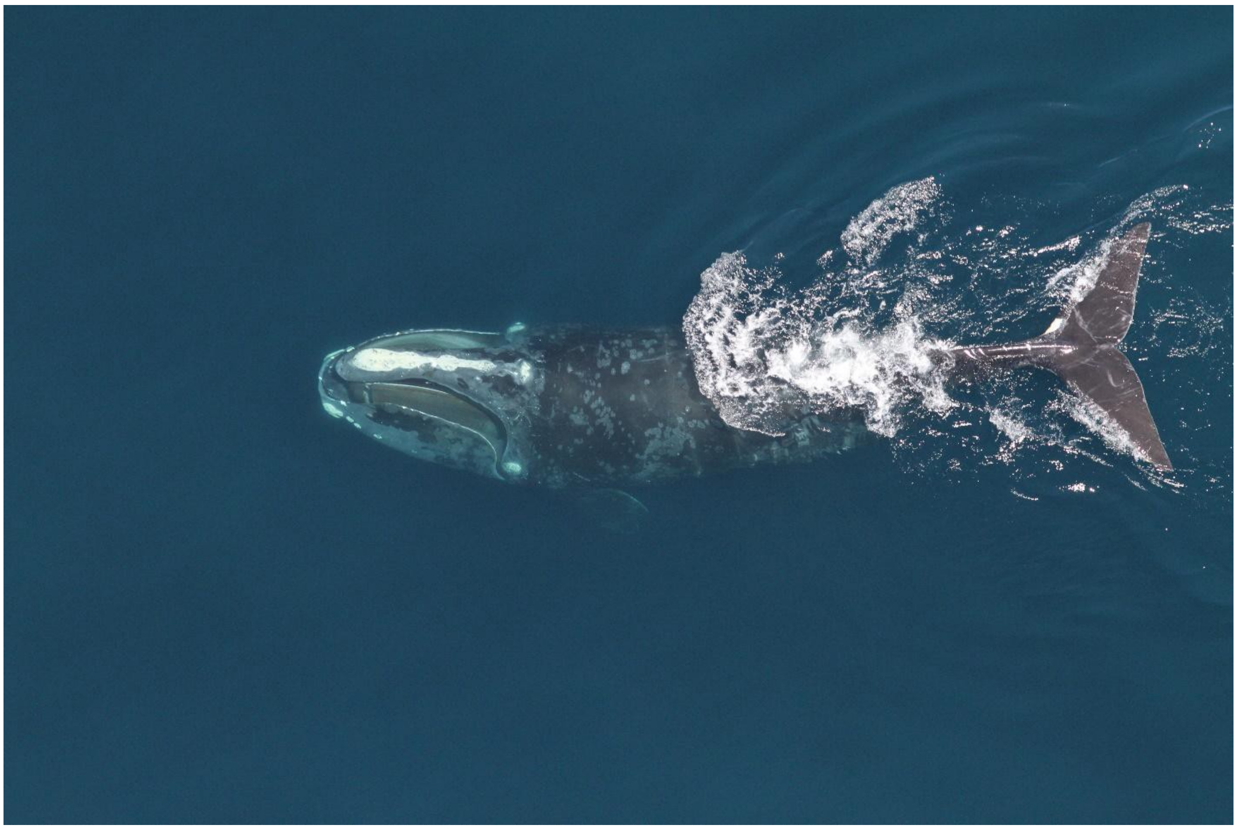
FINAL ENVIRONMENTAL IMPACT STATEMENT, REGULATORY IMPACT REVIEW, AND FINAL REGULATORY FLEXIBILITY ANALYSIS FOR AMENDING THE ATLANTIC LARGE WHALE TAKE REDUCTION PLAN: RISK REDUCTION RULE

VOLUME I



Images collected under MMPA Research permit number MMPA 775-1875 Photo Credit: NOAA/NEFSC/Christin Khan

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

Prepared by: NOAA's National Marine Fisheries Service and Industrial Economics, Incorporated
Final EIS: June 2021

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 through Rhode Island and the Northeast portion of LMA 3.

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:
( ) DRAFT (X) FINAL

FOR FURTHER INFORMATION CONTACT:

Jennifer Anderson
Assistant Regional Administrator for Protected Resources National Marine Fisheries Service, Northeast Region
55 Great Republic Drive Gloucester, MA 01930
978-281-9328

TABLE OF CONTENTS

CHAPTER 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 (hereafter referred to as 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 a rate 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 mortalities and serious injuries caused by incidental entanglements at rates above the 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. The National Marine Fisheries Service (NMFS) intends to modify the Plan, including additional regulatory requirements, to further reduce the risk of entanglement related mortalities and serious injuries of right whales in the Northeast Region Trap/Pot Management Area (Northeast Region) lobster and Jonah crab trap/pot gear.

This Final Environmental Impact Statement (FEIS) evaluates the biological, economic, and social impacts of alternatives for modifying the Plan, including NMFS' Preferred Alternative and the Final Rule 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 FEIS 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

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 PBR– 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 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 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 population model estimates a population size of 368 as of 2019 (Pace 2021). Pettis et al. (2021) gives an estimate of 356 in 2020 removing known mortalities since the latest population estimate used in the report (366). Since 2019, there have been 10 additional documented mortalities or serious injuries. 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 has been set to 0.8 (Pace et al. 2017, Hayes et al. 2020, Pettis et al. 2021, Pace 2021).

- **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 population size is 1,396 and the minimum population size is 1,380 at the end of 2017, and has established a PBR of 22 whales per year (Hayes et al. 2020).

- **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 7,418 at the end of 2017, a minimum population size of 6,029, and PBR of 12 (Hayes et al. 2020)

- **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 24,202 at the end of 2017, with a minimum population estimate of 18,902 and PBR of 189 (Hayes et al. 2020).

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.

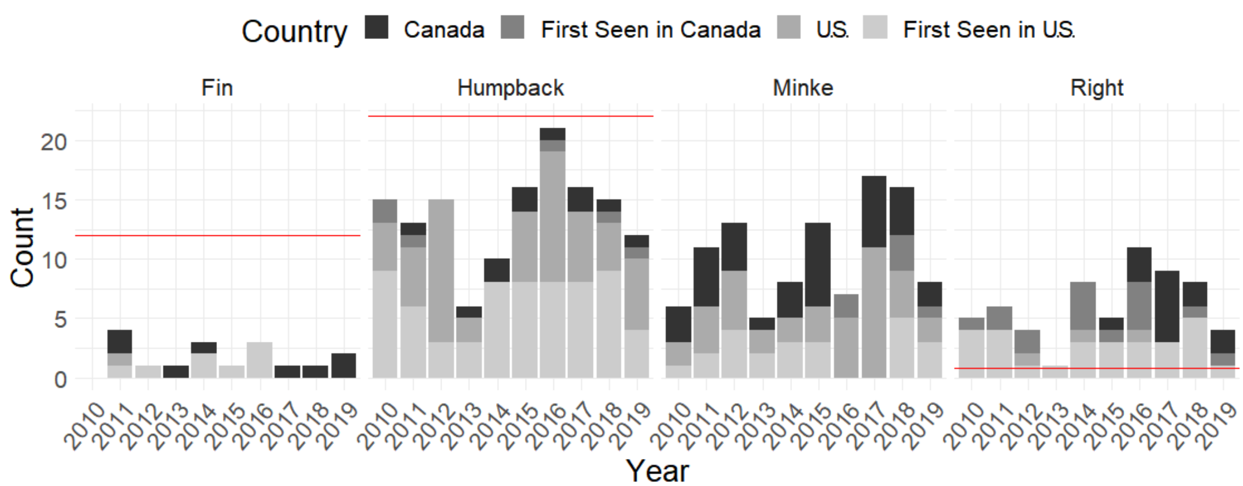


Figure 1.1: Entanglements that resulted in mortality of serious injury, according to the country of origin or country where the incident was first sighted. Incidents with prorated injuries and where serious injury was averted by disentanglement response are included as mortalities and serious injuries. The red line represents the current potential biological removal level (PBR) for the stock (PBR for minke whales is 189 and not pictured due to scale).

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 2019 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 mortalities and serious injuries have been higher than the other large whale species (287), followed by humpback (268), right (89), and fin whales (67). Of all large whale species, only right whale serious mortalities and injuries exceed PBR nearly every year. As Figure 1.1 illustrates, PBR has been exceeded in every year except for one (2013) considering only entanglements in U.S. gear or entanglements first seen in U.S. waters since 2010. Actual mortalities and serious injuries of right whales in U.S. fisheries are likely higher than the number observed in the Stock Assessment Reports, with an estimated 64 percent of all mortalities going undetected between 1990 and 2017 (Pace et al. 2021). 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 (MRA), effective in 2014 and 2015) mortalities and serious injuries of right whales in U.S. gear and first seen in the U.S. at levels above PBR persist.

In this same timeframe, between 2009 and 2017, Pettis et al. (2018a) observed an increased calving interval from an average of four to 10 years. Recent low birth rates are an increasing concern for 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 2020 (Pettis et al. 2021). During the 2020/2021 calving year there were 17 live calves documented in 2021 (B. Zoodsma pers. comm.). While the number of births is encouraging, it is lower than would have been forecasted from the large number of calves born over a decade ago and follows persistent low birth years that are insufficient to counteract current population mortality rates (Pace 2021), increasing concern regarding current levels of entanglement mortality. 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).

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). As described in Chapters 4 and 8, mortalities and serious injuries 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 mortalities and serious injuries by ship strike and entanglements in Canadian waters, and persistent mortalities and serious injuries of right whales above PBR in U.S. waters, is not sustainable.

The primary purpose of the alternatives analyzed in this FEIS is to reduce mortality and serious injury by entanglements in U.S. Northeast Region lobster and Jonah crab trap/pot gear to below PBR. The vast majority of buoy lines along the east coast belong to lobster and crab trap/pot fisheries in northeast waters. The 2017 IEC Line Model, which was developed to estimate the number of buoy lines fished by fisheries managed under the Plan (documentation in Appendix 5.1), estimated 93 percent of the buoy lines in U.S. waters 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 FEIS focuses on the northeast lobster and Jonah crab fisheries to facilitate rapid rulemaking. The Atlantic Large Whale Take Reduction Team (ALWTRT or Team) has been informed of the intention to consider other fixed gear fisheries, coast-wide during the next ALWTRT deliberations.

NMFS estimated in 2019 that to reduce mortality and serious injury below PBR, entanglement risk across U.S. fisheries needed 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 purposes of creating a risk reduction target, NMFS assigned half of these unknown incidents to U.S. fisheries to calculate the 60 percent minimum target, which assumed 50 percent of all entanglements occurred in the U.S. (i.e., lower bound). The 80 percent upper bound of the target range considered estimated undocumented mortalities generated by a population model available at the time that estimates unobserved mortality (Hayes et al. 2020), and assumed 50 percent of all incidents occurred in U.S. waters. 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 ALWTRT focused on recommendations to achieve the lower 60 percent target.

This risk reduction range discussed in Chapter 2 differs from those presented in the Draft Environmental Impact Statement (DEIS) and those presented to the Team in 2019 due to the incorporation of new data. New population models now suggest that up to 64 percent of right whale mortalities and serious injuries are unobserved (Pace et al. 2021), which were used to estimate new upper bound risk reduction estimates. This FEIS explores updated draft mortality and serious injury determinations for 2012 through 2020 to determine how the target might change using more recent information and varying apportionment assumptions. NMFS considered several new methods for determining a minimum and maximum risk reduction target by testing different country and cause attributions to see how robust the 60 to 80 percent target is to these assumptions (see Table 2.4 in Chapter 2). The lower bound estimates ranged from 47 to 66 percent and the upper bound from 78 to 90 percent using data between 2010 and 2018. The lower of these estimates would assume only 30 percent of entanglements occur in the US and as low as 50 percent of those would be entanglements at the upper bound. Because it is known known that unknown and unobserved mortality occurs to some extent, the lowest estimate of 47 percent risk reduction would very likely be insufficient so NMFS is retaining the 60 percent minimum risk reduction target. For the upper target, our updated analyses demonstrate this target should be around 80 percent or more. Therefore, 80 percent is still the upper target risk reduction considered in this FEIS but as new data are finalized the minimum and maximum targets may change in the future.

Large whale entanglement data and the rationale for the scope of the alternatives considered in this FEIS are described in greater detail in Chapter 2: Purpose and Need. 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, reductions in prey availability, and mortality and serious injury outside of

U.S. waters 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 ALWTRT 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 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 FEIS 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 the Plan modifications is to reduce the mortality and serious injury of the 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 trap/pot buoy lines by specifying a low (no greater than 1,700 pounds/771 kilograms) maximum breaking strength for buoy line or inserts within the buoy line, 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 ALWTRT 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 risk reduction alternatives analyzed in the FEIS, arranging the requirements by lobster management area and geographic region (where appropriate). The dark gray highlighted text represents regulations that will be implemented by a state or through ongoing or upcoming fishery management practices. OC = Outer Cape

Component	Area	Alternative 2 (Preferred)	Alternative 3
Restricted Areas	All existing and new 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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.	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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.
	LMA 1 Restricted Area, Offshore ME LMA 1/3 border, zones C/D/E	Oct – Jan	Oct – Feb
	South Island Restricted Area	Feb – April: Area from Non-preferred A in DEIS.	Feb – May: L-shaped area closed to buoy lines.
	Massachusetts Restricted Area	Credit for Feb-Apr, state water in MRA have a soft opening until May 15th, until no more than three whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA and LMA 1/OC state waters unless surveys confirm that right whales have left the area.
	Massachusetts Restricted Area North	Feb-Apr: Expand MRA north in MA state waters to NH border	Feb-Apr: Expand MRA north in MA state waters to NH border
	Georges Basin Restricted Area	-	Closed to buoy lines May through August.
Line Reduction	ME exemption line – 3 nm (5.6 km), Zones A, B, F, G	3 traps/trawl	-
	ME exempt area – 3 nm (5.6 km), Zones C, D, E	Status quo (two traps/trawl)	-
	ME 3 (5.6 km) – 6 nm*, Zone A West**	8 traps/trawl per two buoy lines or 4 traps/trawl per one buoy line	Line allocations capped at 50 percent of average monthly lines in federal waters
	ME 3 (5.6km) – 6 nm*, Zone B	5 traps/trawl per one buoy line	
	ME 3 (5.6 km) – 6 nm*, Zones C, D, E, F, G	10 traps/trawl per two buoy lines or 5 traps/trawl per one buoy line	Same as above
	ME 3 (5.6 km) – 12 nm (22.2 km), Zone A East**	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
Line	ME 6* – 12 nm (22.2	15 traps/trawl per two buoy lines or 8 traps/trawl per	Same as above

Component	Area	Alternative 2 (Preferred)	Alternative 3
Reduction Continued	km), Zone A West**	one buoy line	
	ME 6* – 12 nm (22.2 km), Zone B, D, E, F	10 traps/trawl per two buoy lines or 5 traps/trawl per one buoy line (status quo in D, E, & F)	Same as above
	ME 6* – 12 nm (22.2 km), Zone C, G	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
	MA LMA 1, 6* – 12 nm (22.2 km)	15 traps/trawl	Same as above
	LMA 1 & OC 3 – 12 nm (5.6 – 22.2 km)	15 traps/trawl	Same as above
	LMA 1 over 12 nm (22.2 km)	25 traps/trawl	Same as above
	LMA 3, North of 50 fathom line on the south end of Georges Bank	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)
	LMA 3, South of 50 fathom line on the south end of Georges Bank	Year-round: 35 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
	LMA 3, Georges Basin Restricted Area	Year-round: 50 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	-
	LMA 3	Existing and anticipated 12% reduction in buoy lines	-
Buoy Weak Link	Northeast Region	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system	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
Weak Line	ME Exempt State Waters	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exemption line – 3 nm (5.6 km)	1 weak insertion 50% down the line	Same as above
	MA State Waters	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	NH State Waters	1 weak insertion 50% down the line	Same as above
	RI State Waters	Weak inserts every 60 ft (18.3 m) in top 75% of line or full weak line	Same as above
	ME Zone A West**, B, C, D, E; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above
	ME Zone A East**, F, and G; federal waters 3 – 12 nm (5.6 – 22.2 km)	1 weak insertion 33% down the line	Same as above

Component	Area	Alternative 2 (Preferred)	Alternative 3
	MA and NH LMA 1 , OC; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above
	LMA 1 & OC over 12 nm (22.2 km)	1 weak insertion 33% down the line	Same as above
	LMA 2	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	LMA 3	One buoy line weak year round to 75%	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" down to 20%
Gear Marking	State Waters	One 3 ft (91.4 cm) long state-specific colored mark in surface system within 2 fa of buoy in addition to at least two 1 ft (30.5 cm) marks that must be changed to state color	One 3 ft (91.4 cm) long state-specific colored mark in surface system within 2 fa of buoy and require identification tape indicating home state and fishery woven through buoy line
	Federal waters, except LMA3	Add one 3 ft (91.4 cm) long state specific colored mark within 2 fa of the buoy, at least three 1 ft (30.5 cm) marks that must be changed to state color, and four 1 ft (30.5 cm) long green marks must be added within 6 in. of each state specific mark	One 3 ft (91.4 cm) long state-specific colored mark in surface system within 2 fa of buoy and require identification tape indicating home state and fishery woven through buoy line
	LMA3	Add one 3 ft (91.4 cm) long black mark within 2 fa of the buoy line to existing three 1 ft (30.5 cm) marks in black and add four 1 ft (30.5 cm) long green marks within 6 in. of each black mark	One 3 ft (91.4 cm) long black mark in surface system within 2 fa 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).
**Maine Zone A East is the portion of Zone A that is east of 67°18.00' W and Maine Zone A is west of this longitude.

