northeast Region except for Maine exempt waters. Most of them are fishing for lobsters and a few in Southern New England waters also fish for Jonah Crabs. Proposed rules in the ALWTRP affect vessels differently based on the fishing area. Table 6.23 displays the number of affected vessels under each measure except for restricted areas, which is shown separately in Table 6.24.

Gear marking proposed in both Alternatives 2 and 3 and the weak rope requirements in Alternative Two would affect all vessels in the Northeast Region. Maine Zone A has the most affected vessels, and Massachusetts has the second most. Minimum trap/trawl requirement in Alternative Two affects the most vessels in Maine outside the exempt waters. Fewer inshore or nearshore vessels outside of Maine are affected by trawling up measures because they already fish with the proposed minimum trawl length or more traps per trawl. All LMA 3 vessel would be required to trawl up to 45 traps in Alternative Two. Under Alternative 3, LMA 3 vessels are only required to trawl up to 45 traps during May to August, which would affect 74 offshore vessels. Alternative 3 also requires vessels in the federal waters to reduce their line cap of average monthly buoy lines by 50 percent. A total of 1,491 vessels would be affected, and most of them are from Maine.

A number of vessels would be impacted by proposed seasonal buoy line restricted areas in Alternatives 2 and.3. Under Alternative 3, Massachusetts Bay Restricted Area extension in May will affect 159 vessels, most of which are state permit holders and have to suspend fishing during the seasonal restrictions. The Maine LMA1 restricted area from October to January would require 45 vessels to relocate their traps. Few vessels fish in South Island restricted area proposed by Massachusetts DMF, so the impact under that restricted area is minimal. Under Alternative 3, the same number of vessels would be impacted by Maine LMA1 restricted area with the month of February added. The Mass Bay Restricted area will affect more vessels because of the larger closed area, including 138 vessels that fish in state water and 21 in federal waters. A Georges Basin buoy line restricted area from May to August will affect 16 offshore vessels, most of which are from Rockingham County, New Hampshire. Two buoy line restricted area areas are proposed for the south island area in Alternative 3, both of which are larger than the Massachusetts South Island restricted area in Alternative Two. Version 3a would require 16 vessels to suspend fishing and 11 to relocate their traps during February to May. Version 3b would affect 10 vessels in total. Table 6.24 shows the details of the number of affected vessels by restricted area under Alternative Two and Three.

Table 6.23: Number of Affected Vessels by Measures and Area

	Gear Marking, Weak Rope	Trawling up_a2	Trawling up_a3	Line Cap
ME A	545	341		281
ME B	256	221		129
ME C	439	290		189
ME D	432	335		191
ME E	209	165		107
ME F	233	127		179
ME G	187	123		109
NH	241	0		0
MA	1,216	21		187
RI	131	7		37
LMA3	82	82	74	82
Total	**3,970**	**1,712**		**1,491**

Table 6.24: Number of Affected Vessels in Different Restricted Areas

Restricted area	Alternative	Restricted period	Max vessels-lines out	Max vessels-relocation	Total
ME LMA1	2	Oct - Jan	0	45	**45**
South of Islands	2	Feb - Apr	2	1	**3**
Sum	2		2	46	**48**
ME LMA1	3	Oct - Feb	0	45	**45**
MRA	3	May	138	21	**159**
Georges Basin	3	May - Aug	0	16	**16**
South of Islands	3a	Feb - May	16	11	**27**
South of Islands	3b	Feb - May	3	7	**10**
Sum	**3a**		**154**	**93**	**247**
Sum	**3b**		**141**	**89**	**230**

The compliance costs for these vessels were been discussed in the economic analysis section (see

Section 6.2-6.6). In the next section, we will focus on the community level impacts.

6.7.2 Characterization of Vulnerability and Resilience in Fishing Communities

6.7.2.1 Factors Affecting Vulnerability and Resilience

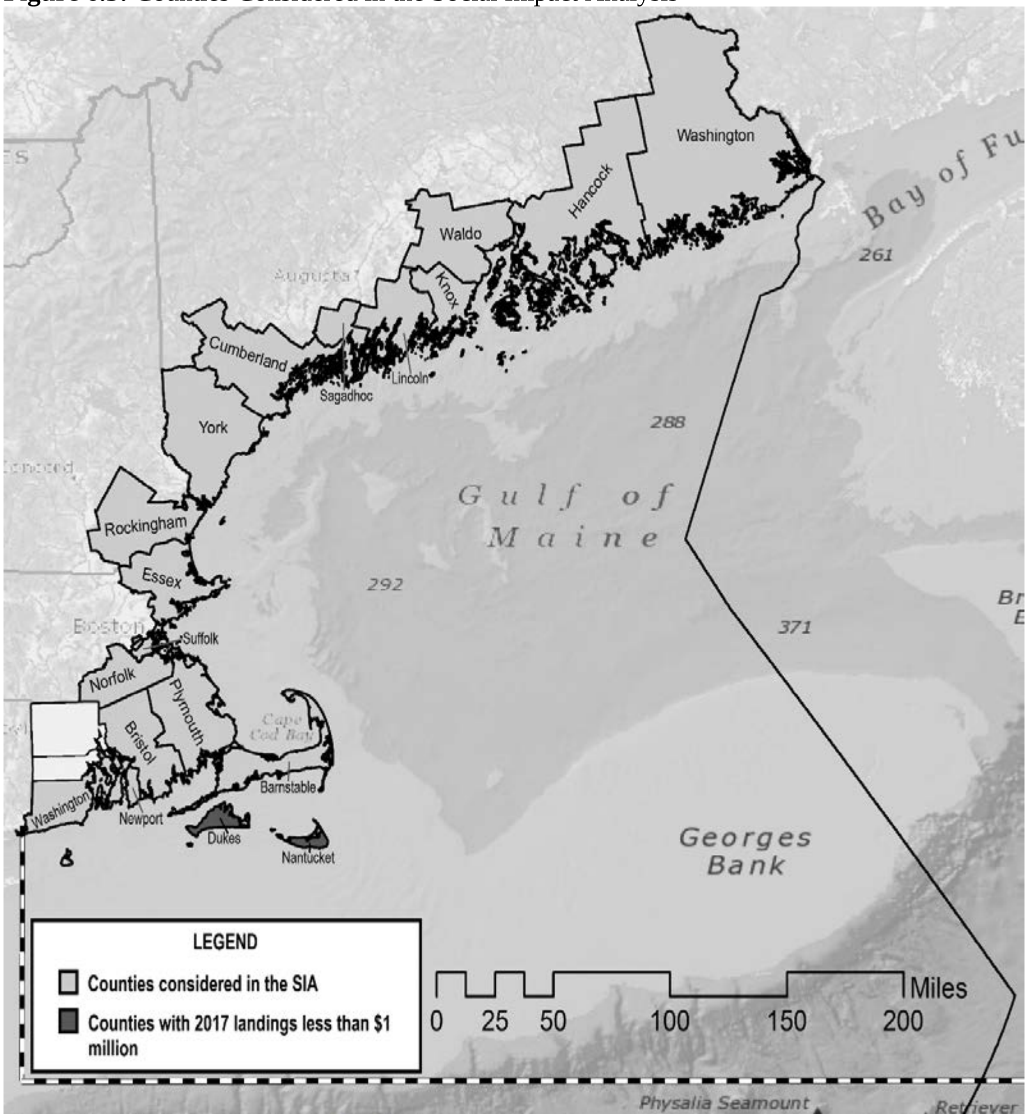
When considering the effect of proposed regulations on fishing communities, one potential approach is to focus the analysis on individual ports or municipalities. Clearly, however, fishing communities can extend beyond the boundaries of a particular port or city. Fish can be landed in one town and processed in a neighboring town. Likewise, a fisherman can land catch in one town, live in a neighboring town, and register his vessel in yet another location. In recognition of these factors, this analysis focuses at the county level.[18] While a county's political boundaries do not limit the network of social interactions and economic resource flows described above, the use of counties as an analytic focus offers several advantages. First, the geographic range of the county is a useful spatial mid-point between individual towns/ports and large regions; this is especially important given that ALWTRP regulations apply to such an extensive geographic area (virtually the entire northeast coast of the U.S.). In addition, many of the data used to characterize communities (e.g., unemployment rate, population) are readily available at the county level.

The analysis focuses primarily on coastal counties in the Northeast that landed ALWTRP affected species at values greater than $1 million per year. As Figure 6.5 indicates, this includes most coastal counties in Maine, New Hampshire, Massachusetts, and Rhode Island. For these counties, NMFS data shows, in 2018, that more than $628 million in ex-vessel revenue was attributable to trap/pot lobster and Jonah crab landings. Trap/pot vessels operating out of ports in this region are most likely to be affected by the weak rope, minimum trawl length, gear marking and restricted area requirements.

In both fishing and non-fishing communities, the ability to adapt to change varies with social, political and economic considerations. The vulnerability of fishing communities, however, is influenced by additional factors, including the importance of familial relationships, the vulnerability of infrastructure, and the commitment to fishing as a culture and way of life (Clay and Olson 2008). From an analytic perspective, vulnerability includes the characteristics of "exposure, sensitivity, and capacity of response to change or perturbation" (Gallopín 2006, as cited in Colburn and Jepson 2012). Consistent with Gallopin's definition, this social impact assessment considers each county's vulnerability to be a function of the extent to which its fishing industry is affected by the regulations (i.e., exposure), the significance of the fishing industry within the county (i.e., sensitivity), and baseline factors that may affect communities' ability to absorb the economic costs imposed by the regulations (i.e., capacity to respond to change). The discussion that follows briefly describes the parameters used to evaluate each aspect of vulnerability.

[18] This discussion thus uses the terms "counties" and "communities" interchangeably

Figure 6.5: Counties Considered in the Social Impact Analysis



Exposure

The analysis first considers the extent to which the local fishing industry is exposed to ALWTRP regulations. Exposure is defined in two ways:

Value/proportion of harvest associated with affected gear – The counties most likely to experience adverse social impacts are those in which gear regulated under the ALWTRP is an important source of commercial fishing revenue, either on an absolute or a relative basis.

Number of entities affected – Similarly, the most vulnerable counties are likely to be those that are home to the greatest number of vessels that fish with gear regulated under the ALWTRP.

Sensitivity

Those communities that are more heavily dependent (both economically and socially) on the fishing industry are more likely to experience adverse social impacts due to fishing regulations. This analysis relies upon a measure of fishing dependence designed to take additional factors into account. This measure, the Occupational Alternative Ratio Summary (OARS), emphasizes the importance of fishing as an occupation to participants in the labor force as a whole, and the dependence of the local economy on the fishing industry. In general, a higher score indicates a greater dependence on fishing as an occupation, and a lower likelihood that displaced fishermen can easily enter into alternate occupations.[19]

Capacity to Respond to Change

A number of economic and demographic factors will influence a community's ability to absorb economic stress, tempering or exacerbating vulnerability to social impacts stemming from ALWTRP regulations:

Unemployment Rate, Poverty Rate, Median Income – Fundamental economic indicators such as the unemployment rate, poverty rate, and median income can indicate the local economy's resilience to regulatory impacts. Communities that are already economically depressed may find it more difficult to absorb the economic effects of regulatory changes and may be subject to greater social impacts.

Gentrification – Gentrification can be a key source of coastal community vulnerability (Jacob et al. 2010 and Clay and Olson 2008, as cited in Colburn and Jepson 2012). According to Hall-Arber et al. (2001), as former working waterfronts succumb to the pressures of gentrification, community character and culture are lost, diversity diminishes, and the fishing community is less able to adapt to changes in the environment. Additional fishing regulations can make it even more difficult for individuals to maintain a "fishing way of life." Communities that are already experiencing gentrification will likely be more susceptible to social impacts as ALWTRP regulations are implemented. Hall-Arber et al. (2001) integrate various measures of gentrification into a score that can be used to characterize community vulnerability.

6.7.2.2 Assessment of Community Vulnerability

Table 6.25 present socioeconomic data for each county identified as potentially vulnerable to social impacts due to ALWTRP regulations. By evaluating the vulnerability indicators described above, the analysis characterizes the extent to which the counties are susceptible to regulatory-driven social impacts.

Counties in mid-coast and Downeast Maine, where the lobster fishery is the major driver of the commercial fishing economy, tend to be the most vulnerable to adverse social impacts from ALWTRP regulations. Hundreds of lobster vessels are based in these counties, and their landings

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[19] Measures of fishing dependence and gentrification (see below) are based on Hall-Arber et al. (2001). At the time the analysis was developed, these data represented the most recent published attempt to address these issues systematically, allowing for a direct comparison between counties. Colburn and Jepsen (2012) have developed additional indices allowing for evaluation of fishing dependence and gentrification; however, they have yet to be broadly applied. For a qualitative discussion of these issues, see the Community Profiles for Northeast U.S. Marine Fisheries developed by the NMFS Northeast Fisheries Science Center (2010). These profiles are available online at: http://www.nefsc.noaa.gov/read/ socialsci/communityProfiles.html

are extensive (see Table 6.26). Hancock and Knox counties report the greatest value of landings with ALWTRP gear ($156 million and $136 million in 2018, respectively), as well as the greatest number of vessels fishing with such gear (approximately 1150 and 950, respectively). The exposure of these counties to adverse impacts is heightened by the fact that landings made with ALWTRP gear account for a high percentage (around 90 percent in both cases) of overall ex-vessel revenues. Washington County (ME) is also highly exposed, with potentially affected landings of $81 million. Each of these counties is highly dependent on fishing, as measured by commercial dependence and commercial reliance indicator. Moreover, the high poverty and unemployment rates in these counties suggest that they have limited capacity to absorb additional economic stress. As a result, they are particularly vulnerable to the impacts of ALWTRP regulations.

More than 50 percent of ex-vessel revenue in Maine's other coastal counties is attributable to landings made with ALWTRP gear. In some instances, however, such as Waldo County, the overall value of these landings is relatively low. In others, such as Lincoln, Sagadahoc, Cumberland, and York, the value of potentially affected landings is substantial, but the economy as a whole is more diversified. As a result, these counties are somewhat less sensitive to adverse impacts that may stem from changes in ALWTRP regulations. The same is true of New Hampshire's Rockingham County. There, 90 percent of ex-vessel revenue is derived from landings made with ALWTRP gear, which suggests that the county's harvesting sector is highly exposed. The sensitivity of the county's economy as a whole, however, is tempered by its low commercial dependence score. In addition, Rockingham County's unemployment rate is lower than most other counties analyzed; this suggests that its economy has a relatively strong capacity to respond to change and that the region is less vulnerable to adverse impacts than areas where the unemployment rate is higher.

In Massachusetts and Rhode Island, the situation is more varied. In general, the value of landings made with ALWTRP gear in the counties of these states is lower than that reported for counties in Maine and New Hampshire, both on an absolute and a relative basis. In addition, the economies of coastal counties in Massachusetts and Rhode Island tend to be more diversified and less dependent on the commercial fishing sector. Nonetheless, ALWTRP gear accounts for ex-vessel revenues of more than $15 million per year in Essex (MA), Barnstable (MA), and Bristol (MA) counties, suggesting that exposure to adverse impacts in these counties may be substantial.

Table 6.25: Social-economic Indicators for Coastal Communities

State	County	Key Ports	Population (2018)	Median Household Income (2014-2018)	Persons below Poverty Level (2014-2018)	Unemployment Rate (2018)	Population Composition	Personal Disruption	Housing Disruption	Urban Sprawl	Commercial Engagement	Commercial Reliance
ME	Washington	Beals Island/Jonesport, Cutler, Eastport, Lubec	31,490	41,384	18.30%	4.90%	1.11	1.50	2.46	1.00	1.71	1.82
ME	Hancock	Stonington/Deer Isle, Bucksport	54,811	53,068	11.60%	3.80%	1.00	1.14	2.18	1.00	1.86	1.93
ME	Waldo	Belfast, Searsport, Northport	39,694	51,564	13.70%	3.50%	1.00	1.53	1.93	1.00	1.00	1.00
ME	Knox	Rockland, Vinalhaven, Port Clyde	39,771	55,402	11.00%	3.20%	0.94	1.28	1.72	0.94	2.11	1.94
ME	Lincoln	South Bristol, Boothbay Harbor	34,342	55,180	11.10%	3.30%	1.00	1.12	1.59	1.00	1.59	1.59
ME	Sagadahoc	Georgetown, Phippsburg	35,634	62,131	8.70%	2.70%	1.00	1.00	1.89	1.00	1.33	1.22
ME	Cumberland	Portland, Harpswell	293,557	69,708	8.20%	2.70%	1.00	1.04	1.48	1.08	1.44	1.24
ME	York	Kennebunkport/Cape Porpoise, York	206,229	65,538	9.00%	3.00%	1.00	1.13	1.96	1.04	1.38	1.17
NH	Rockingham	Hampton/Seabrook, Portsmouth, Isle of Shoals	309,176	90,429	5.30%	2.8%	1.00	1.06	1.65	1.76	1.38	1.12
MA	Essex	Gloucester, Rockport, Marblehead	790,638	75,878	10.70%	3.60%	1.24	1.21	1.55	2.79	1.42	1.06
MA	Suffolk	Boston Harbor	807,252	64,582	17.50%	4.50%	3.33	2.33	2.67	4.00	2.00	1.00
MA	Norfolk	Cohasset	705,388	99,511	6.50%	3.00%	1.16	1.08	1.68	2.84	1.04	1.00
MA	Plymouth	Plymouth, Scituate, Hingham	518,132	85,654	6.20%	3.20%	1.11	1.11	2.25	2.46	1.50	1.04
MA	Barnstable	Sandwich, Hyannis, Chatham, Provincetown, Woods Hole	213,413	70,621	8.00%	2.40%	1.00	1.03	3.03	1.75	1.63	1.25
MA	Bristol	New Bedford, Fairhaven, Westport	564,022	66,157	10.80%	3.20%	1.15	1.30	1.95	2.10	1.50	1.10
RI	Newport	Jamestown, Newport, Tiverton, Sakonnet Point	82,542	77,237	8.10%	3.00%	1.00	1.00	3.00	2.00	1.83	1.17
RI	Washington	Point Judith/Galilee	126,179	81,301	8.00%	4.50%	1.00	1.29	2.43	1.29	2.14	1.29

Source: NMFS social indicator data from 2016.
Maine.gov https://www.maine.gov/labor/cwri/county-economic-profiles/countyProfiles.html , 1/28/2020 US Census Bureau https://www.census.gov/quickfacts/fact/table/washingtoncountymaine,ME/INC110218 US Census Bureau 2018 :ACS 1-year estimates data profiles;FRED https://fred.stlouisfed.org/series/MADUKE7URN
Notes: social indicator data are categorical, ranging from 0 to 4. Higher numbers indicate communities that are more vulnerable.

Table 6.26: Socioeconomic Profile of Substantively Affected Counties – Harvest Parameters

County	State	Top Species Landed by Value	2018 ALWTRP Harvest Value ($)	ALWTRP Harvest Value as% of Total Harvest Value	Estimated Number of Vessels Fishing with ALWTRP Gear	Total Estimated Employment on ALWTRP Vessels_Lower	Total Estimated Employment on ALWTRP Vessels_upper
Washington	ME	Lobster, softshell clam, sea scallop	81,003,814	81%	838	1,601	2,514
Hancock	ME	Lobster, American eel, softshell clam	156,154,329	89%	1158	2,221	3,472
Waldo	ME	Lobster, American eel, sea scallop	3,041,380	72%	113	196	322
Knox	ME	Lobster, softshell clam, Atlantic herring	136,413,697	92%	945	1,834	2,872
Lincoln	ME	Lobster, oysters, softshell clam	29,770,294	69%	465	859	1,374
Sagadahoc	ME	Lobster, worms, quahog	5,808,239	75%	210	375	621
Cumberland	ME	Lobster, pollock, cod	60,664,397	69%	646	1,204	1,950
York	ME	Lobster, bluefin tuna, cod	21,354,828	93%	261	479	770
Rockingham	NH	Lobster, cod, pollock	35,026,477	91%	179	396	574
Essex	MA	Lobster, cod, pollock	30,202,297	39%	277	579	856
Suffolk	MA	Cod, lobster, pollock	2,631,553	16%	28	18	25
Norfolk	MA	Lobster, softshell clam, bluefin tuna	1,916,586	99%	24	47	70
Plymouth	MA	Lobster, oysters, cod	13,502,085	49%	192	421	613
Barnstable	MA	Lobster, sea scallops, bluefin tuna	17,499,519	24%	173	346	519
Bristol	MA	Sea scallop, cod, lobster	26,829,026	6%	97	670	865
Newport	RI	Lobster, sea scallop, monkfish	7,313,508	60%	63	152	215
Washington	RI	Loligo squid, lobster, illex squid	5,923,447	81%	128	349	480

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7 SUMMARY AND INTEGRATION OF IMPACT FINDINGS

This chapter summarizes and integrates the findings of the biological, economic, and social impact analyses presented in the two preceding chapters, assessing the relative merits of the regulatory alternatives considered in this Environmental Impact Statement (EIS). In all cases the analysis measures these impacts relative to Alternative 1, the no action alternative, which considers the fishery as it was fished in 2017.

Alternative One would make no change in the requirements of the Atlantic Large Whale Take Reduction Plan (Plan), preserving the regulatory status quo under the Take Reduction Plan. Ongoing changes in management of the lobster fishery may reduce buoy line numbers, and states may modify fisheries in state waters that could reduce risk to large whales, but no regulations modifying the Plan would be implemented. Alternative 1 would have no economic impact beyond those analyzed for fishery management and Maine gear marking requirements, and no effect on social conditions in fishing communities. Other state regulations such as weak inserts in Maine and rope diameter restrictions in Massachusetts would be unlikely to occur absent federal modifications to the Plan. Therefore Alternative 1 also would have very little impact on the rate at which North Atlantic right whales, North Atlantic humpback whales, fin whales, or minke whales are seriously injured or killed as the result of incidental entanglement in commercial fishing gear.

As Chapter Two discusses in detail, the available data indicate that additional action is needed to reduce the risk of entanglement and achieve the degree of protection mandated for these species, North Atlantic right whales in particular, under the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). Accordingly, NMFS is considering modifications to the Plan designed to meet the requirements of the ESA and MMPA. NMFS estimated that to reduce serious injury and mortality below PBR, entanglement risk across U.S. fisheries needs to be reduced by 60 to 80 percent. The vast majority of vertical lines along the east coast belong to lobster and crab trap/pot fisheries in the Northeast Region Trap/Pot Management Area (Northeast Region). This DEIS focusses on these fisheries to facilitate rapid rulemaking. The Take Reduction Team has been informed of the intention to consider all fixed gear fisheries coastwide during the next Take Reduction Team deliberations. Large whale entanglement data and the rationale for the scope of the alternatives considered in this DEIS are also described in greater detail in Chapter Two: Purposes and Needs.

The modifications analyzed in this DEIS are detailed in Table 1.1. All risk reduction measures are analyzed toward the target of a 60 to 80 percent risk reduction for lobster and crab pot fisheries. The economic analysis considers only those measures that would be implemented to modify the take reduction plan. Measures analyzed include:

- Trawling up requirements; minimum trawl-length standards (traps per trawl), which would apply to the northeast lobster and Jonah crab fisheries;
- Line cap allocation at 50% of 2017 buoy line numbers in Federal waters;
- A change in existing seasonal restricted areas to modify them from trap/pot closure areas to closures to persistent buoy lines that would allow ropeless fishing under exemption

authorization. New seasonal restricted areas that would be closed to persistent buoy lines would be implemented;

- New gear configuration requirements including requiring weak rope or weak inserts in buoy lines, which would apply to all lobster and Jonahcrab trap/pot buoy line in the Northeast Region;
- New gear marking requirements, which would apply to all regulated lobster and Jonah crab trap/pot buoy lines in the Northeast Region.

NMFS has specified two action alternatives – Alternatives Two (Preferred) and Three – that include different parameters and combinations of these measures. NMFS' assessment of the biological impacts of these alternatives and the economic, and social impacts of the components that would be implemented by federal regulations to modify the Plan are summarized below.

7.1 Biological Impacts

7.1.1 Impacts on Large Whales

The provisions that would be implemented by federal and state rulemaking to reduce entanglement risk under consideration are likely to have a direct effect on large whales. Under Alternative One, the no action alternative, the number of vertical lines in the water column would not change. Estimates of North Atlantic right whale mortalities and serious injuries in U.S. commercial fisheries would continue to exceed the population's potential biological removal level (PBR). Alternatives Two (Preferred) and Three incorporate various provisions that would reduce the number of trap/pot buoy lines fished by northeast crab and lobster fishermen to levels below the 2017 vertical line estimate. Analysis using the NMFS/IEc Vertical Line Model indicates that the line reduction measures in the two alternatives, which include ongoing fishery management measures in LMA 2 and 3 as well as Maine, Massachusetts and MRA measures, would reduce the number of vertical lines in the Northeast Region Trap/Pot Management Area by approximately 19 to 50 percent, depending on the alternative implemented. By reducing the number of vertical lines in the water column, these provisions would help to reduce the co-occurrence of whales and lines, lowering encounter rates and reducing the frequency of entanglements. Line numbers are reduced more broadly through a 50% line cap in Alternative Three; however, both alternatives include additional risk reduction measures that accomplish substantial levels of co-occurrence reduction.

Under Alternative Two (Preferred), exempt state waters would remain exempt from minimum trawl-length regulations, with the exception of Massachusetts state regulations, which would prohibit single trap trawls for vessels larger than 29 feet acquiring transferred permits after January 1, 2020 in Massachusetts waters. Other than in waters closed to trap/pot fisheries in Massachusetts Bay, whales are less likely to be found in persistent aggregations in most nearshore areas. NMFS believes that exempting these areas from minimum trawl-length regulations would be unlikely to have a significant adverse impact on endangered or protected whales compared to Alternative One, the no action alternative, and the exemption allows the continuation of traditional fishing practices by smaller vessels and entry level fishermen. Broad weak rope insertion requirements will be implemented by state or federal regulations in these waters, a precautionary measure that would minimize entanglement severity should one occur.

Beyond the provisions described above, Alternatives Two (Preferred) and Three would also allow ropeless fishing but seasonally close designated areas in the Northeast to persistent trap/pot vertical lines during months in which North Atlantic right whales are most likely to be present (Table 7.1). Buoy line closures of these areas further reduces co-occurrence to reduce the risk of entanglement compared to Alternative One, the no action alternative. These seasonal restricted areas are expected to primarily benefit north Atlantic right whales; the co-occurrence model estimates a reduction in co-occurrence or negligible increases for other large whale species (Table 7.2).

Table 7.1: The length and size of the proposed restricted areas included in both alternatives.

Restricted Area	**Alternative**	**Time Period**	**Size (Square Miles)**
Offshore Maine	2	October - January	967
Offshore Maine	3a & b	October - February	967
Georges Basin Core Area	3a & b	May - August	557
Cape Cod Bay	2	May, until only 3 whales remain	664
Outer Cape State Waters	2	May, until only 3 whales remain	260
Massachusetts Restricted Area	3	May, possible early open	2,161
Massachusetts South Island Restricted Area	2	February - April	2,545
Large South Island Restricted Area	3a	February - April	5,468
L-shaped South Island Restricted Area	3b	February - April	3,506

Alternatives Two (Preferred) and Three would also introduce additional gear restrictions for lobster and crab vessels fishing trap/pot gear in the northeast. These restrictions would require weak rope or weak insertions, breaking at 1,700 lbs. or less, to allow large whales to break free from gear before a serious injury or mortality can occur. Different configurations would be required based on lobster management area and distance from shore. The weak rope/weak insertion requirements seek to minimize the severity of an entanglement should one occur, reducing the number of serious injuries and mortalities caused by trap/pot gear. Under Alternative One, the no action alternative, no additional safeguards would be put in place. Alternative Three converts a greater proportion of vertical line than Alternative Two to fully weak or the equivalent and, though this provision does not reduce the risk of entanglement, it would provide additional protection against serious injury and mortality should an entanglement occur.

All of the action alternatives include provisions that would revise the gear marking requirements specified under the Plan. Under gear marking Alternatives Two and Three, the new requirements would apply to all lobster/crab trap/pot gear in the Northeast Region Trap/Pot Restricted Area. Under Alternative Two (Preferred), gear marking will be required under federal rulemaking except that Maine would regulate gear set in Maine exempted waters under regulations already published, effective September 2020. The new gear-marking provisions would have no immediate impact on entanglement risks. In the long run, however, they may help the National Marine Fisheries Service (NMFS) target and improve its efforts to protect large whales. As has been noted, whales showing signs of entanglement often have no gear remaining on them once seen, or gear is not retrieved. However, even when gear is retrieved, it is often difficult to identify the particular location or fishery where an entanglement occurred. The gear marking requirements, including a large mark in the surface system that may be detectable from shipboard or aerial surveys, would increase gear identification and help to generate information on the origins of gear involved in entanglements. The goal is to allow the ALWTRT and NMFS to improve the effectiveness of the ALWTRP. Under Alternative One, the no action alternative, no additional improvements to the effectiveness of the ALWTRP would occur.

7.1.2 Other Biological Impacts

In addition to impacts on large whale species, changes to Plan regulations may affect other aspects of the marine environment, including other protected species and habitat. There are not likely significant differences among Alternatives Two (Preferred) and Three with respect to impacts on habitat; any impacts on habitat are generally expected to be minor. Reductions in vertical line are also likely to benefit other protected species prone to entanglement. Specifically, NMFS believes that trawling up requirements and line caps could help reduce entanglement risks for sea turtles and other large whales. Alternative Three (Non-preferred) has a greater line reduction and so is more favorable.

Likewise, weak line requirements will result in a net positive impact on other protected species, particularly benefiting blue, sei, and sperm whales by reducing entanglement severity similar to the large whale Values Ecosystem Component (VEC). These changes are not likely to impact sea turtle species or minke whales negatively but also do not provide a benefit since the weak line is likely not weak enough for smaller animals to break out, therefore it would likely not decrease entanglement severity for smaller animals. Overall, both Alternatives Two (Preferred) and Three (Non-Preferred) could reduce serious injury and mortality in other protected large whales compared to Alternative One (No Action), where Alternatives Three may reduce entanglement severity to a greater degree than Alternative Two (Preferred).

Alternatives Two (Preferred) does not require small vessels fishing in state waters to trawl up and reduce vertical lines. However, weak rope or weak inserts are required as a precautionary measure to reduce the severity of entanglements. These changes would not benefit other protected species since weak line would likely not decrease entanglement severity for smaller animals such as minke whales and leatherback sea turtles.

The closure of designated areas in the Northeast to trap/pot buoy lines could provide ancillary benefits to sea turtles and sei whales that may be present when the restricted areas are in effect. Compared to Alternative One, the no action alternative, these benefits are likely to be greatest under Alternative Three, which proposes larger restricted areas for longer periods of time, and lower under Alternative Two (Preferred), which proposes the less extensive restricted areas for slightly shorter time periods (see Table 7.1).

7.1.3 Comparison of Biological Impacts across Alternatives

The biological impacts analysis presented in Chapter Five relies primarily on NMFS' Vertical Line Model to examine how the regulatory alternatives might reduce the possibility of interactions between whales and fishing gear. As discussed in that chapter, the model integrates information on fishing activity, gear configurations, and whale sightings to provide indicators of the potential for entanglements to occur at various locations and at different points in time. The fundamental measure of entanglement potential is co-occurrence. The co-occurrence value estimated in the model is an index figure, integrated across the spatial grid, indicating the degree to which whales and the vertical line employed in trap/pot fisheries coincide in the waters subject to the Plan. Biological impacts are characterized with respect to the percentage reduction in the overall co-occurrence indicator each alternative would achieve.

Table 7.2: Reduction in vertical line co-occurrence for right, humpback, and fin whales by alternative

	Right Whale		Humpback Whale		Fin Whale	
Alternative	**Lines Out**	**Lines Relocated**	**Lines Out**	**Lines Relocated**	**Lines Out**	**Lines Relocated**
1 (no action)	0%	0%	0%	0%	0%	0%
2 (preferred)	69.2%	69.1%	19.5%	19.4%	27.9%	27.9%
3a	88.4%	86.0%	57.4%	56.5%	59.1%	58.3%
3b	86.4%	83.8%	57.2%	56.3%	58.9%	58.1%

Table 7.2 summarizes the estimated change in co-occurrence under each action alternative relative to the no-action alternative (Alternative One). Alternative Two, which includes trawling requirements and restricted areas, is estimated to yield a reduction in co-occurrence of approximately 69 percent. Alternative Three estimates a co-occurrence between 83 and 88 percent depending on the different restricted area option selected south of Cape Cod and whether lines are removed or relocated in the presence of a seasonal buoy line closure. The estimated impact of restricted areas is greater when affected vessels are assumed to suspend fishing rather than relocate to alternative fishing grounds but it is anticipated most proposed restricted areas, aside from those in the Massachusetts Bay Restricted Area, will result in relocation of lines. However, the difference between suspending and relocating fishing effort assumptions is not very substantial. Alternative Two also includes conversion of less rope to fully weak vertical line, which does not directly reduce entanglement risk, and less positive benefits for other protected species. Though line numbers are reduced more broadly in Alternative Three, there is greater uncertainty of how this will be implemented and if it will increase lines and potentially co-occurrence in some months. The variation in co-occurrence between alternatives options is fairly small for right whales between alternatives, likely achieving more reduction in co-occurrence with fewer gear modifications and higher compliance rates.

7.2 Economic Impacts

Chapters Six evaluates the economic and social impacts of Alternatives Two and Three relative to the status quo (Alternative One), including a yearly distribution of the compliance costs for the six years following implementation. For the purpose of summarizing and comparing the economic impact of the alternatives, this discussion will focus on initial implementation costs of the two action alternatives.

The first year costs of all proposed measures for Alternative Two including gear marking, weak rope, restricted areas, and trawling up costs range from $6.9 million to $15.4 million. As described in Chapters Six, the range of costs depends primarily on assumptions about catch loss caused by trawling up and about whether fishermen choose to remove lines or relocate due to buoy line closures. Year one compliance costs for Alternative Three A range from $27.9 million to $46.3 million and for Alternative Three B (a smaller restricted area option south of the islands), from $27.7 million to $46.1 million. Thus, the costs associated with Alternative Two are well under one third the Total costs associated with Alternatives Three.

Alternative Two achieves less risk reduction than Alternative Three. The DST indicated Alternative Two would likely achieve over 60 percent risk reduction, on average, for lobster and crab trap/pot buoys in the Northeast Region, within the target established for reaching right whale PBR. The co- occurrence model suggested North Atlantic right whale co-occurrence would be reduced by over 69 percent. The costs associated with the co-occurrence reduction (trawling up and buoy line closures) under Alternative Two range from $3 million to $11.5 million (Table 7.3), depending on implementation assumptions (buoy lines relocated vs. buoy lines removed). For every unit of co-occurrence reduction, the costs of Alternative Two is estimated at $40.1 thousand to $163.4 thousand.

Both options evaluated under Alternative Three performed better at reducing risk than Alternative Two, achieving a risk reduction of nearly 70 percent from the DST, and co-occurrence reduction of greater than 83 percent. This alternative would increase the likelihood of achieving PBR, even when considering cryptic mortality of right whales. However, the costs associated with co- occurrence reduction in Alternatives Three (trawling up, buoy line closures, federal water line caps) are substantially higher, ranging from $13.4 million to $31.9 million dollars; or $156 thousand to $367 thousand for each unit of co-occurrence reduction. That is, each risk reduction unit of Alternative Three would cost about 2 to 3 times the cost per risk reduction unit in Alternative Two.

Analysis of the weak rope modification measures are similar, with Alternative Three performing better but at a high cost. Proposed modifications in Alternative Two would impact every buoy line in the Northeast Region lobster and Jonah crab trap/pot fishery, converting over 26 percent of the rope to weak, with an estimated cost of $2.2 million dollars, or about $81 thousand for each percent of line converted (Table 7.4). Alternative Three would convert over 73 percent of the buoy lines to weak rope, with an estimated cost of $10.2 million or about $139 thousand for each percent of line converted.

Table 7.3: A summary of initial compliance costs related to Co-Occurrence (2017 dollars). Note: the lower and upper bounds of co-occurrence reduction score are based on the assumptions of 100% lines out and 100% relocation respectively.

	Alternative 2	Alternative 3A	Alternative 3B
Trawling Up Lower	$2,660,792	$905,233	$905,233
Trawling Up Upper	$10,957,354	$1,847,949	$1,847,949
New Buoy Line Closure Lower	$106,259	$1,258,265	$1,091,997
New Buoy Line Closure Upper	$315,300	$1,854,057	$1,675,984
Line Cap Lower		$11,397,973	$11,397,973
Line Cap Upper		$28,229,779	$28,229,779
Total Lower	$2,767,051	$13,561,471	$13,395,203
Total Upper	$11,272,654	$31,931,785	$31,753,712
Co-occurrence Reduction Score	69.1%-69.2%	86% to 88.4%	83.8% to 86.4%

Chapters Six provides a full analysis and comparison of the economic impacts of the elements of the alternatives that would modify the Plan through federal rulemaking. While the Table 7.3 comparison of the costs of implementation of the risk reduction elements in each action alternative is an oversimplification, it demonstrates that relative economic impacts, and shows that Alternative Two achieves the purposes laid out in Chapter Two of this DEIS while minimizing the potential economic impacts of the proposed modifications to the Plan.

Table 7.4: A summary of annualized Federal Plan modification compliance costs related to weak line. The percent of rope weakened in Alternative 3 is the average of restricted area scenarios as well as two nearly identical conversions to weak rope in LMA Three proposed in Alternative Three.

	Percent of rope weakened	First year cost of converting to weak rope
Alternative 2	26.6%	2,152,497
Alternative 3 A & B	73.6%	10,202,645

7.3 Social Impact of Alternatives

The social impacts are analyzed in Chapter Six. The analysis estimates that 3,970 vessels in crab and lobster trap/pot fisheries in Northeast Region except for Maine exempt waters (which will be regulated by the state of Maine) would be impacted by either action alternative. These represent 3,504 unique entities including 3,500 small entities, although impacts do not appear to be disproportionate across small and large entities. These vessels fish primarily for lobster and Jonah crab. Under both Alternatives Two and Three, proposed gear marking and weak rope requirements would affect every lobster and crab vessel fishing in the Northeast Region. Line reduction measures (i.e. trawling up) under Alternative Two would affect 1,712 vessels, slightly more than the 1,565 vessels affected by the Alternative Three line reduction measures (line caps, trawling up in LMA Three). Federally regulated seasonal buoy line closures of Alternative Two would affect up to 48 vessels, compared to more than 230 vessels affected by the buoy line closures under Alternative Three. Chapter Six provides further details on the economic impacts of the Alternatives.

Community impacts vary across the region, with more vulnerable communities in Northeast and mid-coast Maine, where the lobster fishery is a major economic driver. The value of 2018 lobster landings in Hancock and Knox Counties each exceeded $130 million. Southern Maine and New Hampshire have a more diversified economy, making communities more resilient to adverse economic impacts that may stem from Plan modifications. Similarly, revenues from Take Reduction Plan fisheries exceed $15 million per year in some counties in Massachusetts and Rhode Island communities suggesting that the economic stability and well-being of those counties rely to some extent on these fisheries. However, relative to Maine communities, the economies are more diversified in Massachusetts and Rhode Island, so there may be other job and economic opportunities within these communities, making them more resilient to loss of fishery revenue.

7.5 Integration of Results

To compare the biological impacts of all alternatives on all VECs we used the impact designations outlined in Table 7.4. This section only compares the VECs as defined in Chapter Four. Table 7.5 describes the direct and indirect impacts of the alternatives on the four VECs

Alternative One (No Action) maintains the Plan's current levels of impacts on the VECs. With this alternative, the impact of trap/pot fishing will remain at a high negative because the rate of serious injury and mortality of North Atlantic right whales is well above PBR and therefore unsustainable for the population. The impact of trap/pot fisheries would remain negative for other protected species and negligible to low negative for habitat as defined in Chapter Four. Under Alternative One, the impact of continuing the fishery in its current state would be mixed for Human Communities, with a positive impact on harvesters but a low negative with respect to the intrinsic public benefits of healthy whale populations (e.g. on whale watching operations). It is important to note that, when assessed individually, Alternative Two and Alternative Three would each have a negative to low negative impact on large whales and other protected species and a negligible to low negative impact on the habitat.

There are a few significant differences between Alternatives Two and Three (Preferred and Non-preferred, respectively), relative to Alternative One, with respect to impacts on all four VEC's. All of the Alternatives (with the exception of Alternative One) include some form ofgear modifications and some level of increased traps per trawl. The main differences among these alternatives stem from differences in the approach and magnitude of vertical line reductions, size or season of closures to persistent buoy lines, and the extent of the use of weak rope or weak insertions. Large whales would positively benefit from implementation of either Alternative Two or Three since they both effectively reduce co-occurrence between whales and buoy line as well as increase the proportion of rope within buoy lines that is weakened to 1700 lbs breaking strength through engineered weak rope or weak inserts. Alternative Three likely reduces entanglement risk to a greater degree than Alternative Two with a larger decrease in the number and strength of lines. A greater decrease in line number and strength will likely offer more benefits, though compliance is expected to be greater for Alternative Two rather than Three because Alternative Two reflects extensive state and stakeholder input and associated preferences. Furthermore, Alternative Two likely contains fewer regulations that would lead to uncertain outcomes. Other protected species prone to entanglement in trap/pot gear would also positively benefit from the Plan modifications being considered compared to Alternative One, with benefits from Alternative Three offering greater benefits than Alternative Two. Any additional indirect impacts of Alternatives Two and Three on habitat are expected to be extremely small and not measurable. Compared to Alternative One, the impact of Alternative Two and Three are expected to be low negative and negative, respectively, due to the initial gear modifications and anticipated short term catch impacts. Alternative Three would require more costs for gear modifications and potentially greater catch losses.

Because some of the value the benefits of potential changes to the ALWTRP are qualitiative, it is difficult to provide a quantitative benefit-cost analysis to identify the regulatory alternative that would likely provide the greatest net benefit. Instead, Table 7.3 summarizes the estimated cost of complying with each federally regulated element in the alternatives, coupled with the estimated decrease in co-occurrence estimated by the NMFS/IEC Vertical Line Model. Nonetheless, the cost-effectiveness figures provide a useful means of comparing the relative impacts of the regulatory provisions that each alternative incorporates.

Table 7.3 reveals several noteworthy findings:

- Co-occurrence reduction: Under Alternative Two, the costs associated with the co-occurrence reduction (trawling up and buoy line closures) range from $2.8 million to $11.3 million. For every unit of co- occurrence reduction, the costs are estimated at $40.1 thousand to $163.4 thousand. Under Alternative Three, the costs associated with co-occurrence reduction in (trawling up, buoy line closures, federal water line caps) are substantially higher, ranging from $13.4 million to $31.9 million dollars; or $156 thousand to $367 thousand for each unit of co-occurrence reduction

- Weak Rope: Under Alternative Two proposed modifications would convert over 26 percent of the rope in all Northeast Region lobster and Jonah crab buoy lines outside of Maine exempt waters to weak, with an estimated cost of $2.2 million dollars, about $81 thousand for each percent of line converted. Alternative Three weak line measures would convert over 73 percent of the rope in all Northeast trap/pot buoy outside of Maine exempted waters to weak rope, with an estimated cost of $10.2 million or about $139 thousand for each percent of line converted.

- Both Alternatives reduce co-occurrence by well over 60 percent and modify all buoy lines to include some weak rope. Alternative Three has higher benefits but at a high cost: for each co-occurrence unit of Alternative Three would cost about two to three times the cost per co-occurrence unit in Alternative Two.

NMFS has considered the benefit and cost information presented above and believes that Alternative Two (Preferred) offers the best option for achieving compliance with MMPA and ESA requirements. Excluding vessels in Maine exempt waters, Alternative Two (Preferred) reduces compliance costs with a small effect on the estimated reduction in co-occurrence.

Alternative Two (Preferred) provides substantial benefits to large whales but does not incur the additional costs associated with the broader use of full weak line and additional costly buoy line reduction in Alternative Three. Based on these considerations, NMFS has identified Alternative Two (Preferred) as its proposed approach to achieve the goals of the Plan.

Table 7.5: A key of the direction and magnitude of the actions being assessed in the biological effects analysis.

	Impact of Action		
VEC	***Positive***	***Negative***	***Negligible***
Large Whales	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or Actions that reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Other Protected Species	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Habitat	• Actions that increase habitat quality	• Actions that decrease habitat quality	• Actions that have little or no positive or negative impact on habitat quality
Human Communities	• Actions that increase revenue and social well-being of fishermen and their communities	• Actions that decrease revenue and social well-being of fishermen and their communities	• Actions that have no positive or negative impact on revenue and social well-being of fishermen and their communities
	Impact Qualifiers		
Low	To a lesser degree		
No qualifier	To a medium degree		
High	To a greater degree		
Likely	Some degree of uncertainty		
ND	Impacts could not be determined at time of this writing		

Table 7.6: The direct and indirect impacts of the Alternatives Two and Three on the four VECs relative to Alternative One (the no action alternative).

Alternatives	*Large Whales*	*Other Protected Species*	*Habitat*	*Human Communities*
Risk Reduction				
Alternative 1 (No Action)	**High Negative** – Serious injury and mortality would continue to occur and impact population health	**Negative** – Injury and mortality would continue to harm protected species	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact	**Mixed –** Positive in that there are no new impacts or costs to harvesters and markets but the lack of recovery of whale species has a low negative impact on public welfare benefits due to whale population declines.
Alternative 2 (Preferred)	**Positive** – Would reduce right whale co-occurrence by 69%	**Positive** – Would reduce likelihood of entanglement via 19% reduction in buoy lines	**Negligible to low negative** – Trawling up to trawls above 15 traps per trawl may have a short-term impact	**Low negative –** Fisheries would experience extra costs and catch reduction in the short term.
Alternative 3 (Non-preferred)	**High Positive** – Would reduce right whale co-occurrence by 83-88%	**High Positive** – Would reduce likelihood of entanglement via 50% reduction in buoy lines	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact	**Negative –** Costs of gear modifications and catch reduction would be significant.
Gear Marking				
Alternative 1 (No Action)	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Alternative 2 (Preferred)	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Alternative 3 (Non-preferred)	**Negligible**	**Negligible**	**Negligible**	**Negligible**

8 CUMULATIVE EFFECTS ANALYSIS

8.1 Introduction

The cumulative effects analysis (CEA) examines the consequences of the regulatory alternatives within the context of past, present, and future factors that influence resources associated with the Atlantic Large Whale Take Reduction Plan (ALWTRP). The National Environmental Policy Act (NEPA) requires all environmental impact statements for proposed Federal actions to include a cumulative effects analysis that examines the impact of the actions in conjunction with other factors that affect the physical, biological, and socioeconomic resource components of the affected environment. The purpose of the cumulative effects analysis is to ensure that Federal decisions consider the full range of an action’s consequences, incorporating this information into the planning process. This document follows steps depicted in Figure 8.1 to conduct a cumulative effects analysis of the proposed actions. Table 8.1 provides the framework used to determine the impacts actions had on each valued ecosystem component

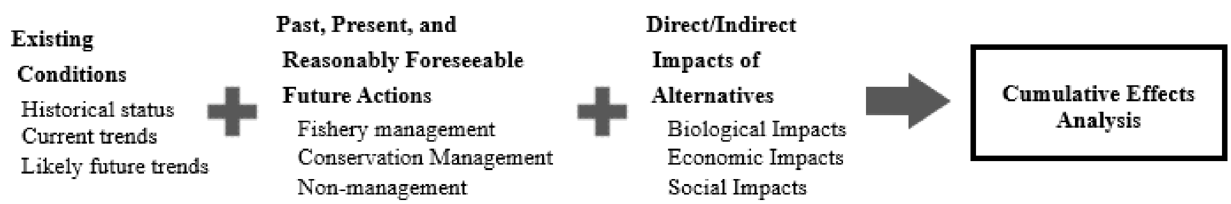

Figure 8.1: Cumulative effects analysis steps; how they inform the cumulative effects analysis (adapted from Canter 2012)

8.1.1 Valued Ecosystem Components

The following valued ecosystem components (VECs) would be affected by changes to the ALWTRP and are addressed in this analysis:

1. **Large whales:** North Atlantic right whale, fin whale, humpback whale, and minke whale
2. **Other protected species:** blue whale, sei whale, sperm whale, leatherback sea turtle, and loggerhead sea turtle
3. **Habitat:** the physical environment, benthic organisms, and essential fish habitat
4. **Human communities:** the economic aspects of the potentially affected fisheries

Table 8.1: A key of the direction and magnitude of the actions being assessed in the cumulative impacts analysis.

	Impact of Action		
VEC	***Positive***	***Negative***	***Negligible***
Large Whales	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or Actions that reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Other Protected Species	• Actions that reduce injury and mortality or support population health	• Actions that increase injury and mortality or reduce population health	• Actions that have little or no positive or negative impact on stocks/populations
Habitat	• Actions that increase habitat quality	• Actions that decrease habitat quality	• Actions that have little or no positive or negative impact on habitat quality
Human Communities	• Actions that increase revenue and social well-being of fishermen and their communities	• Actions that decrease revenue and social well-being of fishermen and their communities	• Actions that have no positive or negative impact on revenue and social well-being of fishermen and their communities
	Impact Qualifiers		
Low	To a lesser degree		
No qualifier	To a medium degree		
High	To a greater degree		
Likely	Some degree of uncertainty		
ND	Impacts could not be determined at time of this writing		

8.1.2 Geographic and Temporal Scope

This analysis and most of the actions considered are focused primarily on the Northeast Region Trap/Pot Management Area (Northeast Region) of the ALWTRP. This includes waters from the U.S./Canada border south to a straight line from Watch Hill Point RI to 40° 00′ N. latitude bounded on the west by land or the 71°51.5′ W. longitude line, and on the east by the eastern edge of the EEZ. This is an area currently subject to the requirements of the ALWTRP and includes the seawater and sea bottom of the Atlantic Ocean within U.S. jurisdiction. We also consider serious injury and mortality that is occurring in Canadian waters as a result of human activities (primarily entanglement and ship strikes) because of the magnitude of impact this is having on the population (see Section 8.3.3.10).

The temporal scope of the analysis varies by resource. In all instances, the analysis attempts to take into account past (primarily the past two decades), present, and reasonably foreseeable future actions (within five years) that could affect valuable physical, biological, or socioeconomic resources. The discussion here focuses on impacts of management actions as well as the direct impact of potential stressors: interactions with commercial and recreational fisheries, ship strikes, pollution, noise, climate change, renewable energy development, oil and gas development, harmful algal blooms, and prey availability. Stressors that are not expected to impact a VEC may be noted but will not be analyzed.

8.2 VEC Status and Trends

The status and trends of each VEC was presented in Chapter 4 and is summarized in Table 8.2.

Table 8.2: A summary of the current status and trends of the four valued ecosystem components

Affected Resource of Concern	*Historical Conditions*	*Current Conditions*	*Possible Future Conditions*	*Implications of Conditions Relative to Sustainability*
Large Whales	Stocks were depleted by whaling and other anthropogenic impacts.	Right and fin whales are endangered. Right whale stock is declining, humpbacks are increasing, and the trends of the others are unknown.	Under current conditions, right whales are likely to continue declining.	The stocks are very vulnerable to anthropogenic perturbations due small sizes and population declines (right whales and fin whales).
Other Protected Species	Many whale species were previously depleted. Sea turtle species were overharvested and caught excessively as bycatch.	Sperm, sei, and blue whales and leatherback turtles are endangered Loggerheads are threatened. Trends are unavailable for the whales, loggerheads have been stable with short term increases, and leatherbacks are generally decreasing in numbers	Certain protected species may be resilient to future changes while others may remain small or continue to decline.	Certain stocks that are still depleted are still vulnerable to additional anthropogenic stressors and population decline.
Habitat	The habitat has slowly degraded over time with increasing exposure to anthropogenic stressors	The habitat is rapidly shifting from historical baselines from the impacts of climate change as well as other anthropogenic stressors.	Shifts in habitat features are expected to continue as the climate shifts and alters the frequency and magnitude of disturbance.	The habitat is vulnerable to additional disturbance.
Human Communiti es	American Lobster stocks have been abundant in GOM but depleted in SNE waters; Jonah Crab fishery was supplement of lobster fishery.	Total lobster landings peaked in 2015 and started to decrease. GOM represents about 80 percent of all lobster landings; Southern MA and RI landed the most Jonah crabs.	GOM lobster landing will keep trending down and SNE stock stay depleted; more Jonah crabs will be landed from SNE.	Target species, lobster and Jonah crab, are vulnerable to anthropogenic and environmental stressors, posing a threat to human communities that depend on commercial fisheries.

8.3 Effects of Past, Present, and Reasonably Foreseeable Future Actions

8.3.1 Fishery Management Actions

Fishery management actions include the creation of a new FMP and additional amendments and addendums that modify how the fishery is conducted. These amendments and addendums can include actions such as quotas, trap reductions, administration of taxes, and guidelines on how data is collected and shared with management agencies. These actions can have a variety of impacts on the economic aspects of fisheries as well as the environment. These are summarized in Table 8.3 and discussed below.

Table 8.3: A summary of the past, present, and foreseeable future fishery management actions on the four VECs.

Fishery	Management Action	Large Whales	Other Protected Species	Habitat	Human Communities
American Lobster	Amendment 3 Addenda I and IV trap reductions Addenda XXI, XXII – Area 2 aggregate trap cap, Area 3 active trap cap with banking• Addendum XXIV - conservation tax Addendum XXVI – expand reporting and sampling Vessel tracking	**Negative**	**Low Negative to Negative**	**Negligible to Low Negative**	**Low Positive**
Northern Black Sea Bass	Amendment 9 harvest quotas Amendment 13 harvest quotas 2020-2021 implemented increased quota up to 60%	**Negligible to Negative**	**Low Negative**	**Negligible to Low Negative**	**Low Positive**
Hagfish	State managed	**Negligible to Low Negative**	**Negligible to Low negative**	**Negligible to Low Negative**	**N/A**
Red Crab	Red Crab FMP harvest quota Amendment 3 (ACL/AM) Amendment 4 - bycatch reporting Developing amendments 2019 2020-2023 new specifications implemented	**Low Negative to Negative**	**Low Negative**	**Negligible to Low Negative**	**Low Positive**
Scup	Amendment 8 harvest quota Amendment 18 (review quota allocations) future action Addendum XXIX - quota periods 2020-2021 specifications implemented	**Negligible to Low Negative**	**Low Negative**	**Negligible to Low Negative**	**Low Positive**
Jonah Crab	Initial FMP Addendum III - the reporting and data collection	**Negative**	**Negative**	**Negligible to Low Negative**	**Low Positive**
Conch/ Whelk	State managed	**N/A**	**N/A**	**N/A**	**N/A**
Net Impact Summary		**Low Negative to Negative**	**Low Negative**	**Negligible to Low Negative**	**Low Positive**

Large Whales

Fishery Management Plans and their amendments can mitigate some of the impact of fishing gear on protected large whale species. The amendments and addendums included here were primarily intended to optimize fishing practices, restrict overfishing, manage bycatch, and gather information to better manage the stock. Lobster and crab management that reduces rope in the water column would have a low positive impact, improved reporting and monitoring would inform future management and may have a net positive impact, and modifications to maintain or restrict fishing on other species and likely would cause negligible impacts. However, any fishing generally has a negative effect on protected species because any line in the water increases the risk of interaction so, while fisheries management can mitigate some of this, the overall effect is anticipated to be between low negative to negative.

Other Protected Species

The impact of past, present, and reasonably foreseeable future fishery management actions that reduce rope in the water column and improve data collection for lobster and crab fisheries would partially mitigate the negative impacts on some protected species, such as leatherback sea turtles. However, this is not enough to eliminate risk entirely and the overall impact of fishing activity is expected to be low negative.

Habitat

The operation of trap/pot fisheries that operate longer trap trawls could have a slightly deleterious impact on the habitat. Setting quotas and trap limits that reduce gear on the bottom are likely indirectly better for the habitat than unmanaged fisheries. Overall, the impact of trap/pot fisheries management on habitat is considered to be negligible to low negative.

Human communities

The aims of many of these management actions include improving maintenance of the target stock and mitigating bycatch. Both of these goals are likely to have a low positive impact on the economics of the fishery by allowing the continuation of a healthy fishery as a source of income for human communities.

8.3.2 Conservation Management Actions

Several management actions have been implemented to mitigate the impact of stressors on wildlife and habitats. Though climate change mitigation is intended to have long term impacts on the VECs analyzed here, the effects of these regional measures are likely not sufficient to impact climate change on a larger scale, particularly within the scope of this analysis, and is therefore considered to have a negligible impact. The impact of other the past, present, and foreseeable future actions are discussed below (Table 8.4).

Large Whales

All of these past, present, and reasonably foreseeable future actions aim to mitigate the impact of known human or environmental stressors. All of these stressors are known or thought to negatively impact large whales and, therefore, mitigating actions are expected to have a low positive impact on this VEC. U.S. ship strike management may be effective (Conn and Silber 2013) but given changes in right whale distribution and status, they are being reviewed and evaluated and may be modified to further reduce the impacts of vessels on right whales. Actions like speed reductions and observers would have a positive benefit on other large whale species.

Table 8.4: A summary of conservation management actions

Stressor	Management Action	Large Whales	Other Protected Species	Habitat	Human Communities
Entanglement Mitigation	ALWTRP modifications, including modifications to closure definitions to allow ropeless fishing in closed areas (may occur in separate rulemaking), new restricted area, gear marking, and gear configurations resulting in less or weaker gear; Maine and other New England states measures to reduce risk to large whales and improve information collection The right whale sighting advisory system	**Positive**	**Low Positive to Positive**	**Negligible**	**Likely Negative**
Ship Strike Reduction	Mandatory Ship Reporting System; Strategy to Reduce Ship Strikes of Right Whales (71 FR 36299; 71 FR 46440); Boston Traffic Separation Scheme	**Positive**	**Positive**	**Negligible**	**Negligible**
Habitat Protection	Clean Water Act; Marine Protection, Research, and Sanctuaries Act; Oil Pollution Act; Omnibus Habitat Amendment 2; • Omnibus Deep-Sea Coral Amendment	**Likely Positive**	**Likely Positive**	**Likely Positive**	**Low Positive**
Climate Change Mitigation	Policies, energy market trends, technological innovation, and other actions that reduce greenhouse gas emissions	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Water Pollution Mitigation	Clean Water Act; Marine Protection, Research, and Sanctuaries Act; Oil Pollution Act; International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978	**Likely Positive**	**Likely Positive**	**Likely Positive**	**Low Positive**
Net Impact Summary		**Low Positive**	**Low Positive**	**Negligible**	**Negligible**

Other Protected Species

Similar to large whales, the mitigation measures for each of these stressors that have been or are expected to be enacted are likely to reduce the impact of the stressor on other protected species. The combination of multiple stressors can impede population health and recovery. For example, sea level rise, coastal development, and climate change have all been factors in reducing available nesting habitat for loggerhead turtles in Florida where climate change and development have pushed nests toward areas with increased erosion risk (Reece et al. 2013). While many species can survive and reproduce despite exposure to environmental stressors, an increasing stress load reduces an organisms' capacity to respond, behaviorally or physiologically, to avoid negative consequences. Mitigating the impact of multiple stressors in the environment by protecting habitats and habitat quality can reduce the overall stress by reducing the energy necessary to adapt to new baselines. Multiple conservation measures are likely to have a low positive impact on other protected species, similar to large whales.

Habitat

Some of the environmental mitigation actions are likely to reduce the number or magnitude of stressors on fish habitat and benthic organisms in the proposed area, particularly those related to regulating pollutants. Pollution and climate change can contribute to habitat degradation through mechanical disruption of habitat structure and negative impacts on the health of organisms (see the next section). Measures that directly protect habitats, address the effects of climate change, or protect water and sediment quality via pollution mitigation will prevent additional environmental degradation as a result of these stressors. These measures are expected to have positive impacts on marine habitats. Other regulations likely have a negligible impact on habitat, such as ship strike regulations, that are not expected to interact with the physical environment. The net impact of all actions is likely low positive.

Human communities

Most of the mitigation actions included in this analysis are expected to have negligible impact on the human communities that rely on fisheries. Actions that have been implemented to mitigate entanglement likely have a negative impact on this VEC whereas those that have a positive impact on fishery habitat are expected to have a low positive impact by supporting healthy fisheries. It is expected that these management actions have a negligible impact on the VEC when combined.

8.3.3 Other Human Activities

Table 8.5: A summary of human activities on the four VECs.