Chapter 3 describes in detail the regulatory alternatives including how they were created and analyzed in this FEIS. Briefly, 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 1, the status quo. The DST aids in the comparison of spatial management measures by calculating right whale entanglement risk based on three components: the density of lines in the water, the distribution of whales, and a gear threat model to determine the relative threat of gear based on gear strength (see Appendix 3.1). The proposed suites of risk reduction elements achieve at least the 60 percent minimum risk reduction target. This target was identified by NMFS as the minimum target necessary to reduce mortalities and serious injuries to below PBR. Alternative 2 (Preferred) is largely made up of recommendations from the states, the Atlantic Offshore Lobstermen's Association, public scoping, and public comment. The alternatives in this FEIS were modified from the Draft Environmental Impact Statement (DEIS) in response to comments that take into account whale density, safety concerns, and conservation equivalencies. See Section 1.5 for a summary of comments received and 1.6 for the changes in the alternatives in this FEIS from the DEIS.

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 (dark gray) and measures that would be implemented through federal rulemaking analyzed within this FEIS. For reference, Figures 1.2 and 1.3 show the scope of the Northeast Region and include the new seasonal restricted areas that would allow fishing without buoy lines, analyzed under each alternative.

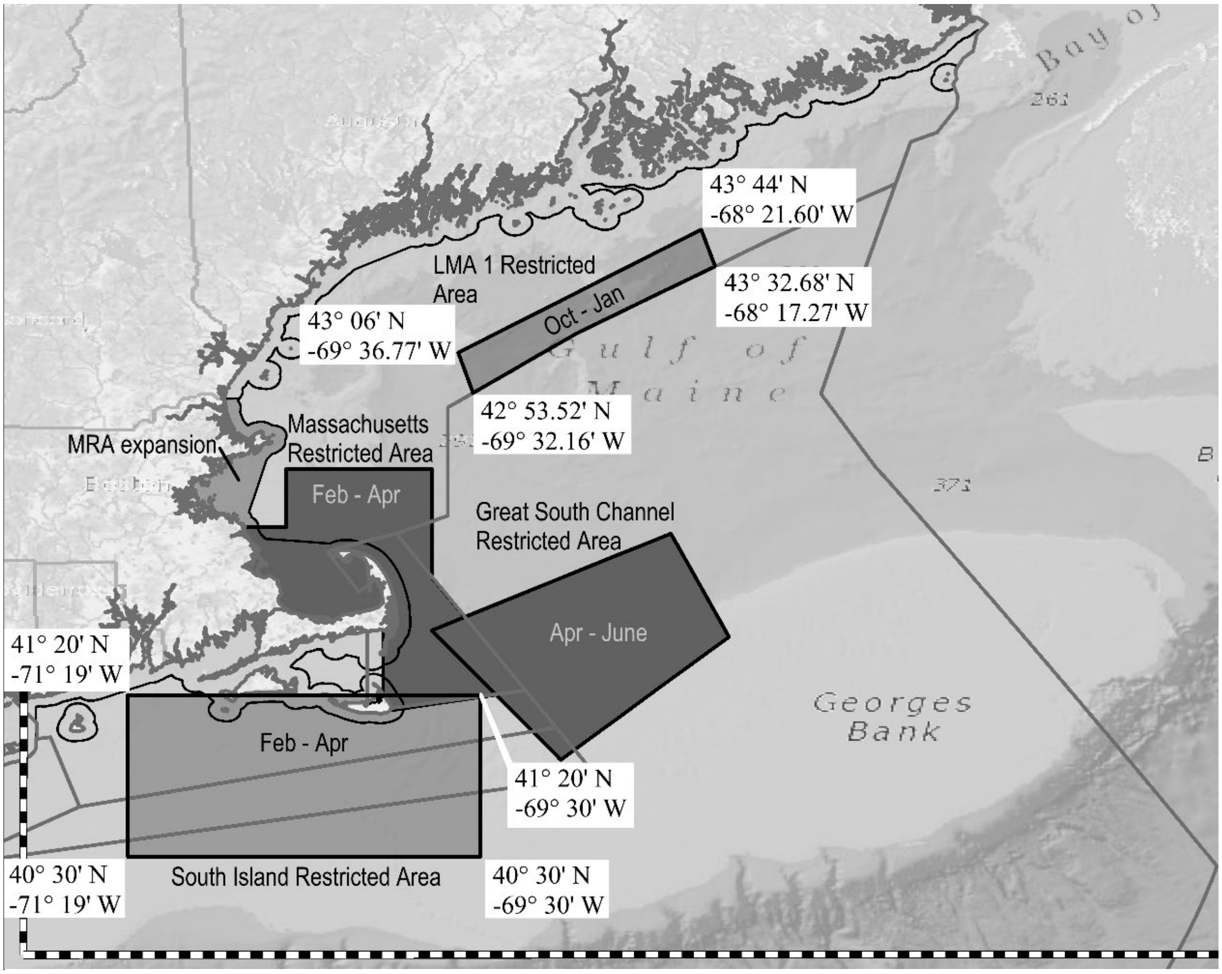


Figure 1.2: The trap/pot buoy line closure areas in Alternative 2 (Preferred). LMAs are delineated by the grey lines. The new South Island Restricted Area would be closed to trap/pot buoy lines from February through April and the LMA 1 Restricted area from October through January. An expansion of the MRA into Massachusetts state waters to the New Hampshire border and extended in state waters in LMA 1 and the Outer Cape through at least May 15th, with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of federal waters in the Outer Cape LMA from February through March. This change may encourage some ropeless gear testing and accelerate the development of ropeless fishing and associated long-term benefits to right whales. The area north and east of the checked line and west of the EEZ encompasses the Northeast Region.

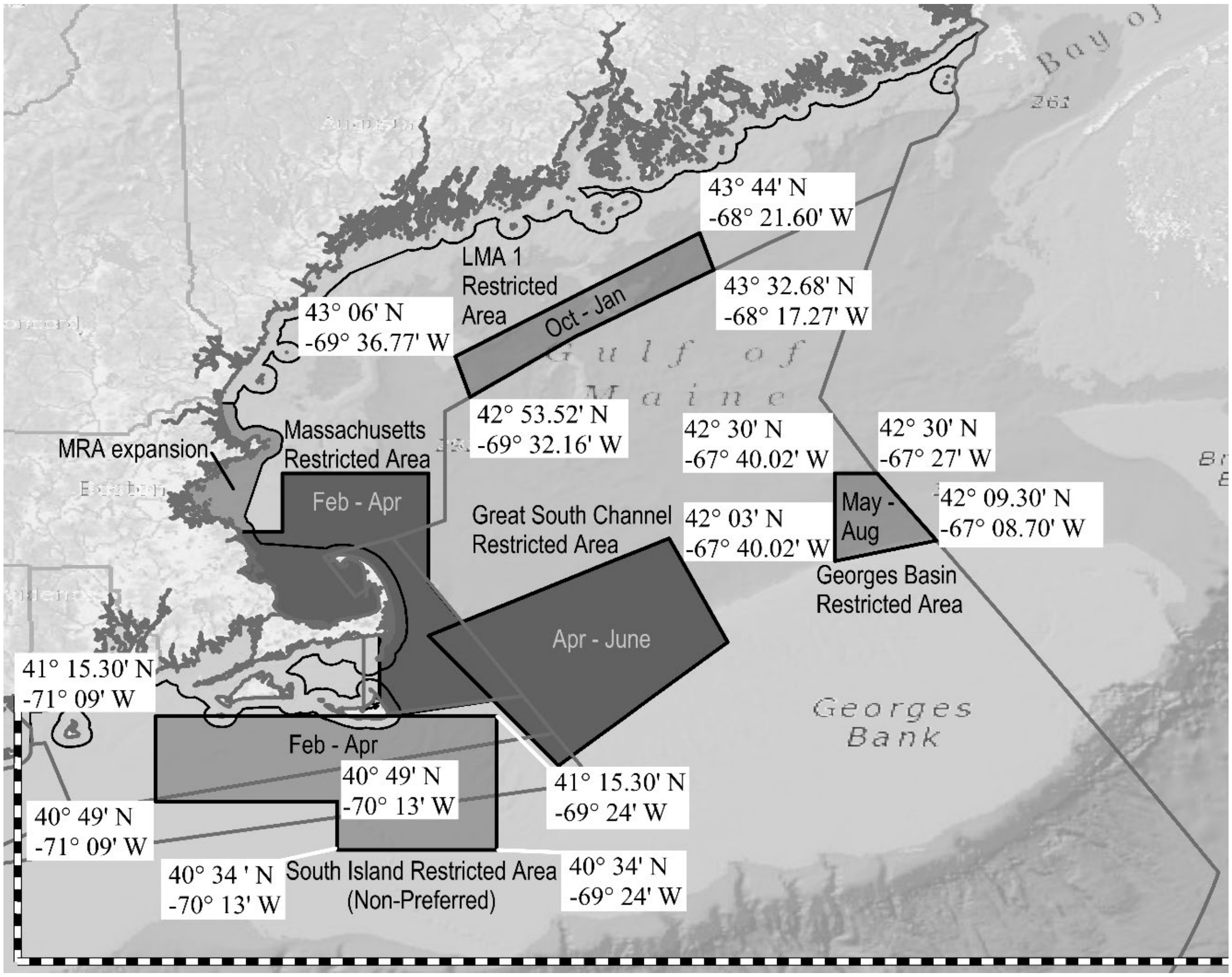


Figure 1.3: The buoy line restriction options in Alternative 3 (Non-preferred). There are two different options for a restricted area south of Cape Cod from February through April, a large restricted area (3a) and an L-shaped restricted area (3b). The LMA 1 Restricted Area would be from October through February. The Georges Basin Restricted Area would be 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. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of federal waters in the Outer Cape LMA from February through March. This change may encourage some ropeless gear testing and accelerate the development of ropeless fishing and associated long-term benefits to right whales. The area north and east of the checked line and west of the EEZ encompasses the Northeast Region.

Alternative 1 (No Action): Under Alternative 1, NMFS would continue with the status quo Plan requirements currently in place (Appendix 2.1).

Alternative 2 (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. The Massachusetts Restricted Area would be expanded into Massachusetts state waters north to the New Hampshire border from February through April in both state regulations and the final rule. Additionally, all state waters within the Massachusetts Restricted Area would be closed by

Massachusetts until May 15th until surveys demonstrate that whales have left the area. Two new seasonal restricted areas would be created that would allow fishing without the use of persistent buoy lines: one in LMA 1 from October through January and one south of Cape Cod from February through April. Fishing without the use of persistent buoy lines would be allowed during these seasons, outside of Cape Cod Bay and the Outer Cape Cod Lobster Management 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 pounds (771 kilograms). This Alternative also includes more robust gear marking requirements that differentiate buoy lines by state, includes unique marks for federal waters, and expands into areas previously exempt from gear marking.

Alternative 3: 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 waters throughout the Northeast except in offshore LMA 3. A seasonal increase in the minimum traps per trawl requirement would be implemented in LMA 3. Additionally, under this alternative, existing closures would be modified to allow fishing without the use of persistent buoy lines. The Massachusetts Restricted area would be extended into state waters north to the New Hampshire border and the entire area would allow 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 1 Restricted Area, an extended restricted period for the South Island Restricted Area, and a summer restricted area north of Georges Bank within Georges Basin. Fishing without the use of persistent buoy lines would be allowed during these seasons, outside of Cape Cod Bay and the Outer Cape Cod Lobster Management area. Additional measures include conversion of the top 75 percent of all lobster and crab trap/pot buoy lines outside of LMA 3 to weaker rope with a maximum breaking strength of 1,700 pounds (771 kilograms). Within LMA 3, buoy lines would be required to convert the top 20 percent of all lines to a maximum of 1,700 pounds (771 kilograms) breaking strength or the equivalent with a seasonal requirement for the extension of one of two weak buoy lines down to 75 percent. The alternative also includes more robust gear marking throughout the buoy line that differentiates buoy 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 5.3 of this FEIS discusses the potential impact of these requirements on reducing the risk of large whale entanglements and associated mortality and serious injury. The major strategies to reduce risk include:

Line Reduction Requirements: Measures to reduce the number of buoy 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 for line allocations in federal waters considered in Alternative 3 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 2 (Preferred) considers two new seasonal restricted areas and Alternative 3 proposes three new seasonal restricted areas. Both alternatives would expand the MRA north into LMA 1 state waters to the New Hampshire border.

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 a maximum of 1,700 pounds (771 kilograms) for substantial lengths of the buoy line or to require weak insertions at varying depths on the buoy line. The specified maximum strength of rope or weak inserts is based on a study that suggested that, if a right 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 lobster and Jonah crab trap/pot buoy lines, predicted right whale habitat density (Roberts et al. 2020), and risk of different gear configurations. In developing the alternatives, the DST was used as described in Chapter 3 to estimate that Alternative 2 (Preferred) achieves greater than 60 percent risk reduction (at least 68 percent with the inclusion of the MRA credit) and Alternative 3 achieves over 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 impact analysis uses both quantitative (produced by the DST) and qualitative indicators to facilitate a comparison of the regulatory alternatives for all large whales as related to the objectives above. First, percent reduction of buoy lines and reduction in co-occurrence between whales and buoy lines to reduce entanglement likelihood. Second, the mean line strength and change in gear threat of rope in buoy lines that are weakened to reduce the likelihood of a serious injury or mortality in the event of an entanglement. The co-occurrence value estimated in the NMFS DST used in this FEIS is an index, integrated across the northeast spatial grid, indicating the degree to which whales and the buoy lines employed in lobster and crab 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. Habitat density models produced by Duke University were used to examine co-occurrence for right, humpback, and fin whales (Roberts et al., 2020). Co-occurrence does not consider the risk of different gear configurations, which is integrated into the total risk reduction estimate.

Table 1.2: The summary of all quantitative measures for each alternative, including the percent change in annual buoy lines, reduction in co-occurrence, and change in line strength and gear threat due to weak line measures. The risk reduction and co-occurrence estimates with and without the credit for the implementation of the MRA are shown according to risk reduction estimates in Chapter 3 (with the upper and lower bound estimates provided for weak inserts) and the Biological Impact Analysis in Chapter 5, which used only the 2017 baseline without the MRA credit to compare the alternatives.

Alternative:	1 (i.e. baseline)	2 (Preferred)	3 (Non-preferred)
Line Reduction		***% Reduction***	***% Reduction***
Risk Reduction		60%	72%
Risk Reduction (with MRA Credit)		69% – 73%	
Line Reduction		7%	7%
Co-Occurrence		**% Reduction**	**% Reduction**
Right Whale		54%	60%
Right Whale (with MRA Credit)		65%	
Humpback Whale		12%	19%
Fin Whale		14%	17%
Weak Line			
Mean Line Strength	2162	1976	1753
Change in Line Strength		9%	19%
Change in Gear Threat		17%	29%

The results of the biological impact analysis are summarized in Table 1.2 and evaluate the percent reduction in buoy lines, reduction of co-occurrence of buoy lines, and the change in gear threat from buoy lines under each action alternative relative to the no action alternative (Alternative 1). The percent reduction in line is estimated to be approximately seven percent under both alternatives but differ in the amount of estimated co-occurrence reduction between buoy lines and large whales.

- Alternative 2 (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 54 to 65 percent, depending on whether the MRA is included (i.e. the baseline model chosen).
- Alternative 3 includes a 50 percent line cap allocation in federal waters, trawling up requirements in LMA 3, and additional seasonal restricted areas and is estimated to reduce co-occurrence by approximately 60 percent.

Both alternatives also convert a portion of buoy line from full strength rope to weakened rope that either is manufactured with a maximum breaking strength of 1,700 pounds (771 kilograms) or includes inserts with the same maximum breaking strength spaced throughout the line. The baseline mean rope strength is estimated at 2,162 pounds (981 kilograms) with a skewed distribution where most estimated breaking strengths are between 1,000 and 4,000 pounds (453 to 1,814 kilograms), with some upwards of 8,000 pounds (3,628 kilograms) or more. For this analysis, inserts placed at least every 40 feet (12.2 meters, i.e. equal to or shorter than the average length of an adult right whale) are considered to be equivalent to full weak rope.

- Alternative 2 (Preferred) proposes weak inserts in all buoy lines, but very few inserts relative to inserts every forty feet. Alternative 2 will reduce line strength by nine percent for an average of 1,976 pounds (896 kilograms) per buoy line. Within this alternative, weak rope is a precautionary measure to reduce serious injury and mortalities if whales are entangled. Weak insertions are required down to 50 percent in the rope in nearshore areas but only down to 33 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 3 reduces line strength by 19 percent to an average 1,753 pounds (795 kilograms) per buoy line. Under this alternative, most areas would require full weak line in the top 75 percent of all buoy lines with the exception of LMA 3.

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 5.4 and 5.5 of this FEIS, 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 6 evaluates the economic and social impacts of Alternatives 2 and 3 relative to the status quo (Alternative 1), 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 incremental 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 fishery management measures that are being phased in or are reasonably foreseeable through other regulatory actions are not analyzed in the FEIS.

The first year costs of all new federal regulatory measures for Alternative 2 including gear marking, weak rope, restricted areas, and trawling up costs range from $9.8 million to $19.2

million. As described in Chapter 6, 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 3 range from $32.8 million to $44.6 million. Thus, the costs associated with Alternative 2 are well under one third the total costs associated with Alternative 3.

Alternative 2 achieves less reduction in co-occurrence between buoy lines and large whales than Alternative 3. The co-occurrence model suggests right whale co-occurrence would be reduced by approximately 65 percent with the MRA credit (54 percent without). The costs associated with the co-occurrence reduction (trawling up and buoy line restricted area) under Alternative 2 range from $2.9 million to $10.8 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 2 is estimated at $54,000 to $199,000.

Alternative 3 performed better at reducing large whale co-occurrence than Alternative 2, achieving a co-occurrence reduction of 60 percent. This alternative would increase the likelihood of achieving the higher target that takes into account estimated right whale mortalities. However, the first year costs associated with co-occurrence reduction in Alternatives 3 (trawling up, buoy line restricted area, federal water line caps) are substantially higher, ranging from $7.8 million to $19.5 million dollars; or $130,000 to $325,000 for each unit of co-occurrence reduction. That is, each risk reduction unit of Alternative 3 would cost more than two or three times the cost per risk reduction unit in Alternative 2.