Action	Description	Large Whales	Other Protected Species	Habitat	Human Communities
Aquaculture	Placement of fish pens and lines in the water	**Negative**	**Negative**	**Negligible to Low Negative**	**Low Negative to Negligible**
Climate Change	Ocean warming, increased climatic variability, ocean acidification, more extreme weather events	**High Negative**	**Likely Negative**	**High Negative**	**High Negative**
Entanglement	Interaction with fishing gear	**Negative**	**Negative**	**Negligible**	**Low Negative**
Noise	Sources of anthropogenic noise, including vessels, military exercises, seismic surveys, etc. (wind turbines discussed below)	**Low Negative to Negative**	**Low Negative to Negative**	**N/A**	**Negligible**
Offshore wind farm	Construction and operation of wind turbine structures in specified area	**Negative**	**Negative**	**Negative**	**Negative**
Pollution/water quality	Land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification; Point-source and unpermitted discharges	**Low Negative**	**Low Negative**	**Low Negative**	**Negligible**
Oil and gas	Prospecting for, construction of, and operation of oil and/or gas platforms in marine areas. May include geological and geophysical surveys (e.g., certain seismic surveys).	**Negative**	**Negative**	**Negative**	**Negative**
Prey availability	Changes in primary production and prey species (i.e. nutritional stress)	**Negative**	**Low Negative**	**N/A**	**N/A**
Ship Strikes	Injury or mortality from vessel collision	**High Negative**	**Negative**	**N/A**	**N/A**
Harmful algal blooms	Overgrowth of algal species that produce biotoxins and also contribute to oxygen-depletion	**Negative**	**Negative**	**Negative**	**Negative**
Canadian Mortalities	Serious injury and mortality as a result of entanglement and ship strike in Canadian waters as well as other unknown causes.	**High Negative**	**Low Negative**	**N/A**	**N/A**
Net Impact Summary		**Negative**	**Negative**	**Negative**	**Negative**

There are several anthropogenic actions that could potentially impact the VECs included in this analysis, including fishing, aquaculture, manufacturing, agriculture, construction, military activities, shipping, and climate change. These activities can have an impact individually as well as collectively and should be considered when proposing management actions and the nature of these activities are listed in table 8.5 with the predicted impact of past, present, and foreseeable future actions on each VEC.

8.3.3.1 Aquaculture

Aquaculture can have a variety of impacts on the environment, some that differ based on the species being farmed. Figure 8.2 shows the distribution of aquaculture structures along the coast of New England, primarily within embayments and river mouths or nearshore. Two proposals to expand existing offshore aquaculture operations are anticipated. One proposal would expand a long line mussel operation from three to twenty horizontal long lines on a 33- acre (0.13 square km) lease site 8.5 miles (13.7 km) off the coast of Cape Ann, Massachusetts. The second proposal would expand existing experimental aquaculture installations off the Isle of Shoals in New Hampshire. The expansion includes a kelp array, as well as an integrated multi-trophic aquaculture raft. Neither the Cape Ann nor the Isle of Shoals project expansions have received permits, nor have they undergone ESA section 7 consultation.

An informal programmatic section 7 consultation with the Army Corps of Engineers has been conducted for aquaculture projects in the Northeast U.S. The programmatic consultation analyzes impacts on endangered and threatened species caused by small-scale shellfish aquaculture (almost entirely oyster shell on bottom, cage on bottom and floating cage/bags). The vast majority of projects occur in the nearshore environment (bays, inlets, and other estuarine/brackish waters). Thirty one New England District (Maine through Connecticut) aquaculture projects were analyzed under the terms of this programmatic consultation in 2019, and a similar number is expected annually moving forward. Considerations for this cumulative impacts analysis are listed below.

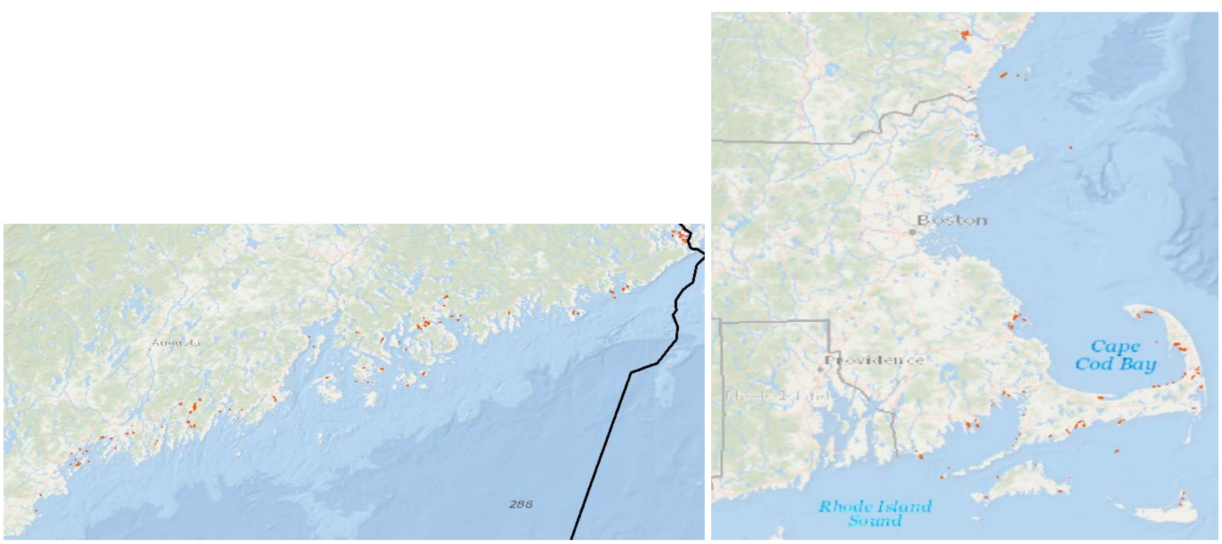

Figure 8.2: The aquaculture structures currently in place along the coast of New England in orange (Northeast Ocean Data Portal download).

Large Whales

Aquaculture structures in open water that involve lines or nets in the water can pose an entanglement risk to large whales in the affected area. Although farms are currently not as abundant compared to other fisheries that entangle large whales, right, humpback, and minke whales have all been found entangled in aquaculture-specific gear (Young 2015, Price et al. 2017). The outcomes of entanglement in aquaculture gear are expected to be similar to entanglement in other fishing gear, ranging from minor injury to mortality (Chapter Two and Five). Aquaculture also is associated with an increase in vessel traffic due to operation and maintenance of the gear as well as from recreational fishermen that aggregate to fish around the gear. Increased vessel traffic would cause increased risk of vessel strike for right whales. The NMFS is developing best practices for minimizing the impacts of aquaculture installations on large whales and other protected species. Therefore, this risk is assumed to be negative at current and reasonably foreseeable aquaculture operations within the geographic scope of this analysis.

Other Protected Species

Similar to large whales, other marine mammals and sea turtles have been found entangled in aquaculture gear, including sperm whales, and leatherback sea turtles (Kemper et al. 2003, Lloyd 2003, Baker 2005, Clement 2013, Ishikawa et al. 2013, Young 2015, Price et al. 2017). The impact of aquaculture on other protected species is assumed to be similar to large whales.

Habitat

Aquaculture can also have impacts on the physical environment and fish habitat. Aquaculture can change the substrate, benthic organisms, and habitat or community structure (Simenstad and Fresh 1995, Gallardi 2014). Aquaculture can result in input of excess contaminants, diseases, and nutrients into the environment (Lai et al. 2018), which can degrade habitats. Shellfish aquaculture that involves filter-feeding species can also have a greater positive effect on the environment than finfish aquaculture by filtering out contaminants and contributing to clearer water (Milewski, Gallardi 2014, Petersen et al. 2016). This excess filtering of water can be positive, by removing waste from the water column, or negative through impacts like out-competing native species for resources and altering food webs (Gallardi 2014). Shellfish structures are more prevalent within the proposed area, it is likely that aquaculture would have a negligible or low negative impact on water quality and other habitat changes within the scope of this analysis.

Human communities

The economic impacts of aquaculture on wild fisheries and fishing communities could be complex. On one hand, aquaculture may cause significant environmental degradation around aquaculture sites, block coastal access, thus cause economic loss for the inshore fisheries (Primavera 2006, Wiber et al. 2012, D’Anna and Murray 2015). On the other hand, aquaculture could provide positive economic support to coastal communities through job creation in related industries such as processing and distribution (Pomeroy et al. 2014, D’Anna and Murray 2015, Grealis et al. 2017). The overall economic impacts will depend on the scale and type of aquaculture. Large scale finfish aquaculture will have more negative impacts on wild fisheries than small scale and shellfish aquaculture.

8.3.3.2 Climate Change

The Northwest Atlantic Ocean is expected to warm at a rate of up to three times faster than the global average (Saba et al. 2016). Climate change has already contributed to oceanographic and marine ecosystem shifts (Doney et al. 2012), including the North Atlantic (Greene et al. 2013). Warming seas have shifted suitable habitats and resource availability for marine vertebrates including marine mammals, sea turtles, and fisheries in the region (e.g. lobster (Boavida-Portugal et al. 2018)). In addition to higher water temperatures, climate change is also expected to increase the frequency and intensity of oxygen depletion, harmful algal blooms, ocean stratification, and acidification (Doney et al. 2012, Stramma et al. 2012, Birchenough et al. 2015, Deutsch et al. 2015, Gobler et al. 2017). These changes can negatively impact the physiological health of marine organisms and habitats and their capacity to respond to additional stressors and therefore

Large Whales

Large whales are susceptible to ecosystem changes caused by climate change. Baleen whales will most likely expand or shift their current range in response to prey species but the nature of the impacts varies by species (MacLeod 2009). Right whale habitat has shifted in recent years to follow their preferred prey farther north as the Gulf of Maine warms (Meyer- Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018, Record et al. 2019a, Record et al. 2019b). Climate change impacts their preferred prey abundance, which is known to impede reproductive success in this species (Meyer-Gutbrod et al. 2015a). Humpback, fin, and minke whales are also species known to shift their range in response to temperature (Kovacs and Lydersen 2008, Becker et al. 2019) but, as more generalist species, may be better able to adjust to changing climates compared to specialist species like the North Atlantic right whale (Flemming and Crawford 2006, Víkingsson et al. 2014, Becker et al. 2019). This is consistent with predictions that climate change range shifts will be unfavorable for the North Atlantic right whale, neutral for minke and humpback whales, and favorable for fin whales (MacLeod 2009). Overall sensitivity estimates have identified fin whales as more vulnerable to climate change in particular due to the small population size (Sousa et al. 2019).

Indirect effects of climate change are also important to consider, including the increase of harmful algal blooms that can lead to die offs (see section 8.3.3.9 on HABs) and potential nutritional stress. Repeated exposure to conditions beyond optimal ranges can also increase the physiological demands on aquatic organisms, reduce physiological resilience to additional stressors, and impact reproductive success (Fair and Becker 2000, Tilbrook et al. 2000). Additionally, because measures to reduce the impacts of shipping and fishing on protected species are often area specific, another indirect effect of climate change is a species distribution shift into unregulated waters, outside of managed areas. For right whales, this has had lethal results (Meyer-Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018). Given the high rate of warming projected by Saba et al. (2016) for the Northwest Atlantic, the anticipated direct and indirect impact of climate change on large whales is likely a high negative.

Other Protected Species

Other marine mammals and sea turtles included in this analysis are also expected to be impacted by climate change in a manner similar to large whales. For marine mammals, the biggest impact is likely to species ranges, availability of prey, and additional physiological stress. MacLeod (2009) predicted minimal significant changes in range for other large whales, including sperm, blue, and sei whales. However, sperm whales were identified as a sensitive marine mammal species based on low population sizes (Sousa et al. 2019) and blue whales are expected to decline in some regions from lack of preferred prey (Becker et al. 2019).

Sea turtles are also vulnerable to the impacts of climate change. Nest temperature is known to determine the proportion of male to female eggs in a nest with higher temperatures producing higher numbers of females (Mrosovsky 1980, Yntema and Mrosovsky 1980). This occurs over a narrow temperature range and existing changes have already started producing majority female nests in some regions (Mrosovsky 1980, Yntema and Mrosovsky 1980). Increased tidal inundation and sea level rise on nesting beaches could reduce the amount of nesting habitat available and the success rate of nests on remaining beaches (Caut et al. 2010, Reece et al. 2013, Patino-Martinez et al. 2014, Pike et al. 2015), a pattern that has occurred at a faster rate along the Northwest Atlantic coast than the global average (Sallenger et al. 2012). Climate change could cause range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson et al.2009) and also move or restrict the availability of suitable nesting habitat for several species (McMahon and Hays 2006, Mazaris et al. 2008, Pike 2013a, b). Despite these impacts, it is thought that leatherback and loggerhead population management units in the Northwest Atlantic specifically will be more resilient to climatic change than similar species in other areas (Fuentes et al. 2013). Overall, in the study area it is expected that protected species will be negatively impacted by climate change.

Habitat

The impacts of climate change have already been observed in many parts of the North Atlantic. Climate change has already influenced the distribution, density, and species richness of benthic organisms in the North Atlantic (Birchenough et al. 2015). Ocean acidification may further lead to population declines in structural organisms that rely on calcification (e.g. calcifying algae, mollusks) and increases in others species (e.g. other algae) leading to changes in primary ecosystem structures (Birchenough et al. 2015, Sunday et al. 2017). Increasing storm frequency is also likely to change the seafloor substrate in some areas (Brierley and Kingsford 2009). Combined, these impacts may be highly negative on fish habitat and habitat areas of particular concern, particularly those that are more sensitive to changes in temperature or physical disturbance.

Human communities

Target species of several fisheries have already exhibited changes in distribution northward (Kleisner et al. 2017), including the North American lobster (Boavida-Portugal et al. 2018, Le Bris et al. 2018). This shift has already had an economic impact on fisheries in southern New England (Peck and Pinnegar 2019) and is expected to reduce catch and revenues (Cheung et al. 2010, Lam et al. 2016) and put economic strain on fishing dependent communities along the eastern seaboard (Colburn et al. 2016). Oremus (2019) estimated that climate variability from 1996 to 2017 is responsible for a 16% decline in county-level fishing employment in New England, beyond the changes in employment attributable to management or other factors. Shellfish in particular are vulnerable to both changes in temperature as well as ocean acidification, which could lead to revenue losses under future climate scenarios. Mackenzie and Tarnowski (2018) estimated that between 1980 and 2010 landings of the four most important bivalve mollusks (oysters, quahogs, soft shell clams and bay scallops) fell by 85 percent. Warmer winter water played the key role in the declines. For these reasons, climate change is expected to have a highly negative impact on fisheries and fishing communities.

8.3.3.3 Noise

Anthropogenic noise is a known stressor that can impact wildlife health. This includes such activities as vessel traffic, air traffic, construction, military exercises, seismic surveys, the use of sonar, and other human activities. Noise can either be lethal or impose sublethal stress on vertebrates, which can impact population health by reducing reproduction or increasing susceptibility to other stressors (e.g. a compromised immune system that increases disease susceptibility). Since it is assumed that noise has a negligible impact on the physical environment or fish habitat, it will not be discussed here.

Large Whales

Anthropogenic noise can impact whales both physiologically and behaviorally. Physiologically, noise causes a stress response in the North Atlantic right whale (Rolland et al. 2012). Over an extended period of time, physiological stress can impact marine mammal health by altering metabolism and energy stores (Romero and Butler 2007, Christiansen et al. 2014, Lysiak et al. 2018), decreasing immunity (Romano et al 2004, Romero and Butler 2007), and impacting reproduction (Tilbrook et al. 2000, Romero and Butler 2007). Noise can also impact behavior, including initiation of avoidance behavior in large whales (McCauley et al. 2000), changing communication patterns (Di Iorio and Clark 2010, Parks et al. 2011) that can reduce mating opportunities, and interrupting feeding behavior (Blair et al. 2016, Sivle et al. 2016). The physiological impacts of these behavioral changes is unclear but could impact nutritional health and reproductive success. Small populations with limited home ranges may be more vulnerable to the physiological impacts of noise (Forney et al. 2017). Given this information, impacts of noise on large whales is likely to be low negative to negative.

Other Protected Species

Other large marine mammals are similarly sensitive to physiological and behavioral responses to noise as large whales. Many of the predicted impacts on large whales noted above are similar for other large whales (outside of the Large Whale VEC). For example, noise from geological and geophysical survey activities related to oil and gas in the Gulf of Mexico was predicted to cause as high as a 25% stock declines in sperm whales (Farmer et al. 2018). Though these whales were not from the same stock that is present in the Northeast Region, the species in general may be sensitive to particularly loud noises.

Limited evidence suggests that noise can affect sea turtles through habitat exclusion or hearing damage (Nelms et al. 2016). Many sources of anthropogenic noise fall within the range of sea turtle detection (50 Hz to 1100 Hz (DeRuiter and Larbi Doukara 2012, Martin et al. 2012, Lavender et al. 2014)) and could impact their behavior or damage their hearing at close range. Noise from prospecting or removal of oil and gas structures is thought to pose risk of injury or behavioral modification (Viada et al. 2008, DeRuiter and Larbi Doukara 2012). It is anticipated that other protected species also experience a low negative to negative impact from noise.

Human communities

There is a limited amount of information that suggests noise can impact catch of some species (Skalski et al. 1992, Engås et al. 1996). However, most crustaceans only show physiological rather than behavioral responses to noise (Weilgart 2018), reducing the likelihood of a reduction in catch. As such, impact of noise on fishery revenue is assumed to be negligible.

8.3.3.4 Offshore wind farm energy projects

This section describes offshore wind development activities that NMFS is considering reasonably foreseeable for the purpose of assessing cumulative effects in this EIS. The impact of offshore wind farms on the VEC's includes noise (discussed in further detail in Section 9.4.2.3) emitted during site assessment activities exploration, construction pile driving, and operation, and other effects during construction, including cable laying, dredging, and increased vessel traffic.

Offshore wind energy development is being considered in parts of the Atlantic Outer Continental Shelf (OCS) that overlap with resources associated with the ALWTRP, specifically in the southern New England region. Both large whales, other protected species, and potentially affected fisheries occur in southern New England at present and are expected to be for the near future.

To identify the possible extent of reasonably foreseeable future offshore wind development on the OCS, the Bureau of Ocean Energy Management (BOEM) conducted a thorough process to develop criteria levels. As a result of this process, BOEM has assumed that approximately 18 gigawatts (GW) of Atlantic offshore wind development is reasonably foreseeable within the 13 lease areas along the east coast ranging from offshore of Massachusetts to Virginia (Figure 8.3). Reasonably foreseeable development includes 17 named projects within lease areas. In addition, BOEM has assumed future development is reasonably foreseeable to occur within lease areas outside of named project boundaries. Levels of assumed future development are based on state commitments to renewable energy development, available turbine technology, and the size of potential development areas.

Under the renewable energy regulations (30 CFR § 585), the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision making process and occurs over several years with each step having varying impacts to marine and/or terrestrial resources. The process follows these general steps: lease issuance, site assessment plan approval, and construction and operation plan review/approval including permitting with cooperating agencies. Reasonably foreseeable activities associated with offshore wind development include site characterization studies, site assessment activities, construction, operation/maintenance and decommissioning of offshore wind farms, port upgrades, and construction and maintenance of offshore export cables. These activities in total will span approximately 30-40 years (beyond the scope of this analysis), and are expected to impact all VECs. However, impacts may be short- or long-term in duration, direct or indirect, may be intermittent or persistent, and may differ between phases. The types of activities expected during each phase are described below and followed up with the anticipated effects of these activities on the VECs. It is important to note that currently no utility scale offshore wind energy development exists in United States waters; though projects exist in Europe, not all effects are transferable and there are many uncertainties as to how humans, marine and terrestrial resources will interact or be affected by offshore wind energy development.

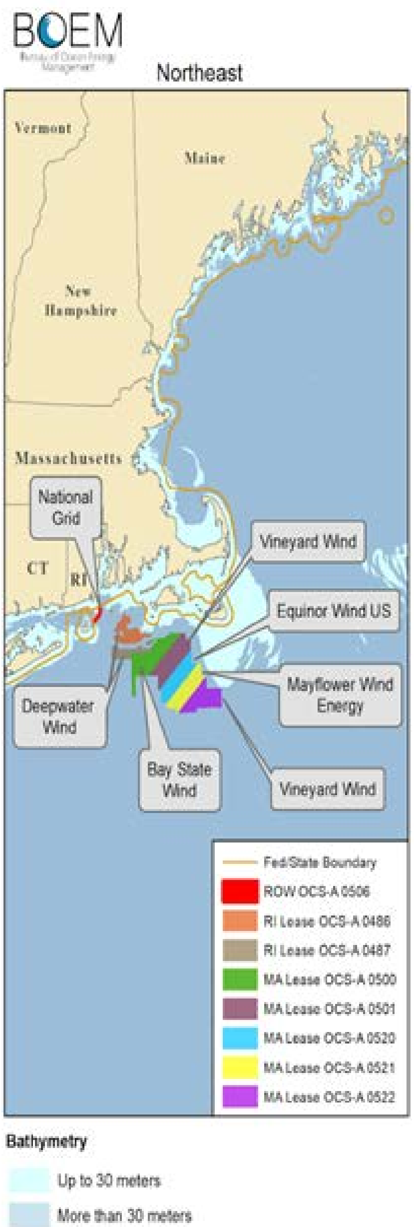

Figure 8.3: A map of the anticipated wind energy developments expected to start construction in the reasonably foreseeable future.

Site Assessment and Construction Activities: During site assessment and construction activities, both direct and indirect impacts on all VECs may occur. Activities that will occur pre-construction include geophysical, geotechnical, habitat and biological surveys as well as potential deployment of meteorological buoys or meteorological towers for data collection. It is important to note that air guns are not anticipated to be used during offshore wind site assessment activities. During the construction phase, activities are anticipated to include foundation installation (which is likely to include pile driving at some projects) to support wind turbine generators and electric service platforms and installation of submarine cables to connect turbines and export cables to route generated power to land based facilities. During the site assessment and construction periods, anticipated impacts include short-term, temporary, increases in vessel traffic, short-term, temporary increases in anthropogenic noise from vessel traffic, survey activities, and wind turbine foundation and cable installation, short-term, temporary increased turbidity during foundation and cable installation, and short-term, temporary displacement of other users including fisheries and non-project vessels. These are the primary activities expected to occur during the scope of this analysis.

Operation and Maintenance Activities: During operational and maintenance activities, anticipated activities include the use of vessels to carry out inspections and maintenance as well as the operation of the turbines themselves. It is important to note that currently available information, though limited, indicates that the operational noise of wind turbines is not detectable underwater at distances of more than 50 m from the foundation (Miller and Potty 2017) and is not loud enough to anticipate behavioral disturbances of large whales (Tougaard and Henriksen 2009, Thomsen et al. 2016). Both direct and indirect impacts on all VECs may occur including long-term, increased presence of structures which may affect recreational and commercial fishery operations, habitat, oceanographic and atmospheric environments, patterns of movement, spawning and recruitment success, and prey availability for various species, long-term, increased electromagnetic fields due to presence of inter-array and offshore export cables, long- term, increased vessel traffic, long-term, variable socioeconomic impacts, and long-term, variable fishery displacement impacts as it remains unclear how fishing or transiting to and from fishing grounds might be affected by offshore wind energy development. It is possible that wind farms will become operational within the timeframe of this analysis and thus they are considered below.

Decommissioning Activities: During decommissioning, foundations, wind turbines generators, and associated structures will be removed. During this period, both direct and indirect impacts on all VECs may occur including short-term, temporary increased vessel traffic; short-term, temporary increased anthropogenic noise from vessel traffic and wind turbine removal; short-term, temporary increased turbidity during foundation and cable removall and short-term, temporary fishery displacement. It is unlikely that decommissioning will occur during the next six to ten years or within the timeframe of this analysis and thus decommissioning is not considered further.

For the purposes of this analysis, the description below will focus on the potential impacts of site assessment and construction as well as operation and maintenance of offshore wind energy developments on the potentially affected VECs.

Large Whales

All four of the large whale stocks in this VEC have been found frequently in planned offshore wind farm areas in southern New England (Stone et al. 2017). Generally, these species are most sensitive to low frequency sounds and could respond to the range of sounds emitted during pile driving and operation (Madsen et al. 2006, Bailey et al. 2010). Pile driving of turbine foundations during construction would produce the most noise and poses the greatest risk to marine mammals within close range during this period. One developer in the proposed region, Vineyard Wind, has worked with environmental organizations to develop mitigation measures to avoid pile driving during times of peak right whale presence (January 22, 2019; CLF 2019)) but this does not take into account other seasons where right whales are present at lower abundance levels and when other large whale species are likely present (e.g. summer, Stone et al. 2017). During construction, it is also likely that vessel traffic will increase, adding additional noise and risk of vessel strikes in the area.

Operational sounds are quieter and often masked by shipping traffic unless in very close proximity to a turbine and may not change overall noise risk significantly in high traffic areas (Madsen et al. 2006). Other habitat effects that are predicted to impact turbidity and potential ecosystem structure, such as dredging, could reduce the ability of this area to serve as foraging grounds for large whales. Wind farm development in this area is likely to have a negative impact on large whales given the most impactful stage (i.e. construction) is planned to occur during this time within the timeframe of this analysis (approximately 5 years), with a possible decline in the magnitude of the impact after construction.

Other Protected Species

The impact of wind farm development on other protected marine mammals outside of the large whale VEC is expected to be similar to the impact on other large whales. Sei whales have been known to frequent the areas in southern New England where wind energy developments are planned (Stone et al. 2017). Species that spend more time in deep waters, such as sperm whales and blue whales, are less likely to be close to construction or operations and therefore will likely not be significantly impacted by the proposed activities, though there have been a few sperm whale sightings (Stone et al. 2017).

There is very little information available about the impact of wind turbine development on sea turtles. Turtles may respond to loud noise or electromagnetic fields and can be injured or killed through direct interaction with dredging equipment (Gill 2005, Riefolo et al. 2016). Increased vessel traffic during construction and maintenance could increase chances of a vessel strike. The sound or increase in turbidity could temporarily displace turtles from the area due to disturbance to individuals or their prey items. Other habitat changes could also impact occurrence of sea turtles in the area but it is uncertain if that would have any substantial population-wide effects. Overall, the effect of offshore wind energy development is likely negative for other protected species during the timeframe of this analysis with a possible decline in the magnitude of the negative impact during the operational phase.

Habitat

There are several potential impacts of offshore windfarms on fish habitats, both positive and negative. The most significant changes likely occur during construction and include removal of or changes in the substrate on the bottom through dredging and the addition of gravel (Gill 2005, Riefolo et al. 2016). Dredging is also expected to increase water turbidity. These physical changes could impact other aspects of the habitat, including the biodiversity and food availability in the area (Gill 2005, Riefolo et al. 2016, Dannheim et al. 2019). After construction, the turbines could add additional habitat diversity that can be beneficial for sessile organisms (Gill 2005, Riefolo et al. 2016). This could include regrowth of species that were displaced during construction or introduction of invasive species. The addition of structures could also alter water currents and temperature, potentially changing the microhabitats in the area. Together, these suggest that offshore windfarms will have a negative impact on habitat, with a possible change in impact over time (i.e. after construction).

Human communities

Wind farms have positive impacts on recreational fisheries and mostly negative impacts on commercial fisheries. Wind turbine bases work as artificial reefs and increase the abundance of demersal fish in the nearby area (Wilhelmsson et al. 2006). It will attract more recreational activities like bottom fishing and spearfishing. Some research found no changes in flatfish in Rhode Island (Wilber et al. 2018), while others found decreased flatfish landings in wind farm area in the North Sea (Berkenhagen et al. 2010). While there are no currently no anticipated efforts to exclude fishing vessels from wind turbine arrays, there may be some disruption to normal fishing operations or transit amongst the wind turbines, depending on the spacing and orientation of the array. Commercial vessels are losing their fishing grounds due to crowded vessel traffic and gear conflicts. The spacing of the turbines represent navigational hazards to safe fishing practices. Gear conflicts in remaining fishing grounds may increase. Fishermen will likely be displaced. A survey conducted by researchers from University of Rhode Island found positive impacts from Block Island Wind Farm (BIWF) on recreational anglers, while neutral or negative impacts on commercial fisheries (ten Brink and Dalton 2018). This research also points out that BIWF has no ecological impact on fish. However, BIWF is the first offshore wind project in the U.S. with only 5 turbines. When the number of turbines increase, the cumulative effects may be different (Berkenhagen et al. 2010). This may have some individual economic impacts on fishermen who are unable to relocate to a new fishing ground. It is expected to have a negative short-term impact.

8.3.3.5 Pollution/Water Quality

Humans have significantly increased the quantity of pollution that is introduced into the ocean. Types of pollution entering the coastal environment from both point and non-point sources include suspended solids, organic and non-organic debris (e.g. plastic waste), metals, synthetic organic compounds, oil, nutrients, pathogens, and nanoparticles (i.e. microscopic forms of compounds like metals). Some of these contaminants are very slow to degrade and accumulate in wildlife species, particularly at high trophic levels (i.e. persistent organic pollutants). Others, while more easily degraded or metabolized when ingested, can still be toxic to marine organisms. Exposure to these compounds can be lethal or sub lethal, causing acute or chronic health issues in several wildlife species. Overloading of nutrients will be discussed further in the Harmful Algal Bloom section.

The coastal waters near Boston, Massachusetts have historically been among the most contaminated in North America, with elevated concentrations of trace metals, PCBs and petroleum hydrocarbons (Pearce 1990). Additional chemical and nutrient loads flow into Massachusetts Bay from the Merrimack River in the north, and several other large rivers from the southern coast of Maine. Contaminant sources include sewage and industrial discharges, combined sewer overflows, stormwater runoff, groundwater inflows, in-place sediments, seeps, and atmospheric deposition (Massachusetts Bay Program 1991). Dominant current patterns in the Northeast make it probable that industrial pollutants released into coastal waters will affect important feeding areas off the coast of Massachusetts and Cape Cod Bay.

Large Whales

Large baleen whales are exposed to a variety of contaminants through their diet that are known to have negative impacts on marine mammals, including persistent organic pollutants, oil, metals, plastic debris, and nanoparticles. These compounds can disrupt hormones (Letcher et al. 2010, Schwacke et al. 2012, Bushra and Ahmad 2014), inhibit reproduction (Wells et al. 2005, Kellar et al. 2017), increase susceptibility to disease (Ross et al. 1996, Schwacke et al. 2012, Desforges et al. 2016), cause genotoxicity (Wang et al. 2013, Wise et al. 2014, Wise et al. 2015), and impact nutritional health (Tabuchi et al. 2006, Schwacke et al. 2012, Avio et al. 2017). Large whales are likely exposed to smaller quantities of contaminants than marine mammals that feed at higher trophic levels. Though, some of these compounds can have an impact at low levels (Vandenberg et al. 2012) and in tandem with other compounds (Mori et al. 2008). Contaminant levels in marine mammals are high relative to other ocean areas (Aguilar et al. 2002). North Atlantic right whales, humpback whales, fin whales, and minke whales in the affected environment are exposed to many of these compounds (Weisbrod et al. 2000, Hobbs et al. 2001, Hobbs et al. 2003a, Hobbs et al. 2003b, Metcalfe et al. 2004, Elfes et al. 2010, Montie et al. 2010, Ryan et al. 2013) but mostly at relatively less concerning levels than toothed marine mammals (Elfes et al. 2010). It is unknown what contaminant levels are biologically meaningful in different marine mammal species or the effect of multiple compounds at low levels. There may be a slightly higher risk during fasting periods where compounds are released into the blood.

Plastic ingestion is also a concern for large whales and has been documented in fin, humpback and minke whales (Sadove and Morreale 1990, Williams et al. 2011, Fossi et al. 2016, Kühn and van Franeker 2020). Baleen whales also can ingest plastic debris (Simmonds 2012, Nelms et al. 2018, Kühn and van Franeker 2020) which can lead to starvation (Jacobsen et al. 2010) and mortality and can potentially increase the risk of infection (Nelms et al. 2019). Ingested plastic can also increase chemical exposure via sorption to plastic in the environment (Rochman et al. 2013). Thus, contaminant exposure likely represents a low negative risk in these species.

Other Protected Species

Like the large whale species discussed above, other marine mammals and turtles can be impacted by contaminant exposure as well. Marine mammals at higher trophic levels are more at risk than those that feed lower trophic level organisms. Blue whales have been observed with similar contaminant levels as the other Large Whales (Gauthier et al. 1997). There is little known on Sei whales in this area but, given similar diets and distribution, it is likely that levels are similar to other mysticetes (Borrell and Aguilar 1987). Conversely, sperm whales are at a higher trophic level and have relatively high contaminant loads (Aguilar 1983, Pinzone 2015) and there is concern this could impact their health. Large amounts of plastic debris are of particular concern for sperm whales but are also a health hazard for baleen whales for the same reasons discussed above (Jacobsen et al. 2010, Simmonds 2012, Kühn and van Franeker 2020).

Sea turtles are also exposed to similar compounds and can be susceptible to similar health issues, such as impaired reproduction, development, immune system, and metabolic function (Bergeron et al. 1994, Keller et al. 2004, Guirlet et al. 2010, van de Merve et al. 2010, Camacho et al. 2013, Andrés et al. 2016). Though sea turtles are also generally at a low trophic level, contaminant loads do correlate with health parameters in loggerhead (Keller et al. 2004, Keller et al. 2006) and leatherback turtles (Andrés et al. 2016). Plastic ingestion is also prevalent in loggerheads and leatherbacks (Sadove and Morreale 1990, Mrosovsky et al. 2009, Wilcox et al. 2016, Pham et al. 2017, Kühn and van Franeker 2020), posing a mortality and starvation risk (Mrosovsky et al. 2009, Stamper et al. 2009, Wilcox et al. 2016). When combined, past, present, and reasonably foreseeable future actions represent a low negative impact.

Habitat

Pollution can impact oceanic habitats and ecosystems by altering ecosystem productivity and benthic organisms (Chang et al. 1992, Alve and Olsgard 1999, Johnston et al. 2015). Plastic pollution is also prevalent in the region (Law et al. 2010). However, there is little evidence in the proposed area that suggests pollution has or will have large impacts on habitat features considered in this VEC, so it is assumed that the impact is low negative.

Human communities

The economic stability of a fishery can be impacted by pollution as well when there is a mortality event or related closure. Alternatively, if a large amount of the target species were exposed to non-lethal levels of contaminants that pose a human health risk, it could change demand for the target species. An exposure of this magnitude is likely rare in the proposed area and likely negligible in the time frame of this analysis.

8.3.3.6 Oil and Gas

Currently offshore oil and gas development activities are not ongoing or anticipated within the next six to ten years in the Northeast Region. Few concrete proposals are likely to be implemented in the foreseeable immediate or long-term future. NOAA had issued five individual harassment authorizations (IHA) under the Marine Mammal Protection Act for planned seismic surveys involving airguns on the Atlantic Outer Continental Shelf (OCS). One applicant subsequently withdrew their survey application pending with BOEM and returned their IHA to NOAA. The remaining IHAs expired in November 2020, and these proposed surveys will not take place until the applicants obtain new authorizations from NOAA and BOEM issues their own permits for the surveys, which are still pending. There are currently no active oil and gas leases on the Atlantic OCS, so there are currently no drilling or production activities. There is a multistage process under the OCS Lands Act, before oil and gas leasing, development, or production can occur on the Atlantic OCS. First, BOEM must develop every five years a National OCS Oil and Gas Leasing Program (National Program), which sets out the proposed dates and locations of proposed sales. No Atlantic lease sales are included in the current 2017-2022 National Program. BOEM is in the process of developing the next five-year National Program, which is expected to be completed around the time the current program ends in 2022. The next stage after the National Program is the decision on whether and under what terms to hold a specific lease sale. Even if Atlantic lease sales are included in a future National program, it could be several years before a decision on whether to hold an individual lease sale, as compliance with other laws (e.g., NEPA reviews, CZMA consistency determination, ESA consultation) will be necessary before any sale decision. Once a sale is held and leases issued, the lessee must obtain approval of its exploration plan and then its development and production plan (if it has identified sufficient resources to enter into oil and gas production). After these plans are approved, additional permit approvals are required before any individual exploration or production well can be drilled. Given this multistage process, it would likely be several years after inclusion in a National Program before oil and gas leasing could be expected in the Atlantic, and even longer before exploration or production activities could occur. On September 8, 2020, the President issued a Memorandum on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition, which withdraws from disposition by leasing the areas designated by BOEM as the South Atlantic Planning Area, the Straits of Florida Planning Area and portions of the eastern Gulf of Mexico; this effectively prevents any leasing of these areas under the OCS Lands Act through June 30, 2032. On September 25, 2020, a similar Presidential Memorandum was issued withdrawing from disposition by leasing the area off the short of North Carolina.[20] Thus, for the South Atlantic and offshore North Carolina, oil and gas leasing is not foreseeable until at least 2032.

Given the above, it is unclear at this time when or if offshore oil and gas activity will take place in the Atlantic. Should oil and gas activity occur offshore in the Atlantic, it could impact the marine environment in several different ways. During the exploration phase, the greatest impact is likely sound exposure from air gun seismic survey activities. Any exploratory drilling could add chemical contamination into the environment. During the drilling phase there could be chemical pollution (air and water discharges through USEPA regulated discharge permits) and manual disruption of physical habitat structure. During exploration and production, there is a risk of certain sizes of oil and chemical spills that could increase the risk of oil exposure in many marine organisms. Oil can persist in the marine environment after a spill (Barron et al. 2020, Kingston 2002, McClain et al. 2019, Peterson et al. 2003, Teal et al. 1978) and is even slower to degrade in cooler areas compared with warmer climates (Campo et al. 2013,, Brakstad and Bonaunet. 2006). A very large spill could increase the risk of chronic or acute oil exposure in some organisms (Pulster et al. 2020), but is not reasonably foreseeable in the Atlantic given no expected current and long-term oil and gas development activities are anticipated. Though noise and chemical pollution are broadly described in separate sections, this section will focus specifically on the potential impact of oil- and gas-related activities on marine environments, specifically air gun surveys and oil exposure, should any oil and gas activities take place. If new oil and gas activity occurs in the region, seismic surveys would likely be the primary concern

[20] Both Presidential Memorandums stated the withdrawals do "not apply to leasing for environmental conservation purposes, including the purposes of shore protection, beach nourishment and restoration, wetlands restoration, and habitat protection."

within the timeframe of this analysis.

Large Whales

As previously mentioned, several large whale species do respond behaviorally and physiologically to noise in the marine environment (see noise section 8.3.3.3). Air guns and other seismic activity involved in oil and gas exploration are known to be loud compared to other sources of anthropogenic sound (e.g. pile driving, (Moore et al. 2012)) and sound travels much longer distances underwater than in air and thus has a larger impact radius. Louder sounds are more likely to disrupt behavior (Parks et al. 2011), such as feeding (Blair et al. 2016, Sivle et al. 2016), or could potentially cause physical damage if it occurs in very close proximity to marine mammals.

The effects of oil exposure can be difficult to study in the wild because they are metabolized rapidly and therefore it can be a challenge to measure the level of oil exposure. However, there is plenty of evidence that suggests marine mammals are generally susceptible to adverse impacts due to oil exposure, including mortality and reproductive or immune impairment (Schwacke et al. 2012, Beyer et al. 2016, Kellar et al. 2017, Farmer et al. 2018). Less is known about larger whales specifically but these species do share some similarities within the well- established physiological pathway known to respond to oil exposure and subsequent effects (Wise et al. 2014; Angell et al. 2004). Thus, oil and gas activities are expected to have a negative impact on large whales and other protected species.

Other Protected Species

Both sound and oil exposure can similarly impact other protected large whale species, for the same reasons as above, as well as sea turtles (Fraser et al. 2020). For example, after the Deepwater Horizon Oil Spill in the Gulf of Mexico, sperm whale density declined (Ackleh et al. 2012) and exhibited evidence of exposure to genotoxic dispersants and metals associated with the spill and response (Wise et al. 2014). Both oil and noise exposure from oil and gas activity was predicted to have significant negative impacts on sperm whale population reproduction and survival (Farmer et al. 2018). Sea turtles are also impacted by oil and sound exposure. Sea turtles are sensitive to oil exposure during all life stages (Milton et al. 2003) through direct contact, ingestion, or inhalation. An oil spill is far more costly for beginning life stages, which are generally associated with *Sargassum*. Sublethal effects of oil on sea turtles likely includes respiratory damage, metabolic changes, and a general decline in reproductive success (Lamont et al. 2012, Stacy et al. 2017). Loggerheads may be particularly sensitive to exposure through diet since they eat mollusks that can accumulate high levels of oil (Milton et al. 2003). Nesting habitat is shifting with climate change and as such could be more of an issue in the future, though the impact from any reasonably foreseeable oil and gas activities in the Atlantic to any nesting turtles, eggs, and hatchlings would be negligible within the timeframe of this analysis.

The life stages that occur and are most likely impacted in the proposed area are adult and juvenile Kemp's ridley, loggerhead and leatherback sea turtles. Exposure during this stage can lead to death, as was observed after the Deepwater Horizon Oil Spill in the Gulf of Mexico when sea turtle strandings increased (Beyer et al. 2016) and over 600 sea turtle mortalities were documented. Deepwater Horizon Natural Resource Damage Assessment Trustees estimated that between 4,900 and 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the Deepwater Horizon oil spill (DWH NRDA Trustees 2016). Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities, while some were relocated to the Atlantic (DWH NRDA Trustees 2016). Other impacts assessed include reproductive failure and adverse health effects. Air gun activity during prospecting has been shown to impact loggerhead behavior (DeRuiter and Larbi Doukara 2012) and could impact population health by disrupting feeding behavior and increasing stress albeit temporarily. Thus, oil and gas activities are expected to have a negative impact on other protected species.

Habitat

Habitat is vulnerable to oil and gas activities largely from construction, operation, removal, and release of pollution into the environment. Construction, operation, and removal likely contribute to changes in the local habitat, including changes in substrate, water turbidity, impacts similar to dredging, and other changes similar to constructing and deconstructing renewable energy structures discussed above. However, oil and gas infrastructure functions as an artificial reef (Montagna et al. 2002) and fish attracting device (Hinck et al. 2004) There is likely an increase in contaminants released into the environment from accidental oil releases and other discharged waste (e.g. (Ellis et al. 2012)). An increase in oil released into the environment through oil platform operations or removals, through either through slow seeps or large spills, can impact habitat structure, community composition, and the health or density of benthic organisms (Percy 1977, Suchanek 1993, Bomkamp et al. 2004, Bik et al. 2012, Baguley et al. 2015, Beyer et al. 2016). Oil and gas exploration and operations, including the risk of a major spill, would likely have a negative impact on the habitat, but not continuously and would vary per stage.

Human communities

The impacts from oil and gas activities on fisheries can be both positive and negative. Firstly, the physical presence of oil and gas infrastructure functions as an artificial reef (Montagna et al. 2002) and fish attracting device (Hinck et al. 2004). But like wind energy structures, oil and gas infrastructures also create a fishing exclusion zone (Hall 2001, Love et al. 2006) which may reduce fishermen's access to traditional fishing grounds as a sole point source in a vast ocean while also further decreasing the fishing mortality rate. Therefore, the oil and gas infrastructure will most likely have a positive impact on fish population once it finishes construction or is decommissioned (Macreadie et al. 2011). On the other hand, oil spill incidents could be detrimental to both fish population and fishing activities. For example, Smith et al. (2011) assumed a 40% reduction in catch in the Gulf of Mexico after the Deepwater Horizon well blowout, from which the loss to the fishing industry was estimated to be $4.36 billion. The likelihood of a Deepwater Horizon sized event is not reasonably foreseeable in the Northwest Atlantic, overall, the potential impacts from oil and gas to fisheries are likely to be negative from an oil spill, but there are positive implications for recreational fisheries and general survival rates.

8.3.3.7 Prey availability

Marine ecosystems are dynamic environments that are constantly shifting in response to local and global changes in climate. The North Atlantic Oscillation contributes to decadal scale regime changes that impact primary productivity and food availability for many top predators. Though it is natural for the North Atlantic ecosystem to experience fluctuations, climate change (as noted in the separate discussion of climate change above) and overfishing additionally contribute to additional variation in prey species and these events are expected to increase in number and magnitude in the future. As the climate changes and shifts the distribution of primary prey farther to the north, nutritional stress could be more of an issue, particularly species with less dietary flexibility or that have to travel farther for food (e.g. longer migration distances to optimal habitat).

Large Whales

Large whales need to consume large quantities of prey to meet their basic energy requirements and to support population reproduction, migrations, and lactation (Klanjscek et al. 2007, Williams et al. 2013, Meyer-Gutbrod et al. 2015b, Irvine et al. 2017). North Atlantic Right Whales are specialists primarily relying upon dense aggregations of *Calanus finmarchicus* to meet energetic demands (van der Hoop et al. 2019). Climate change has already shifted *C. finmarchicus* abundance and phenology in the Gulf of Maine (Record et al. 2019a, Record et al. 2019b) and model projections suggest resource limitation will likely worsen in the future (Grieve et al. 2017). Periods of low *C. finmarchicus* abundance coincide with periods of low calving in the North Atlantic Right Whale (Meyer-Gutbrod et al. 2015a). Lactating females in particular appear to be getting less energy than expected and could contribute to low reproductive output due to an energy deficit (Fortune et al. 2013). Shifts of prey species farther north suggests longer travel between calving grounds and feeding grounds and could contribute further to nutritional stress. Other large whale species, such as humpback and minke whales, have shown greater flexibility in coping with shifting prey availability (Gavrilchuk et al. 2014, Víkingsson et al. 2014). More flexible species may be more resilient to changes in prey than those that are specialists, such as North Atlantic Right Whales and blue whales. Overall, data indicate a negative impact on large whales.

Other Protected Species

Other large whales with more specialized diets, such as blue and sei whales, are also vulnerable to changes in prey availability (Gavrilchuk et al. 2014). Lack of proper nutrition can alter investment in energetically costly activities, such as reproduction (Williams et al. 2013, Meyer-Gutbrod et al. 2015a). Sperm whales feed at a higher trophic level than many baleen whales, maintain more consistent energy stores compared to species that undertake costly seasonal migrations (Irvine et al. 2017), and there is evidence they are evolved to make use of lower quality prey than other toothed whales with higher energy requirements (Spitz et al. 2012). These last two characteristics may mean sperm whales could have some resilience to changes in prey availability and distribution but there is a lack of sufficient information on diet and health in sperm whales for more accurate predictions.

Sea turtles are also vulnerable to changes in prey availability given the long distances species travel to feed during various life stages. Resource variation can impact reproductive success of leatherback turtles (Wallace et al. 2006). Evidence suggests that the Atlantic leatherback population is less resource limited than the population in the Pacific (Wallace et al. 2006) and the different foraging strategies between these populations has been linked to reproductive success (Bailey et al. 2012). The availability of gelatinous prey is expected to increase with climate-related ecosystem changes in parts of the North Atlantic (Attrill et al. 2007), which suggests resource limitation may not be the most pressing issue for this population. Loggerheads are more of a generalist species (Thomson et al. 2012) and forage in many different types of habitats. The flexibility of a generalist diet may allow loggerheads to adjust to changes in dietary resources. However, they are susceptible to changes in growth rate with regime shifts (Bjorndal et al. 2017), suggesting there could be some physiological consequences to changes in primary productivity. Prey availability will likely have a low negative impact on other protected species.

8.3.3.8 Ship Strikes

Large Whales

All of the large whales included in this valued ecosystem component have been casualties of vessel strikes. Historically, minke whales have been impacted less than larger species followed by the humpback whale, North Atlantic Right Whale, and fin whale (in order of increasing mortality rate between 1970 and 2009 (Van Der Hoop et al. 2013)). North Atlantic Right whales in particular spend a lot of time at the surface when feeding or nursing, making them vulnerable to strikes (Baumgartner et al. 2017). Between 2003 and 2018, 42% of stranded North Atlantic Right Whales where the cause of death was determine died by vessel strike (Sharp et al. 2019). Not all whales die after a vessel strike but can experience serious injury. At least 14% of Humpback whales in the Gulf of Maine showed signs of one or more strikes and is likely an underestimate (Hill et al. 2017). Regulations to reduce ship strikes were implemented in 2008 and contributed to a decline in lethal ship strikes along the Atlantic coast of the US (Laist et al. 2014, van der Hoop et al. 2015). However, some of these regulations are not mandatory and simply shifts the threat of ship strikes to other areas (Vanderlaan and Taggart 2009) or do not account for changes in whale behavior. Fatal ship strikes have recently increased in occurrence as North Atlantic Right Whales shift north to locate their preferred prey species, *C. finmarchicus* into areas where they did not previously frequent and where mitigation measures were not yet in place (see chapter 2 and (Themelis et al. 2016, Davies and Brillant 2019, Plourde et al. 2019, Sharp et al. 2019)). Vessel strikes have a high negative impact on large whales.

Other Protected Species

There is limited information on ship strikes for other large whale species that are infrequently spotted nearshore. Ship strikes and other incidents are less likely to be reported or discovered when they occur very far offshore. Very little information is available on the size and range of these populations given the amount of time they spend far offshore and at depth. It is possible that ship strikes pose at least a threat to these species but it is impossible to tell to what extent this threat would have an impact on the population. It is unlikely to match the same threat as observed in nearshore species where vessel and whale density is higher.

Sea turtles can also be injured or killed by vessels (Denkinger et al. 2013, Barco et al. 2016, Barrios-Garrido and Montiel-Villalobos 2016), including both loggerheads and leatherbacks (Barco et al. 2016, Barrios-Garrido and Montiel-Villalobos 2016) and likely benefit from regulations that reduce vessel speeds (Hazel et al. 2007, Shimada et al. 2017). Though slower speeds do not guarantee a turtle will not get hit, it is more likely to prevent severe damage to the injured sea turtle (Work et al. 2010). A low negative impact is likely for protected species.

8.3.3.9 Harmful algal blooms

Harmful algal blooms impact all coastlines in the US and have contributed to protected species mortality, fish kills, and human health issues. There are several different species of microalgae that can form blooms and produce toxic compounds. Different species can produce several different classes of neurotoxins, including saxitoxins, domoic acid, brevetoxins, and ciguatoxins. The formation of toxic blooms is linked in part to oceanographic conditions like temperature and pH (Fu et al. 2012). Climate change is already increasing the number and magnitude of blooms and will also likely increase toxicity of some species (Johnk et al. 2008, Fu et al. 2012). This indicates a potential increase in risk for the VECs discussed here in the future. However, proving toxin exposure still has some technical limitations and it is not always possible to link exposure to cause of death.

Large Whales

Large whales are primarily exposed to the toxins from harmful algal blooms via their diet (Geraci et al. 1989, Fire et al. 2010). Larger rich copepod species like *C. finmarchicus* tend to accumulate higher levels than smaller species (Turner et al. 2000, Turner et al. 2005), posing a particular threat to the North Atlantic Right Whale (Durbin et al. 2002, Leandro et al. 2010, Doucette et al. 2012). Toxins associated with harmful algal blooms have been indicated in mortalities of humpback, minke, fin, and southern right whales (Geraci et al. 1989, Fire et al. 2010, Wilson et al. 2016, Savage 2017). Humpback whales that died in Cape Cod Bay in 1987 were exposed to a saxitoxin, a paralytic shellfish toxin, from fish likely exposed in the Gulf of St. Lawrence suggesting whales are not only susceptible to local blooms (Geraci et al. 1989). The North Atlantic Right Whale are exposed to both saxitoxin and domoic acid, often concurrently but the potential interacting effects of multiple toxins is unknown (Durbin et al. 2002, Leandro et al. 2010, Doucette et al. 2012). Other toxin classes have not been studied in baleen whales in the North Atlantic. Sublethal concerns include reproductive impacts, maternal transfer, respiration, and disruption of feeding behavior and nutritional health (Durbin et al. 2002, Brodie et al. 2006, Doucette et al. 2012, Fire and Dolah 2012). Harmful algal blooms, and their predicted increase, will likely have a negative effect on large whales.

Other Protected Species

Similar to the large whale species discussed above, other baleen and toothed whales are susceptible to the negative impacts of harmful algal blooms. Less is known about the level of exposure of sei, blue, and sperm whales in the proposed area, but they are likely susceptible to exposure similar to their counterparts in other ocean regions. Sei whales in the southern hemisphere experienced a mass mortality where toxin exposure was suspected (Häussermann et al. 2017). Blue whales showed exposure to domoic acid on the west coast of the US (Lefebvre et al. 2002). Very little is known about sperm whale exposure in the population off the east coast given their cryptic nature. However, both pygmy and dwarf sperm whales in the southeast and mid-Atlantic have been exposed to domoic acid indicating pelagic, deep-diving species are likely still at risk of exposure (Fire et al. 2009). Potential health effects are expected to be similar to those listed for large whales.

Sea turtles are also exposed to toxins from harmful algal blooms and can experience negative health impacts. Brevitoxin exposure in the southeast is the primary documented toxin concern for loggerhead populations from the east coast of the US (Jacobson et al. 2006, Walsh et al. 2010, Manire et al. 2013, Perrault et al. 2016). Ciguatoxins, saxitoxins, and domoic acid were undetectable in loggerheads tested off the south of Florida (Jacobson et al. 2006). Leatherbacks from the Atlantic are not known to be exposed to domoic acid (Harris et al. 2011) but are potentially exposed to other toxin classes. Additional information on neurotoxins in leatherbacks on the east coast is limited and more research is necessary to confirm broader exposure levels in these species. Though exposure is primarily documented outside of the proposed area, it can still impact the health of the populations present in the Northeast Region. Potential health effects of brevitoxin exposure include immunomodulation (i.e. alteration of the immune system) (Walsh et al. 2010, Perrault et al. 2016), reproductive impacts (Perrault et al. 2016), neurological symptoms (Manire et al. 2013), and death (Fauquier et al. 2013). Thus, harmful algal blooms will have a negative effect on other protected species.

Habitat

Harmful algal blooms can impact fish habitat through chemical and ecological changes in the marine environment. Toxic blooms can deplete dissolved oxygen in the water, among other chemical changes, and suffocate fish in the immediate area (Thronson and Quigg 2008). The toxins produced by harmful algal blooms are also transferred to benthic organisms (Negri et al. 2004, Kvitek et al. 2008) and can change the abundance and diversity of species present in the area for years the bloom dissipates (Olsgard 1993, Kröger et al. 2006). These ecological shifts in the benthic community could indirectly impact the health of benthic habitats. Current evidence suggests that harmful algal blooms will have a low negative effect on the habitat.

Human communities

Harmful algal blooms (HABs) have negative economic impacts on both aquaculture and wild fisheries. Shumway (1990) summarized the estimated economic losses of HABs on shellfish aquaculture around the world. Each HAB caused a loss of multiple million U.S. dollars. Crustaceans in the Northeast Region can also be affected by HABs, including lobsters and crabs (Anderson et al. 1993, Anderson 1995). Finfish activity during or after a toxic bloom could change as a result of fish kills or from fishing restrictions when species pose a threat to human health. Between 1987 and 1992, harmful algal blooms cost the commercial fishing industry tens of millions of dollars (Anderson et al. 2000, Hoagland et al. 2002)

8.3.3.10 Canadian Serious Injury and Mortality

Large Whales

Large whale entanglements and vessel strikes occur in both U.S. and Canadian waters, but there has been a notable increase in serious injuries or mortalities of right whales occurring in Canadian waters since at least 2016, if not sooner. Since 2010, there has been a documented change in right whales' prey distribution that has shifted right whales into new areas with nascent risk reduction measures that have increased documented anthropogenic mortality in Canada (see chapter 2 and Themelis et al. 2016, Davies and Brillant 2019, Plourde et al. 2019, Record et al. 2019, Sharp et al. 2019). It is impossible to confirm the country where every incident originated, but several cases had distinctive snow crab gear that was identified as Canadian or were otherwise hit by vessels in Canadian waters. Given reporting biases between species, trends in entanglements are difficult to examine, but there is some evidence that country-specific trends have shifted over the years, possibly in concert with regulatory and ecosystem changes that have shifted human activities and species' distribution (Hayes et al. 2018, Davies et al. 2019, Record et al. 2019). Figure 8.4 shows the recent increase in new reports of right whale vessel strikes and entanglements in Canada.

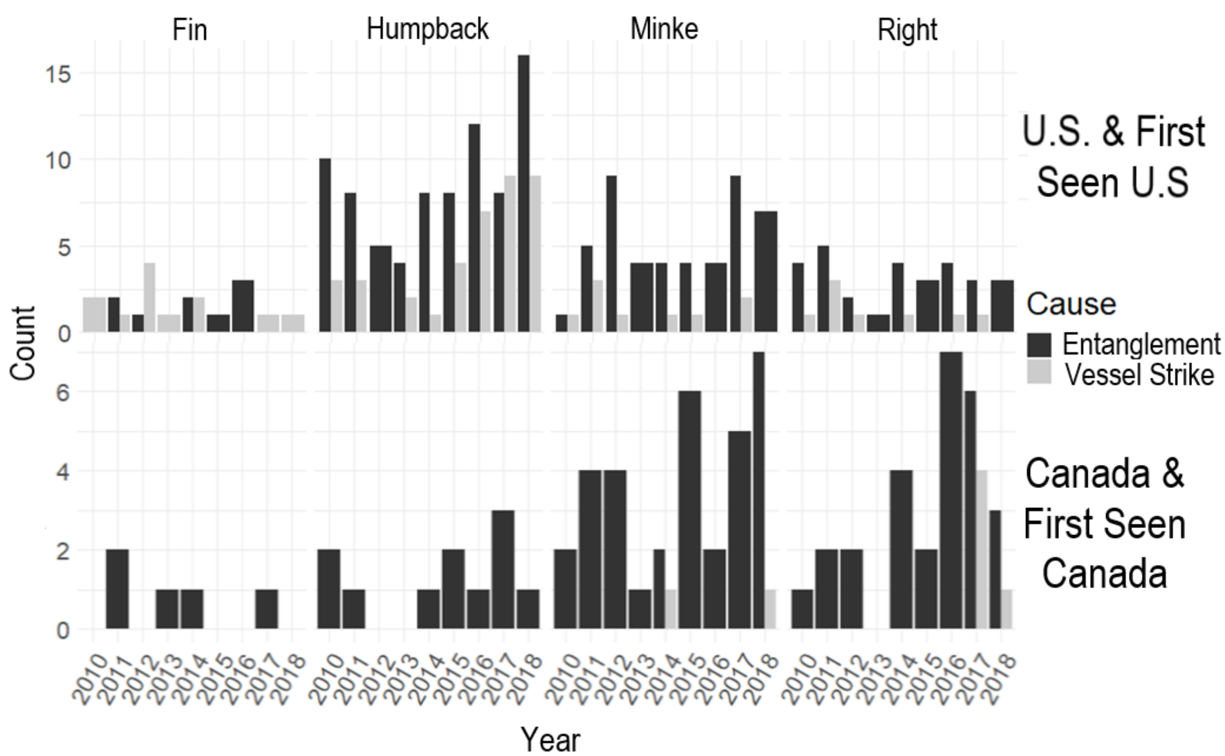

Figure 8.4: Serious injury and mortality cases (including those averted by disentanglement response or prorated injuries) caused by entanglements and vessel strikes according to the country where the incident occurred or, in the absence of that information, where the individual was first sighted.

Coast-wide, annual right whale serious injuries and mortalities caused by entanglement far exceed the PBR level for the population (0.9 whales per year) and this remains true when viewing entanglements or vessel strikes, individually, that were first seen in Canada or known to be in Canadian waters. Thus, the levels of human-induced serious injury and mortality that is occurring in both countries is unsustainable, though this proposed rule would have no effect on Canadian fisheries. Furthermore, the estimates provided here are likely underestimates given they rely on documented cases and there are additional mortalities where cause of death was not investigated or determined.

Entanglement in fishing gear can have substantial health and energetic costs that affect both survival and reproduction of right whales (Robbins et al. 2015, Pettis et al. 2017, Rolland et al. 2017, van der Hoop et al. 2017, Hayes et al. 2018a, Hunt et al. 2018, Lysiak et al. 2018), which further inhibits recovery of the species even in the absence of mortality. Similarly, not all whales die after a vessel strike, and those that survive may also be more susceptible to reproductive or energetic impacts. As described in Chapter 4 and in section 8.3.3.8, serious injuries and mortalities by ship strike in Canada and the U.S. have also been documented in recent years. During a period of lower calving rates and increased mortalities by ship strike and entanglements in Canadian waters, persistent serious injuries and mortalities of right whales above PBR in U.S. waters is not sustainable.