Analysis of the weak rope modification measures are similar, with Alternative 3 performing better but at a high cost. Final modifications in Alternative 2 would weaken the rope in buoy lines by approximately 9 percent, with an estimated cost of $2.2 million dollars, about $250,000 for each percent of rope strength reduction (Table 1.4). Alternative 3 would weaken rope in buoy lines by 19 percent, with an estimated cost of $10.6 million or about $557,000 for each percent of rope strength reduction.

Table 1.3: A summary of initial compliance costs associated with trawling up, buoy line closures, and a line cap (2020 dollars) compared to co-occurrence reduction for each alternative without the MRA credit.

	Alternative 2	Alternative 3
Trawling Up Lower	$1.6 million	$1.0 million
Trawling Up Upper	$8.8 million	$2.0 million
New Buoy Line Closure Lower	$1.3 million	$3.0 million
New Buoy Line Closure Upper	$2.0 million	$4.1 million
Line Cap Lower		$3.9 million
Line Cap Upper		$13.4 million
Total Lower	$2.9 million	$7.8 million
Total Upper	$10.8 million	$19.5 million

	Alternative 2	Alternative 3
Co-occurrence Reduction Score	54%	60%

Chapters 6 and 9 provide 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 2 achieves the purposes laid out in Chapter 2 of this FEIS while minimizing the potential economic impacts of the final modifications to the Plan. That is, while Alternative 3 was estimated to achieve higher co-occurrence reduction and risk reduction than the preferred alternaitve, both the total costs and per-unit risk reduction costs were much higher than the selected alternative and the implementing measures in the final rule. Therefore, Alternative Two achieves the purpose and need for action, but with less economic impact on all regulated entities.

Table 1.4: A summary of annualized Federal Plan modification compliance costs related to weak line.

	Percent reduction in rope strength	First year cost of converting to weak rope
Alternative 2	9	$2.2 million
Alternative 3	19	$10.6 million

According to the estimation in the IEc Vertical Line Model, there are 3,970 vessels in lobster and Jonah crab trap/pot fisheries in the Northeast Region except for Maine exempt waters (which will be regulated by the state of Maine). These represent 3,460 unique entities including 3,458 small entities. Impacts do not appear to be disproportionate across small and large entities. These vessels fish for lobster and Jonah crab. Under Alternatives 2 and 3, 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 2 would affect 1,206 vessels, slightly fewer than the 1,565 vessels affected by the Alternative 3 line reduction measures (line caps, trawling up in LMA 3). Federally regulated seasonal buoy line closures of Alternative 2 would affect up to 256 vessels, compared to more than 501 vessels affected by the buoy line closures under Alternative 3. Chapter 6 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 2020 lobster landings in Hancock and Knox Counties each exceeded $100 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*

NMFS has identified Alternative 2 as the Preferred Alternative in this FEIS. The alternative includes measures largely drawn from proposals from the Team, New England states, input from fishermen, and public comments. Measures were aggregated and evaluated using the DST, which estimated that Alternative 2 would achieve at least a 60 percent risk reduction in the northeast lobster and Jonah crab trap/pot fisheries through a substantial reduction in entanglement risk via co-occurrence and the reduction in threat of severe entanglement through the introduction of weak rope or inserts into buoy lines. Alternative 2 includes concurrent fishery management measures and measures implemented by Maine and Massachusetts for fishermen in exempted or state waters that would reduce entanglement risk to right whales. Alternative 2 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 ALWTRT made to NMFS in April 2019 Team 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 primarily include 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 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. One is a large South Islands Restricted Area south of Cape Cod and the LMA 1 Restricted Area was included to boost the LMA 1 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 MRA. The Preferred Alternative and Final Rule would also expand the size of the MRA north into Massachusetts State waters to the New Hampshire border.

Analysis of Alternative 2 using the DST estimated a high reduction in right whale co-occurrence (65 percent, 54 without the MRA). 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 2 also includes precautionary weak insert and weak rope requirements across all lobster and crab trap/pot trawls, reducing line strength by nine percent and gear threat by 17 percent. 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 2 would have a much lower economic impact relative to the federal measures under Alternative 3.

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 buoy lines as well as by the reduction in mean line strength and threat of buoy lines to reduce the severity of entanglement injuries. By these measures, Alternative 3, with the largest number of restricted areas, offers the greatest protection to all large whales unless the MRA credit is taken into account within Alternative 2. This Alternative is estimated to reduce co-occurrence by 60 percent for right whales, 19 percent for humpback whales, and 17 percent for fin whales. The buoy lines in the Northeast would be weakened by 19 percent and the gear threat of those lines would be reduced by an estimated 29 percent. Alternative 2 offers less benefit, with a reduction in co-occurrence without consideration of the MRA of 54, 12, and 14 percent for right, humpback, and fin whales respectively. However, the MRA is critical to right whale conservation, the Team recommended this credit in the final rule, and it was implemented shortly before the 2017 buoy line baseline year. With the MRA credit, co-occurrence is reduced by approximately 65 percent under Alternative 2. Buoy lines would be weakened by nine percent and gear threat of those lines by 17 percent. 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 2 as its Preferred Alternative. The reduction in co-occurrence achieved under this alternative is considerable, particularly when the MRA credit is included as recommended by the ALWTRT. 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 3 is greater than that achieved under Alternative 2 (Preferred) when compared using the same baseline (i.e. without the MRA restricted area) but at nearly three times the cost, 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 3 applies more restricted areas and even greater percent reduction in buoy line strength, compared to Alternative 2. 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 2 are at least two thirds lower than the costs of implementing Alternative 3, making Alternative 2 the most cost-effective of the alternatives. Additionally, the measures in Alternative 2 were derived primarily from proposals submitted by the states, from the public comment period, and were informed by extensive outreach with fishermen in those states and in the LMA 3 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 2, the Preferred Alternative, addresses the Purpose and Need for Action stated in this FEIS, 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. On this basis, NMFS believes that Alternative 2 (Preferred) offers the best option for achieving compliance with MMPA requirements.

1.5 Public Comment

1.5.1 *Public Scoping and Comments Received*

On August 2, 2019, we published a Notice of Intent to Prepare an Environmental Impact Statement and Request for Comments regarding Atlantic Large Whale Take Reduction Plan Modifications (84 FR 37822). As part of the scoping process, we held eight public meetings at locations around New England between August 8 and 21, 2019:

1. Thursday, August 8, 2019—Narragansett, RI, 6 p.m. to 9 p.m. URI Graduate School of Oceanography, Corless Auditorium, 215 South Ferry Road, Narragansett, RI 02882
2. Monday, August 12, 2019—Machias, ME, 6 p.m. to 9 p.m. University of Maine at Machias, Performing Arts Center, 116 O'Brien Avenue, Machias, ME 04654
3. Tuesday, August 13, 2019—Ellsworth, ME, 6 p.m. to 9 p.m. Ellsworth High School Performing Arts Center, 24 Lejok Street, Ellsworth, ME 04605
4. Wednesday, August 14, 2019—Waldoboro, ME, 6 p.m. to 9 p.m. Medomak Valley High School, 320 Manktown Road, Waldoboro, Maine 04572
5. Thursday, August 15, 2019—Portland, ME, 6 p.m. to 9 p.m. South Portland High School, 637 Highland Ave., South Portland ME, 04106
6. Monday, August 19, 2019—Portsmouth, NH, 6 p.m. to 9 p.m. Urban Forestry Center, 45 Elwyn Road, Portsmouth, NH 03801
7. Tuesday, August 20, 2019—Gloucester, MA, 6 p.m. to 9 p.m. NMFS Greater Atlantic Region, 55 Great Republic Drive, Gloucester, MA 01930
8. Wednesday, August 21, 2019—Bourne, MA, 6 p.m. to 9 p.m. Upper Cape Cod Regional Technical School, 220 Sandwich Rd., Bourne, MA 02352

These eight public meetings were attended by more than 800 stakeholders. We received more than 89,200 written comments during this process, of which the majority were campaign postcards organized by various non-governmental groups, including Natural Resources Defense Council (39,559), Conservation Law Foundation (859), Defenders of Wildlife (8,755), as well as various other online campaigns (39,805). We also received letters 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 we received more than 50 unique letters from fishermen providing details about their fishing practices by mail, as well as 125 form letters. By email, we received more than 120 unique comments, including 30 emails from fishermen or fishing families. Eleven representatives from environmental organizations sent letters and emails, and we received more than 89,000 emails associated with at least 12 non-governmental organizations' campaigns. For a complete list of comments and how they were addressed, please see Appendix 1.1 and Volume 3.

After receiving and reviewing these comments, we developed the Final Rule to Amend the Atlantic Large Whale Take Reduction Plan to Reduce Risk of Serious Injury and Mortality to

North Atlantic Right Whales Caused by Entanglement in Northeast Crab and Lobster Trap/Pot Fisheries and Draft Environmental Impact Statement.

1.5.2 *Public Comments on DEIS*

We published the Proposed Rule to Amend the Atlantic Large Whale Take Reduction Plan to Reduce Risk of Serious Injury and Mortality to North Atlantic Right Whales Caused by Entanglement in Northeast Crab and Lobster Trap/Pot Fisheries and Draft Environmental Impact Statement on December 31, 2020. A 60-day public comment period began on December 31, 2020, and ended on March 1, 2021 (85 FR 86878, December 31, 2020).

Oral Comments
In January 2021, we held four public information sessions and in February 2021, we held four public hearings, all virtual due to the global pandemic. The sessions were organized by region, though everyone was welcome to attend any session. Although the purpose of the January meetings was to provide information and answer questions, we accepted oral comments on the proposed rule and the Draft Environmental Impact Statement (DEIS) at all eight meetings. See Tables 1.5 and 1.6 for a breakdown of participants that attended the information sessions and public hearings.

Information Sessions

1. Rhode Island, Southern Massachusetts and LMA3, Tuesday, January 12, 2021, 6:30-8:30 pm
2. Massachusetts (Outer Cape and LMA1) and New Hampshire (LMA1), Wednesday, January 13, 2021, 6:30-8:30 pm
3. Southern Maine, Tuesday, January 19, 2021, 6:30-8:30 pm
4. Northern Maine, Wednesday, January 20, 2021, 6:30-8:30 pm

Table 1.5: Nightly attendance for the proposed rule and DEIS information sessions held in January 2021

Session	**Participants**
Jan. 12, RI, Southern MA, LMA3	79
Jan. 13, Outer Cape MA, LMA1, MA and LMA1 NH	79
Jan. 19, Southern Maine	73
Jan. 20, Northern Maine	85
Total Attendees	316
Total Unique Registrants	**230**
Attended 1 Session	166
Attended 2 Sessions	48
Attended 3 Sessions	10
Attended all 4 Sessions	6
Attended more than one session	64

Public Hearings

1. Rhode Island, Southern Massachusetts and LMA3, Tuesday, February 16, 2021, 6:30-8:30 pm
2. Massachusetts (Outer Cape and LMA1) and New Hampshire (LMA1), Wednesday, February 17, 2021, 6:30-8:30 pm
3. Southern Maine, Tuesday, February 23, 2021, 6:30-8:30 pm

4. Northern Maine, Wednesday, February 24, 2021, 6:30-8:30 pm

A total of 211 people ask questions or provided comments through these informational sessions and public hearings. Of these, at least 59 identified themselves as fishermen on the calls. About 77 commenters voiced support for this rule or strengthening this rule, while 44 generally opposed the rule or questioned the need for a rule. Many people had questions or wanted clarification on particular parts of the rule, but did not specifically voice either support or opposition.

Table 1.6: Nightly attendance for the proposed rule and DEIS public hearings held in February 2021

Session	Participants
Feb. 16, RI, Southern MA, LMA3	112
Feb. 17, Outer Cape MA, LMA1, MA and LMA1 NH	123
Feb. 23, Southern Maine	234
Feb. 24, Northern Maine	344
Total Attendees	813
Total Unique Registrants	**635**
Attended 1 Session	517
Attended 2 Sessions	76
Attended 3 Sessions	24
Attended all 4 Sessions	18
Attended more than one session	118

To see summaries of the comments made at public information sessions and hearings, please see Appendix 1.1 and Volume 3. Table 1.7 below summarizes the commenters and the key themes of their statements. Responses to comments are available in Appendix 1.1.

Written Comments

We received 171,213 comments on the Proposed Rule and the Draft Environmental Impact Statement (DEIS) through the comment portal. Of these, six comments from Non-Governmental Organizations were entered as counting for more than one comment:

- Pew Charitable Trusts: 47,699
- Conservation Law Foundation: 1,192
- Humane Society of the U.S: 15,922
- Oceana: 18,440
- Natural Resources Defense Council: 33,045
- Riverkeepers: 4

Five additional comments from Non-Governmental Organization were entered as one comment, but had thousands of signatures attached:

- International Fund for Animal Welfare: 31,912
- Whale and Dolphin Conservation: 3,629
- Environment America: 11,727
- Center for Biological Diversity: 26,594
- Environmental Action: 11,135

All of the above-referenced comments, which represent up to 201,269 people, were in favor of stronger regulations to protect North Atlantic right whales. They strongly favored the following measures: longer and larger restricted areas, increased gear marking, transition to ropeless gear, and a risk reduction target of more than 60 percent. While many were in favor of weak rope or weak link requirements, many also voiced concerns that 1700 lb breaking strength has not been proven to reduce entanglements and could still severely entangle juveniles and calves. In addition, the vast majority urged NMFS to use the most updated population data in setting risk reduction targets and recommended the use of emergency measures to take action immediately.

After accounting for the bulk submissions, we received 53,585 comments uploaded through the regulations.gov portal, as well as 9 comments emailed directly to our office, 3 of which were added to Regulations.gov, and are included in the 53,585 total above. After running a deduplication analysis, identifying additional campaign emails not detected by the deduplication analysis, and reviewing the entries for double submissions or submissions of supporting documentation separate from the original comment letter, we received approximately 1,076 unique comments that were not clearly part of a coordinated campaign. We received 28 comments from academic/scientific individuals or organizations, 2 federal agencies, 1 federal resource manager, 2 fishery management associations, 10 fishing industry associations, 2 manufacturers, 71 non-governmental organizations, 617 members of the public, 300 fishermen, 2 representatives from other industries, 32 state/federal legislators, 7 state fishery resource managers, and 2 towns.

A total of 122 speakers submitted comments orally at public information sessions or public hearings. Many of the speakers submitted more than one comment, and several submitted comments at more than one session. If an individual commented at more than one session, the individual was counted as a unique speaker on each day. We received 2 comments from academic/scientific individuals or organizations, 3 fishing industry associations, 27 non-governmental organizations, 27 members of the public, 59 fishermen, 2 state fishery resource managers, and 2 state/federal legislators.

As many of the speakers who submitted comments orally also submitted comments through the Regulations.gov portal, we considered each individual's comments, both oral and written, as one submission. This gives us a total of 1,129 unique submissions. Combining both written and oral submissions, and excluding duplicates, we received submissions from 28 academic/scientific individuals or organizations, 2 federal agencies, 1 federal resource manager, 2 fishery management associations, 10 fishing industry associations, 2 manufacturers, 76 non-governmental organizations, 628 members of the public, 336 fishermen, 2 representatives from other industries, 33 state/federal legislators, 7 state fishery resource managers, and 2 towns.

Of the 336 unique commenters who identified themselves as fishermen, either directly or through context, 312 voiced opposition to all or part of the rule, 19 commented on particular provisions, but did not expressly support or oppose, and 5 supported the general idea of the rule, though had specific comments on some measures. Of the ten fishing industry groups, eight opposed all or part of the rule, one gave specific recommendations, but did expressly support or oppose, and one supported the general idea of the rule. The primary concerns raised by fishermen are that right whales are not in the areas that they fish and this rule will not protect right whales, but instead will place a large economic burden on fishermen with no benefit for the whales (>147);

the economic impact of this rule will put them out of business and devastate coastal communities (>126); and that ropeless fishing is not yet and may never be feasible on a large scale (>105).

Of the 628 unique commenters who identified themselves as members of the public, either directly or through context, the vast majority (534) supported this rule, but expressed the opinion that the rule did not go far enough to protect right whales, with 84 suggesting NMFS use emergency authority to implement immediate protections for whales. Only 54 expressed opposition to the rule. A small number suggested that this rule should be withdrawn because it does not provide adequate levels of protection for right whales, and NMFS should start over.

To summarize, overall, nearly 59 percent of unique commenters supported the Proposed Rule in whole or in part, with the majority expressing the opinion that the proposed regulations should be strengthened to provide more protection to right whales. A little over 34 percent of commenters opposed the rule in whole or in part, and about 4 percent suggested that the rule should be scrapped because it does not provide adequate levels of protection for right whales, and NMFS should start over. About 4 percent of commenters did not express support or opposition, but suggested specific measures or strategies that NMFS should employ. In addition, about 14 percent of commenters (who had either supported the rule or suggested starting over) wanted NMFS to take emergency action.

Table 1.7 below summarizes the substantive comments received on the proposed rule and DEIS, and provides information on how we responded to the comments. Our responses to these comments are available in Appendix 1.1. In the Appendix, we categorize the comments according to the topic identified in written statements or oral testimony regarding the proposed action and alternatives. We first summarize the topic category, and then provide specific comments, and responses to each. Responses may refer to portions of the FEIS or Final Rule that have been modified as a result of comments. We also made changes to the FEIS and the Final Rule in response to the comments, where appropriate, including updates to data where the comments affect the impact analysis. Technical or editorial comments on the DEIS merely pointing out a mistake or missing information were addressed directly in the body of the FEIS and Final Rule.

NMFS identified a total of 187 distinct substantive comments that were within the scope of the current rulemaking. The majority of these comments were submitted by multiple people, some of them by thousands of people.

Section 1.4.3 below serves as a guide for reviewing the comments and should not substitute for reading the comments directly. See FEIS Volume III for a more complete description of the comments received.

1.5.3 *Response to Comments*

When preparing a FEIS, an agency must address comments received on the DEIS, either by modifying the alternatives in the DEIS, supplementing the DEIS alternatives, revising the analyses, making factual corrections, or explaining why the comments do not warrant further agency response (40 CFR 1503.4). In the table below, we identify the major topics and subtopics we received, and where we provided responses.

Table 1.7: A summary of comments received on the Proposed Rule and DEIS as well as where to find the responses to the comment, organized by subtopics.

Topic	Subtopic	Comment	Response
Collaboration with Canada	Apportionment	Split of 50/50 of unknown entanglement cases	Appendix 1.1, Comment 1.1
	Fishery	Canada's regulations insufficient	Appendix 1.1, Comment 1.2
	Research	More collaboration with Canada needed	Appendix 1.1, Comment 1.3
	Bilateral	Maine DMR should be involved in bilateral discussions	Appendix 1.1, Comment 1.4
Economics	Economic Effects	Competition with Canada	Appendix 1.1, Comment 2.1
		Costs of LMA1	Appendix 1.1, Comment 2.2
		Disentanglement costs	Appendix 1.1, Comment 2.3
		Economic analysis of benefits of ropeless fishing	Appendix 1.1, Comment 2.4
		Economic benefits of weak lines	Appendix 1.1, Comment 2.5
		Economic cost of prior rules	Appendix 1.1, Comment 2.5
		Effects on fishermen from other states (CT, NY)	Appendix 1.1, Comment 2.6
		Fleet consolidation	Appendix 1.1, Comment 2.7
		Gear conversion/replacement savings	Appendix 1.1, Comment 2.8
		Gear marking time and labor	Appendix 1.1, Comment 2.9
		Gear loss due to changes required by rule	Appendix 1.1, Comment 2.10
		Include cost of gear marking done in anticipation of rule	Appendix 1.1, Comment 2.11
		NMFS should analyze economic effects to supply chain	Appendix 1.1, Comment 2.12
		Socioeconomic effects/culture/heritage	See FEIS Section 6.7
	Economic Assistance	Buybacks	Appendix 1.1, Comment 2.13
		Compensation for fishermen	Appendix 1.1, Comment 2.14
		Institute a lobster/crab tax to support fishermen	Out of Scope
	Economic Analysis	Costs of AIS/vessel tracking systems	Appendix 1.1, Comment 2.15
		Ecological value of whales	Appendix 1.1, Comment 2.16
		Issue with Casco Bay Ferry Line data	Out of Scope

Topic	Subtopic	Comment	Response
		Meyers and Moore 2020 Paper	Appendix 1.1, Comment 2.17
		Equipment durability	Appendix 1.1, Comment 2.18
		Use of dealer data	Appendix 1.1, Comment 2.19
		Fails to analyze reduced catch	Appendix 1.1, Comment 2.20
Enforcement	Compliance	NMFS should develop comprehensive plan	Appendix 1.1, Comment 3.1
		Monitor/patrol offshore	Appendix 1.1, Comment 3.2
		Enforce regs in different areas	Appendix 1.1, Comment 3.3
		Enfrorce regulations on offshore dumping	Out of Scope
Gear Marking	Evaluation	3-year evaluation period	Appendix 1.1, Comment 4.1
	Exemptions	Hand-haulting	Appendix 1.1, Comment 4.2
	Manufacturers	NMFS should work with manufacturers	Out of Scope
	More specific gear marks	Individual ID tags	Appendix 1.1, Comment 4.3
		Subdividing areas	Appendix 1.1, Comment 4.4
	Requirements	NMFS should not add any gear-marking requirements	Appendix 1.1, Comment 4.5
		Should apply to all fisheries in migratory path	Appendix 1.1, Comment 4.6
		Should be required every 17 fathoms	Appendix 1.1, Comment 4.7
		Sinking groundlines	Appendix 1.1, Comment 4.8
		Visibility of gear marks	Appendix 1.1, Comment 4.9
		Gear marking every 40 feet	Appendix 1.1, Comment 4.10
	Timing	Implement during the off-season	Appendix 1.1, Comment 4.11
	Visual or acoustic	Could visual or acoustic cues alert whales to lines in the water	Appendix 1.1, Comment 4.12
Legal Issues	APA	APA - Refusal to Evaluate Some Strategies	Appendix 1.1, Comment 5.1
	EO 12898	EO 12898 - Violates	Appendix 1.1, Comment 5.2
	ESA	ESA - Authorization of fisheries violates	Appendix 1.1, Comment 5.3
	MMPA	MMPA - Violates by Allocating Full PBR to Pot/Trap Fishery	Appendix 1.1, Comment 5.4
		MMPA - Violates by Considering Economics in Alternatives	Appendix 1.1, Comment 5.5
		MMPA - Violates by Not Meeting ZMRG Within 5 Years	Appendix 1.1, Comment 5.6

Topic	Subtopic	Comment	Response
		MMPA - Violates by Not Reducing PBR in 6 Months	Appendix 1.1, Comment 5.7
		MMPA - ALWTRP may not prevent decline of right whales	Appendix 1.1, Comment 5.8
		MMPA - State Measures Should Be Included in the Final Rule	Appendix 1.1, Comment 5.9
	NEPA	NEPA - “Purpose and Need” Statement Too Narrow	Appendix 1.1, Comment 5.10
		NEPA - CEQ’s Recent Amendments	Appendix 1.1, Comment 5.11
		NEPA - Did Not Consider a “No Commercial Fishing” Alternative	Appendix 1.1, Comment 5.12
		NEPA - Did Not Evaluate a Reasonable Range of Alternatives	Appendix 1.1, Comment 5.13
		NEPA - Rejected Trap Reductions	Appendix 1.1, Comment 5.14
	Multiple	NEPA/APA - DEIS Did Not Analyze All Risks	Appendix 1.1, Comment 5.15
		NEPA/APA - Did Not Consider Dynamic Area Management	Appendix 1.1, Comment 5.16
		MMPA/ESA - Regulations Are Not Effective and Immediate	Appendix 1.1, Comment 5.17
		MMPA/NEPA/APA - Violated Best Scientific Information Available	Appendix 1.1, Comment 5.18
	Unconstitutional	Exceeds authority of unelected officials	Appendix 1.1, Comment 5.19
Line/Effort Reduction	Buyback program	NMFS should establish a buyback program	Appendix 1.1. Comment 2.13
	Latent effort	Properly account for latent effort	Appendix 1.1, Comment 6.1
	Reduce Effort	Cap endlines	Appendix 1.1, Comment 6.2
		Cap and reduce licenses	Appendix 1.1, Comment 6.3
		Remove half the traps from the water	Appendix 1.1, Comment 6.4
Management	Adaptive Management	Should reassess and recalibrate measures on regular basis	Appendix 1.1, Comment 7.1
		Should develop another process	Appendix 1.1, Comment 7.2
	Apportionment	Split of 50/50 of unknown entanglement cases	Appendix 1.1, Comment 1.1
	Areas	Should include southeast states in future rulemakings	Appendix 1.1, Comment 7.3
	Disentanglement Teams	Fishermen should be part of disentanglement teams	Appendix 1.1, Comment 7.4
	Emergency Rulemaking	Close all fisheries or all areas	Appendix 1.1, Comment 7.5
		Shut down high seas transport	Out of Scope
		Implement year-round closure for South Island area	Appendix 1.1, Comment 7.6
		Seasonal closures in Gulf of Maine	Appendix 1.1, Comment 7.7

Topic	Subtopic	Comment	Response
		Remove verticals lines in areas of high co-occurrence	Appendix 1.1, Comment 7.8
	Evaluation	How will regulation be evaluated?	Appendix 1.1, Comment 7.9
		Past regulations should be evaluated before adding new ones	Appendix 1.1, Comment 7.10
	Fisheries	NMFS should ban/reduce commercial fisheries	Appendix 1.1, Comment 7.11
		Harvester reporting	Appendix 1.1, Comment 7.12
		Should be managed like multispecies fishery	Appendix 1.1, Comment 7.13
	MMPA Mandate	Regulations won't bring the right whales back	Appendix 1.1, Comment 7.14
	Other whale species	Effects of regulations on other species	Appendix 1.1, Comment 7.15
	Risk Reduction Target	Cryptic mortality taken into account?	Appendix 1.1, Comment 7.16
		Focus on areas of high occurrence	Appendix 1.1, Comment 7.17
	Risk Reduction Calculations	ASMFC Pending Measures Should Not Be Counted in Analyzing Risk Reduction	Appendix 1.1, Comment 7.18
		Changes to MA regulations	Appendix 1.1, Comment 7.19
		Conservation Equivalences	Appendix 1.1, Comment 7.20
		If Maine funds GPS trackers, should get risk reduction credit	Appendix 1.1, Comment 7.21
		LMA3 - 50% endline reduction v. closed area/gear displacement	Appendix 1.1, Comment 7.22
		State credits	Appendix 1.1, Comment 7.23
		Proposal evaluations	Appendix 1.1, Comment 7.24
		Threat of gear based on water column	Appendix 1.1, Comment 7.25
		Validity of the threat component of the DST	Appendix 1.1, Comment 7.26
		Uncertainty in DST	Appendix 1.1, Comment 7.27
	Timing	Implementation timing	Appendix 1.1, Comment 7.28
	Language Clarification	From previous regulations	Appendix 1.1, Comment 7.29
	Trap tags	Rule applies to all traps with trap tags	Appendix 1.1, Comment 7.30
	Justification	Benefit to whales not sufficient to justify rule	Appendix 1.1, Comment 7.31
	Recreational fisheries	Should be eliminated	Appendix 1.1, Comment 7.32
Research	Entanglements	Effects of entanglements on birth rates	Appendix 1.1, Comment 8.1
		Healthy whales capable of avoiding lines	Appendix 1.1,

Topic	Subtopic	Comment	Response
			Comment 8.2
		Mechanical engineers should study cause of entanglements	Appendix 1.1, Comment 8.3
		Monitor whale entanglements with satellites and observers	Appendix 1.1, Comment 8.4
		No Maine lobster gear involved in entanglements	Appendix 1.1, Comment 8.5
		Gillnet and netting more prevalent	Appendix 1.1, Comment 8.6
	Data Insufficient	Line density model too uncertain	Appendix 1.1, Comment 8.7
		Model overestimates right whale mortalities	Appendix 1.1, Comment 8.8
		Monitor whale travel routes	Out of Scope
		NMFS should use acoustic/prey data, longer/shorter time series	Appendix 1.1, Comment 8.9
		PBR based on outdated population data	Appendix 1.1, Comment 8.10
		Peer-reviewed science required	Appendix 1.1, Comment 8.11
	Distribution	Data on distribution flawed/incomplete	Appendix 1.1, Comment 8.12
		Migratory patterns of whales in Area 2?	Appendix 1.1, Comment 8.13
		NMFS should increase aerial, boat-based, and drone surveys	Appendix 1.1, Comment 8.14
		NMFS should tag and track whales	Appendix 1.1, Comment 8.15
		NMFS should use spotter planes to alert fishermen to whales	Appendix 1.1, Comment 8.16
		Whale distribution has changed due to climate change/copepod distribution	Appendix 1.1, Comment 8.17
		Whales do not occur in inshore Maine waters, no need for rules	Appendix 1.1, Comment 8.18
		Whales not injured by Massachusetts fishing gear	Appendix 1.1, Comment 8.19
		Whales traveling to Iceland and Labrador, not dead, as model says	Appendix 1.1, Comment 8.20
Restricted Areas	Broad Application	Should apply to all fisheries/mobile gear fishermen	Appendix 1.1, Comment 9.1
	Dynamic Closures	NMFS should implement dynamic closures based on presence of whales	Appendix 1.1, Comment 9.2
	Effects	Effort displacement/crowding in other areas	Appendix 1.1, Comment 9.3
		Mobile gear fishermen	Appendix 1.1, Comment 9.4
		Walls of dense gear	Appendix 1.1, Comment 9.5
	Georges Bank	Add Georges Bank Restricted Area	Appendix 1.1, Comment 9.6
	Gulf of Maine	3 seasonal closures recommended by Pew	Appendix 1.1, Comment 9.7

Topic	Subtopic	Comment	Response
	Justification	Changes in whale distribution	Appendix 1.1, Comment 9.8
		Use best available data	Appendix 1.1, Comment 9.9
	Seasonal Closures	LMA 1 trigger	Appendix 1.1, Comment 9.10
		LMA1 "hotspot" designation based on old data	Appendix 1.1, Comment 9.11
		LMA 1 hotspot designation based on improper calculation	Appendix 1.1, Comment 9.12
		LMA1 should be closed in the fall, not spring	Appendix 1.1, Comment 9.13
		LMA1 should be open for ropeless	Appendix 1.1, Comment 9.14
		LMA1 should be reconfigured	Appendix 1.1, Comment 9.15
		LMA 1 not supported by acoustic data	Appendix 1.1, Comment 9.16
		LMA3 closure should be added	Appendix 1.1, Comment 9.17
		Mass Bay closure area should be expanded	Appendix 1.1, Comment 9.18
		Mass Bay closure trigger should include mom/calf pair	Appendix 1.1, Comment 9.19
		Pot/Trap should be entirely managed by seasonal closures	Out of Scope
		Ropeless fishing should be re-evaluated in seasonal closures	Appendix 1.1, Comment 9.20
		South Island RA effects on other species?	Appendix 1.1, Comment 9.21
		South Island RA should be expanded	Appendix 1.1, Comment 9.22
		South Island RA should be year-round	Appendix 1.1, Comment 9.23
		South Island RA should include vessel speed reduction	Appendix 1.1, Comment 11.10
		South Island RA should require one buoy ine	Appendix 1.1, Comment 9.24
		Underestimated fishermen in LMA1	Appendix 1.1, Comment 9.25
	Timing	Recommend no summer closures	Appendix 1.1, Comment 9.26
	Vessel speeds	Add speed restrictions to EFPs	Appendix 1.1, Comment 9.27
	Offshore closures	Offshore closures would affect fewer fishermen	Appendix 1.1, Comment 9.28
Ropeless Gear	Access	Should make EFPs accessible to all fishermen	Appendix 1.1, Comment 10.1
	Feasibility	Various feasibility issues	Appendix 1.1, Comment 10.2
	Economics	Buybacks/subsidies for fishermen	Appendix 1.1, Comment 10.3
		Economic effects of lost gear/gear conflicts	Appendix 1.1,

Topic	Subtopic	Comment	Response
		with mobile gear	Comment 10.4
		NMFS needs to invest in gear development	Appendix 1.1, Comment 10.5
	Enforcement	How can ropeless be enforced?	Appendix 1.1, Comment 10.6
	Gear Conflicts	Need to reduce number of traps for ropeless to work	Appendix 1.1, Comment 10.7
		Space-sharing agreements	Appendix 1.1, Comment 10.8
	Planning	Fast-track/simplify permitting process	Appendix 1.1, Comment 10.9
		Need comprehensive long-term plan/roadmap	Appendix 1.1, Comment 10.10
		Need to have a uniform system so everyone can see gear placement	Appendix 1.1, Comment 10.11
		Require transition in 3 years	Appendix 1.1, Comment 10.12
		Should not be allowed in Cape Cod Bay	Appendix 1.1, Comment 10.13
		What about the Gray Zone?	Appendix 1.1, Comment 10.14
		Will increase risk due to lack of tension in lines?	Appendix 1.1, Comment 10.15
	Risk Reduction	Should not be considered neutral risk	Appendix 1.1, Comment 10.16
Stressors	Climate Change	Climate has changed distribution, putting whales in harm's way	Appendix 1.1, Comment 11.1
		Food sources shifted, whales rebounding	Appendix 1.1, Comment 11.2
	Health	Effects of disease and pollution	Appendix 1.1, Comment 11.3
		Inbreeding	Appendix 1.1, Comment 11.4
	Inudstrial Sonar/Noise	Effects on whales	Appendix 1.1, Comment 11.5
	Oil Spills	Could the BP oil spill have affected right whale calving?	Appendix 1.1, Comment 11.6
	Plastic pollution	Rule increases ocean plastics	Appendix 1.1, Comment 11.7
	Seismic testing	Effects on right whale population	Appendix 1.1, Comment 11.8
	Sharks	Predation on calves	Out of Scope
	Vessels	Vessel strikes a greater, more immediate threat	Appendix 1.1, Comment 11.10
	Wind energy	Offshore wind will displace fishermen	Appendix 1.1, Comment 11.11
Trawls	Economics	50% vertical line reduction will lead to consolidation	Appendix 1.1, Comment 12.1
		Expense will put fishermen out of business	Appendix 1.1, Comment 12.2
		Effects on landings	Appendix 1.1, Comment 12.3

Topic	Subtopic	Comment	Response
	Flexibility	Trawl lengths should be flexible, depending on situation	Appendix 1.1, Comment 12.4
		Exempt gear along 50 fathom line	Appendix 1.1, Comment 12.5
		Maine islands should be regulated as coastal	Appendix 1.1, Comment 12.6
	Gear conflict	One buoy line leads to more gear conflict	Appendix 1.1, Comment 12.7
	Gear loss	Longer trawls lead to more gear conflict	Appendix 1.1, Comment 12.8
	Risk reduction	Agreements among vessels should not be required	Appendix 1.1, Comment 12.9
	Safety of whales	Longer trawls lead to worse entanglements	Appendix 1.1, Comment 12.10
	Safety of fishermen	Concerns re injury, capsizing, unsafe conditions	Appendix 1.1, Comment 12.11
	Trawl requirements	NMFS should require all mobile gear, no traps/pots	Appendix 1.1, Comment 12.12
	Tension	Focus should be on tension in endlines	Appendix 1.1, Comment 12.13
Weak Rope/Links	Configurations	Comments/suggestions on weak rope, links, contrivances	Appendix 1.1, Comment 13.1
	Effects on Fishermen	Comments/suggestions on safey and economic losses	Appendix 1.1, Comment 13.2
	Effects on Whales	Comments on effects of weak links/inserts/rope on right whales	Appendix 1.1, Comment 13.3
	Surface systems	Surface system buoy links	Appendix 1.1, Comment 13.4
	Unproven	Weak links/inserts/rope unproven	Appendix 1.1, Comment 13.5

1.6 Changes from the DEIS to the FEIS

The measures included in this FEIS were modified from the analyses in the DEIS based on comments received during the comment period on the DEIS but are all within the range of alternatives analyzed in the DEIS (as summarized in Table 1.8). NMFS received numerous comments from diverse interested parties during the public scoping and public comment periods on the DEIS. The comments included both formal written comments as well as oral comments offered at public hearings. Those comments are summarized in Appendices 1.1 and 3.4. These comments were taken into consideration with a new round of analyses described and justified in Chapter 3, Section 3.3. The results of these analyses and the public comment period informed the final alternatives included in this FEIS. Responsive to comments, the modifications to the DEIS for the FEIS prioritized use of an updated right whale density model to estimate risk reduction for right whales, the updated right whale population information including information on unobserved mortalities, feasibility of implementation and safety concerns (particularly for small entities) that could be ameliorated by conservation equivalencies, and consideration of indirect effects of measures that may adversely increase co-occurrence between buoy lines and whales.