Human-caused serious injury and mortality of humpback, fin, and minke whales also occurs in Canadian waters, though the five-year rates of serious injuries and mortalities have remained below PBR for these stocks (Hayes et al. 2019). Exposure to additional human-induced mortality outside of U.S. waters could still impact the health of these populations and potentially the recovery of fin whales. Historically, minke whales have been impacted by vessel strikes less than larger species followed by the humpback whale, North Atlantic Right Whale, and fin whale (in order of increasing mortality rate between 1970 and 2009; Van Der Hoop et al. 2013) but have higher entanglement rates than fin whales. Overall, Canadian serious injury and mortality likely have a high negative impact on large whales. Continued bilateral discussions with Canada to identify and resolve information gaps and to support risk reduction range-wide are necessary to reduce mortalities and serious injuries and promote recovery of North Atlantic right whales and to protect other Atlantic large whales.

Other Protected Species

Canadian mortalities and serious injuries for other large whale species can occur in Canadian waters, but the threat likely differs between species. Blue whales are present in the Gulf of Saint Lawrence and are at risk of entanglement and vessel collision (Bauchamp et al. 2009), but it is unknown whether Canadian mortality is a primary concern. Three of 14 sperm whale strandings between 2008 and 2014 were documented in Canadian pelagic longline or trap/pot fisheries. Sei whales do spend time in Canadian waters, but there were no confirmed mortalities that occurred with in Canadian waters in recent years (Hayes et al. 2019). There was only one documented human-caused mortality of a Sei whale in Canadian fishing gear between 2000 and 2018 (NMFS large whale data). During this time frame, eight more died of unknown causes in Canadian waters, one where country of origin was undetermined. Thus, injury and mortality in Canadian waters are likely, whether from entanglements, ship strikes, or other causes. The level sustained outside of U.S waters may or may not be a threat to these species, with the potential exception of blue whales. It is unlikely to match the same threat observed in nearshore large whale species where whale density is higher, particularly right whales.

Loggerhead and leatherback sea turtles can also be injured or killed by vessels (Denkinger et al. 2013, Barco et al. 2016, Barrios-Garrido and Montiel-Villalobos 2016) and entanglements in a variety of fishing gear, including pots, gillnets, pelagic longlines, trawls, pound nets, and scallop dredges (NMFS and USFWS 2008). Sea turtles do not spend as much time in Canadian waters, but when they do, it is during summer when fisheries are active. However, Canadian waters likely do not pose the greatest threat to these species. Thus, Canadian mortality is likely a low negative for other protected species.

8.4 Direct and Indirect Impacts

The direct and indirect impacts of the alternatives were covered in chapters five through eight and are summarized in table 8.6

Table 8.6: The direct and indirect impacts of the alternatives on the four VECs relative to Alternative One

Alternatives	***Large Whales***	***Other Protected Species***	***Habitat***	***Human Communities***
Risk Reduction				
Alternative 1 (No Action)	**High Negative** – Serious injury and mortality would continue to occur and impact population health	**Negative** – Injury and mortality would continue to harm protected species	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact	**Mixed –** Positive in that there are no new impacts or costs to harvesters and markets but the lack of recovery of whale species has a low negative impact on public welfare benefits due to whale population declines.
Alternative 2 (Preferred)	**Positive** – Would reduce right whale co-occurrence by 69%	**Positive** – Would reduce likelihood of entanglement via 19% reduction in buoy lines	**Negligible to low negative** – Trawling up to trawls above 15 traps per trawl may have a short-term impact	**Low negative –** Fisheries would experience extra costs and catch reduction in the short term.
Alternative 3 (Non-preferred)	**High Positive** – Would reduce right whale co-occurrence by 83-88%	**High Positive** – Would reduce likelihood of entanglement via 50% reduction in buoy lines	**Negligible to low negative** – Areas with trawls above 15 traps per trawl may have a short-term impact	**Negative –** Costs of gear modifications and catch reduction would be significant.
Gear Marking				
Alternative 1 (No Action)	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Alternative 2 (Preferred)	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Alternative 3 (Non-preferred)	**Negligible**	**Negligible**	**Negligible**	**Negligible**

8.5 Cumulative Impacts of Alternatives

Table 8.7: A summary of the final cumulative impacts analysis on all four VECs

Alternatives	Direct and Indirect Impacts	Existing Conditions	Fishing Management Actions	Non-fishery Management Actions	Non-Management Actions	Cumulative Impacts
Alternative 1 No Action Alternative	**Low to high negative** – Impacts to habitat and human communities would remain low or mixed but negative to high negative for large whales and other protected species	**Negative** – Several protected species are still listed as endangered or threatened. Habitats have experienced degradation from human activities and are shifting as a result climate change. Commercial fisheries are also shifting as a result of climate change.	**Negative –** Fisheries negatively impact protected species, though some management actions may have mitigated the risk. Overall, fisheries management positively impacts human communities, though certain management actions may have had a short term negative effect.	**Low Positive –** Non-fishery management actions likely improved ocean quality, which benefitted protected species, habitat, and (fisheries). Low Positive – reduced gear encounters through effort reductions and management actions taken under the ESA/MMPA should also help mitigate the risk of gear interactions	**Negative –** Anthropogenic and natural stressors have had negative impacts on the VECs and likely will continue to do so in the future.	**High Negative –** Large whales and other protected species would continue to decline as a result of fishing activity.
Alternative 2 60% risk reduction across entire area	**Low Negative to Negative** – Would reduce entanglement risk by approximately for protected species. However negative risk will not be entirely eliminated by the proposed action.					**Low Positive** – Low Positive – Continued catch and effort controls, is likely to reduce gear encounters through effort reductions. Additional management actions taken under ESA/MMPA should also help mitigate the risk of gear interactions
Alternative 3 Weak rope, line reduction, & restricted areas	**Low Negative** – Would substantially reduce entanglement risk for protected species. However negative risk will not be entirely eliminated by the proposed action.					**Low Positive –** Continued catch and effort controls, is likely to reduce gear encounters through effort reductions. Additional management actions taken under ESA/MMPA should also help mitigate the risk of gear interactions.

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9 REGULATORY IMPACT REVIEW & INITIAL REGULATORY FLEXIBILITY ANALYSIS

9.1 Introduction

Actions taken to amend fisheries management plans or implement other regulations governing U.S. fisheries are subject to the requirements of several Federal laws and executive orders, including conducting a Regulatory Impact Review (RIR) and an Initial Regulatory Flexibility Analysis (IRFA). An RIR evaluates the costs and benefits of modifications to the Atlantic Large Whale Take Reduction Plan (Plan) that the National Marine Fisheries Service (NMFS) is considering. This includes the justifications for modifications, a cost benefit analysis of the alternatives, and the potential social impacts of the proposed rule. The Regulatory Flexibility Act (RFA) requires Federal regulatory agencies to develop an Initial Regulatory Flexibility Analysis (IRFA) and a Final Regulatory Flexibility Analysis (FRFA) to evaluate the impact that the regulatory alternatives would have on small entities and examine ways to minimize these impacts. Although the RFA does not require that the alternative with the least impact on small entities be selected, it does require that the expected impacts be adequately characterized. This chapter includes both the RIR and IRFA of the proposed modifications to the Plan.

9.2 Objectives and Legal Basis of Proposed Rules

The revisions to the Plan that NMFS is considering are designed to improve the effectiveness of commercial fishing regulations implemented to conserve and protect two endangered species – north Atlantic right whales (*Eubalaena glacialis*) and fin whales (*Balaenoptera physalus*) – thereby fulfilling NMFS' obligations under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). The need for the proposed revisions is demonstrated by the continuing risk of serious injury and mortality of Atlantic large whales due to entanglement in commercial fishing gear (see Chapter Two for a detailed analysis).

The MMPA of 1972 provides protection for species or stocks that are, or may be, in danger of extinction or depletion as a result of human activity. The MMPA states that measures should be taken immediately to replenish the population of any marine mammal species or stock that has diminished below its optimum sustainable level. With respect to any stock or species, the "optimum sustainable population" is the number of animals that will result in the maximum productivity of the stock or species, taking into account the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element.

Under the MMPA, the Secretary of Commerce is responsible for the conservation and management of pinnipeds (other than walruses) and cetaceans (including whales). The Secretary of Commerce has delegated MMPA authority to NMFS.

In 1994, Congress amended the MMPA, establishing new provisions to govern the incidental taking of marine mammals in commercial fishing operations. These new provisionsinclude the preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction and development and implementation of take reduction plans for stocks that are reduced or remaining below their optimum sustainable population due to commercial fisheries interactions.

Take reduction plans are required for all "strategic stocks." Under the MMPA, a "strategic stock" is a stock: (1) for which the level of direct human-caused mortality exceeds the Potential Biological Removal (PBR) level; (2) that is declining and is likely to be listed under the ESA in the foreseeable future; or (3) that is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA. The immediate goal of a take reduction plan is to reduce the serious injury and mortality of strategic stocks being taken during U.S. commercial fishing operations to below PBR levels within six months of its implementation. The long-term goal of a take reduction plan is to reduce, within five years of its implementation, the incidental mortality and serious injury of strategic marine mammals taken in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans.

Right and fin whales are listed as endangered species under the ESA and are considered strategic stocks under the MMPA. Pursuant to its obligations under the MMPA, NMFS in 1996 established the Atlantic Large Whale Take Reduction Team (Team), an advisory group empaneled to develop recommendations for reducing the incidental take of large whales in commercial fisheries along the Atlantic Coast. The Team includes representatives of the fishing industry, state and Federal resource management agencies, the scientific community, and conservation organizations. The purpose of the Team is to provide guidance to NMFS in developing and amending the Plan to meet the goals of the MMPA with respect to Atlantic large whales.

In addition to the MMPA, the ESA provides a legal foundation for measures to protect right and fin whales. The ESA provides for the conservation of species that are in danger of extinction throughout all or a significant portion of their range in addition to the conservation of the ecosystems on which these species depend. North Atlantic right whales and fin whales stocks in the Northeast Region are federally listed as endangered and are therefore subject to protection under the ESA.

Section 7 of the ESA directs all Federal agencies to use their existing authorities to conserve threatened and endangered species and to ensure that their actions do not jeopardize listed species or adversely modify the critical habitat of those species. When a proposed Federal action may affect an ESA-listed marine species, Section 7 directs that the "Action agency" consult with the Secretary of Commerce; this is referred to as a Section 7 consultation.

Many of the trap/pot and gillnet fisheries regulated under the Atlantic Large Whale Take Reduction Plan are also regulated under Federal authorizations and rulemaking that undergoes review under the ESA Section 7 requirements. If it is determined through the section 7 process that a Federally permitted fishery (or fisheries) is likely to adversely affect listed species and/or critical habitat, then a formal consultation is initiated to determine whether the proposed action is likely to jeopardize the continued existence of a listed species and/or destroy or adversely modify critical habitat. Formal consultation concludes with the issuance of a NOAA Fisheries Biological Opinion (Opinion).

To assess impacts on large whale and sea turtle species protected under the ESA, NMFS has prepared Biological Opinions for the continued authorization of Federal fisheries under Federal regulations for the deep-sea red crab and lobster fishery, amongst others as well as consultations on rulemakings to modify the Atlantic Large Whale Take Reduction Plan. Section 7 consultations were first initiated for each of these fisheries either at the time the FMP was developed or, in the case of lobster, when a significant amendment (Amendment Five) to the Interstate Fishery Management Plan (FMP) for American Lobster (Lobster FMP) was under consideration. Formal consultation was first initiated for lobster on March 23, 1994. Subsequent ESA Section 7 consultations on those fisheries incorporated ALWTRP measures as a Reasonable and Prudent Alternative (RPA) to avoid jeopardy to right whales. NMFS reinitiated consultation on June 22, 2000 for the lobster fishery following new whale entanglements resulting in serious injuries to right whales, new information indicating a declining status for north Atlantic right whales, and revisions to the Plan.

The Biological Opinions from the 2000 Section 7 consultations, finalized June 14, 2001, found that NMFS' authorization of these Federal fisheries, as modified by the Plan requirements in effect at that time, was likely to jeopardize the continued existence of the western North Atlantic right whale. The Biological Opinions identified a set of RPAs designed to avoid the likelihood of jeopardy to right whales. These measures included:

- Seasonal Area Management (SAM);
- Dynamic Area Management (DAM);
- An expansion of gillnet gear modification requirements and restrictions to Mid-Atlantic waters and modification of fishing practices in Southeastern waters;
- Continued gear research and modifications; and
- Additional measures that implement and monitor the effectiveness of the RPAs.
- These measures were intended, in combination, to reduce the risk of serious injury or mortality of large whales from entanglements in commercial fishing gear, and to minimize adverse impacts if entanglements occur.

Following implementation of the measures described above, entanglements leading to serious injury or death of protected whales, including the North Atlantic right whale, continued to occur. Accordingly, NMFS reinitiated consultation on the continued authorization of a number of fisheries and began to develop modifications to the Plan. At its 2003 meeting, the Team agreed to manage entanglement risks by focusing first on reducing the risk associated with groundlines, then reducing the risk associated with vertical lines. In October 2007, NMFS issued a final rule that replaced the SAM and DAM programs with broad-based gear modification requirements, including the use of sinking groundline; expanded weak link requirements; additional gear marking requirements; changes in boundaries; seasonal restrictions for gear modifications; expanded exempted areas; and changes in regulatory language for the purposes of clarification and consistency (72 FR 57104, October 5, 2007). The broad-based sinking groundline requirement became fully effective on April 5, 2009. This final rule also incorporated an amendment to the ALWTRP (72 FR 34632, June 25, 2007) that implemented, with revisions, previous ALWTRP regulations by expanding the Southeast U.S. Restricted Area to include waters within 35 nm (64.82 km) of the South Carolina coast, dividing the Southeast U.S.

Restricted Area into Southeast U.S. Restricted Areas North and South, and modified regulations pertaining to gillnetting within the Southeast U.S. Restricted Area.

Following implementation of these measures, NMFS and the Team turned their collective focus to vertical line risk reduction. At the 2009 ALWTRT meeting, the Team agreed on a schedule to develop a management approach to reduce the risk of serious injury and mortality due to vertical lines. As a result of this schedule, NMFS committed to publishing a final rule to address vertical line entanglement by 2014. NMFS also reinitiated consultation on continued authorization of FMPs for a number of trap/pot fisheries (American lobster, scup, and Northern black sea bass). These consultations concluded in October 2010. After identifying the steps being taken by NMFS to develop, analyze and implement a vertical line reduction rule, the agency concluded new consultation and issued the resulting Biological Opinions in 2013 (scup and black sea bass) and 2014 (Lobster), that concluded that continued operation of the fisheries noted above would be likely to adversely affect, but not jeopardize, the continued existence of right, humpback, and fin whales.The Opinion on the lobster fishery concluded that the continued operation of the American lobster fishery may adversely affect, but would not jeopardize the continued existence of, North Atlantic right whales, fin whales, and sei whales; or loggerhead (northwest Atlantic distinct population segment) and leatherback sea turtles. The Opinion also concluded that the continued operation of the American lobster fishery would not destroy or adversely modify designated critical habitat for North Atlantic right whales or loggerhead sea turtles. An incidental take statement for loggerhead and leatherback sea turtles was issued along with the Opinion exempting a level of annual take for the Lobster FMP. Reasonable and Prudent Measures and accompanying Terms and Conditions to minimize the impacts of incidental take were also provided in the ITS.

The confirmation that the North Atlantic right whale population had been in decline since 2010 (Pace et al. 2017) and the mortality of 17 right whales in 2017, including many whales showing signs of shipstrike and entanglement, caused NMFS to declare an Unusual Mortality Event, which continues through 2020. Although most of the mortalities occurred in the Gulf of St. Lawrence, three mortalities first seen in U.S. waters exhibited signs of entanglement. As a result of evidence of a declining population exacerbated by 2017's high mortalities, in 2018, NMFS reconvened the Atlantic Large Whale Take Reduction Team to further reduce the risk of large whale entanglement in vertical lines. As discussed in Section 2.1.3, over 95% of vertical lines fished along the U.S. East Coast in waters not exempt from Plan requirements are fished by the lobster trap/pot fishery, 93% within the Northeast Management Area. For this reason NMFS focused the scope of the proposed Plan Modifications on developing recommendations for the Northeast lobster and crab trap/pot fisheries. In addition to reconvening the ALWTRT because new information about the right whale population is different from that considered and analyzed in Section 7 Biological Opinions, per an October 17, 2017, ESA 7(a)(2)/7(d) memo issued by NMFS, consultation has been reinitiated on the federal permitted Atlantic deep sea red crab and American lobster fisheries as well as other fisheries that use fixed gillnet and trap/pot gear. Consultation on these fisheries/FMPs is currently in progress. The conclusion of the reinitiated consultation (a biological opinion) is anticipated prior to publication of the Final Rule implementing modifications to the Plan.

Note that in January and February of 2018, four environmental organizations filed two lawsuits in the U.S. District Court for the District of Columbia alleging violations of the ESA and the Marine Mammal Protection Act, and the two lawsuits were consolidated into a single case. On April 9, 2020, the Court ruled against NMFS on the parties' cross motions for summary judgment, finding that the 2014 Biological Opinion on the lobster fishery was legally deficient. On August 19, 2020, the Court issued an order on remedy that vacated the 2014 Biological Opinion, but stayed the vacatur until May 31, 2021, by which date NMFS anticipates issuing a new final Biological Opinion concluding the consultation that was initiated in 2017 for the federal American lobster fishery and other federal fisheries.

9.3 Problem Addressed by Plan

Right and fin whales are listed as endangered species under the ESA, and are thus considered strategic stocks under the MMPA. Until recently, humback whales were also listed as endangered. While no longer a strategic stock, they are caught in Category One and Two fisheries and considered in the Plan. The measures that the ALWTRP requires focus on the conservation of these species, and also benefit minke whales. The current status of these species is summarized below:

- **Right Whale**: The western North Atlantic right whale (*Eubalaena glacialis*) is one of the rarest of all large cetaceans and among the most endangered species in the world. The most recent stock assessment report published by NMFS estimates a minimum population size of 412 at the end of 2016. Pettis et al. (2020) gives an estimate of 409 at the end of 2018. Since the end of 2018 there have been ten documented mortalities and 17 births including a calf that was struck by a vessel and likely did not survive. NMFS believes that the stock is well below the optimum sustainable population, especially given apparent declines in the population; as such, the stock's PBR level has been set to 0.9 (Pace et al. 2017, Hayes et al. 2019, Pettis et al. 2020).

- **Humpback Whale**: As noted above, the North Atlantic humpback whale (*Megaptera novaeangliae*) is no longer listed as an endangered species under the ESA but is still protected under the MMPA. For the Gulf of Maine stock of humpback whales, the best and minimum population size is 896 at the end of 2016, and has established a PBR level of 14.6 whales per year (Hayes et al. 2019).

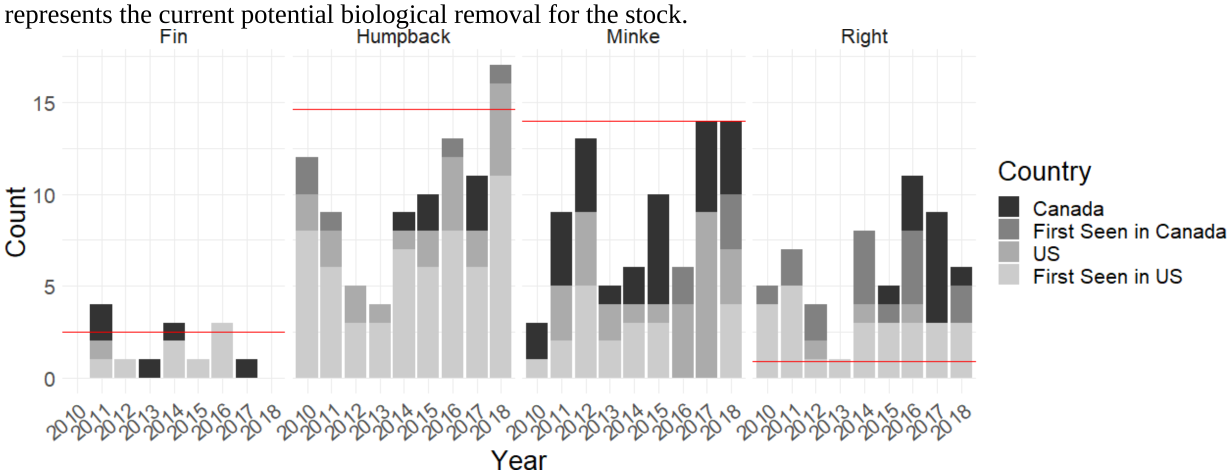
- **Fin Whale**: NMFS has designated one population of fin whale (*Balaenoptera physalus*) as endangered for U.S. waters of the North Atlantic, although researchers debate the possibility of several distinct subpopulations. NMFS estimates a best population size of 1,618 at the end of 2016, a minimum population size of 1,234, and PBR of 2.5 (Hayes et al. 2019)

- **Minke Whale**: As previously noted, the minke whale (*Balaenoptera acutorostrata*) is not listed as endangered or threatened under the ESA. The best estimate of the population of Canadian east coast minke whales is 2,591 at the end of 2016, with a minimum population estimate of 1,425 and PBR of 14 (Hayes et al. 2019).

Atlantic large whales are at risk of becoming entangled in fishing gear because the whales feed, travel, and breed in many of the same ocean areas utilized for commercial fishing. Fishermen typically leave fishing gear such as gillnets and traps/pots in the water for a discrete period, after which time the nets/traps/pots are hauled and their catch retrieved. While the gear is in the water, whales may become entangled in the lines and nets that comprise trap/pot and gillnet fishing gear. The effects of entanglement can range from no permanent injury to death.

A scarification analysis conducted by the New England Aquarium (Knowlton et al. 2012) found that juvenile right whales are entangled with greater frequency than adults. Juvenile animals may not have sufficient strength to break free from entangling lines, which can lead to serious injury and infection resulting from the animal "growing into" the lines.

Figure 9.1: Serious injury and mortality cases (including those with prorated injuries and right whales where serious injury was averted by disentanglement response) caused by entanglements according to the country. The red line represents the current potential biological removal for the stock.



A study of right whale and humpback whale entanglements (Johnson et al. 2005) found that in cases where the point of gear attachment was known, right whale entanglements frequently (77.4 percent; 24 of 31 entanglement events) involved the mouth, which may indicate that many entanglements occur while whales are feeding. The study also found that humpback whales are more commonly reported with entanglements in the tail region (53.0 percent; 16 of 30 entanglement events), in cases where the point of attachment was known. The number of entanglements for which gear type can be identified is too small to detect any trends in the type of gear involved in lethal entanglements. Trap/pot and gillnet gear, however, seem to be the most common, as in 89 percent of the cases the gear was identified as or consistent with trap/pot or gillnet gear (Johnson et al. 2005). The study confirmed that vertical lines and floating groundlines posed risks for large whales but concluded that any type and part of fixed gear is capable of entangling a whale and several body parts of the whale can be involved.

Figure 9.1 summarizes all known serious injury and mortalities due to entanglement of right, humpback, fin, and minke whales from 2010 through 2018, the most recent year that data is available for all species. Humpback whales account for the greatest number of serious injury and mortalities (90), followed by minke whales (80), right whales (56), and fin whales (14).

9.4 Affected Fisheries

As required by the MMPA, NMFS maintains a List of Fisheries that places each commercial fishery into one of three categories. Fisheries are categorized according to the level of serious injury and mortality of marine mammals that occurs incidental to that fishery. The categorization of a fishery in the List of Fisheries determines whether participants in that fishery are subject to certain provisions of the MMPA such as registration, observer coverage, and take reduction plan requirements. Individuals fishing in Category I or II fisheries must comply with requirements of any applicable take reduction plan.

Category I fisheries are associated with frequent incidental mortality and serious injury of marine mammals. These fisheries have a serious injury/mortality rate of 50 percent or more of a stock's potential biological removal rate. Category II fisheries are associated with occasional incidental mortality and serious injury of marine mammals, and have a serious injury/mortality rate of more than one percent but less than 50 percent of a stock's PBR. Category III fisheries rarely cause serious injury or mortality to marine mammals. Category III fisheries have a serious injury/mortality rate of one percent or less of a stock's PBR (NOAA, February 2002).

The List of Fisheries indicates which fisheries NMFS may regulate under the Plan. Specific fisheries were initially identified for inclusion under the Plan based on documented whale interactions. In 1996, NMFS announced its intention to regulate the Gulf of Maine, U.S. Mid-Atlantic lobster trap/pot fishery, U.S. Mid-Atlantic coastal gillnet fishery, New England multispecies sink-gillnet fishery, and Southeastern U.S. Atlantic shark gillnet fishery (61 FR 40819-40821).

This list has evolved since 1996, reflecting both changes in nomenclature and modification of the Plan to address additional fisheries. As previously mentioned, NMFS is focusing scope of the proposed Plan Modifications to the northeast trap/pot fisheries given these represent the vast majority of vertical lines in the region where entanglements are currently of most concern. The fisheries regulated under the Plan that will be included in this rulemaking and that are therefore considered in this analysis include northeast American lobster trap/pot fishery and the Jonah crab trap/pot fishery. Only measures that will be implemented through federal Plan amendment rulemaking are analyzed; Lobster management and state regulations are not included.

9.5 Regulatory Alternatives

NMFS has identified three regulatory alternatives for consideration. The first of these (Alternative One) is the No Action Alternative, which would make no changes to the Plan. Table 9.1 provides an overview and comparison of the two action alternatives. These alternatives propose modifications to the Plan that include some combination of the following:

- **Gear Modifications –** Both of the action alternatives include area-specific minimum trawl lengths for trap/pot fisheries in the northeast. The minimum trawl length specified varies by alternative (see below). Additional provisions set a maximum number of vertical lines allowed to be set at any one time by the trap/pot fishery.
- **Seasonal Buoy Line Closures –** Both of the action alternatives would prohibit Plan trap/pot vessels from fishing in designated areas during designated periods (see below).

Table 9.1 summarizes the key components of the proposed risk reduction alternatives that would be included in federal regulations amending the ALWTRP, arranging the requirements by lobster management area and geographic region (where appropriate).

Component	Area	Alternative Two	Alternative Three
Line	**Reduction**		
Trawl up/ Line Reduction	ME exempt area – 3 nm (5.56 km)	3 traps/trawl	-
	ME 3 (5.56 km) – 6 nm*	8 traps/trawl	Line allocations capped at 50 percent of average monthly lines in federal waters
	LMA 1, 6* – 12 nm (22.22 km)	15 traps/trawl	Same as above
	LMA 2, OCC 3 – 12 nm (5.56 – 22.22 km)	15 traps/trawl	Same as above
	LMA 1, 2 over 12 nm (22.22 km)	25 traps/trawl	Same as above
	MA State waters, all zones	No singles on vessels longer than 29’ (8.84 m) permits after 1/1/2020	-
	LMA3	Year-round: 45 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	May - August: 45 trap trawls; Year-round increase of maximum trawl length from 1.5 nm (2.78 km) to 1.75nm (3.24 km)
Seasonal Buoy Line Restricted Areas	Existing closures become closed to buoy lines	Allow trap/pot fishing without buoy lines. Will require exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would likely include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.	Allow trap/pot fishing without buoy lines. Requires exemption from fishery management regulations requiring buoys and other devices to mark the ends of the bottom fishing gear. Exemption authorizations would include conditions to protect right whales such as area restrictions, low vessel speed, observer monitoring, and reporting requirements. All restricted areas listed here would require an exemption.
	LMA1 Restricted Area, Offshore ME LMA1/3 border, zones C/D/E	Oct-Jan. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Oct – Feb. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts South Island Restricted Area	Feb-April: State of Massachusetts proposed buoy line restriction areas South of Nantucket Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)	Closed to buoy lines Feb – May: C. Large rectangular area, edited yearly D. L-shaped area Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
	Massachusetts Restricted Area	Credit for Feb-Apr, State water closed through May until no more than 3 whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA unless surveys confirm that right whales have left the area. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)

Component	Area	Alternative Two	Alternative Three
Seasonal Buoy Line Restricted Areas-cont'd	Georges Basin Restricted Area	-	Closed to buoy lines May through August. Would allow fishing without buoy lines (with appropriate authorizations for exemption from surface gear requirements)
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	Existing 18% reduction in the number of buoy lines
	LMA 3	Existing and anticipated fishery management resulting in an estimated 12% reduction in buoy lines	Existing and anticipated fishery management resulting in an estimated 12% reduction in buoy lines
Weak Line			
Weak Link Modification	Northeast Region	Retain current weak link/line requirement at surface system but allow it to be at base of surface system or, as currently required, at buoy	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system
Weak Line	ME exempt area	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exempt area – 3 nm (5.56 km)	2 weak insertions, at 25% and 50% down line	Same as above
	NH/MA/RI Coast – 3 nm (5.56 km)	1 weak insertion 50% down the line	Same as above
	All areas 3 – 12 nm (5.56 – 22.22 km)	2 weak insertions, at 25% and 50% down line	Same as above
	LMA 1, 2, OCC over 12 nm (22.22 km)	1 weak insertion 35% down the line	Same as above
	LMA 2	Same weak insertions as above based on distance from shore	Same as above
	LMA 3	One buoy line weak year round to 75%	One weak line to 75% year round OR
	LMA 3	Same as above	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" to 20%

- **Weak Line –** Both of the action alternatives convert a portion of line to "weak rope", whether by using full weak line or weak inserts into the line at a particular distance from the top.
- **Gear Marking –** Each of the action alternatives includes revised gear marking requirements for vessels subject to the Plan. All trap/pot vessels in the northeast will be required to have state specific markings on their vertical line. The proposed gear marking scheme expands the use of three 12-inch marks per vertical line in currently exemptwaters of New Hampshire and Maine. It further requires an additional three foot mark representing the state of origin near the buoy and an additional color representative of all northeast trap/pot fisheries. Alternative Three would further require the addition of identification tape woven through the core of the line.

As noted, some of the alternatives under consideration would introduce the seasonal closure of designated areas to trap/pot buoy lines. Table 9.2 summarizes the basic parameters of each closure, while Figures 9.2 and 9.3 presents a series of maps illustrating the location of the areas in which fishing would be restricted. The objective of these provisions is to reduce the concentration of fishing gear when whales are likely to congregate in the areas designated for a restricted area, thus reducing the risk of entanglement. Chapter 3 provides additional detail on the rationale for each restricted area.

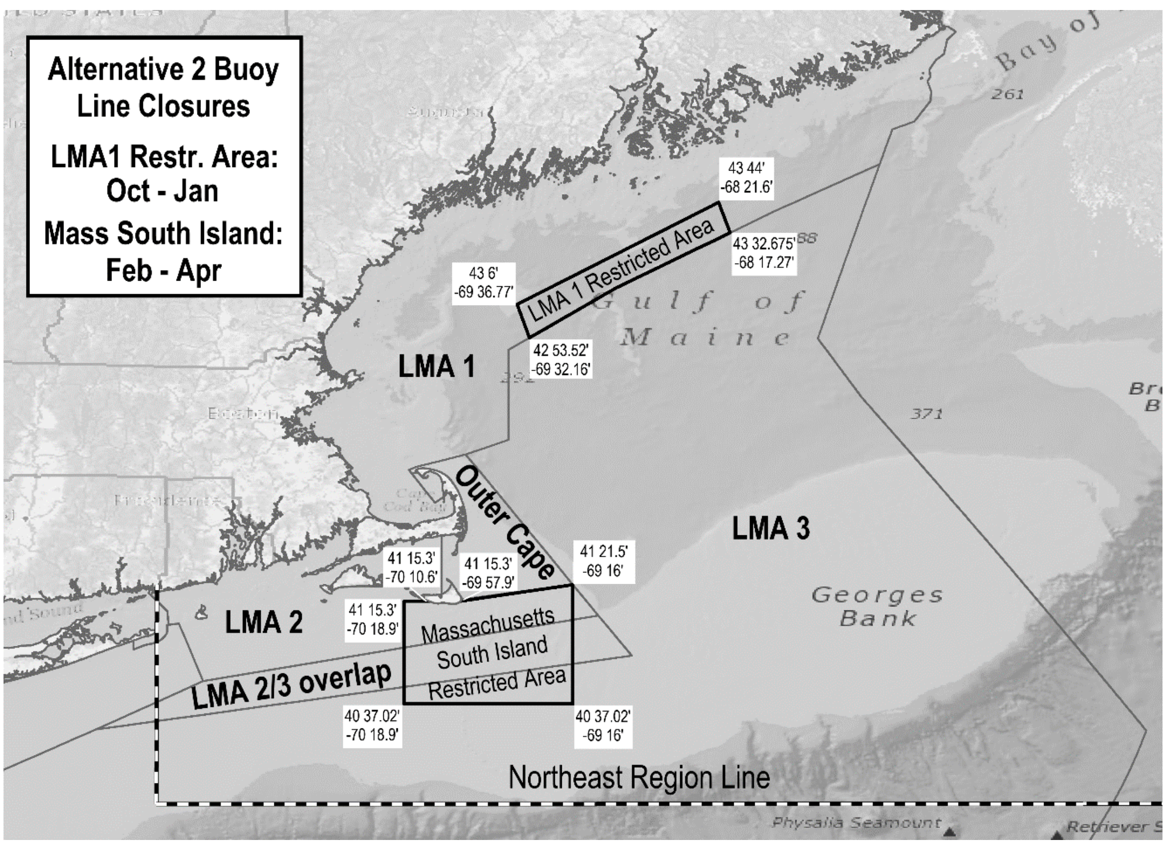


Figure 9.2: The restricted areas proposed in Alternative Two (Preferred). The Cape Cod Bay and Outer Cape State Water areas represent soft openings of the Massachusetts Restricted Area where persistent buoy lines will not be allowed until no more than three whales are left or surveys are no longer feasible. The Massachusetts South Island Restricted Area is proposed from February through April and the LMA1 Restricted Area is proposed from October through January.

Table 9.2: The length and size of the proposed restricted areas included in both alternatives.

Restricted Area	Alternative	Time Period	Size (km^2)
Offshore Maine	2	October - January	**2,504**
Offshore Maine	3a & b	October - February	**2,504**
Georges Basin Core Area	3a & b	May - August	**1,443**
Cape Cod Bay	2	May, until only 3 whales remain	**1,720**
Outer Cape State Waters	2	May, until only 3 whales remain	**673**
Massachusetts Restricted Area	3	May, possible early open	**5,597**
Massachusetts South Island Restricted Area	2	February - April	**6,592**
Large South Island Restricted Area	3a	February - April	**14,162**
L-shaped South Island Restricted Area	3b	February - April	**9,080**

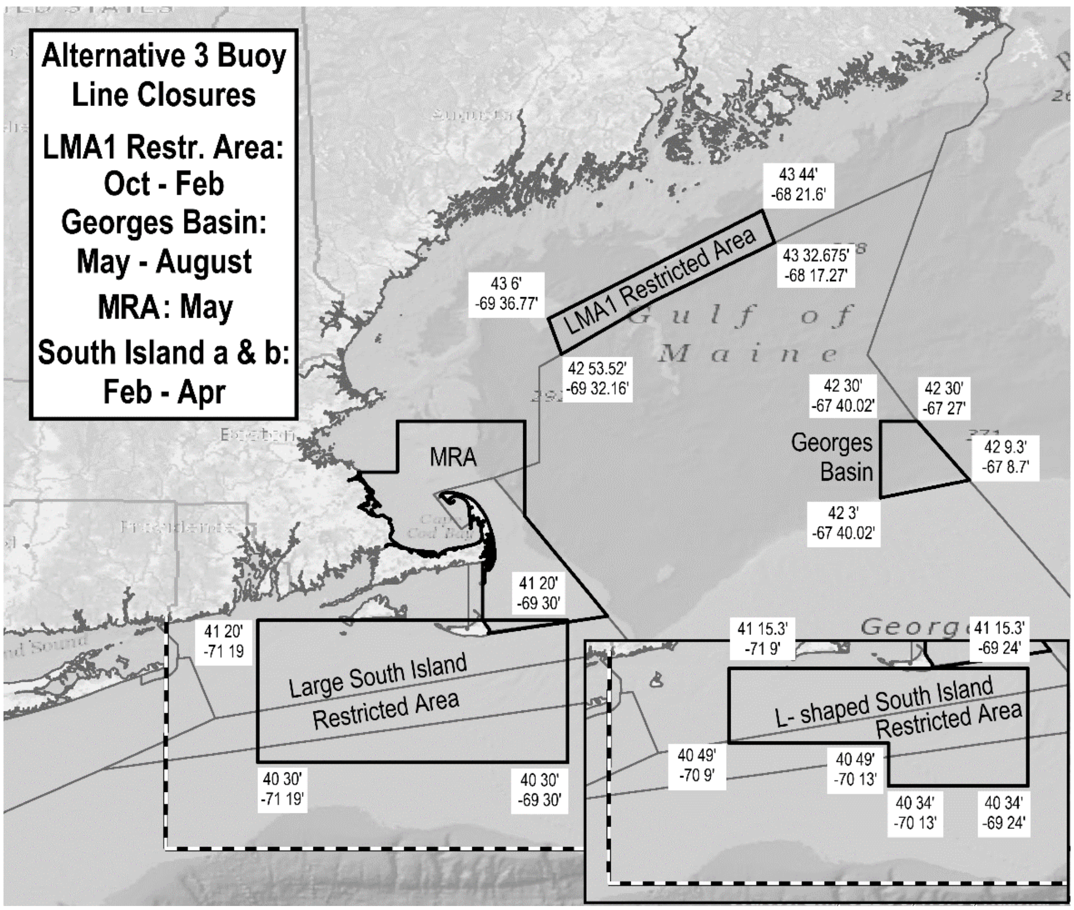


Figure 9.3: The restricted area options proposed in Alternative Three (Non-preferred). There are two different options for a restricted area south of Cape Cod from February through April, a large restricted area (3a) and an L-shaped restricted area (3b). The LMA1 Restricted Area is proposed from October through February. The Georges Basin Core area is proposed from May through August. An extension of the Massachusetts Restricted Area through May, with a potential opening if whales are no longer present, is also included.

9.6 Regulatory Impact Review

9.6.1 Economic Analysis of Alternatives

Benefit-Cost Framework

Benefit-cost analysis (BCA) is the preferred method for analyzing the consequences of a regulatory action such as modifying the requirements of the ALWTRP. BCA is a well-established procedure for assessing the "best" course or scale of action, where "best" is that course which maximizes net benefits (i.e., benefits minus costs). Because BCA assesses the value of an activity in net benefit terms, it requires that a single metric, most commonly dollars, be used to gauge both benefits and costs. The data and economic models necessary to estimate costs may be difficult or costly to gather and develop, and a comprehensive analysis of the costs associated with a regulatory action is not always feasible. Nonetheless, the principle is straightforward, and it is generally possible in practice to develop a monetary estimate of at least some portion of regulatory costs. This is the case for costs stemming from changes to the ALWTRP, which would impose additional restrictions on commercial fishing operations.

Assessing the benefits of changes to the ALWTRP in a BCA framework is also straightforward in principle but much more difficult in practice. To the extent that new regulations would reduce the risk that whales will suffer serious injury or mortality as a result of entanglement in commercial fishing gear, they would produce real benefits. Ideally, these benefits would be measured first by a biological metric, and then by a dollar metric. A biological metric could take the form of the percentage of risk reduction, the associated expected decrease in extinction risk, increase in the annual growth of the population, or similar measures. A BCA would then value these quantified biological benefits in terms of willingness-to-pay, the standard economic measure of economic value recommended by the Office of Management and Budget (OMB 2003). This would produce a dollar estimate of the benefits of the change in regulations, which could then be compared directly to the costs. In the case of the ALWTRP, however, the data required to complete such an analysis are not available. Estimation of the economic benefits attributable to each of the regulatory alternatives that NMFS is considering would require a more detailed understanding of the biological impacts of each measure than current models can provide. It also would require more extensive research than economists have conducted to date on the relationship between conservation and restoration of these species and associated economic values.

In the absence of the information required to conduct a full BCA, the discussion that follows presents qualitative information on the benefits that may stem from improved protection of endangered whales, coupled with a quantitative indicator of the potential impact of each alternative. It then presents estimates of the costs attributable to each alternative. As discussed later in this chapter, the analysis uses this information to evaluate the cost-effectiveness of the regulatory alternatives under consideration. Because the alternatives vary with respect to the benefits they would achieve, it is not possible to identify a superior option based on cost-effectiveness alone. Nonetheless, the cost-effectiveness figures provide a useful means of comparing the relative impacts of the regulatory provisions that each alternative incorporates.

Benefits of Large Whale Protection

Since the suspension of commercial whaling in the U.S., there has been no conventional market for the consumptive use of products derived from whales. While it is difficult to establish the full value of reducing risks to large whales, whale protection and associated increases in whale populations can be described in terms of two types of benefits: (1) non- consumptive use benefits; and (2) non-use benefits.

Non-Consumptive Use Benefits

A variety of recreational activities involve the non-consumptive use of natural resources, either in a market or non-market context. The opportunity to enjoy one such activity, whale watching, has fostered the development of the commercial whale watching industry. Although current data on the industry are lacking, a study by Hoyt (2000) suggests that roughly half of all commercial whale watching worldwide occurs in the U.S., and that much of this activity is centered in New England. As shown in Table 9.3, the Hoyt study identified 36 whale watching businesses in New England, with most operating multiple vessels. Hoyt estimated that over one million individuals each year take whale watching tours in the region, generating over $30 million in annual revenue for the industry. Because these figures only apply to permitted and registered operations, the full scale and economic impact of whale watching activity is likely to be greater.

Table 9.3: New England Whale Watching Industry

State	Number of Operations	Number of Vessels	Annual Ridership	Annual Revenue (millions $)
Maine	14	18-24	137,500	$4.4
New Hampshire	4	6-10	80,000	$1.9
Massachusetts	17	30-35	1,000,000	$24.0
Rhode Island	1	1	12,500	$0.3
TOTAL	**36**	**55-70**	**1,230,000**	**$30.6**

Source: Hoyt 2000

A special report from the International Fund for Animal Welfare (O’Connor et al. 2009) pointed out that whale watchers in the New England area decreased by 3% per year from 1998 to 2008 (Table 9.4). This negative annual growth rate was very likely in relation to poor numbers of whale sightings. The Stellwagen Bank National Marine Sanctuary Draft Management Plan quotes various reports suggesting a decline of one of the main food sources for fin and humpback whales was causing the decline in whale sightings. Several studies have linked whale sightings to concentrations of a small, semi-pelagic fish called sand lance (NOAA 2008). Although the number of whale watch operators and passengers decreased from 1998 to 2008, average passenger fees increased from $25 to $38 resulting in an increase of 14% in direct sales to whale watch operators and an increase of 17% in sales in the economy.

Table 9.4: Change in the Number of Whale Watchers and Expenditures (Gross Sales) from 1998 to 2008 in New England

Year	Number of Whale Watchers	Number of Operators	Direct Expenditure	Indirect Expenditure	Total Expenditure
1998	1,240,000	36	$30,600,000	$76,650,000	$107,250,000
2008	910,071	31	$35,000,000	$91,000,000	$126,000,000

It is not feasible at present to estimate the impact of potential modifications to the Plan on the values in the whale watching market. Estimation of these impacts would require the ability to forecast the impact of various management measures on the population of whales, coupled with a far more detailed understanding of the relationship between an increase in this population and demand for viewing opportunities. Given the level of activity in the industry, however, it is reasonable to assume that the benefits associated with additional opportunities to see, photograph, and otherwise experience whales in their natural environment could be substantial.

Non-Use Benefits

The protection and restoration of populations of endangered whales may also generate non-use benefits. Economic research has demonstrated that society places economic value on (relatively) unique environmental assets, whether or not those assets are ever directly exploited. For example, society places real (and potentially measurable) economic value on simply knowing that large whale populations are flourishing in their natural environment (often referred to as "existence value") and will be preserved for the enjoyment of future generations. Using survey research methods, economists have developed several studies of non-use values associated with protection of whales or other marine mammals. Table 9.5 summarizes these studies. In each, researchers surveyed individuals on their willingness to pay (WTP) for programs that would maintain or increase marine mammal populations. The most recent of the studies (Wallmo and Lew 2012) employed a stated preference method to estimate the value of recovering or down-listing eight ESA-listed marine species, including the North Atlantic right whale. Through a survey of 8,476 households, the authors estimated an average WTP (per household per year, for a 10-year period) of $71.62 for full recovery of the species and $38.79 for recovery sufficient to down-list the species from "endangered" to "threatened." While the other studies noted do not focus specifically on the North Atlantic populations of right, humpback, fin, or minke whales, they do demonstrate that individuals derive significant economic value from the protection of marine mammals.

9.6.2 Relative Ranking of Alternatives

As noted above, it is not feasible at present to estimate the economic benefits attributable to each of the regulatory alternatives that NMFS is considering. It is possible, however, to develop a relative ranking of the alternatives with respect to potential benefits, based on the estimated impact of each alternative on the potential for whales to become entangled in commercial fishing gear.

The biological impacts analysis presented in Chapter 5 relies primarily on NMFS' Vertical Line

Model to examine how the regulatory alternatives might reduce the possibility of interactions between whales and fishing gear. As discussed in that chapter, the model integrates information on fishing activity, gear configurations, and whale sightings to provide indicators of the potential for entanglements to occur at various locations and at different points in time. The fundamental measure of entanglement potential is co-occurrence. The co-occurrence value estimated in the model is an index figure, integrated across the spatial grid, indicating the degree to which whales and the vertical line employed northeast trap/pot fisheries coincide in the waters subject to the ALWTRP. Biological impacts are characterized with respect to the percentage reduction in the overall co-occurrence indicator each alternative would achieve.

Table 9.5: Studies of Non-Use Value Associated with Marine Mammals

Author	Title	Findings
Lew (2015)	Willingness to Pay for Threatened and Endangered Marine Species: A Review of the Literature and rospects for Policy Use	Comprehensive literature review on the methods and case studies on WTP for threatened and endangered marine species.
Wallmo and Lew (2012)	Public Willingness to Pay for Recovering and Downlisting Threatened and Endangered Marine Species	Per-household mean WTP annually over 10 years for increase in North Atlantic right whale populations estimated to be $71.62 (for recovery) and $38.79 (for down-listing to threatened status) (2010 dollars).
Giraud et al. (2002)	Economic Benefit of the Protection of the Steller Sea Lion	Estimated WTP for an expanded Steller sea lion protection program. The average WTP for the entire nation amounted to roughly $61 per person.
Loomis and Larson (1994)	Total Economic Values of Increasing Gray Whale Populations: ResultsFrom a Contingent Valuation Survey of Visitors and Households	Mean WTP of U.S. households for an increase in gray whale populations estimated to be $16.18 for a 50 percent increase and $18.14 for a 100 percent increase.
Samples and Hoyller (1990)	Contingent Valuation of Wildlife Resources in the Presence of Substitutes and Complements	Respondents' average WTP (lump sum payment) to protect humpback whales in Hawaii ranged from $125 to $142 (1986 dollars).
Samples et al. (1986)	Information Disclosure and Endangered Species Valuation	Estimated individual WTP for protection of humpback whales of $39.62 per year.
Day (1985), cited in Rumage (1990)	The Economic Value of Whalewatching at Stellwagen Bank. The Resources and Uses of Stellwagen Bank	Non-use value of the presence of whales in the Massachusetts Bays system estimated to be $24 million.
Hageman (1985)	Valuing Marine Mammal Populations: Benefit Valuations in a Multi-Species Ecosystem	Per-household WTP for Gray and Blue Whales, Bottlenose Dolphins, California Sea Otters, and Northern Elephant Seals estimated to be $23.95, $17.73, $20.75, and $18.29 per year, respectively (1984 dollars).

Table 9.6 summarizes the estimated change in co-occurrence under each action alternative relative to the no-action alternative (Alternative One). Alternative Two, the preferred alternative, which includes trawling requirements, weak rope, and restricted areas, is estimated to yield a reduction in co-occurrence of approximately 69 percent. Alternative Three proposes a 50% line cap reduction, more extensive weak rope and closed areas, yielding more than 80% reduction in co-occurrence score. Although Alternative Three reaches a high reduction score, the compliance costs of large restricted areas and line reduction measures are higher compared to Alternative

Two.

Table 9.6: Annual Change in Co-Occurrence

Alternative	Percent Reduction in Co-Occurrence Score
Alternative One (No Action)	0.0 %
Alternative Two (Lines out)	69.2%
Alternative Two (Relocation)	69.1%
Alternative Three A (Lines out)	88.4%
Alternative Three A (Relocation)	86.0%
Alternative Three B (Lines out)	86.4%
Alternative Three B (Relocation)	83.8%

9.6.3 Fishing Industry Compliance Costs

The costs attributable to the introduction of new regulations on the fisheries subject to the Plan would be borne primarily by commercial fishermen, particularly those in the lobster fishery. This fishery includes thousands of licensed participants, none of whom account for a substantial share of the market. As a result, those in the harvest sector lack the ability to raise prices to cover any increase in their operating costs; the price they receive for their landed catch is dictated by market conditions, which can vary considerably from season to season. Thus, the costs of complying with new regulatory requirements are likely to be reflected in changes in fishing behavior or reductions in fishing effort.

The economic impact analysis developed for this DEIS provides detailed estimates of the compliance costs associated with potential changes to the ALWTRP. The analysis estimates compliance costs for model vessels and extrapolates from these findings to estimate the overall cost to the commercial fishing industry of complying with the regulatory changes under consideration. The analysis measures the cost of complying with new requirements relative to the status quo − i.e., a baseline scenario that assumes no change in existing Plan requirements. Thus, all estimates of compliance costs are incremental to those already incurred in complying with the ALWTRP. All costs are presented on an annualized basis and reported in 2017 dollars where annualized costs reflect initial and replacement costs over time. The calculation of annualized costs is based on a discount rate of seven percent, consistent with current OMB guidelines. We also use a discount rate of three percent to test the sensitivity of the analysis. The timeline for the rulemaking is assumed to be six years, which has been the interval between Plan modifications.

The discussion that follows summarizes the estimated cost of complying with each of the regulatory alternatives that NMFS is considering. Additional detail on the methods and results of the economic impact analysis can be found in Chapter 6.

Compliance Cost Estimation Methods

As discussed above, Alternatives Two (Preferred) and Three propose modifications to the ALWTRP that include some combination of trawling requirements, weak rope, the seasonal restricted areas, and gear marking requirements. The methods employed to estimate the costs attributable to these requirements are described below.

Trawling Requirements

A major component of Alternative Two is a minimum trawl length requirement – i.e., prohibiting trawls of less than a specified number of traps or pots – for trap/pot fisheries in Northeast waters. The exact nature of this requirement varies by alternative and location. The costs that fishermen are likely to incur in complying with such requirements are primarily composed of gear conversion costs and landed catch impacts.

Vessels fishing fewer traps/trawl configurations (e.g., singles, doubles) would need to reconfigure their gear to comply with trawling requirements. These changes may require expenditures on new equipment as well as investments of fishermen's time. Analysis of the economic impact of the trawling requirements entails comparing the baseline configuration of gear assigned to model vessels in NMFS' Vertical Line Model with the minimum trawl length that would be required under each regulatory alternative. The analysis identifies instances in which the reconfiguration of gear would be required, estimates the material and labor necessary to bring all gear into compliance, and calculates the resulting cost. Equipment costs are a function of the quantity of gear to be converted and the unit cost of the materials needed to satisfy the trawling requirement. Labor costs are a function of the time required to implement a specific modification, the quantity of gear to be converted, and the implicit labor rate. All costs are calculated on an incremental basis, taking into account any savings in material or labor costs that might result from efforts to comply with new ALWTRP regulations.

In addition to the direct cost of gear conversion, catch rates (in these analyses referring to the catch brought back to port and sold, also known as landed catch or landings) may decline for vessels that are required to convert from shorter sets to longer trawls, reducing the revenues of affected operations. To estimate impacts in the lower bound, the analysis assumes that vessels implementing a major increase in trawl length (an increase of a factor of three or more in the number of traps in each set) would experience a 5 percent reduction in their annual catch. In the upper bound, the analysis assumes that these vessels would experience a 10 percent reduction in catch. Vessels with an increase of less than three traps per trawl would experience a 0-5 percent catch reduction for lower and upper bound estimates. The resulting impact on each vessel's annual revenues is based on prevailing ex-vessel prices for lobster.

Weak Rope Requirements

All vessels in federally regulated Northeast waters are required to comply with weak rope requirements. Some state waters have their own regulations and some mirror the federal regulation. To comply with the new weak rope requirement, vessels in different areas need to add one or more weak insertions into their buoy lines, or replace their entire line with weak line if they are stronger than 1,700 lbs (771 kg) strength.

Alternative Two requires areas except for LMA Three to insert weak points into the original ropes to make them weak. LMA Three gears are required to have 75 percent of one buoy line to be fully engineered weak rope. In Alternative Three, all areas but LMA Three are required to have both buoy lines to be 75 percent weak, and LMA Three to have either one buoy line 75 percent weak year round, or one 75 percent weak line during May to August and the other buoyline 20 percent weak year round.

The cost of weak rope consists of material and labor cost. The so-called South Shore sleeve is so far the only proven solution for a weak insert. The sleeve costs $2 a piece and five minutes to install. The labor rate is the same as calculated in trawling requirements. Fully engineered weak rope is not available in the market right now, but a price quote from a gear manufacturer was used for this analysis.

Seasonal Buoy Line Closure Requirements

The analysis of the costs associated with the seasonal restricted areas begins by using the Vertical Line Model to estimate the number and type of vessels ordinarily active in each area during the proposed restricted area period. Depending on the location of the restricted area, fishermen could react in two ways: they may relocate their traps outside the restricted area if they have an available permit and their vessels allow them to do so; or they may remove buoy lines from the area by either fishing ropelessly or suspending fishing if their permit or vessel characteristics would not allow them to move to an alternative location to set their gear. For relocated vessels, we calculate the change in travel related costs, which could be an extra fuel cost or some savings on fuel cost, depending on feasible relocation areas. We also assume a 5-10% catch reduction because fishermen have to move out from their preferred fishing grounds. This takes into account possible saturation effects associated with setting gear in areas they do not normally fish and/or areas that are already being fished by other vessels. To evaluate removal of buoy lines, we calculated the cost of suspending fishing including both forgone fishing revenue and saved operating costs. The cost of ropeless fishing, which could provide access to buoy line closure areas, was not estimated. The technology as currently available costs a minimum of $5,000 per buoy line. Fishing fixed gear without buoy lines would require exemptions under other fishery management regulations. Unless purchase of ropeless gear is subsidized and until surface system requirements are modified to allow fishing without an exempted fishing permit, ropeless fishing is likely to occur on a very low scale by fishermen interested in improving the technology under commercial fishing conditions.

Gear Marking Requirements

The proposed action would implement additional gear marking requirements compared to no action. Under Alternative Two (Preferred), NMFS would mirror the Maine state regulations for all non-exempted waters, and would implement analogous marking for the other New England states. The gear marking requirement would include one state-specific three-foot colored mark within two fathoms of the buoy, two one-foot additional marks in the top and bottom half of gear in state waters, and three in Federal waters including a green six inch mark in the top two fathoms of line. This proposal would continue to allow multiple methods for marking line (paint, tape, rope, etc). Under Alternative Three (Non-preferred) a three-foot state specific color would be marked on the buoy line within two fathoms of the buoy, as in the preferred, but the entire line would also have to be replaced with a line woven with identification tape with the home state and fishery (for example Maine, lobster/crab trap/pot) repeated in writing along the length of the buoy line.

The analysis relies on the Vertical Line Model to estimate the number of vertical lines it would be necessary to mark under Alternatives Two and Three. In each case, the estimate of gear marking demands is consistent with the new trawling up requirements the alternative specifies.

Aggregate gear marking costs are based on numbers of active vessels estimated in the Vertical Line Model.

The estimate of gear marking costs considers both the cost of material/equipment and labor costs. To model these costs, lines were assumed to be marked using duct tape at a cost of $0.04 per foot. Each foot of tape takes a minute to install. ID tape ropes are created on demand and are used by some fishermen participating in the Canadian snow crab fishery. Commercial batches are not available at this time and suppliers would not speculate on the cost. On a conservative basis, here we assume that the cost of ID tape rope will be the twice as expensive as the original size rope.

Economic Impact Results

As noted in Chapter 6, the economic analysis is designed to measure regulatory compliance costs on an incremental basis i.e., to measure the change in costs associated with a change in regulatory requirements. If no change in regulatory requirements is imposed as would be the case under Alternative One the economic burden attributable to the ALWTRP would be unaffected. Thus, Alternative One would impose no additional costs on the regulated community.

The present value and annualized value of cost changes in Alternative Two and two versions of Alternative Three are presented in Table 9.7. In general, the largest cost changes originate from the assumed catch impacts associated with the gear configuration change. If using 7 percent discount rate, in Alternative Two, trawling up measures were estimated to cost between $2.8 million and $9.4 million per year. Under Alternative Three, a 50 percent buoy line reduction would cost more than $10 million per year.

Weak rope requirements cost half a million dollars per year in Alternative Two, but cost around $2.4 million per year in Alternative Three because fully engineered weak ropes are required for most buoy lines. Alternative Two gear marking measures would cost $2.5 million per year, while ID taped rope required in Alternative Three cost more than $3.2 million per year. Compared to the annualized compliance costs for the gear modification measures the marginal compliance costs of the Alternative Two restricted areas are lower because of the size and location choice of the restricted areas. Restricted areas in Alternative Three cost $1.6 million to $2.3 million per year for fishermen due to the large coverage and extended time period.

The total annualized cost of all proposed measures for Alternative Two including gear marking, weak rope, restricted area, and gear conversion costs range from $5.9 million to $12.8 million, much lower than the two versions of Alternative Three, which range from $17 million to $33 million.

Table 9.7: Summary of Annualized Value and Present Value of Compliance Costs by Alternatives (2017 US dollars)

	Discount Rate	Gear Marking	Weak Rope	Trawling up Lower	Trawling up Upper	Restricted Area Lower	Restricted Area Upper	Line Cap Lower	Line Cap Upper	Total Lower	Total Upper	Co-occurrence Reduction
Alt 2 AV	3%	2,234,312	470,008	2,895,403	9,814,577	139,213	413,083			6,147,521	13,340,566	69.1%-69.2%
Alt 2 PV	3%	12,103,698	2,152,497	13,260,096	44,947,889	637,554	1,891,800			28,153,845	61,095,884	
Alt 2 AV	7%	2,539,305	451,585	2,781,912	9,429,878	133,756	396,892			5,906,558	12,817,660	
Alt 2 PV	7%	12,103,698	2,152,497	13,260,096	44,947,889	637,554	1,891,800			28,153,845	61,095,884	
Alt 3a AV	3%	2,815,360	2,227,794	592,710	1,416,096	1,648,487	2,429,051	9,940,762	24,949,353	17,739,955	34,352,495	86% to 88.4%
Alt 3a PV	3%	15,251,346	10,202,645	2,714,439	6,485,303	7,549,590	11,124,342	45,525,779	114,260,732	81,243,799	157,324,368	
Alt 3a AV	7%	3,199,668	2,140,472	569,478	1,360,589	1,583,872	2,333,840	9,551,117	23,971,422	17,044,608	33,005,992	
Alt 3a PV	7%	15,251,346	10,202,645	2,714,439	6,485,303	7,549,590	11,124,342	45,525,779	114,260,732	81,243,799	157,324,368	
Alt 3b AV	3%	2,815,360	2,227,794	592,710	1,416,096	1,430,655	2,195,753	9,940,762	24,949,353	17,522,123	34,119,197	83.8% to 86.4%
Alt 3b PV	3%	15,251,346	10,202,645	2,714,439	6,485,303	6,551,982	10,055,904	45,525,779	114,260,732	80,246,191	156,255,930	
Alt 3b AV	7%	3,199,668	2,140,472	569,478	1,360,589	1,374,578	2,109,686	9,551,117	23,971,422	16,835,314	32,781,838	
Alt 3b PV	**7%**	**15,251,346**	**10,202,645**	**2,714,439**	**6,485,303**	**6,551,982**	**10,055,904**	**45,525,779**	**114,260,732**	**80,246,191**	**156,255,930**	

Notes: the lower and upper bounds of co-occurrence reduction score are based on the assumptions of 100% lines out and 100% relocation respectively.