Gear marking alternatives analyzed for the FEIS are discussed in Section 3.2.2. Marking gear does not reduce risk but if marked gear is retrieved from entangled whales it can provide information about where entanglement incidents occur. Alternative 2 (preferred) and the Final Rule would increase the number of marks required in federal water compared to the Proposed Rule but have lesser impacts within the scope of impacts considered for the buoy line replacement analyzed in Alternative 3 in the DEIS and retained as Alternative 3 in this FEIS.

Modifications to the risk reduction measures in Alternative 2 in this FEIS relative to Alternative 2 in the DEIS include:

- The seasonal restricted area south of Cape Cod in this Alternative is larger than the restricted area analyzed within the Preferred Alternative in the DEIS, coming instead from DEIS Alternative 3.
- The removal of the requirement for a weak link at the buoy, which was analyzed as part of Alternative 3 in the DEIS.
- Adoption of conservation equivalency recommendations submitted by Rhode Island and as public comments on the DEIS and Proposed Rule for LMA 2 exchanging new trawl length requirements with more expansive weak insert requirements throughout the LMA
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for LMA 3 that would require more traps per trawl than in the DEIS within the Georges Basin area that was analyzed as a restricted area in Alternative 3 of the DEIS. This increase in number of traps per trawl was offset by a lower number of traps required within the Northeast Region south of the 50 fathom depth contour on the south end of Georges Bank.
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for Maine waters in LMA 1, including modification of regulations implementing the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) at 50 CFR 697.21(b)2) requiring two buoy lines on trawls with more than three pots to accommodate Maine conservation equivalency options. This would allow the use of half the minimum number of traps required with two buoy lines if only one buoy line is used. Other differences in the FEIS Alternative 2 compared to the DEIS are trade-offs in the number of traps on a trawl based on Maine fishery zones and distance from shore between the Maine exemption line and the 12 nm line (see the discussion of conservation equivalencies in Section 3.3.2).

Changes in Alternative 3 risk reduction elements analyzed in this FEIS relative to the DEIS Alternative 3 include:

- Retaining the weak link at the buoy or allowing it to be lowered to the base of the surface system and retaining only one South Island Restricted Area closure
- Only analyzes the seasonal weak line option in LMA 3 because the other option is analyzed in the Preferred Alternative
- No longer offers two options for the South Island Restricted Area, maintaining the medium sized L-shaped area
- Includes the special expansion of the MRA into state waters as implemented by state Regulations (see Table 3.5)

The only gear marking alternative that changed between the DEIS and FEIS is Alternative 2. The DEIS only required one 6 inch (15.2 centimeter) long green mark to be included in state waters within the top two fathoms of the buoy. In the FEIS, gear in federal waters would be required to include at least four 1 foot long (30.5 centimeter) green marks within 6 inches (15.2 centimeter) of each state specific mark. The number of marks in federal waters has increased from the DEIS (four 1 foot/30.5 centimeter marks instead of one 6 inch/15.2 centimeter mark). This change is responsive to concerns about distinguishing state and federal buoy lines, identified during public hearings. Additionally, recently, retrieved gear from a right whale included gear marks of six and 9 inches (22.9) long, inconsistent with current U.S. gear marking requirements but consistent with past Canadian gear marks. Use of a minimum of a 12 inch (30.5 centimeter) mark in U.S. commercial fisheries could help distinguish U.S. marks from Canadian gear This change is within the scope of impacts analyzed within the DEIS, and would increase gear specialists' ability to distinguish state from federal waters than Alternative 2 in the DEIS. For more information on the details of the alternatives, changes from the DEIS, and on the comments received from the public see Chapter 3 and Appendix 1.1.

Table 1.8: Changes to Alternative 2 (Preferred, top) and Alternative 3 (Non-preferred, bottom) in this FEIS compared to the DEIS.

DEIS	Alternative 2
Trawl Length (reduced line) and Co Occurrence reduction	
MA State Measures: no singles on vessels >29',	No longer being implemented by the state
LMA 2: Increase in trawl lengths over 3 nm	No Trawling up, only weak inserts
LMA 3: 45 traps/trawl	50 traps per trawl in Georges Basin Core area,
	35 traps per trawl deeper than 50 fa south of Georges Bank,
	45 traps/trawl otherwise.
ME LMA1: Trawling up to three traps per trawl in state waters outside of exempt area	Trawling up most places by distance from shore **and by zone** outside exemption line. One string option with half the traps through most of three to 12 nm.
ME LMA1: Trawling up everywhere between three to 12 nm by distance from shore (eight to 15 traps per trawl with two buoy lines)	Trawling up most places by distance from shore **and by zone** between three to 12 nautical miles. Some areas stay at status quo, others go farther than the DEIS for an equivalent risk reduction overall (five to 20 traps per trawl with two buoy lines). One string option with half the traps through most of three to 12 nm.
Restricted Areas	
No expansion of MRA included	Expanded closure in MA state waters north of MRA to border, keep the area closed along with all other state waters from Outer Cape Cod through to NH border until May 15th, with soft opening option. Final Rule will include closure until April.
South Island area proposed by Massachusetts; closed Feb-Apr	Move DEIS closure to considered but rejected, include large South Island Restricted Area from Alternative 3A in DEIS in Alternative 2, for same season of Feb-Apr
Weak Link	
Retain current weak link 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
Weakened Rope	

DEIS	Alternative 2
MA State waters: one weak insertion at 50% (didn't include non-exempt)	Weak inserts or full weak line every 60 ft (18.3 m) to 75%
ME State Waters: two inserts in state waters outside of exempt area	One insert, consistent with exempt state waters
ME LMA 1, 3 to 12 nm: two weak insertions 25% and 50%	Maintain 2 weak lines except those increasing trawl lengths to 20 traps per trawl (one at 33% in these areas)
LMA 2, 3 to 12 nm: Two weak insertions 25% and 50%	Weak insertions every 60 ft (18.3 m) or full weak line to 75%
LMA 2: Over 12 nm: one weak insertion in topper at 33%	Weak insertions every 60 ft (18.3 m) or full weak line to 75%
Gear Marking	
State Colors in lower buoy line: 2 in. buoy line below surface system in state waters, 3 in. Federal waters (top, middle and bottom)	At least 2 in. below surface system in state waters and at least three in federal waters (top, middle and bottom)
Federal waters: 6 in. green mark within 1 ft of large surface system mark	Federal waters: Four 1 ft green marks adjacent to ALL state color mark

DEIS	Alternative 3
Restricted Areas	
No expansion of MRA included	Expanded closure in MA state waters north of MRA to border, keep the area closed along with all other state waters from OCC through to NH border until May 15th, with soft opening option. Final Rule will include closure until April.
Two South Island Options (Feb - May): A) Large closure B) L-shaped closure	Move large area from Alternative 3A in DEIS to Alternative 2 for Feb-Apr, keep only L-Shaped area from Feb - May in Alternative 3
Weak Link	
For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system	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
Weakened Rope	
LMA 3: two options for weak rope 1) fully weak line in the top 75% of one line, 2) May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" to 20%	Keep seasonal option: May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" to 20%

1.7 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. 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 public comment period on the Proposed Rule and DEIS, including public information sessions in January 2021, and public hearings in February of 2021 provided additional public input (see Section 1.5). 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. 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 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 mortality and serious injury 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 2, and accelerated support for ropeless fishing alternatives. The alternatives under consideration seek to reduce large whale entanglement by decreasing the number of buoy 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 3 further explains the revisions under consideration to the existing Plan.

- The ALWTRT 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 nor did they propose the same area included in the Preferred Alternative in this FEIS. Fishing industry participants disagree that ropeless technology is ready for use in commercial fisheries or affordable and therefore 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 lobster and crab, 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 mortality and serious injury 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 right whale population models (unobserved 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 PBR. 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 FEIS 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 DST was used to develop and evaluate the risk reduction measures in Alternatives Two and Three. The model applies 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 FEIS 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. The models underwent Center of Independent Expert peer review in 2019 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 right whale habitat density model that used data from 2010 through 2018 to compare a few options for a restricted area in this region and compared these areas to updated survey data through April 2021. 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 FEIS 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 and 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 unobserved 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 mortalities and serious injuries in U.S. fisheries may have caused 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 2 (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 LMA 1, 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 1 foot (30.5 centimeter) long 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 2 foot (61 centimeter) long marks of two or three colors, including a 1 foot (30.5 centimeter) long 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.

- Several commenters disputed the need for and presence of right whales near the LMA 1 Restricted Area, particularly as drawn with only a closure within LMA 1. This FEIS uses a new right whale density model with data only from 2010 through 2018, after the change in right whale distribution was detected, which still predicts this area as a relative hotspot in this region where there is also a high density of buoy lines. Additionally, restricting buoy lines in this area will prevent additional movement of fishing vessels offshore into habitat more frequented by right whales (see discussion in Chapter 5, Section 5.3). Without this area, the Preferred Alternative would likely not meet the minimum risk reduction target needed to reduce mortality and serious injury of right whales below PBR.

1.8 Report Structure

The remainder of this FEIS is organized as follows:

- **Chapter 2** reviews entanglement data and current Plan requirements.

- **Chapter 3** describes the proposed alternatives considered within this FEIS 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 and past, present, and reasonably foreseeable future actions.

- **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 FEIS 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 FEIS for review (Chapter 12), and a glossary, list of acronyms, and index (Chapter 13).

1.9 References

Christiansen, F., S. M. Dawson, J. W. Durban, H. Fearnbach, C. A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H. A. Warick, I. Kerr, M. S. Lynn, H. M. Pettis, and M. J. Moore. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Marine Ecology Progress Series 640:1-16.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. NOAA Technical Memorandum NMFS-NE-258, NEFSC, NMFS, NOAA, DOC, Woods Hole, MA.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, B. Byrd, S. Chavez-Rosales, T. V. N. Col, L. Engleby, L. P. Garrison, J. Hatch, A. Henry, S. C. Horstman, J. Litz, M. C. Lyssikatos, K. D. Mullin, C. Orphanides, R. M. Pace, D. L. Palka, M. Soldevilla, and F. W. Wenzel. 2018b. TM 245 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2017. Page 371 *in* NMFS, editor., NOAA Tech Memo.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. Page 479. Northeast Fisheries Science Center, Woods Hole, MA.

Henry, A. G., M. Garron, D. Morin, A. Reid, W. Ledwell, and T. V. Cole. 2020. Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2013-2017. Page 59. Northeast Fisheries Science Center Reference Document, U.S. Department of Commerce.

Hunt, K. E., N. S. J. Lysiak, C. J. D. Matthews, C. Lowe, A. Fernandez Ajo, D. Dillon, C. Willing, M. P. Heide-Jorgensen, S. H. Ferguson, M. J. Moore, and C. L. Buck. 2018. Multi-year patterns in testosterone, cortisol and corticosterone in baleen from adult males of three whale species. Conserv Physiol **6**:coy049.

Johnson, C., E. Devred, B. Casault, E. Head, and J. Spry. 2018. Optical, Chemical, and Biological Oceanographic Conditions on the Scotian Shelf and in the Eastern Gulf of Maine in 2016. Page 58.

Lysiak, N. S. J., S. J. Trumble, A. R. Knowlton, and M. J. Moore. 2018. Characterizing the Duration and Severity of Fishing Gear Entanglement on a North Atlantic Right Whale (Eubalaena glacialis) Using Stable Isotopes, Steroid and Thyroid Hormones in Baleen. Frontiers in Marine Science **5**.

Meyer-Gutbrod, E. L., C. H. Greene, P. J. Sullivan, and A. J. Pershing. 2015. Climate-associated changes in prey availability drive reproductive dynamics of the North Atlantic right whale population. Marine Ecology Progress Series **535**:243-258.

Meyer-Gutbrod, E., C. Greene, and K. Davies. 2018. Marine Species Range Shifts Necessitate Advanced Policy Planning: The Case of the North Atlantic Right Whale. Oceanography **31**.

Meyer-Gutbrod, E. L., and C. H. Greene. 2018. Uncertain recovery of the North Atlantic right whale in a changing ocean. Global Change Biology **24**:455-464.

Pace, R. M., 3rd, P. J. Corkeron, and S. D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution **7**:8730-8741.

Pace, R. M., R. Williams, S. D. Kraus, A. R. Knowlton, and H. M. Pettis. 2021. Cryptic mortality of North Atlantic right whales:e346.

Pace, RM. 2021. Revisions and further evaluations of the right whale abundance model: improvements for hypothesis testing. NOAA Tech. Memo. NMFS-NE 269.

Pettis, H. M., R. M. I. Pace, R. S. Schick, and P. K. Hamilton. 2018b. North Atlantic Right Whale Consortium 2017 annual report card.

Pettis, H. M., R. M. I. Pace, and P. K. Hamilton. 2020. North Atlantic Right Whale Consortium 2019 Annual Report Card.

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Pettis, H. M., R. M. Rolland, P. K. Hamilton, A. R. Knowlton, E. A. Burgess, and S. D. Kraus. 2017. Body condition changes arising from natural factors and fishing gear entanglements in North Atlantic right whales Eubalaena glacialis. Endangered Species Research **32**:237-249.

Plourde, S., C. Lehoux, C. L. Johnson, G. Perrin, and V. Lesage. 2019. North Atlantic right whale (Eubalaena glacialis) and its food: (I) a spatial climatology of Calanus biomass and potential foraging habitats in Canadian waters. **00**:19.

Record, N. R., J. Runge, D. Pendleton, W. Balch, K. Davies, A. Pershing, C. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S. Kraus, R. Kenney, C. Hudak, C. Mayo, C. Chen, J. Salisbury, and C. Thompson. 2019. Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography 32.

Robbins, J., A. R. Knowlton, and S. Landry. 2015. Apparent survival of North Atlantic right whales after entanglement in fishing gear. Biological Conservation **191**:421-427.

Roberts, J. J., R. S. Schick, and P. N. Halpin. 2020. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018-2020 (Opt. Year 3*). Report prepared for Naval Facilities Engineering Command, Atlantic, Marine Geospatial Ecology Lab (MGEL), Duke University, Durham, NC.

Rolland, R. M., R. S. Schick, H. M. Pettis, A. R. Knowlton, P. K. Hamilton, J. S. Clark, and S. D. Kraus. 2016. Health of North Atlantic right whales Eubalaena glacialis over three decades: from individual health to demographic and population health trends. Marine Ecology Progress Series **542**:265-282.

van der Hoop, J., P. Corkeron, and M. Moore. 2017. Entanglement is a costly life-history stage in large whales. Ecol Evol **7**:92-106.

CHAPTER 2 PURPOSE AND NEED FOR ACTION

The National Marine Fisheries Service (NMFS) is revising 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*, hereafter right whales), 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 mortality and serious injury 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 right whale and other large whale species due to mortality and serious injury 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).

This Chapter will discuss large whale entanglement patterns since 2010, describe the current need for rulemaking (i.e. right whale population decline), and identify an estimate of the amount of risk reduction that is needed to reduce mortality and serious injury 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 (NEFSC) 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 2019 is analyzed here because it represents the best available peer-reviewed data for the period after the right whale population decline began in 2010 (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 were detected. Preliminary population data since 2019 are also provided where available and appropriate for context, largely from the publicly available data on monitored right whale incidents that caused NMFS to declare an Unusual Mortality Event, as well as annual calf counts. Given the level of mortality and serious injury of right whales documented and estimated since 2010 combined with low reproductive rates, it has become more urgent to ensure that mortality and serious injury caused by incidental entanglements in U.S. commercial fisheries be reduced below PBR.

This chapter describes in detail the purpose and need for revisions to the existing Plan and 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 mortality and serious injury.
- 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 U.S. commercial fishing gear in fixed gear fisheries 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 to help them comply with Plan requirements, 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 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 stranding and sighting 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. 2021). Take reduction teams including representative stakeholders are convened to help NMFS reduce mortality and serious injury in commercial fisheries when the rate exceeds PBR.