9.6.4 Integration of Results

A few assumption are made for this analysis. The first one is the effective time period for the new rules would be six years. This assumption could affect the distribution of compliance costs as well as present value and annualized value. Another important one is the catch reduction caused by trawl length. We assume the catch reduction impact is likely to decrease in magnitude after six years. Although no available data have shown a definitive relationship between trawl length and catch rate, an analysis by NEFSC lobster stock assessment group suggests that gear configuration change may lead to change in fishing effectiveness and efforts and then cause landing reduction. However, this is a dynamic process: landings drop in the first year that effort reductions are implemented, and then increase after a few years when fishermen adapt to the new regulations, reaching baseline landings between five and seven years after implementation and exceeding baseline catch in subsequent years.

As previously noted, the inability to quantify and value the benefits of potential changes to the ALWTRP prohibits the use of BCA to identify the regulatory alternative that would provide the greatest net benefit. Instead, Table 9.7 summarizes the estimated cost of complying with each regulatory alternative, coupled with the estimated impact of each alternative on the Vertical Line Model's co-occurrence indicator. As stated in Chapter 3, the co-occurrence reduction score needed to help reach the legal PBR level is 60 percent. Comparing Alternative Two and Three, though Alternative Three achieves a much higher reduction score, the compliance costs associated are also nearly 100 percent higher than Alternative Two.

NMFS has considered the benefit and cost information presented above and believes that Alternative Two (Preferred) offers the best option for achieving compliance with MMPA and ESA requirements. In addition, Alternative Two (Preferred) provides most of the benefits that would be achieved under more stringent alternatives, sacrificing only the relatively costly additional reduction in co-occurrence that would be achieved by the extended South Island Restricted Area. Based on these considerations, NMFS has identified Alternative Two (Preferred) as its proposed approach to achieving the goals of the ALWTRP.

9.7 Initial Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) requires Federal regulatory agencies to examine the expected economic impacts of the various alternatives contained in the proposed rulemaking on small entities, and to ensure that the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the proposed regulation.

9.7.1 Description and Estimate of the Number of Small Entities

The RFA requires agencies to assure that decision makers consider disproportionate and/or significant adverse economic impacts of their proposed regulations on small entities. The Regulatory Flexibility Act Analysis (RFAA) determines whether the proposed action would have a significant economic impact on a substantial number of small entities. This section provides an assessment and discussion of the potential economic impacts of the proposed action, as required of the RFA.

Section 3 of the SBA defines affiliation as: Affiliation may arise among two or more persons with an identity of interest. Individuals or firms that have identical or substantially identical business or economic interests (such as family members, individuals or firms with common investments, or firms that are economically dependent through contractual or other relationships) may be treated as one party with such interests aggregated (13 CFR 121.103(f)). These principles of affiliation allow for consideration of shared interest that does not necessarily require common ownership. However, data are not available to ascertain non-ownership interest so we use an affiliated[21] vessel database created by Social Sciences Branch (SSB) of NEFSC. There are three major components of this dataset: vessel affiliation information, landing values by species, and vessel permits. All Federal permitted vessels in the Northeast Region from 2016 to 2018 are included in this dataset. Vessels are affiliated into entities according to common owners. The entity definition used by the SSB uses only unique combinations of owners.

The total number of directly regulated entities is based on permits held. Since this proposed regulation applies only to the pot/trap lobster businesses[22] in LMA One, LMA Two, LMA Three, and OCC, only entities that possess one or more of these permits are evaluated. Then for each affiliation, the revenues from all member vessels of the entity are summed into affiliation revenue in each year. On December 29, 2015, the NMFS issued a final rule establishing a small business size standard of $11 million in annual gross receipts for all businesses primarily engaged in the commercial fishing industry (NAICS 11411) for Regulatory Flexibility Act (RFA) compliance purposes only. The $11 million standard became effective on July 1, 2016. Thus, the RFA defines a small business in the lobster fishery as a firm that is independently owned and operated with receipts of less than $11 million annually. Based on this size standard, the three-year average (2016-2018) affiliation revenue is greater than $11 million, the fishing business is considered a large entity, otherwise it is a small entity. Then we determine the number of impacted entities by examining the landing values of lobster. If one or more members of the affiliation landed lobster in 2018, this business will be considered an impacted entity in our analysis.

Regulated entities in this rulemaking include both entities with federal lobster permits and lobster vessels that only fish in state managed waters except for the exempted areas in Maine. Using vessel data from Vertical Line Model, we identify an additional 1,913 vessels that fished only in state waters outside Maine exempted areas. Due to the lack of owner and landing information of these vessels, we could not provide detailed analysis but have to assume all to be small entities. Using federal permit data, there are 1,591 distinct entities identified as directly regulated entities in this action, those that held lobster permits in LMA One, Two, Three, or OCC, or some combination. So all together, 3,504 entities are regulated under this action. Table 9.10 displays the details of regulated entities holding federal permits. Of all 1,591 entities, only four of them are large. Within the 1,587 small entities, 259 had no earned revenue from fishing activity even though they had a lobster permit. Because they had no revenue, they would be considered small by default. Among the 1,328 small entities with fishing revenue, 110 entities

[21] We use terms affiliation, fishing business and entity interchangeably in this section.

[22] During the time period of our analysis (2016-2018), no specific permit needed for Jonah crab fishery. Beginning on December 12, 2019, only vessels that have a federal American lobster trap or non-trap permit may retain Jonah crabs.

had no lobster landings. Therefore, 3,131 small entities would be considered as impacted small entities during this rulemaking.

Table 9.8: The Number of Regulated Entities and Their Lobster Landing Value Percentage of Annual Gross Revenue in 2018

	Large Entity	Lob% Large	Small Entity	Lob% Small	Sum
Fishing with Lobster Landing	3	73.76%	1,218	90.79%	**1,221**
Fishing Without Lobster Landing	1	0	110	0	**111**
Sum1	**4**	**68.29%**	**1,328**	**83.37%**	1,332
No revenue	0	0	259	0	**259**
Total (Sum1+No Revenue)	**4**		**1,587**		**1,591**

Notes: The determination of large or small entity is based on three-year average affiliation revenue from 2016 to 2018. Lobster landing percentage is calculated using only 2018 data.
Source: Social Science Branch vessel affiliation data, 2016-2018

9.7.2 Economic Impacts of the Proposed Rules on Small Entities

In this section we examine the two economic impacts of the proposed rules on small entities. The first one is the disproportionality and profitability, and the second one is the average compliance cost per entity.

Disproportionality and profitability of small entities

No absolute dollar or quantity threshold exists to establish criteria for significance of economic impacts. However, NMFS and SBA guidelines suggest that disproportionality and profitability as the primary drivers of significance. Disproportionality is calculated as the distribution of impacts over large and small entities. This is important to determine whether the regulations place a substantial number of small entities at a significant competitive disadvantage to large entities. Profitability is the magnitude of these impacts. Entities with lower profitability are likely to be more impacted by the action.

Although available data are limited to make a definitive determination, a comparison of lobster revenue dependence by large vs. small entities can be used to highlight the potential for disproportionate impacts. The average annual percent of total ex-vessel revenue earned from lobsters compared to their total ex-vessel revenue is specified by business entity in Table 9.10. The dependence on lobsters is relatively higher for impacted small entities than for large entities, but both exceed 70 percent. This would suggest that a substantial number of small entities are not at a significant competitive disadvantage. However, the fact that there are a greater number of small entities in total should be highlighted.

To calculate the average profitability of small entities and large entities, we need to deduct the operation costs and fixed costs from the annual gross revenue for each vessel, and then sum the profits of all vessels in each entity. A vessel by vessel evaluation is not feasible for this analysis, therefore we adopt the results from a lobster fleet profitability study based on cost survey data collected by SSB for fishing years 2010, 2011, and 2015[23]. The profit was calculated by vessel size class, so we assign the profits to the affiliated vessel data by matching vessel length. Vessels less than 35 feet (10.7 meters) normally have a net profit of $38,446[24], vessels between 35 and 45 feet have a net profit[25] of $47,404; large vessels between 45 and 55 feet have an average profit of 73,063; and vessels above 55 feet have a profit of $34,463. Table 9.11 displays the average profit for all large and small entities, compared to their mean total revenue. Results indicate the profitability for large entities is 1.77% and for small entities is 18.48%. So we could conclude that the action would not create more significant economic impact on small entities compared to large entities.

Table 9.9: Profitability of Large and Small Entities

	Mean Profit	Mean Total Revenue	Profitability
Large Entity	469,784	26,485,600	**1.77%**
Small Entity	**52,235**	**282,586**	**18.48%**

Compliance Costs for Each Affected Entity from Preferred Alternative

Under Alternative Two, a few measures are proposed to reduce the probability of serious injury and mortality of North Atlantic right whales including weak ropes, minimum trawl length requirement, and restricted areas. Gear marking requirement is also proposed to increase the chance of threat identification. All these measures generate a series of compliance cost for small entities. In this section, we first identify the costs for each measure year by year using economic analysis from Chapter 6. Then we can calculate the present value and annualized value for each measure. At last, we can have an estimate of the compliance cost for each affected small entity.

As stated in Chapter 6, we assume the rulemaking cycle is six years. Table 9.12 displays the compliance costs for all affected entities from Year 1 to Year 6. Year 0 is the status quo, so the compliance cost is zero, and we do not include it in the table. The discount rate of 7 percent is used for the present value and annualized value calculation. Weak rope only generates costs in Year 1, while gear marking, trawling up and restricted areas measures have costs in the subsequent years due to the catch reduction impacts. Results indicate that trawling up measures would have the largest economic impacts on small entities ranging from $13 million to $45 million over six years. Restricted areas costs range from $6 million to $1.9 million. Gear marking and weak rope will have $12 million and $2.2 million impacts respectively. As a sum, Alternative Two would cost small entities about $28 to $61 million in the six years if new rules were implemented. The annualized cost would be $5.9 million to $12.9 million. If applied to roughly 3,100 affected small entities, each entity would have to bear a compliance cost of $1,900 to $4,500 per year for six years. If we are using 3% as discount rate, the final cost for each vessel would be around $1,700 to $3,600 per year. In terms of realized Year 1 costs compliance costs would range between $2,200 and $5,000 but would be lower in Years 2-6. The Year 1 costs

[23] Research by Zou, Thunberg, and Ardini to be published as Center Reference Document at NEFSC.
[24] All values are in 2018 US dollars.
[25] We use net profit here instead of economic profit. Economic profit takes the opportunity cost of labor and capital away from the net profit, and end up with negative values for most vessels.

would result in an estimated reduction in profit ranging from 4.3% to 9.5%.

Table 9.10: Yearly Compliance Cost of Preferred Alternative (In 2017 US $)

	Gear Marking	Weak Rope	Trawling up Lower	Trawling up Upper	Restricted Area Lower	Restricted Area Upper	Total Lower	Total Upper
Year 1	$2,017,283	$2,152,497	$2,660,792	$10,957,354	$106,259	$315,300	$6,936,831	**$15,442,434**
Year 2	$2,017,283	$0	$4,239,722	$12,236,593	$106,259	$315,300	$6,363,264	**$14,569,176**
Year 3	$2,017,283	$0	$3,179,791	$9,517,350	$106,259	$315,300	$5,303,333	**$11,849,933**
Year 4	$2,017,283	$0	$2,119,861	$6,798,107	$106,259	$315,300	$4,243,403	**$9,130,690**
Year 5	$2,017,283	$0	$1,059,930	$4,078,864	$106,259	$315,300	$3,183,472	**$6,411,447**
Year 6	$2,017,283	$0	$0	$1,359,621	$106,259	$315,300	$2,123,542	**$3,692,204**
PV	$12,103,698	$2,152,497	$13,260,096	$44,947,889	$637,554	$1,891,800	$28,153,845	**$61,095,884**
AV (3%)	$2,234,312	$397,346	$2,447,781	$8,297,268	$117,691	$349,222	$5,197,129	**$11,278,147**
AV (7%)	**$2,539,305**	**$451,585**	**$2,781,912**	**$9,429,878**	**$133,756**	**$396,892**	**$5,906,558**	**$12,817,660**

Notes: 1. Year 1 to year 6 values are in 2017 dollars
2. PV represents net present value of year 1 to year 6, also in 2017 dollars
3. AV represents annualized value of the net present value. It is an equalized yearly cost during the 6-year time period with 3% and 7% discount rate.

9.7.3 Rules That May Duplicate, Overlap, or Conflict with Proposed Rule

No duplicative, overlapping, or conflicting Federal rules have been identified.

9.8 References

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10 APPLICABLE LAWS

10.1 Magnuson-Stevens Fisher Conservation and Management Act Including Essential Fish Habitat

The Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act require NOAA Fisheries to provide recommendations to Federal and state agencies for conserving and enhancing EFH if a determination is made that an action may adversely impact EFH. NOAA Fisheries policy regarding the preparation of NEPA documents recommends incorporating EFH assessments into environmental impact statements; therefore, this Draft Environmental Impact Statement (DEIS) will also serve as an EFH assessment.

Pursuant to these requirements, Chapter 3 of this document provides a description of the alternatives considered for amending the Atlantic Large Whale Take Reduction Plan (Plan). Chapter 4 provides a description of the affected environment, including the identification of areas designated as EFH (section 4.2.1), Habitat Areas of Particular Concern (section 4.2.2), and an analysis of the impacts of fishing gear on that environment (section 4.2.4). Chapter 5 evaluates the impacts on EFH of the proposed action and other alternatives. An EFH consultation conducted on the preferred alternative was concluded on May 15, 2020. The consultation determined that the proposed measures would have a minimal impact on EFH. There would likely be increased bottom contact and disturbance during haul back caused by the use of longer trap trawls, especially in areas with rocky substrates where lobsters are commonly caught. The other proposed measures (e.g., weak links in buoy lines) would not have any adverse habitat impacts.

10.2 National Environmental Policy Act

The analysis in this document was prepared in full compliance with the requirements of the National Environmental Policy Act (NEPA). All established procedures to ensure that Federal agency decision makers take environmental factors into account, including the use of a public process, were followed (Table 10.1 Summary of Scoping Comments). This DEIS contains all the components required by NEPA, CEQ Regulations for Implementing NEPA, and NOAA Administrative Order 216-6A, including a brief discussion of the purpose and need for the proposal (Chapter 2), the alternatives considered (Chapter 3), the environmental impacts of the proposed action and the alternatives (Chapter 5), a list of document preparers and contributors (Chapter 12), and other relevant information.

NEPA provides a mechanism for identifying and evaluating the full spectrum of environmental issues associated with federal actions, and for considering a reasonable range of alternatives to avoid or minimize adverse environmental impacts. The Council on Environmental Quality (CEQ) has issued regulations specifying the requirements for NEPA documents (40 CFR 1500 – 1508) and NOAA's policy and procedures for NEPA are found in NOAA Administrative Order 216-6A. All of those requirements are addressed in this document, as referenced below. The required elements of an Environmental Impact Statement Assessment (EIS) are specified in 40 CFR 1502.10 and NAO 216-6A Section 5.04b.1. They are included in this document as follows:

- A Cover Sheet
- An Executive Summary
- A table of contents
- The purpose and need for this action - Section 2.2
- The alternatives that were considered – Chapter 3
- Affected environment – Chapter 4
- Environmental consequences, including cumulative effects – Chapters 5 and 8
- A list of preparers - Chapter 11
- The agencies and persons consulted on this action - Section 12
- A Glossary
- Appendices (if any)

10.2.1 Public Scoping

We announced our intent to prepare an EIS for this action on August 2, 2019 (84 FR 37822) and held eight public meetings as well as requesting written public comments on management options to reduce the risk of large whale entanglements in trap pot fisheries. During the public scoping process, which ended September 16, 2019, NOAA Fisheries requested suggestions and information from the public on the range of issues that should be addressed and alternatives that should be considered in this document. Over 89,200 comments were received. Comments included oral comments received during scoping meetings attended by over 800 people. Posted letters were received from each New England state's fishery management organization, from the Marine Mammal Commission, Atlantic States Marine Fisheries Commission, the Maine Congressional delegation, and a Maine State representative. Four fishing industry representatives sent comments by mail or email, and over 50 unique letters from fishermen providing details about their fishing practices were received by postal mail as well as 125 form letters. By email, we received over 120 unique comments, including 30 emails from fishermen or fishing families. Eleven representatives from environmental organizations send letters and emails, and over 89,000 emails associated with 12 non-governmental organizations' campaigns were received. A summary of the written and oral comments received during the public scoping process identifying where those comments are addressed in this DEIS can be found in Appendix 3.3.

Currently, NOAA Fisheries is not requesting any abridgement of the rulemaking process for this action, anticipating at least a 60-day comment period on the proposed rule.

10.2.2 Areas of Controversy

Litigation related to this action is ongoing, and the action has received close attention from the Maine Congressional Delegation as well as members of the fishing industry and conservation organizations, demonstrating that it is highly controversial. Known and anticipated areas of controversy are discussed in detail in Section 1.5 of this DEIS, but primary issues include the following:

- Ongoing litigation is largely related to non-governmental organizations' and whale conservationists' concerns that rapid changes to current fishing practices are needed to address impacts to right whales in U.S. fisheries and reverse the decline of the population.

- The alternatives considered in this DEIS are consistent with, but not identical to, the Atlantic Large Whale Take Reduction Team recommendations to NMFS in April 2019 (see Table 3.1). Additionally, as described in Section 3.1.1, while measures proposed by New England states provided the basis for the alternatives analyzed, not all measures proposed by the states are included in the preferred alternative. Particularly, measures proposed by Rhode Island are not in the preferred alternative, and a seasonal buoy line closure area 30 miles offshore of Maine was not proposed by Maine or the Take Reduction Team.
- Northeast U.S. trap/pot fishermen are frustrated that after two decades of modifying their fishing practices, the North Atlantic right whale population is declining. Fishermen are concerned that some of the major causes of decline, such as climate change and mortality in Canada, are not being sufficiently addressed and that as a result the burden of reversing the population decline is being disproportionately placed on the northeast U.S. lobster and crab fisheries.
- The fishing industry and some states have criticized the assessment of the amount of risk reduction (60 to 80 percent) that NMFS indicated needed to be achieved in U.S. trap pot fisheries. As discussed in Chapter 3, it is difficult to identify the initial location of fishing gear that causes serious injury and mortalities to right whales because in most cases no gear is retrieved or if retrieved the gear cannot be identified to a fishery or location. U.S. fishermen disagree with the apportionment of serious injury and mortality assigned to them, and lobster fishermen disagree with the apportionment attributed toward trap/pot or lobster buoy line.
- Stakeholders and commenters criticized the decision support tool (DST) created to help the Team compare risk reduction measures. A recent peer review of the DST recommended a number of improvements but also determined it was a useful tool for assisting the Team in making risk reduction decisions.
- There is continued frustration expressed by fishermen regarding how gaps in information about right whale distribution and habitat use, which influences risk reduction targets as well as DST and co-occurrence model evaluation of risk reduction alternatives towards achieving targets. Research needs include amplification of distribution surveys across the range, right whale tagging, and research to support predictions of future shifts in food availability and distribution.
- Similar data concerns were expressed by Team members during meetings regarding gaps in crab and lobster fishery data. Increased vessel trip reporting and vessel monitoring are needed to inform the DST and co-occurrence models to evaluate the fishery and the risk reduction measures.

Chapter 2 discusses evidence that mortalities and serious injuries of right whales in U.S. fisheries continues to occur at rates above the potential biological removal level established in the MMPA. Modifications to the Take Reduction Plan are necessary at this time. Chapter 3 describes how, considering the best available information, risk reduction measures in Alternatives Two and Three were developed to reduce the risk of mortality and serious injuries in the lobster and crab fisheries toward achieving PBR.

10.2.3 Document Distribution

This document is available on the GARFO ALWTRP web page (https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/atlantic-large-whale-take-reduction-plan). Announcements of document availability will be made in the *Federal Register* and to the interested parties' mailing list. Copies were distributed to:

US Environmental Protection Agency EIS Filing Section
Office of Federal Activities
Ariel Rios Building (South Oval Lobby) Mail Code 2252-A
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10.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires Federal agencies conducting, authorizing, or funding activities that may affect threatened or endangered species to ensure that those impacts do not jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat determined to be critical. Many of the trap/pot and gillnet fisheries regulated under the Atlantic Large Whale Take Reduction Plan are also managed under federal fishery management plans (FMPs) that undergo review under the ESA Section 7 requirements. If it is determined through the section 7 process that a fishery (or fisheries) is likely to adversely affect listed species and/or critical habitat, then a formal consultation is initiated to determine whether the proposed action is likely to jeopardized the continued existence of a listed species and/or destroy or adversely modify critical habitat. Formal consultation concludes with the issuance of a NOAA Fisheries Biological Opinion (Opinion). The most recent relevant Opinion on fisheries regulated under the Take Reduction Plan include:

- February 6, 2002: ESA Section 7 Consultation on Implementation of the Deep-Sea Red Crab, *Chaceon quinquedens*, FMP. NMFS most recently considered the effects of activities occurring under the Atlantic Deep-Sea Red Crab FMP on ESA-listed marine mammals and sea turtles during a formal Section 7 consultation completed on February 6, 2002. An Opinion resulting from this consultation concluded that the continued operation of the red crab fishery as authorized under the Red Crab FMP may adversely affect, but would not jeopardize, the continued existence of North Atlantic right whales, fin whales, sei whales, and sperm whales; and loggerhead[26] and leatherback sea turtles. That Opinion also concluded that the continued operation of the red crab fishery would not destroy or adversely modify designated critical habitat for North Atlantic right whales. An Incidental Take Statement (ITS) for sea turtles was issued along with the Opinion exempting a level of annual take. Reasonable and Prudent Measures and accompanying Terms and Conditions to minimize the impacts of incidental take were also provided in the ITS. The preferred alternative does impact the red crab fishery, which will be considered in 2021 along with other crap/pot fisheries and gillnet fisheries.

- December 16, 2013: Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish, Northeast Skate Complex, Mackerel/Squid/Butterfish, and Summer Flounder/Scup/Black Sea Bass Fisheries (Batched Opinion). The Opinion concluded that the continued operation of the seven FMPs may adversely affect, but

[26] At the time of the 2002 red crab Opinion, loggerhead sea turtles were listed globally, not by distinct population segments (DPSs). On September 22, 2011 (76 FR 58868), nine DPSs were designated, replacing the global listing of loggerhead sea turtles; loggerhead sea turtles in the Greater Atlantic Region are listed as the Northwest Atlantic Ocean DPS. NMFS issued a memo on November 15, 2011, concluding that designation of the Northwest Atlantic Ocean DPS of loggerhead sea turtle did not trigger reinitiation of the 2002 red crab Opinion.

would not jeopardize, the continued existence of North Atlantic right whales, fin and sei whales; loggerhead (Northwest Atlantic Ocean Distinct Population Segment (NWA DPS)), leatherback, Kemp's ridley, and green sea turtles; the five listed DPSs of Atlantic sturgeon; or the Gulf of Maine DPS of Atlantic salmon. The Opinion also concluded that the continued operation of the seven FMPs would not destroy or adversely modify designated critical habitat for right whales or Atlantic salmon. An ITS for listed sea turtles, the five DPSs of Atlantic sturgeon, and the Gulf of Maine DPS of Atlantic salmon was issued along with the Opinion exempting a level of annual take for the seven FMPs. Reasonable and Prudent Measures and accompanying Terms and Conditions to minimize the impacts of incidental take were also provided in the ITS. The preferred alternative does not impact the Batched Opinion fisheries, which will be considered in 2021 along with other crap/pot fisheries and gillnet fisheries.

- July 31, 2014: Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the American Lobster Fishery ("2014 Biological Opinion"). The 2014 Biological Opinion concluded that the continued operation of the American lobster fishery may adversely affect, but is not likely to jeopardize the continued existence of North Atlantic right whales, fin whales, and sei whales; or loggerhead (NWA DPS) and leatherback sea turtles. The 2014 Biological Opinion also concluded that the continued operation of the American lobster fishery is not likely to destroy or adversely modify designated critical habitat for North Atlantic right whales or the NWA DPS of loggerhead sea turtles. An ITS for the NWA DPS loggerhead and leatherback sea turtles was issued along with the Opinion exempting a level of annual take for the lobster FMP. Reasonable and Prudent Measures and accompanying Terms and Conditions to minimize the impacts of incidental take were also provided in the ITS. On April 9, 2020, the U.S. District Court for the District of Columbia found that the 2014 Biological Opinion was legally deficient. On August 19, 2020, the Court issued a remedy order vacating the 2014 Biological Opinion, but staying that vacatur until May 31, 2021, by which date NMFS anticipates issuing a new final Biological Opinion for the federal American lobster fishery and other federal fisheries.

- A formal consultation was conducted on the Atlantic Large Whale Take Reduction Plan in 1997. Six informal consultations were completed in 2004, 2008, 2014, and 2015 associated with modifications to the Plan. The most recent consultation dated March 3, 2015 concluded that the modification to the Plan proposed in 2015 to complete the implementation of a vertical line reduction strategy did not cause effects not already considered in the 1997 Biological Opinion or any subsequent informal consultation, and therefore did not trigger the need for a new formal consultation.

Until recently, the Section 7 consultation findings noted above remained in effect. However, elevated right whale mortalities in Canada and the U.S. in 2017 exacerbated a decline in the right whale population that began in 2010, according to a 2017 publication (Pace et al., 2017). This new information is different from that considered and analyzed in the Opinions and informal consultations discussed above and therefore, may reveal effects of the Batched, Atlantic Deep Sea Red Crab, and Lobster fisheries that were not previously considered. As a result, per an October 17, 2017, ESA 7(a)(2)/7(d) memo issued by NMFS the agency reinitiated consultation on these fisheries. Consultation on these fisheries/FMPs is currently in progress. The conclusion of the reinitiated consultation is anticipated prior to publication of the Final Rule implementing modifications to the Plan.

This document analyzes the potential impacts of the alternative on ESA-listed species in Chapter 5. This discussion concludes that the preferred alternative (Alternative Two) would directly benefit right whales and fin whales, the ESA-listed large whales. The preferred alternative (Alternative Two) would also benefit leatherback sea turtles, which are known to become entangled in buoy lines of trap/pot gear, by reducing the number of buoy lines in the water. No other effects to ESA-listed species are expected as a result of the alternative. Therefore, this action is not expected to affect endangered or threatened species or critical habitat in any manner not considered in previous consultations on these fisheries.

10.4 Marine Mammal Protection Act

Under the Marine Mammal Protection Act (MMPA), Federal responsibility for protecting and conserving marine mammals is vested with the Departments of Commerce (NOAA Fisheries) and Interior (USFWS) and the MMPA is the authority under which much of the proposed rulemaking is being undertake. The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in cooperation with the applicable provisions of the ESA. The ESA- listed species of marine mammal that occur in the Atlantic Large Whale Take Reduction Plan management areas are discussed in section 4.1 of the DEIS. The species of marine mammal not listed under the ESA that occur in the Plan management areas are discussed in section 4.1.2 except minke whales, which are discussed in section 4.1.1. The potential impact of the alternatives considered on marine mammals is provided in Chapter 5.

10.5 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) is designed to encourage and assist states in developing coastal management programs, to coordinate state activities, and to safeguard regional and national interests in the coastal zone. Section 307(c) of the CZMA requires that any Federal activity affecting the land or water uses or natural resources of a state’s coastal zone be consistent with the state’s approved coastal management program, to the maximum extent practicable. NMFS has determined that the implementation of the preferred alternative would be consistent to the maximum extent practicable with the approved coastal management programs of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. This determination will be submitted, along with a copy of this document, for review and concurrence by the responsible state agencies under Section 307 of the Coastal Zone Management Act.

10.6 Administrative Procedure Act

The Federal Administrative Procedure Act (APA) establishes procedural requirements applicable to informal rulemaking by Federal agencies. The purpose of the APA is to ensure public access to the Federal rulemaking process and to give the public notice and an opportunity to comment before the agency promulgates new regulations. Specifically, the APA requires NOAA Fisheries to solicit, review, and respond to public comments on rulemaking actions taken in the development of take reduction plans and subsequent amendments and modifications. Development of the alternatives considered for this amendment to the Atlantic Large Whale Take Reduction Plan provided several opportunities for public review, input, and access to the rulemaking process. NOAA Fisheries published a notice of intent to prepare an environmental impact statement at 84 FR 37822 scheduling eight public meetings and requesting in person or written public comments on management options to reduce the risk of large whale entanglements in trap pot fisheries. During the public scoping process, NOAA Fisheries requested suggestions and information from the public on the range of issues that should be addressed and alternatives that should be considered in this document. Over 89,200 comments were received. Comments included oral comments received during scoping meetings attended by over 800 people. Posted letters were received from each New England state's fishery management organization, from the Marine Mammal Commission, Atlantic States Marine Fisheries Commission, the Maine Congressional delegation, and a Maine State representative. Four fishing industry representatives sent comments by mail or email, and over 50 unique letters from fishermen providing details about their fishing practices were received by postal mail as well as 125 form letters. By email, we received over 120 unique comments, including 30 emails from fishermen or fishing families. Eleven representatives from environmental organizations send letters and emails, and over 89,000 emails associated with 12 non-governmental organizations' campaigns were received. A summary of the written and oral comments received during the public scoping process identifying where those comments are addressed in this DEIS can be found in Appendix 3.3. Currently, NOAA Fisheries is not requesting any abridgement of the rulemaking process for this action, anticipating at least a 60-day comment period on the proposed rule and the DEIS.

10.7 Information Quality Act (Section 515)

The Information Quality Act directed the Office of Management and Budget to issue government wide guidelines that "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies." Under the NOAA guidelines, the Atlantic Large Whale Take Reduction Plan is considered a Natural Resource Plan. It is a composite of several types of information, including scientific, management, and stakeholder input, from a variety of sources. Compliance of this document with NOAA guidelines is evaluated below.

- **Utility:** The information disseminated is intended to describe proposed management actions and the impacts of those actions. The information is intended to be useful to: 1) fishermen and other fishing industry participants, conservation groups, and other interested parties so they can provide informed comments on the alternatives considered; and 2) managers and policy makers so they can choose an alternative for implementation.
- **Integrity:** Information and data, including statistics that may be considered as confidential, were used in the analysis of impacts associated with this document. This information was necessary to assess the biological, social, and economic impacts of the alternatives considered as required under the National Environmental Policy Act and Regulatory Flexibility Act for the preparation of a final environmental impact statement/regulatory impact review. NOAA Fisheries complied with all relevant statutory

and regulatory requirements as well as NOAA policy regarding confidentiality of data. For example, confidential data were only accessible to authorized Federal employees and contractors for the performance of legally required analyses. In addition, confidential data are safeguarded to prevent improper disclosure or unauthorized use. Finally, the information to be made available to the public was done so in aggregate, summary, or other such form that does not disclose the identity or business of any person.