Throughout the history of the Atlantic Large Whale Take Reduction program, the primary species driving Plan modifications has been the right whale. PBR for the endangered 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. 2020) identified PBR as 0.8 right whale mortality or serious injury a year. Coast-wide, human-caused mortality and serious injury 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[1] 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 distinct population segment (DPS), 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 widespread 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 increase 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 was designed so that if a large whale does become entangled, it should be able to exert enough force to break the

[1] NMFS determined that the Gulf of Maine stock of humpback whales was not strategic for the 2019 Stock Assessment Report, but was strategic for the 2020 draft Stock Assessment Report because human-caused mortality exceeds PBR; the 2020 Report is still under review.

weak link and break free of the buoy (trap/pot) 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 Mortalities and Injuries, 2010 to 2019*

Large whales in the Atlantic are impacted by a variety of threats, both natural and human-caused (Table 2.1). It is important to note that the methods followed to make annual mortality and serious injury determinations of observed large whale incidents may under report entanglements and vessel strike (see Henry et al. 2020). Determinations are only made when they can be decided with absolute certainty and therefore likely do not represent the total number of incidents caused by entanglement or vessel strikes. The number of documented incidents summarized in Table 2.1 also represent only those that were sighted and reported, and does not include unobserved mortalities. For right whales, it is estimated that only an average 36 percent of all mortalities between 1990 and 2017 were detected (Pace et al. 2021). Therefore, mortality and serious injury determinations discussed in this section are underestimates. Additionally, incidents involving 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 compared to other large whale species due to extensive survey effort dedicated to this species throughout their range.

As delineated in Table 2.1, entanglement is identified as the cause of 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 mortalities and serious injuries did not have a cause definitively determined. For right whales, human sources were the leading causes of mortality and serious injury; 57 percent of all detected right whale mortalities and serious injuries between

2010 and 2019 occurred as a result of entanglement[2], 15 percent were caused by vessel strikes, and 3 percent were entrapments. The remaining 25 percent could not be attributed to a source. There were no confirmed natural mortality or serious injury incidents reported for right whales during this time period. Entanglement was also the highest cause of mortality and serious injury 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 mortality and serious injury for all but minke whales, followed by non-human causes and entrapments, incidents where an individual is confined or otherwise restricted in movement but not entangled in gear and can reach the surface for air.

Table 2.1: Atlantic coast-wide causes of large whale human interaction incidents between 2010 and 2019 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 84 incidents where serious injury or mortality due to incidental entanglement were averted due to successful disentanglement (52 humpback, 21 fin, and 11 right whales). Also included are 93 individuals where injuries were "prorated" as highly likely to have a serious outcome (6 fin, 51 humpback, 24 minke, 12 right whales).

Cause	Fin N	Fin %	Humpback N	Humpback %	Minke N	Minke %	Right N	Right %	Total N	Total %
All Incidents										
Unknown	43	51.2%	146	31.2%	189	52.9%	28	15.1%	406	37.1%
Entanglement	22	26.2%	231	49.4%	109	30.5%	114	61.6%	476	43.5%
Vessel Strike	15	17.8%	66	14.1%	11	3.1%	38	20.6%	130	11.9%
Non-human Induced	3	3.6%	16	3.4%	42	11.8%	2	1.1%	63	5.8%
Entrapment	1	1.2%	9	1.9%	6	1.7%	3	1.6%	19	1.7%
TOTAL	**84**		**468**		**357**		**185**		**1094**	
Mortality & Serious Injury										
Unknown	43	57.3%	146	41.5%	188	54%	26	24.3%	403	45.7%
Entanglement	17	22.7%	139	39.5%	104	29.9%	61	57%	321	36.4%
Vessel Strike	12	16%	44	12.5%	11	3.2%	17	15.9%	84	9.5%
Non-human Induced	3	4%	16	4.5%	40	11.5%	-	-	59	6.7%
Entrapment	-		7	2%	5	1.4%	3	2.8%	15	1.7%
Total	**75**		**352**		**348**		**107**		**882**	

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 from 21 percent (n = 479) of all large whale entanglements

[2] This estimate includes 11 disentangled whales where serious injury was avoided in order to better estimate the frequency at which mortality and serious injury 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 mortality and serious injury rates puts peoples' safety at risk and may not always be an available conservation measure

between 2010 and 2019, and only 73 percent of the gear retrieved could be identified to fishery or gear type (i.e. 15 percent of observed entanglement incidents were identified). Of the 79 percent of cases where gear is not retrieved, only 16 percent were identified to a fishery or gear type and 24 percent had no gear present. It is impossible to confirm the country of origin for every incident, particularly for cases where gear was not retrieved or analyzed. 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. Even for right whale incidents that come under more intense scrutiny, location of entanglement incidents can rarely be determined. Of 1462 entanglement incidents evaluated by the New England Aquarium between 1980 and 2016, only 110 had attached gear present and fewer could be traced to a country (Amy Knowlton pers. comm. August 13, 2019) with only 13 identified to the site of entanglement.

When coast-wide mortalities and serious injuries 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, entanglement incidents occur in higher numbers than vessel strikes each year for all species except fin whales (Figure 2.1). Entanglement is the primary source of mortality and serious injury regardless of the location of first sighting or origin of the incident. Vessel strikes have been reported more frequently in U.S. waters than Canadian waters for all four large whale species with the exception of right whales from 2017 through 2019.

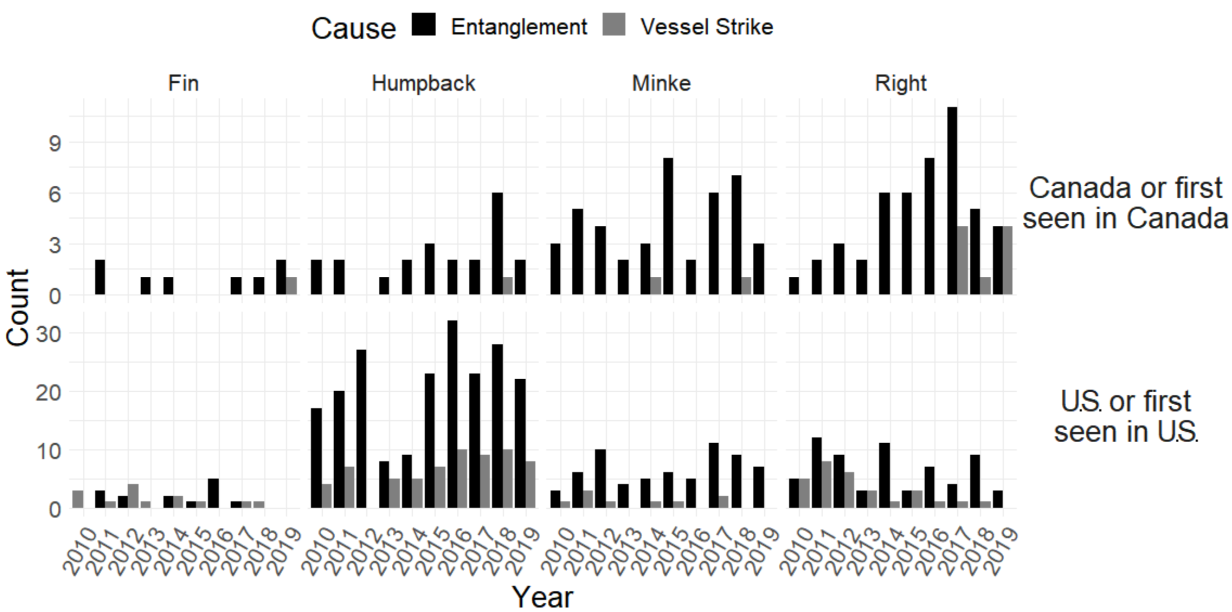


Figure 2.1: mortality and serious injury cases (including prorated injuries and those averted by disentanglement response) caused by entanglements and vessel strikes according to the country where the incident occurred or, in the absence of that information, where the individual was first sighted.

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 mortality and serious injury 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 observed mortality and serious injury has approached but not surpassed PBR in some years, but this represents the minimum number of takes by U.S. fisheries as not all incidents are seen and not all observed incidents of humpback and minke whales are as well documented as right whales. Using only documented incidents, the five-year rates of mortality and serious injury 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 right whale stock because of the urgent need to reduce mortality and serious injury from entanglement interactions below PBR for this species.

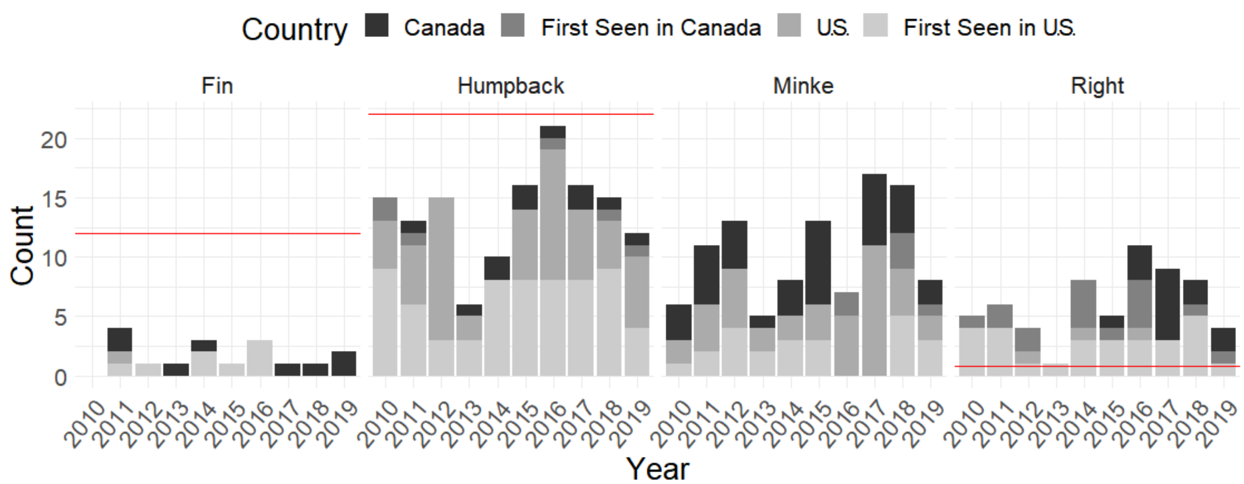


Figure 2.2: Entanglements that resulted in serious injury or mortality, according to the country of origin or country where the incident was first sighted. Incidents with prorated injuries and where serious injury was averted by disentanglement response are included as serious injuries. The red line represents the current PBR for the stock (PBR for minke whales is 189 and not pictured due to scale).

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 476 incidents documented between 2010 and 2019 (Table 2.2). The type of fishing gear involved in an entanglement is not identifiable for a large portion of entanglements, including 85 percent of right whale events. 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 primary gear types detected on Atlantic large whales and the outcome of the incident. These data suggest that mortality and serious injury is more likely with trap/pot gear than netting, but they also demonstrate the large knowledge gap in identifying gear types that are contributing to mortality and serious injury. Humpbacks generally experience a higher number of entanglements than other species in a wide variety of gear types (48.5 percent of all entanglements), though many (40 percent) of them did not result in serious injuries. Minke whale entanglements result in serious injury or mortality more often (Table 2.1) and involve trap/pot, netting, and other gear types (Table 2.2). 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 mortality and serious injury. 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. Buoy lines associated with fixed gear fisheries are very prevalent in the marine environment and the type of gear most frequently identified on entangled large whales in the Northwest Atlantic (81 percent, Johnson et al. 2005), making fixed gear fisheries a particular concern for the endangered right whale.

Table 2.2: The types of gear that have been identified on all documented entanglement incidents between 2010 and 2019 (including those not causing serious injury), identified to country and fishery, if possible. Confirmed U.S. trap/pot gear is highlighted in grey. This table does not include incidents where the type of gear or the presence of gear was undetermined. Gear determinations could change as additional information is acquired.

Fishery	Fin	Humpback	Minke	Right	Total
Trap/Pot Gear					
CAN trap/pot	0	1	0	0	1
CAN lobster	0	7	3	0	10
CAN snow crab	0	1	0	14	15
CAN crab	0	1	0	0	1
U.S. trap/pot	1	8	0	2	11
U.S. lobster	1	29	19	1	50
U.S. whelk trap/pot	0	1	0	0	1
U.S. recreational lobster	0	1	0	0	1
Unknown trap/pot	0	2	0	1	3
Subtotal Trap/Pot	**2**	**51**	**22**	**18**	**93**
Gillnet & Other Netting					
CAN netting	0	1	0	0	1
U.S. gillnet	0	3	0	1	4
U.S. gillnet - dogfish	0	4	1	0	5
U.S. gillnet - striped bass	0	1	0	0	1
U.S. gillnet - winter skate	0	1	0	0	1
U.S. gillnet - ground fish	0	1	0	0	1
U.S. gillnet - spot fish	0	1	0	0	1
U.S. gillnet - blue fish	0	1	0	0	1
U.S. gillnet - croaker	0	1	0	0	1
U.S. midwater trawl - herring	0	0	1	0	1
U.S. bait net	0	1	0	0	1
Unknown netting	0	6	2	1	9
Unknown gillnet	0	6	1	6	13
Unknown gillnet - non-groundfish	0	1	0	0	1
Subtotal Netting	**0**	**28**	**5**	**8**	**41**
Monofilament Gear					
U.S. monofilament	0	28	0	0	28

Fishery	Fin	Humpback	Minke	Right	Total
U.S. recreational	0	1	0	0	1
Unknown monofilament	1	31	2	0	34
Subtotal Monofilament	1	60	2	0	**63**
Multiple Gear Types					
Unkown gillnet & U.S. lobster	0	2	0	0	2
Unknown & U.S. lobster	0	1	0	0	1
Unknown ghost trap & U.S. lobster	0	0	1	0	1
U.S. lobster & unknown	0	2	1	0	3
Subtotal Multiple Gear Types	**0**	**5**	**2**	**0**	**7**
Other					
U.S. anchor	0	3	0	0	3
Debris	0	0	1	0	1
Subtotal Other	**0**	**3**	**1**	**0**	**4**
Unknown Gear					
CAN unknown	0	2	1	4	7
U.S. unknown	0	3	4	3	10
Unknown	10	65	23	29	127
No gear present	5	13	21	48	87
Subtotal Unknown	**15**	**83**	**49**	**84**	**231**
Totals	**18**	**230**	**81**	**110**	**439**

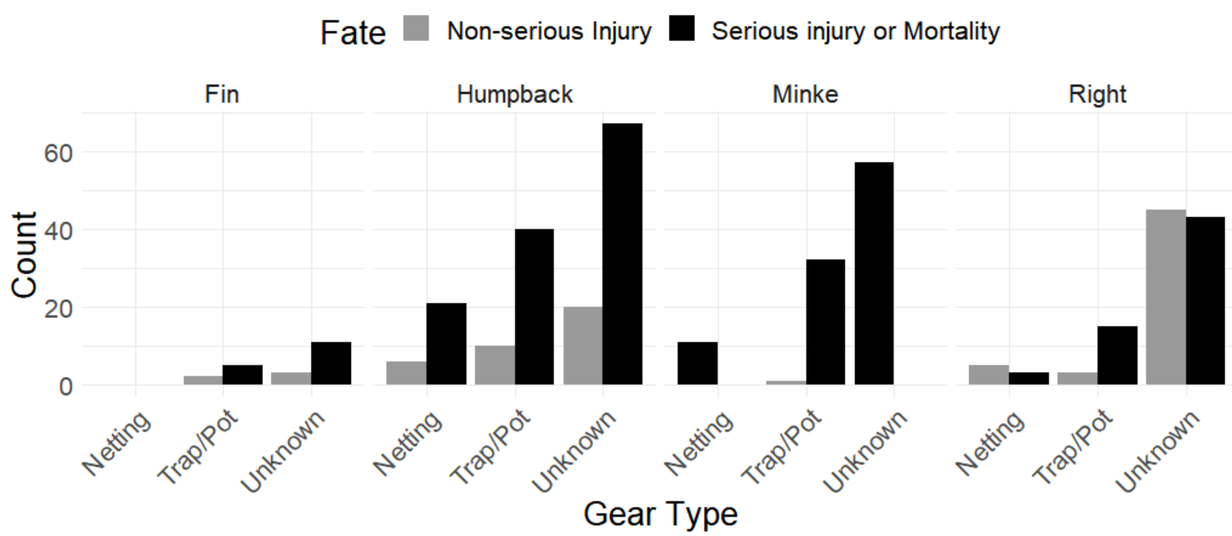


Figure 2.3: Entanglement cases by species and gear type, where available, relative to the fate of the incidents for documented incidents between 2010 and 2019.

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 percent of fixed gear buoy lines 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%	95.2%
Gillnet	1.5%	0.4%	0%	1.9%
Other Trap/Pot	0.1%	1.3%	0.9%	2.3%
Blue Crab Trap/Pot	0%	0%	0.6%	0.6%
Total	95.3%	3.2%	1.5%	100%

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

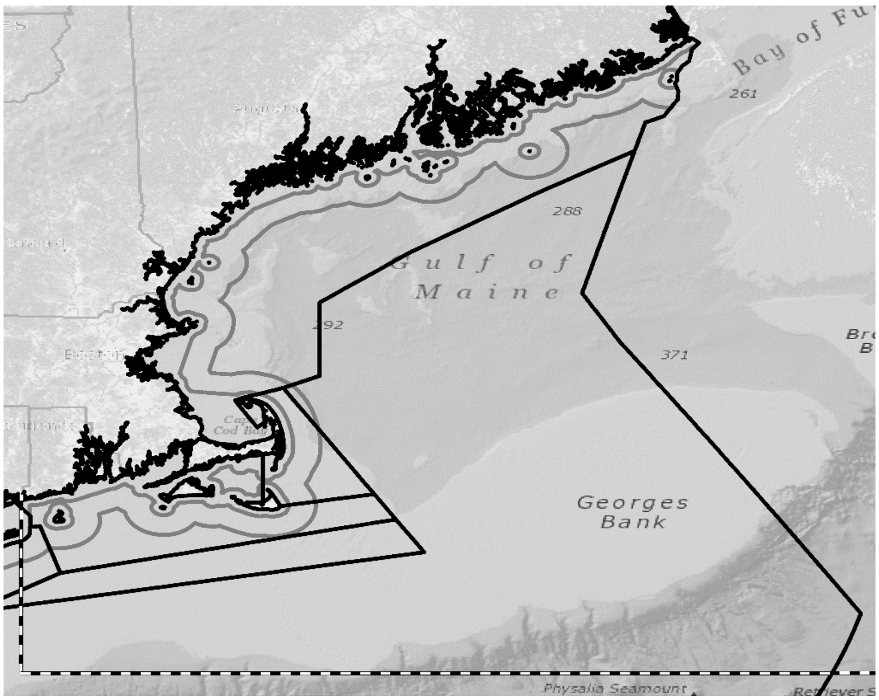


Figure 2.4: The Northeast Region that will be regulated by this EIS are those north and east of the dashed line that lie within U.S. waters. The black line represents the Lobster Management Areas that will be analyzed. Three and 12 nautical mile lines are represented in gray.

Coast-wide rulemaking to modify diverse, relatively data-poor, fisheries can take three to four years. The source of mortality and serious injury to right whales cannot be determined in the majority of documented entanglements but, in the cases where gear can be identified, entanglements to right whales are frequently the result of trap/pot line (Table 2.2). 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 Jonah crab trap/pot fisheries (Figure 2.4), representing the highest number of buoy lines 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 FEIS (IEc Line Model, 2019). The Take Reduction Team will focus on other coast-wide trap/pot fisheries and gillnet fisheries in developing further Plan modifications.

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, right whales have continued to experience unsustainable levels of mortality and serious injury from entanglement, as discussed above. The right whale population is critically endangered and a 2017 study found that the population has been in decline since 2010 (Figure 2.5, 2.6; Pace et al. 2017). The best estimate of the right whale population in 2019 is 368 whales (± 11) with a strong male bias (approximately 60 percent male) (Pace et al. 2017, Pace 2021). New research confirms a significant reduction in survival since 2010 and that an estimated 64 percent of all mortalities are not observed and accounted for in the right whale incident data (Pace 2021, Pace et al. 2021). This population corresponds with, but not demonstrated to be caused by, the shift in distribution. Carcass counts did not parallel the estimated reduction in survival, although Pace notes that his estimates validate the declaration of an Unusual Mortality Event (UME). Declared in 2017, the UME remains open and as of April 2021 includes 34 detected mortalities (17 in 2017, 3 in 2018, 10 in 2019, 2 in 2020, and 2 in 2021). In 2020, 15 serious injuries were included in the UME tally (2 in 2017, 5 in 2018, 1 in 2019, 4 in 2020, and 3 in 2021; see: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event). In addition, NARWs have also been determined to be in poor body condition in comparison to southern right whales (*Eubalaena australis*; Christiansen et al. 2020). In particular, a poor female body condition may be contributing to reduction in calf survival or delayed first-calving age and an increase in calving intervals, which is an additional concern for NARW viability and recovery (Christiansen et al. 2020).

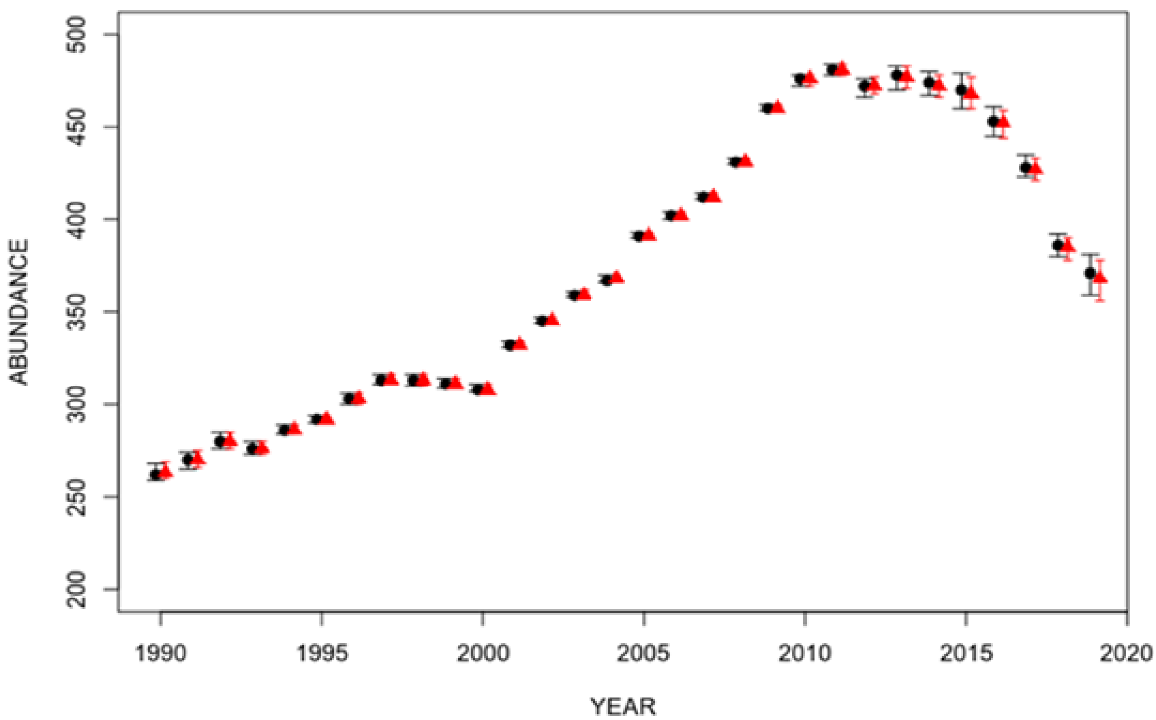


Figure 2.5: The estimated abundance of right whales and 95 percent credible intervals from Pace 2021.

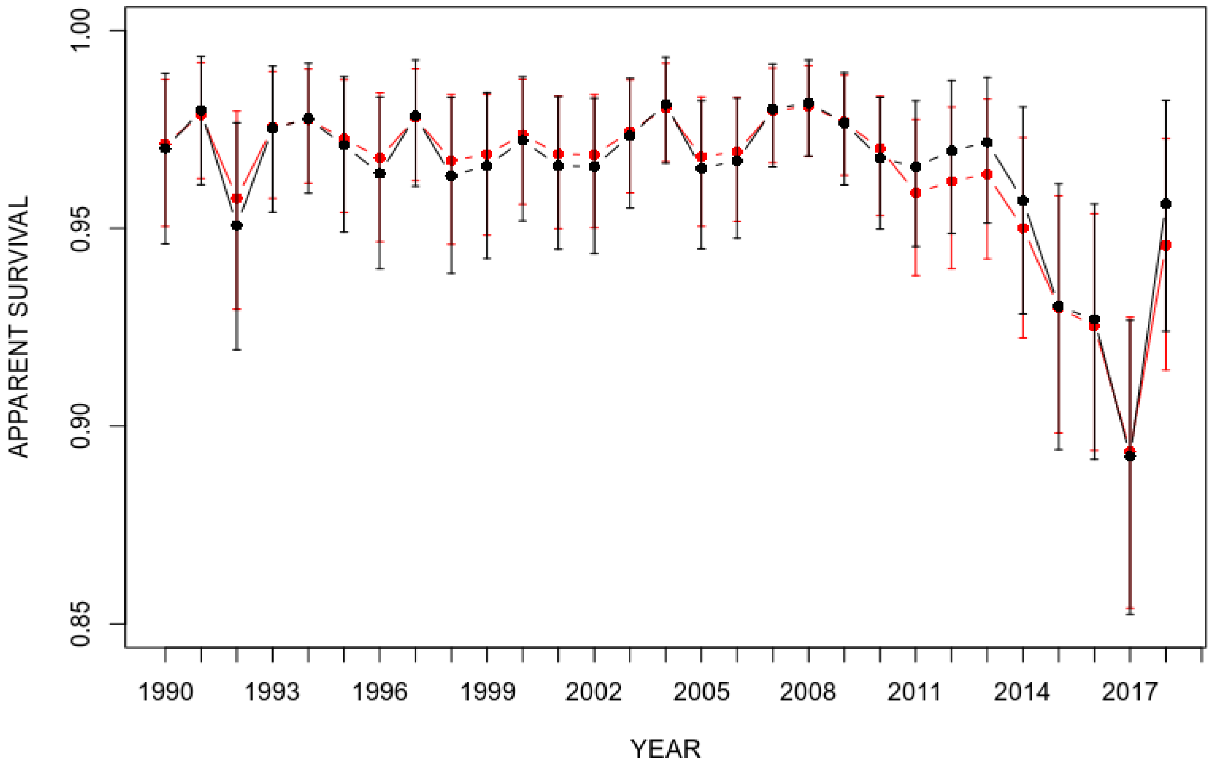


Figure 2.6: Survival rates estimated for the right whale with medians (black) and 95 percent credible intervals (red) derived in Pace 2021

Recent low birth rates are an increasing concern for 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 2020 (Pettis et al. 2021). 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 for the entire monitoring period, which began in 1990. More recently, there were 17 live calves documented in 2021, as of March 29 (https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2021) including some first time mothers who were born during the high birthing years that occurred before 2011. While the number of births in the 2020/2021 calving year is encouraging, it is lower than would have been forecasted from the large number of calves born over a decade ago and follows persistent low birth years that are insufficient to counteract current population mortality rates (Figure 2.5; Pace 2021), increasing concern regarding current levels of entanglement mortality.

Documented, minimum counts of anthropogenic mortality and serious injury of right whales from fishing gear have exceeded the allowable PBR in all but one year (Figure 2.2). The 2019 right whale stock assessment establishes a PBR level of 0.8 right whales a year based on the 2017 population estimates (Hayes et al. 2020). For the five year period from 2014 to 2018 the report documents a minimum average annual mortality and serious injury caused by entanglement is 6.85, including 0.2 attributed to U.S. fisheries, 1.55 attributed to the Canadian snow crab fishery, and 5.1 that could not be identified to a particular fishery (Henry et al. 2021). Since 2018, an additional eight right whale entanglement mortalities and serious injuries have been documented including three identified as consistent with Canadian snow crab and five that could not be identified to a country or fishery (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event reviewed May 1, 2021).

Entanglement rates are higher than the mortality and serious injury rates reflected in the Stock Assessment Report, in part because whales apparently often free themselves of gear following an entanglement event. In an analysis of the scarification of right whales, 519 of 626 (82.9 percent) whales examined from 1980 to 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 percent and 33.6 percent of right whales acquire new scars annually (Knowlton et al. 2012). Evidence collected following right whale mortalities document that entanglement remains the biggest threat, range wide, to right whales (Sharp et al. 2019). Finally, entanglements are certainly a cause of death of some portion of the 64 percent of estimated mortalities that are unobserved (Pace et al. 2021) but there is no agreement on how to assign the cause of mortality to unobserved but estimated mortality. Pace (2021) and Sharp et al. (2019) caution against using observed mortality ratios to apportion the cause of death due to potential carcass detection biases. Pace (2021) observed more serious injuries are entanglement related rather than from vessel strikes, consistent with the observed incident data. Moore et al. (2020) reported how carcass detection of whales that succumb to entanglement may be very low, due to limited buoyancy from poor body condition associated with months to years of chronic entanglement. Additionally, differences in mission priority and geography create significant detection biases between the U.S. and Canadian waters. Specifically, the geographically closed Gulf of St. Lawrence provides more opportunity for carcasses to strand on land and is surveyed regularly since 2017 by five aircrafts for dynamic management. Surveys in other Canadian waters support a broader science mission, and in the U.S. aerial survey missions are directed towards population assessment which requires far less effort, but reduces the potential for carcass detection.

Despite these uncertainties, there is sufficient evidence to determine that the rate of human-caused mortality and serious injury to right whales exceeds the PBR during a sustained period of population decline, requiring additional modifications to the Plan to reduce entanglement mortality and serious injury risk.

2.1.5 *Needed Reduction in Entanglement Mortality and Serious Injury*

As presented to the Team in an October 2018 meeting, there is only one year since 2010 (when the decline in the right whale population began) in which right whale entanglement mortality and serious injury 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 Team in determining the magnitude of reduction in mortality and serious injury that is needed. As delineated in Table 2.2 and described previously, many entanglements are never seen by humans, even when seen 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 mortality and serious injury estimates for use in Stock Assessment Reports and by the Team, NMFS attributes definitive sources of mortality and serious injury only when gear is present and identified to a fishery source or, rarely, when an individual is anchored by the gear. The Canadian snow crab fishery has clearly identifiable ropes and splices that assist in 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 mortality and serious injury are unassigned in the Stock Assessment Reports.

To estimate 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 three-fold reduction is necessary to achieve PBR. An alternative approach provided very similar results, discussed below.

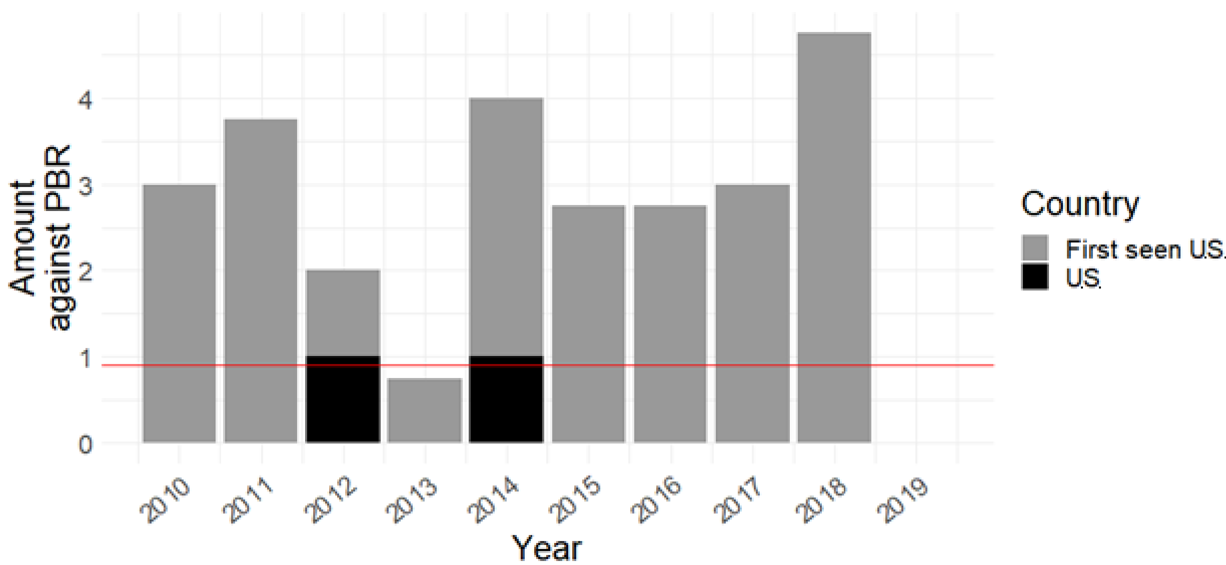


Figure 2.7: Documented entanglement incidents that caused mortality and serious injury of right whales, counted against PBR for right whales from 2010 to 2019. For this purpose, mortalities or confirmed serious injuries are counted as one animal and injuries with a 0.75 probability of becoming serious are adjusted accordingly (e.g. only one prorated injury was detected in 2013). The red line represents the PBR for each year.

Although since 2010 right whale aggregation distribution has continued to shift, much of the right whale population may spend more time exposed to fisheries in U.S. waters than in Canadian waters. Mortality and serious injury from unknown sources could be allocated by percentage of time spent in each country's waters, which would apportion more of these unknown mortalities and serious injuries to U.S. commercial fisheries. However, for the following reasons, this FEIS assumes that 50 percent 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 and Canadian Department of Fisheries and Oceans 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, pers. comm. 2020).

- U.S. take reduction measures over the past two decades have been implemented coast-wide rather than in finite areas like those implemented in July 2017 by Canada. Although the ALWTRP measures are not achieving PBR and the effectiveness of the regulations cannot be evaluated, all the existing sinking ground line, closures, weak links, and other risk reduction Plan measures are affording more protections to right whales than if there were no ALWTRP measures implemented.

At the annual meeting of the Atlantic Scientific Review Group (ASRG) in February 2021, the ASRG commended the use of unobserved mortality estimates (Pace 2021) with the NARW stock assessment report and recommended that the 1:1 apportionment of mortality between the U.S. and Canada be reconsidered based on recent documented mortalities and serious injuries, which occurred at higher frequency in Canadian waters. They also considered Pace (2021), Sharp et al. (2019) and Moore et al. (2020) and suggested that more unobserved mortality could be due to entanglement than to vessel strikes, recommending that NMFS review mortality analysis further to inform future apportionment of estimated mortality to mortality sources.

Table 2.4 uses mortality and serious injury determinations for 2012 through 2020 to determine how the target might change using more recent information and varying apportionment assumptions. Note that the incident data is only peer reviewed through 2019 and published through 2018 so anything after 2018 is not considered final (Hayes et al. 2019, 2020). The table below considers the risk reduction targets needed by assigning unattributed and/or unobserved mortalities to a particular country across multiple rolling five-year averages as well as a combined average. This risk reduction range differs from those presented in the Draft Environmental Impact Statement and those presented to the Team in 2019 due to the incorporation of new data. Sixty percent is still the minimum target risk reduction considered in this FEIS but as new data are finalized the minimum target may change in the future.

Table 2.4: Average mortality and serious injury by country of origin or country where the individual was first sighted for different date ranges. The amount of reduction in mortality and serious injury needed to meet PBR based on where the unattributed individuals were first sighted and with 50 percent of unattributed individuals assigned to each country. For incidents with no cause of death determination or estimated unobserved mortality, we assumed seventy-seven percent resulted from an entanglement according to the large whale incident data. PBR was calculated according to the five year period reported in line with the stock assessment reports. The current PBR published at the time of this FEIS was used for the nine year period summary. The reduction needed was calculated by dividing PBR from all cases assigned to the U.S. fisheries and subtracted from one.