- **Objectivity:** The NOAA Information Quality Guidelines for Natural Resource Plans state that plans must be presented in an accurate, clear, complete, and unbiased manner. Because take reduction plans and their implementing regulations affect such a wide range of interests, NOAA Fisheries strives to draft and present proposed management measures in a clear and easily understandable manner with detailed descriptions that explain the decision making process and the implications of management measures on marine resources and the public. Although the alternatives considered in this document rely upon scientific information, analyses, and conclusions, clear distinctions would be drawn between policy choices and the supporting science. In addition, the scientific information relied upon in the development, drafting, and publication of this DEIS was properly cited and a list of references was provided. Finally, this document was reviewed by a variety of biologists, policy analysts, economists, and attorneys from the Greater Atlantic Region as well as the Headquarters office in Silver Spring, MD. In general, this team of reviewers has extensive experience with the policies and programs established for the protection of marine mammals, and specifically with the development and implementation of the Atlantic Large Whale Take Reduction Plan. Therefore, this Natural Resource Plan was reviewed by technically qualified individuals to ensure that the document was complete, unbiased, objective, and relevant. This review was conducted at a level commensurate with the importance of the interpreted product and the constraints imposed by legally-enforceable deadlines.

10.8 Paperwork Reduction Act

The collection of information for or by the Federal government − in the case of the Atlantic Large Whale Take Reduction Plan regulations, the marking of fishing gear − is subject to the requirements of the Paperwork Reduction Act (PRA) of 1995. PRA establishes a process for the review and approval of information collections by the Office of Management and Budget (OMB), in an effort to minimize the paperwork burden resulting from federal information collection efforts. Pursuant to PRA, NOAA Fisheries must file a separate supporting statement to OMB that requests clearance for the gear marking provisions of the final rule. In this submission, NOAA Fisheries will detail the purpose, necessity, implementation methods, responses to public comments, and estimates of the time and cost burdens of the new gear marking provisions. The gear marking requirements under Alternative 2 (Preferred) are discussed in section 3.1.6. of this document.

10.9 Executive Order 13132 - Federalism

EO 13132, otherwise known as the Federalism EO, was signed by President Clinton on August 4, 1999, and published in the *Federal Register* on August 10, 1999 (64 FR 43255). This EO is intended to guide Federal agencies in the formulation and implementation of “policies that have federal implications." Such policies are regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. EO 13132 requires Federal agencies to have a process to ensure meaningful and timely input by state and local officials in the development of regulatory policies that have federalism implications. A Federal summary impact statement is also required for rules that have federalism implications.

EO 13132 establishes fundamental federalism principles based on the U.S. Constitution, and specifies both federalism policy-making criteria and special requirements for the preemption of state law. For example, a Federal action that limits the policy making discretion of a state is to be taken only where there is constitutional and statutory authority for the action and it is appropriate in light of the presence of a problem of national significance. In addition, where a Federal statute does not have expressed provisions for preemption of state law, such a preemption by Federal rule-making may be done only when the exercise of state authority directly conflicts with the exercise of Federal authority. To preclude conflict between state and Federal law on take reduction plans, the Marine Mammal Protection Act explicitly establishes conditions for Federal preemption of state regulations. Furthermore, close state-Federal consultation on fishery management measures implemented under the Atlantic Large Whale Take Reduction Plan is provided by the take reduction team process. The implementation of any of the alternatives considered would contain policies with federalism implications sufficient to warrant the preparation of a federalism assessment under EO 13132. Therefore, the Assistant Secretary for Legislative and Intergovernmental Affairs will provide notice of the action to the appropriate official(s) of affected state, local and/or tribal governments.

10.10 Executive Order 12866

The requirements for all regulatory actions specified in EO 12866 are summarized in the following statement from the order:

In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

The analysis meeting the above described requirements of the EO are found in the section entitled Regulatory Impact Review (RIR), which is included within this Draft EIS in Chapter 9.

10.11 Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) was enacted in 1980 to place the burden on the Federal government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA emphasizes predicting significant adverse impacts on small entities as a group distinct from other entities and on the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. When an agency publishes a final rule, unless it can provide a factual basis upon which to certify that no such adverse effects will accrue, it must prepare and make available for public review an Initial Regulatory Flexibility Analysis (IRFA) that describes the impact of the rule on small entities. The IRFA for this action is provided in Chapter 9.

10.12 Executive Order 12898 – Environmental Justice

The Environmental Protection Agency (EPA) defines environmental justice as, “the fair treatment for all people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.” EO 12898 was implemented in response to the growing need to address the impacts of environmental pollution on particular segments of our society. This order requires each Federal agency to achieve environmental justice by addressing “disproportionately high and adverse human health and environmental effects on minority and low-income populations.” In furtherance of this objective, the EPA developed an Environmental Justice Strategy that focuses the agency’s efforts in addressing these concerns. For example, to determine whether environmental justice concerns exist, the demographics of the affected area should be examined to ascertain whether minority populations and low-income populations are present, and, if so, a determination must be made as to whether implementation of the alternatives may cause disproportionately high and adverse human health or environmental effects on these populations. Environmental justice concerns typically embody pollution and other environmental health issues, but the EPA has stated that addressing environmental justice concerns is consistent with NEPA; therefore, all Federal agencies are required to identify and address these issues.

Many of the participants in the fisheries regulated under the Atlantic Large Whale Take Reduction Plan in the Northeast U.S. may come from lower income and/or ethnic minority populations. These populations may be more vulnerable to the management measures considered in this documents. However, demographic data on participants in the lobster and crab fisheries affected by measures analyzed in this DEIS do not allow identification of those who live below the poverty level or are racial or ethnic minorities. Table 10.1 describes poverty and minority rate data at the state and county levels for the primary port communities relevant to this action. In terms of poverty, Washington County is the only county that is more than 1% higher than its state average (Maine). Washington and Cumberland Counties are the only counties with a minority rate more than 1% higher than their state average (Maine). Fewer minorities live in the one coastal county in New Hampshire relative to the rest of the state. In Massachusetts, only Suffolk County, which includes the city of Boston, has poverty rates more than one percent higher than the poverty rate for the state as a whole. Suffolk and Norfolk Counties in Massachusetts both are also home to minorities at a rate more than one percent higher than the comparable rate for the state as a whole. Washington County in Rhode Island is less diverse and wealthier than the state as a whole. These data do not demonstrate that lower income or minority populations will be disproportionately impacted by the alternatives analyzed within this DEIS.

With respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. While NMFS tracks these issues, there are no federally recognized tribal agreements for subsistence fishing in New England federal waters.

Table 10.1: Demographic data for Northeast Crab/Lobster Trap/Pot Fishing Communities (Counties)

State	County	Key Ports	Median Household Income ($, 2014-2018)	Persons below Poverty Level (2014-2018)	Minority Population (did not report as white alone)[27]
ME	Washington	Beals Island/Jonesport, Cutler, Eastport, Lubec	41,384	18.30%	8.80%
ME	Hancock	Stonington/Deer Isle, Bucksport	53,068	11.60%	4.10%
ME	Waldo	Belfast, Searsport, Northport	51,564	13.70%	3.50%
ME	Knox	Rockland, Vinalhaven, Port Clyde	55,402	11.00%	3.60%
ME	Lincoln	South Bristol, Boothbay Harbor	55,180	11.10%	3%
ME	Sagadahoc	Georgetown, Phippsburg	62,131	8.70%	4.40%
ME	Cumberland	Portland, Harpswell	69,708	8.20%	8.10%
ME	York	Kennebunkport, Cape Porpoise, York	65,538	9.00%	4.30%
NH	Rockingham	Hampton/Seabrook,Portsmouth, Isle of Shoals	90,429	5.30%	5.20%
MA	Essex	Gloucester, Rockport, Marblehead	75,878	10.70%	19.9
MA	Suffolk	Boston Harbor	64,582	17.50%	44.80%
MA	Norfolk	Cohasset	99,511	6.50%	21.60%
MA	Plymouth	Plymouth, Scituate, Hingham	85,654	6.20%	14.7
MA	Barnstable	Sandwich, Hyannis, Chatham, Provincetown, Woods Hole	70,621	8.00%	8.10%
MA	Bristol	New Bedford, Fairhaven, Westport	66,157	10.80%	15.40%
RI	Newport	Jamestown, Newport, Tiverton, Sakonnet Point	77,237	8.10%	10.40%
RI	Washington	Point Judith/Galilee	81,301	8.00%	7%

[27] From United States Census Data, 2018 American Community Survey 5-Year estimates, retrieved May 11, 2020. https://www.census.gov/programs-surveys/acs/

10.13 Executive Order 13158 - Marine Protected Areas

EO 13158 requires each Federal agency whose actions affect the natural or cultural resources that are protected by a Marine Protected Area (MPA) to identify such actions, and, to the extent permitted by law and to the extent practicable, avoid harm to the natural and cultural resources that are protected by an MPA. EO 13158 promotes the development of MPAs by enhancing or expanding the protection of existing MPAs and establishing or recommending new MPAs. The EO defines an MPA as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein."

Pursuant to this order, the Departments of Commerce and the Interior developed a list of MPAs that meet the definition. The Stellwagen Bank National Marine Sanctuary was classified as a MPA. In addition, four Tilefish Gear Restricted Areas in the Mid-Atlantic have been added to the National System of Marine Protected Areas: Lydonia Canyon, Norfolk Canyon, Oceanographer Canyon, and Veatch Canyon. These are the first Federal fishery management areas to become part of the national MPA system. Stellwagen Bank National Marine Sanctuary and Oceanographer and Veatch Canyons within the Tilefish Gear Restricted Areas are the MPAs that overlap the footprint of the proposed action.

This action is not expected to more than minimally affect the biological/habitat resources of MPAs, which was comprehensively analyzed in the Omnibus Habitat Amendment 2 (NEFMC 2016b). Lobster and crab trap/pot fishing gears regulated under this action are unlikely to damage shipwrecks and other cultural artifacts, because fishing vessel operators avoid contact with cultural resources on the seafloor to minimize costly gear losses and interruptions to fishing.

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13 GLOSSARY, ACRONYMS, AND INDEX

13.1 Glossary

Action agency: The Federal agency charged with permitting, conducting, or funding the proposed activity serving as the basis for a consultation under the Endangered Species Act.
Algae: Single-celled or simple multi-cellular photosynthetic organisms.
ALWTRP gear: Gear that is currently or potentially subject to the requirements of the Atlantic Large Whale Take Reduction Plan.
Anchored gillnet: Any gillnet gear, including a sink gillnet or stab net, that is set anywhere in the water column and which is anchored, secured or weighted to the bottom of the sea. Also called a set gillnet.
Annualize: Convert the summation of multi-year discounted value into equalized yearly value for a certain period of time using determined interest rate.
Anthropogenic: Human made.
Baleen whales: Baleen whales (also known as Mysticeti, or mustached whales) are filter feeders that have baleen, a sieve-like device used for filter feeding krill, copepods, plankton, and small fish. They are the largest whales and have two blowholes. Baleen whales include blue, fin, gray, humpback, minke, bowhead, and right whales.
Benthic: The bottom habitat of any aquatic environment.
Berried: Carrying eggs.
Bioaccumulation: The ability of organisms to retain and concentrate substances from their environment. The gradual build-up of substances in living tissue; usually used in referring to toxic substances; may result from direct absorption from the environment or through the food-chain.
Biological opinion: Under the provisions of the Endangered Species Act, an opinion prepared by the Action agency as to whether or not a proposed action is likely to jeopardize the continued existence of a listed species, or adversely modify critical habitat.
Biomagnification: Increasing concentration of a substance in successive trophic levels of a food chain.
Biotoxins: Highly toxic compounds produced by harmful algal blooms (HABs).
Breaking strength: The highest tensile force that an object can withstand before breaking.
Buoy line: A line connecting fishing gear in the water to a buoy at the surface of the water.
Bycatch: Fish that are harvested in a fishery but are not sold or kept for personal use, including economic discards and regulatory discards, but not fish released alive under a recreational catch and release fishery management program.
Carapace: The shield-like exoskeleton plate that covers at least part of the anterior dorsal surface of many arthropods.
Cetaceans: Aquatic mammals, including whales.
Climate change: The term “climate change” is sometimes used to refer to all forms of climatic inconsistency, but because the Earth’s climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, “climate change” has been used synonymously with the term, “global warming;” scientists, however, tend to use the term in the wider sense to also include natural changes in climate.
Compliance costs: All costs associated with adapting vessel operations to meet regulatory requirements.

Copepods: Microscopic crustaceans that are important members of the zooplankton.
Critical habitat: The specific areas within the geographical area occupied by a threatened or endangered species, on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection.
Crustacean: Invertebrates characterized by a hard outer shell and jointed appendages and bodies. Higher forms of this class include lobsters, shrimp and crawfish; lower forms include barnacles.
Days at sea (DAS) allocation: The total days, including steaming time that a boat is permitted to spend at sea fishing.
DDT (dichloro-diphenyl-trichloroethane): An organochlorine insecticide no longer registered for use in the United States.
Depleted: Under the provisions of the Marine Mammal Protection Act, any species or population stock below its optimum sustainable population as determined by the Secretary of Commerce after consultation with the Marine Mammal Commission (MMC) and the Committee of Scientific Advisors on Marine Mammals.
Discount rate: An interest rate used in calculating the discounted cash flow value.
Driftnet: A gillnet that is unattached to the ocean bottom and not anchored, secured or weighted to the bottom, regardless of whether attached to a vessel.
Endangered: Any species that is in danger of extinction throughout all or a significant portion of its range.
Endocrine system: The endocrine system refers to all of the body's hormone-secreting glands. This system works in conjunction with the nervous system to control the production of hormones and their release into the circulatory system.
Entanglement: An event in the wild in which a living or dead marine mammal has gear, rope, line, net, or other material wrapped around or attached to it and is:

a. on a beach or shore of the United States; or
b. in waters under the jurisdiction of the United States (including any navigable waters).

Epifauna: Animals and plants that live on the surface of the seafloor, attached to rocks or moving over the bottom.
Essential Fish Habitat (EFH): Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The EFH designation for most managed species is based on a legal text definition and geographical area that are described in the Habitat Omnibus Amendment (1998).
Eutrophication: A set of physical, chemical, and biological changes brought about when excessive nutrients are released into the water.
Exclusive Economic Zone (EEZ): A zone in which the inner boundary is a line coterminous with the seaward boundary of each of the coastal States and the outer boundary is a line 200 miles away and parallel to the inner boundary
Fathom: A measure of length, containing six feet; the space to which a man can extend his arms; used chiefly in measuring cables, cordage, and the depth of navigable water by soundings.
Fecundity: Fertility or ability to reproduce.
Finfish: Bony fishes such as bass, trout, salmon, goldfish, carp, etc; does not include sharks or rays.
Fishery: The Magnuson-Stevens Fishery Conservation and Management Act defines fishery as "one or more stocks of fish which can be treated as a unit for purposes of conservation and

management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics; and...any fishing for such stocks."

Fishery Management Plan (FMP): A plan developed by a Regional Fishery Management Council, or the Secretary of Commerce under certain circumstances, to manage a fishery resource in the U.S. EEZ pursuant to the MFCMA (Magnuson Act).

Fishing effort: the amount of time and fishing power used to harvest fish. Fishing power is a function of gear size, boat size and horsepower.

Fishing mortality (F): A measurement of the rate of removal of fish from a population caused by fishing. This is usually expressed as an instantaneous rate (F) and is the rate at which fish are harvested at any given point in a year. Instantaneous fishing mortality rates can be either fully recruited or biomass weighted. Fishing mortality can also be expressed as an exploitation rate or, less commonly, as a conditional rate of fishing mortality m, the fraction of fish removed during the year if no other competing sources of mortality occurred. (Lower case m should not be confused with upper case M, the instantaneous rate of natural mortality.)

Float line: The rope at the top of a gillnet from which the mesh portion of the net is hung.

Food web: The complete set of food links between species in an ecosystem.

Fork length: Length of a fish measured from the tip of the snout to the posterior end of the middle caudal rays. This measurement is used instead of standard length for fishes on which it is difficult to ascertain the end of the vertebral column, and instead of total length in fish with a stiff, forked tail, e.g., tuna. Mostly used in fishery biology and not in systematics.

Gear conflict: Interactions between the gear employed by commercial fishing vessels, such as the severing of a buoy line by a dragger.

Gillnet: Fishing gear consisting of a wall of webbing (meshes) or nets, designed or configured so that the webbing (meshes) or nets are placed in the water column, usually approximately vertically. Gillnets are designed to capture fish by entanglement, gilling, or wedging. The term "gillnet" includes gillnets of all types, including but not limited to sink gillnets, other anchored gillnets (e.g., stab and set nets), and drift gillnets. Gillnets may or may not be attached to a vessel. The term is intended to include gillnets with or without tiedowns. Haul/beach seines have bunt/capture bags and wings, and are therefore not considered gillnets for the purposes of the ALWTRP. North Carolina beach-anchored gillnets, which are fished from shore and report their landings as part of the haul/beach seine fishery, are also not considered gillnets for the purposes of the ALWTRP. Nearshore gillnets, which are set from small vessels just off the beach, but are not attached to the beach, are considered gillnets and are regulated under the ALWTRP.

Greenhouse gas: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Ground line/groundline: With reference to trap/pot gear, a line connecting traps in a trap trawl; with reference to gillnet gear, a line connecting a gillnet or gillnet bridle to an anchor.

Harmful algal blooms (HABs): The proliferation of toxic nuisance algae that cause a negative impact to natural resources or humans. The neurotoxins that are emitted, such as saxitoxins, ciguatoxins, domoic acid, and brevitoxins, can be transferred through tropic levels and have a variety of negative health impacts.

Heavy metal: A generic term for a range of metals with a moderate to high atomic weight (e.g., cadmium, mercury, lead). Although many are essential for life in trace quantities, in elevated concentrations most are toxic and bioaccumulate.

Holding power: The force an anchor can withstand before being dragged along or from the bottom.
Hydrocarbons: Organic compounds containing mainly hydrogen and carbon; the basic constituents of fossil fuels.
Injury: A wound or other physical harm. In whales, signs of injury include, but are not limited to, visible blood flow, loss of or damage to an appendage or jaw, inability to use one or more appendages, asymmetry in the shape of the body or body position, noticeable swelling or hemorrhage, laceration, puncture, or rupture of eyeball, listless appearance or inability to defend itself, inability to swim or dive upon release from fishing gear, or signs of equilibrium imbalance. Any animal that ingests fishing gear, or any animal that is released with fishing gear entangling, trailing, or perforating any part of the body is considered injured regardless of the absence of any wound or other evidence of an injury.
Isobath: Line connecting points of equal water depth on a chart; a seabed contour.
Labor cost: the implicit value of time that fishermen could have earned if invested in other jobs/industries.
Landings: The portion of the catch that is harvested for personal use or sold.
Limited access: Describes a fishery or permit for which a vessel must meet certain criteria by a specified "control date" to participate.
List of fisheries (LOF): A list maintained by NMFS that places each commercial fishery into one of three categories. Fisheries are categorized according to the level of serious injury and mortality of marine mammals that occurs incidental to that fishery.
Marine Mammal Commission (MMC): A scientific advisory board comprised of experts that oversees the administration of the Marine Mammal Protection Act.
Marine Mammal Protection Act (MMPA): An Act passed by the United States Congress in 1972 that prohibits the hunting, killing, harassing, or injuring of marine mammals by any person under U.S. jurisdiction; limited exceptions apply.
Model vessel: Representative of a group of vessels that share similar operating characteristics and would face similar requirements under a given regulatory alternative.
Molting: The regular shedding of an outer body covering such as fur, skin, feathers, or, in the case of crustaceans, a shell.
Monofilament: A twine composed of a single yarn.
Multispecies: The group of species managed under the Northeast Multispecies Fishery Management Plan. This group includes whiting, red hake and ocean pout plus the regulated species (cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane flounder, white hake and redfish).
Natural mortality: A measurement of the rate of death from all causes other than fishing, such as predation, disease, starvation, and pollution.
Neonate: A newborn baby in the first few months of life.
Net panel: Sheet of netting often comprising two or more sections joined together.
Night: Any time between one-half hour before sunset and one-half hour after sunrise.
No action alternative: The status quo, i.e., the baseline set of ALWTRP requirements currently in place.
Nonpoint source: A pollution source that cannot be defined as originating from discrete points such as pipe discharge. Areas of fertilizer and pesticide applications, atmospheric deposition, manure, and natural inputs from plants and trees are types of nonpoint source pollution.
Notice of intent: A statement published by NMFS alerting the public to a forthcoming action.

Observer: any person required or authorized to be carried on a vessel for conservation and management purposes by regulations or permits under the MSA.
Odontocetes: The sub-order of whales that includes toothed-whales.
Open access: Describes a fishery or permit for which there are no qualification criteria to participate.
Optimum sustainable population (OSP): The number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element.
Overfished: A conditioned defined when stock biomass is below minimum biomass threshold and the probability of successful spawning production is low.
Overfishing: A level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis.
Ovigerous: Lobsters that are carrying eggs; egg-bearing lobsters.
Pelagic: A term to describe fish that spend most of their life swimming in the open sea with little contact with or dependency on the ocean bottom.
Phase-in costs: The incremental gear conversion costs that fishermen would incur between promulgation of a final rule and full implementation of the rule's provisions several years later.
Phytoplankton: Microscopic marine plants or algae, which are responsible for most of the photosynthetic activity in the oceans.
Pinnipeds: A suborder of carnivorous marine mammals that includes the seals, walruses, and similar animals using finlike flippers for propulsion.
Planktivorous: Feeding on planktonic organisms.
Poaching: The illegal hunting or taking of wildlife out of its natural habitat.
Point source: A single identifiable source that discharges pollutants into the environment. Examples are smokestack, sewer, ditch, or pipe.
Polychlorinated biphenyls (PCBs): A group of industrial chemicals (of the chlorinated hydrocarbon class) that are commonly used and have become serious and widespread pollutants. They are extremely resistant to breakdown and have contaminated most of the earth's food chains, resulting in biomagnification at higher trophic levels. Known to cause cancer.
Potential biological removal (PBR): Maximum number of animals, not including mortalities that can be removed from a stock while allowing that stock to reach its OSP.
Present value: In economics and finance, present value, also known as present discounted value, is the value of an expected stream determined as of the date of valuation.
Prey availability: The availability or accessibility of prey (food) to a predator. Important for growth and survival.
Profile: The outline of fishing line in the water column, i.e., the amount of line that lies in the water column.
Protected Species: As used in this document, protected species refers to any species protected by either the ESA or the MMPA, and which is under the jurisdiction of NMFS. This includes all threatened, endangered, and candidate species, as well as all cetaceans and pinnipeds excluding walruses.
Quota: A pre-determined total catch of a particular species allowed to be harvested in a season.
Reasonable and prudent alternatives: Alternative actions identified during a formal ESA consultation that (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the Action agency's legal authority and jurisdiction; (3) are economically and technically feasible; and (4) avoid the likelihood of

jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Recovery factor: A factor used in calculating PBR. It accounts for endangered, depleted, or threatened stocks or stocks of unknown status relative to OSP.

Recruitment: The amount of fish added to the fishery each year due to growth and/or migration into the fishing area. For example, the number of fish that grow to become vulnerable to fishing gear in one year would be the recruitment to the fishery. "Recruitment" also refers to new year classes entering the population (prior to recruiting to the fishery).

Ropeless fishing: Ropeless fishing refers to fixed gear fishing without the use of persistent buoy lines to mark and retrieve gear. Often includes the use of timed or remotely controlled technology to retrieve floating devices and buoy lines in fixed gear fisheries.

Scarification analysis: An analysis to determine the cause or potential causes for scars found on a whale's body.

Section 7 consultation: The consultation with the Secretary of Commerce that occurs when a proposed Federal action may affect an ESA-listed marine species.

Serious injury: Any injury that is likely to result in mortality.

Ship strike: A collision between a ship and a whale.

Sink gillnet or stab net: Any gillnet, anchored or otherwise, that is designed to be, or is fished on or near the bottom in the lower third of the water column.

Sinking line: rope that sinks and does not float at any point in the water column. Polypropylene rope is not sinking unless it contains a lead core.

Spawning stock biomass (SSB): The total weight of fish in a stock that are old enough to reproduce.

Species: As defined in the Endangered Species Act (ESA), a species, a subspecies, or, for vertebrates only, a distinct population.

Splice: A joint made by interweaving strands of line together.

Stock: A grouping of fish usually based on genetic relationship, geographic distribution and movement patterns. A region may have more than one stock of a species (for example, Gulf of Maine cod and Georges Bank cod). A species, subspecies, geographical grouping, or other category of fish capable of management as a unit.

Stock assessment: Study to determine the number (abundance/biomass) and status (life-history characteristics, including age distribution, natural mortality rate, age at maturity, fecundity as a function of age) of individuals in a stock.

Stranding: An event in which a marine mammal is dead on a beach, shore, or waters under U.S. jurisdiction; or alive on a beach or shore and unable to return to the water or in need of medical attention, or in waters under U.S. jurisdiction and unable to return to its natural habitat without assistance.

Strategic stock: Under the provisions of the MMPA, a marine mammal stock for which the level of direct human-caused mortality exceeds the potential biological removal level (PBR). Stock which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA of 1973 in the foreseeable future; or which is listed as a threatened species or endangered species under the ESA of 1973; or is designated as depleted under the MMPA.

Substrate: Ocean floor.

Take: As defined in the Marine Mammal Protection Act (MMPA), to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.

Threatened: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Toggle: A small buoy used to keep a net or line upright in the water column.
Total length: A fish's greatest length, as measured from the most anterior point of the body to the most posterior point, in a straight line, not over the curve of the body.
Trawl: A series of three or more pots linked together by lines, surface lines, and buoys being placed at intervals, or at the first and last pot.
Trawling up: Increase the minimum number of traps per set of gear (trawl).
Trophic level: The position of a species in a food chain, indicating its level of energy transfer in the ecosystem.
Turbidity: A measurement of the extent to which light passing through water is reduced due to suspended materials; relative water clarity.
Up and down lines: The line that connects the floatline and leadline at the end of each net panel.
Useful life: Under typical circumstances, the length of time a piece of gear can be used before replacement is necessary.
Vessel Monitoring System (VMS): Wireless information system that automatically reports fishing vessel position and activity to NMFS.
Vertical Line: Synonymous with buoy line, a line connecting fishing gear in the water to a buoy at the surface of the water
Water column: The open ocean environment that lies between the surface and the sea floor.
Weak insert (or weak insertion): A modification or addition to line to allow it to part when subject to a tension load greater than 1700 lbs (e.g. a sleeve or knot).
Weak link: A breakable component of gear that will part when subject to a certain tension load.
Weak line or rope: Rope that will part when subject to a tension load greater than 1700 lbs.
Wet storage: Leaving gear in the water for extended periods of time. ALWTRP regulations prohibit wet storage (i.e., require that lobster traps and anchored gillnet gear must be hauled out of the water at least once every 30 days).
Zero mortality rate goal: The requirement for commercial fisheries to reduce incidental mortality and serious injury of marine mammals to insignificant levels approaching a zero mortality and serious injury rate, as identified in the MMPA. An insignificance threshold has been established as 10 percent of the Potential Biological Removal (PBR) of a stock of marine mammals (See 69 FR 43338 for further details).
Zooplankton: *See Phytoplankton*. Small, often microscopic animals that drift in currents. They feed on detritus, phytoplankton, and other zooplankton. They are preyed upon by fish, shellfish, whales, and other zooplankton.

13.2 Acronyms

ACFCMA Atlantic Coastal Fisheries Cooperative Management Act
ALWTRP Atlantic Large Whale Take Reduction Plan
ALWTRT Atlantic Large Whale Take Reduction Team
ASMFC Atlantic States Marine Fisheries Commission
CEA Cumulative Effects Analysis
CETAP Cetacean and Turtle Assessment Program
CFR Code of Federal Regulations
COLREGS Demarcation Line for the International Regulations for Preventing Collisions at Sea,

1972

DAM Dynamic Area Management
DDT Dichloro Diphenyl Trichloroethane
DEIS Draft Environmental Impact Statement
DMR (Maine) Department of Marine Resources
DPS Distinct Population Segment
EEZ Exclusive Economic Zone
EFH Essential Fish Habitat
EIA Energy Information Administration
EIS Environmental Impact Statement
EO Executive Order
EPA Environmental Protection Agency
ESA Endangered Species Act of 1973
FEIS Final Environmental Impact Statement
FMP Fishery Management Plan
FR Federal Register
FRED Federal Reserve Economic Data
FRFA Final Regulatory Flexibility Analysis
FY Fishing Year
GARFO Greater Atlantic Regional Fisheries Office
GMRI Gulf of Maine Research Institute
GOM Gulf of Maine
HAB Harmful Algal Blooms
HAPC Habitat Areas of Particular Concern
ICES International Council for the Exploration of the Sea
IRFA Initial Regulatory Flexibility Analysis
IUCN International World Conservation Union
IWC International Whaling Commission
LCMA Lobster Conservation Management Area
LCMT Lobster Conservation Management Teams
LMA Lobster Management Area
LOF List of Fisheries
MAFMC Mid-Atlantic Fishery Management Council
MMPA Marine Mammal Protection Act
MSA Magnuson-Stevens Act of 1976
NAO NOAA Administrative Order
NEFMC New England Fishery Management Council
NEFSC Northeast Fisheries Science Center
NEPA National Environmental Policy Act of 1969
NGO Non-Governmental Organization
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
NOI Notice of Intent
OCS Outer Continental Shelf
OTP Other Trap/Pot
PBR Potential Biological Removal

PCB Polychlorinated Biphenyl
PPRFFAs Past, Present, and Reasonably Foreseeable Future Actions
RFA Regulatory Flexibility Act
RFAA Regulatory Flexibility Act Analysis
RIR Regulatory Impact Review
SAM Seasonal Area Management
SAR Stock Assessment Report
SARC Stock Assessment Review Committee
SSB Social Science Branch
STSSN Sea Turtle Stranding & Salvage Network
TEWG Turtle Expert Working Group
TRP Take Reduction Plan
USCG United States Coast Guard
VEC Valued Ecosystem Component
VMS Vessel Monitoring System
VTR Vessel Trip Report
WTP willingness to pay