					Country First Sighted		50% of First Country Sighted		All Observed & Unobserved U.S. Estimated Entanglement	
Date range	**PBR**	**Total**	**U.S.**	**Canada**	**U.S.**	**Canada**	**Estimated U.S.**	**Reduction Needed**	**Estimated U.S. Entanglement**	**Reduction Needed**
2012-2016	**0.9**	5.15	0.4	0.6	2.05	2.1	2.08	64%	8.19	89%
2013-2017	**0.8**	5.55	0.2	1.2	2.45	1.7	2.08	65%	9.80	92%
2014-2018	**0.8**	6.85	0.2	1.55	3.25	1.85	2.55	71%	10.16	92%
2015-2019*	**0.7***	5.65	0	1.95	2.65	1.05	1.85	62%	**	**
2016-2020*	**0.7***	5.7	0	1.95	2.85	0.9	1.88	63%	**	**
2010-2018	**0.8**	5.39	0.22	0.78	2.75	1.56	2.15	66%	7.96	90%

***Uses preliminary data**

****Data on unobserved mortalities are not available for 2019 or 2020 and thus that risk reduction is unable to be calculated at this time.**

As delineated in Table 2.4, these findings are slightly lower than results attained by attributing unknown mortality and serious injury sources to the country of first sighting. For this calculation, the incidents where location was unattributed to a specific country were split in half, assuming 50 percent occurred in each country. The necessary reduction ranges from 63 to 77 percent risk reduction and is higher than the fifty percent split due to the number of entanglements detected in U.S. waters. Since right whales spend more time in U.S. waters and can travel far from the original entanglement location, it is possible detection bias could be a factor with an estimate using the country where the individual was first seen.

However, as discussed above, calculations that include only documented mortality and serious injury also are subject to a detection bias and are likely underestimating mortality and serious injury due to entanglement. Actual mortality and serious injury of right whales in U.S. fisheries are likely higher than the observed 2.56 per year between 2010 and 2019 (Pace et al. 2021). Population models provide an estimate of mortality that suggests 40 to 64 percent of right whale mortalities and serious injuries are unobserved (applying the methods from Pace et al. 2017 and new method in Pace 2021). Additionally, there are mortalities where no cause of death was determined, despite some evidence of human causes, and it is likely a proportion of these cases also resulted from an entanglement.

In order to take into account unobserved mortality as well as mortality where the cause of death was not confirmed, additional unobserved mortality was estimated and added to the observed mortality estimates in Table 2.4. To estimate unobserved mortality from entanglements, the observed mortality and serious injury was first subtracted from the total estimated mortality between 2012 and 2018 (the most recent data available) from a population model published by Pace et al. (2021). The remaining unobserved right whale mortality was added to those with unknown cause of death, 50 percent of which were attributed to the U.S. We then estimated that 77 percent of unknown or unobserved right whale incidents apportioned to the U.S. were likely caused by entanglement according to long term right whale incident data.

For example, according to data from the model from Pace et al. (2021) and NMFS right whale incident data, there was an annual average of 2.2 incidents with an undetermined cause of death and an estimated 12.3 unobserved mortalities from 2010 through 2018, for a total of 14.5 incidents that were not accounted for in the calculations for minimum risk reduction target. If we assume half of these incidents occurred in the U.S as described above, then 7.25 additional incidents likely occurred in the U.S. According to incident data, 77 percent of all incidents (from 2010-2019) are a result of entanglement mortality and serious injury so we then assume 77 percent of 7.25 unknown or unobserved incidents were the result of an entanglement, or 5.6 per year. Adding this to the known entanglement data yields an annual average of 7.96 entanglements causing serious injury or mortality in U.S. waters every year between 2010 and 2018. This number would require a 90 percent reduction in mortality and serious injury (equation: 1-(0.8/7.96)). Under those assumptions, mortality and serious injury of right whales in U.S. fishing gear would need to be reduced by at least 60 percent according to documented mortality but may require up to 92 percent, depending on the year range and cause assumptions used, to reduce actual estimated mortality and serious injury below PBR. As Table 2.5 illustrates, across various assumptions and recent time frames, an upper target reduction in mortality and serious injury from 77 to 92 percent would be needed to achieve PBR under recent mortality conditions.

Table 2.5: Examples of risk reduction target effects of varying assumptions regarding country of origin and cause of the incident for unattributed documented and estimated unobserved entanglement mortality and serious injury. Three country apportionments were tested for cases where country of origin is unknown: a 50:50, 40:60, and 30:70 (US:Canada). For incidents with no cause of death determination and estimated unobserved mortality, we tested four approaches to estimate the proportion resulting from entanglement: the proportion of entanglements observed between 2010 and 2019 (77 percent), the proportion in Pace et al. 2021 (67 percent), the proportion from Sharp et al. 2019 (58 percent), and a 50 percent split. PBR was calculated according to the five year period reported in line with the stock assessment reports. The current PBR published at the time of this FEIS was used for the nine year period summary. EN = Entanglement.

				Estimated entanglements that were unobserved or observed with no known cause			
Country Split	**Date range**	**PBR**	**Observed M/SI**	**77% EN**	**67% EN**	**58% EN**	**50% EN**
50 U.S. / 50 CAN	**2012-2016**	**0.9**	64%	89%	88%	87%	85%
	2013-2017	**0.8**	65%	92%	91%	90%	89%
	2014-2018	**0.8**	71%	92%	91%	90%	89%
	2010-2018	**0.8**	66%	90%	89%	88%	87%
40 U.S. / 60 CAN	**2012-2016**	**0.9**	56%	86%	85%	84%	82%
	2013-2017	**0.8**	57%	90%	89%	87%	86%
	2014-2018	**0.8**	64%	90%	89%	88%	87%
	2010-2018	**0.8**	59%	88%	86%	85%	83%
30 U.S. / 70 CAN	**2012-2016**	**0.9**	45%	82%	81%	79%	77%
	2013-2017	**0.8**	45%	87%	85%	83%	82%
	2014-2018	**0.8**	54%	87%	86%	84%	83%
	2010-2018	**0.8**	47%	84%	82%	80%	78%

*See Column 10 in Table 2.4.

Further consideration of these alternative assumptions are anticipated to inform future Stock Assessment Reports and in assessing appropriate risk reduction targets. Additionally, the population estimate for 2019 is estimated to be 368 (± 11, Pace 2021) based on modifications to the population model, described in Pace et al. (2021) which recognized that mortality of right whales since the regime shift in 2010 and during the Unusual Mortality Event that began in 2017 was higher than originally anticipated. PBR will likely be lowered to 0.7 in the next Stock Assessment Report. This new PBR would require a target risk reduction range of 71 to 91 percent using data from 2010 through 2018 (Pace 2021, Hayes et al. 2020).

Because of the urgency of responding to the rapid decline in the right whale population and because the fishery source of mortality and serious injury to right whales cannot be determined in 77 percent of the documented cases since 2010, for this action NMFS is focusing its scope on the area and fishery that fishes the greatest number of buoy lines in the U.S. Atlantic: lobster and Jonah crab trap/pot fisheries in the Northeast Region (Figure 2.5). As shown in Table 2.3, the 2017 buoy line estimates derived through a model created to support the Team efforts indicate that over 93 percent of fixed gear buoy line within right whale habitats along the Atlantic coast are fished by the U.S. lobster and Jonah crab trap/pot 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 with discussions that started in the spring of 2021.

The regulatory options for reducing the risk of entanglement mortality and serious injury 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 mortality and serious injury of entangled whales and mitigate potential sublethal impacts. Most whales in the 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, van der Hoop et al. 2017, Christiansen et al. 2020, Moore et al. 2021). There is new evidence that lower strength rope (i.e. 1,700 pounds/771 kilograms) may be less likely to remain on entangled adult whales (Knowlton et al. 2016, DeCew et al. 2017), thereby allowing modifications in rope strength to be used to minimize the lethality of fishing gear.

In addition to reducing risk of mortality and serious injury, there is an additional need to acquire more data to inform future management actions. Additional gear marking 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 mortality and serious injury 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

This EIS is being prepared using the 1978 CEQ NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14,

2020. This review began on August 2, 2019 (Notice of Intent published on this date) and the agency has decided to proceed under the 1978 regulations.

Need	Purposes
To reduce right whale mortality and serious injury in Northeast trap/pot commercial fisheries to below PBR, by at least 60 to 80 percent 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 mortality and serious injury 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

2.3 References

2012. Policy for Distinguishing Serious from Non-Serious Injury of Marine Mammals Pursuant to the Marine Mammal Protection Act. 77 FR 3233, US.

Christiansen, F., S. M. Dawson, J. W. Durban, H. Fearnbach, C. A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H. A. Warick, I. Kerr, M. S. Lynn, H. M. Pettis, and M. J. Moore. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Marine Ecology Progress Series 640:1-16.

Davies, K., M. Brown, P. Hamilton, A. Knowlton, C. Taggart, and A. Vanderlaan. 2019. Variation in North Atlantic right whale *Eubalaena glacialis* occurrence in the Bay of Fundy, Canada, over three decades. Endangered Species Research **39**:159-171.

DeCew, J., P. Lane, and E. Kingston. 2017. Numerical analysis of a lobster pot system. Page 61. New England Aquarium.

Hayes, S. A., S. Gardner, L. Garrison, A. Henry, and L. Leandro. 2018. North Atlantic Right Whales: evaluating their recovery challenges in 2018.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. NOAA Technical Memorandum NMFS-NE-258, NEFSC, NMFS, NOAA, DOC, Woods Hole, MA.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. Page 479. Northeast Fisheries Science Center, Woods Hole, MA.

Henry, A. G., M. Garron, D. Morin, A. Smith, A. Reid, W. Ledwell, and T. V. Cole. 2021. Serious injury and mortality determinations for baleen whale stocks 2014-2018. Page 62. Northeast Fisheries Science Center Reference Document, U.S. Department of Commerce.

Henry, A. G., T. V. N. Cole, L. Hall, W. Ledwell, D. Morin, and A. Reid. 2014. Mortality determinations for baleen whale stocks along the Gulf of Mexico, United States east coast, and Atlantic Canadian provinces, 2008 - 2012. US Department of Commerce, Northeast Fisheries Science Center.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21:635–645.

Knowlton, A., P. K. Hamilton, M. Marx, H. Pettis, and S. Kraus. 2012. Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: A 30 yr retrospective. Marine Ecology Progress Series **466**:293-302.

Knowlton, A. R., J. Robbins, S. Landry, H. A. McKenna, S. D. Kraus, and T. B. Werner. 2016. Effects of fishing rope strength on the severity of large whale entanglements. Conserv Biol **30**:318-328.

Kraus, S. D., M. W. Brown, H. Caswell, C. W. Clark, M. Fujiwara, P. K. Hamilton, R. D. Kenney, A. R. Knowlton, S. Landry, C. A. Mayo, W. A. McLellan, M. J. Moore, D. P. Nowacek, D. A. Pabst, A. J. Read, and R. M. Rolland. 2005. North Atlantic right whales in crisis. Science 309:561-562.

Moore, M., T. Rowles, D. Fauquier, J. Baker, I. Biedron, J. Durban, P. Hamilton, A. Henry, A. Knowlton, W. McLellan, C. Miller, R. Pace, H. Pettis, S. Raverty, R. Rolland, R. Schick, S. Sharp, C. Smith, L. Thomas, J. van der Hoop, and M. Ziccardi. 2021. REVIEW Assessing North Atlantic right whale health: threats, and development of tools critical for conservation of the species. Diseases of Aquatic Organisms 143:205–226.

NMFS. 2012. Protected Resources Management Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals. National Marine Fisheries Service Instruction 02-038-01. NMFS, NOAA, DOC.

NMFS 2012. Process for Injury Determination Distinguishing Serious from Non-Serious Injury of Marine Mammals. NMFS-PD- 02-238-01. Renewed 2014. Available at https://media.fisheries.noaa.gov/dam-migration/02-238-01.pdf

Oleson, E.M, Jason Baker, Jay Barlow, Jeff E. Moore, Paul Wade. 2020. North Atlantic Right Whale Monitoring and Surveillance: Report and Recommendations of the National Marine Fisheries Service's Expert Working Group. NOAA Tech. Memo. NMFS-F/OPR-64, 47 p.

Pace, R. M., 3rd, P. J. Corkeron, and S. D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution **7**:8730-8741.

Pace, R. M., R. Williams, S. D. Kraus, A. R. Knowlton, and H. M. Pettis. 2021. Cryptic mortality of North Atlantic right whales:e346.

Pace, RM. 2021. Revisions and further evaluations of the right whale abundance model: improvements for hypothesis testing. NOAA Tech. Memo. NMFS-NE 269.Pettis, H. M., R. M. I. Pace, and P. K. Hamilton. 2018a. North Atlantic Right Whale Consortium 2018 Annual Report Card.

Pettis, H. M., R. M. I. Pace, R. S. Schick, and P. K. Hamilton. 2018b. North Atlantic Right Whale Consortium 2017 annual report card.

Pettis, H. M., R. M. I. Pace, and P. K. Hamilton. 2020. North Atlantic Right Whale Consortium 2019 Annual Report Card.

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Pettis, H. M., R. M. Rolland, P. K. Hamilton, A. R. Knowlton, E. A. Burgess, and S. D. Kraus. 2017. Body condition changes arising from natural factors and fishing gear entanglements in North Atlantic right whales *Eubalaena glacialis*. Endangered Species Research **32**:237-249.

Record, N. R., J. Runge, D. Pendleton, W. Balch, K. Davies, A. Pershing, C. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S. Kraus, R. Kenney, C. Hudak, C. Mayo, C. Chen, J. Salisbury, and C. Thompson. 2019. Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography **32**.

Rolland, R. M., R. S. Schick, H. M. Pettis, A. R. Knowlton, P. K. Hamilton, J. S. Clark, and S. D. Kraus.

2016. Health of North Atlantic right whales *Eubalaena glacialis* over three decades: from individual health to demographic and population health trends. Marine Ecology Progress Series **542**:265-282.

Sharp, S., W. McLellan, D. Rotstein, A. Costidis, S. Barco, K. Durham, T. Pitchford, K. Jackson, P. Daoust, T. Wimmer, E. Couture, L. Bourque, T. Frasier, B. Frasier, D. Fauquier, T. Rowles, P. Hamilton, H. Pettis, and M. Moore. 2019. Gross and histopathologic diagnoses from North

Atlantic right whale *Eubalaena glacialis* mortalities between 2003 and 2018. Diseases of Aquatic Organisms **135**:1-31.

van der Hoop, J., P. Corkeron, and M. Moore. 2017. Entanglement is a costly life-history stage in large whales. Ecology and Evolution 7:92–106.

CHAPTER 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 Final Environmental Impact Statement (FEIS) 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 (hereafter referred to as right whale), occur nearly year round and where the vast majority of buoy lines are fished (see Chapter 2). This chapter is organized as follows:

- Section 3.1 describes the process that was followed in developing the alternatives analyzed in the DEIS and modified due to public comments and new information for analysis in this FEIS.
- Section 3.2 provides a description of the regulatory alternatives under consideration.
- Section 3.3 details justification for the alternatives selected for analysis in this FEIS.
- Section 3.4 contains an overview of the alternatives that NMFS considered but rejected.

3.1 Development of Alternatives

NMFS is considering two types of actions: 1) modifications to the existing Take Reduction Plan requirements to reduce frequency or severity of entanglements and 2) small modifications to the federal regulations for American Lobster related to increasing maximum length of trawls between buoys and increasing the number of traps on a trawl using only one buoy. 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 and the type of gear involved.

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. While development of alternatives began with consideration of recommendations of conceptual buoy line and weak rope measures spread across jurisdictions within the Northeast Region, scoping results and implementation challenges resulted in substantial modifications that included the addition of seasonal restricted areas. 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 aggregate seasonally, measures to reduce the number of buoy lines, close areas to buoy lines, or require buoy lines to be reconfigured to include a portion that breaks at 1,700 pounds (771 kilograms) are analyzed. The measures under consideration aim to reduce entanglement risk posed by Northeast Region trap/pot fisheries gear by at least 60 percent or greater to help achieve the potential biological removal level (PBR) 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 right whales in lobster and Jonah crab 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 and in response to public input, to create the alternatives considered in this FEIS.

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 the groundline that runs between traps along a multi trap trawl; replacing floating line with sinking groundline 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 buoy lines, culminating with 2014 and 2015 measures that expanded the Cape Cod Bay restricted area for trap/pot fisheries into Massachusetts Restricted Area (MRA; 50 CFR 229.32(c)(3). These 2014 and 2015 amendments reduced the number of buoy lines substantially through both the expanded closure area largely resulting in the removal of gear to shore storage, and by establishing "trawling up" areas that increased the number of traps between buoy lines.

Confirmation that the 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 2021. In 2017, due to decomposition or lack of access, the 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 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 to consider the operational feasibility of potential risk reduction measures. One subgroup was charged with investigating the feasibility of using weak rope (1,700 pounds/771 kilograms 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 and Jonah crab fishery; 93 percent within the Northeast Region. For this reason NMFS focused the scope of the Team's discussions on developing recommendations for the Northeast Region lobster and Jonah crab trap/pot fisheries.

In recent years, no gear has been retrieved from 79 percent of large whales (80 percent of all right whales) where entanglement-related serious injuries and mortalities are identified. Therefore while the subgroups concurred that expanded gear marking requirements were feasible, expensive approaches such as micro-chips or transponders were identified as possibly too expensive given the relatively low benefits of the gear marking. 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 considering ropeless fishing alternatives suggested that it was impractical for rapid deployment and therefore should not be considered for imminent plan modification recommendations. The subgroups' findings were shared with the Team in support of a full in-person meeting in October 2018.

Additionally, in preparation of Also prior to the October 2018 in-person meeting, team members were invited to submit risk reduction proposals. Eight proposals were submitted to NMFS prior to the meeting and an additional proposal was crafted during the meeting and shared with all 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. As a result, the Team created work plans for NMFS identifying data needs for decision making to have at the April 2019 meeting. 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. Additionally, NMFS hosted a third teleconference with the Team in order for the New England Aquarium to share the results of a rope workshop they held. 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 (DMR) rope research was also reviewed during this 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 closures to the use of buoy lines. Under a revised closure definition, trap/pot fishermen could fish with trap/pot gear using "ropeless" methods that did not use buoy lines, although exempted fishing permits would be required to exempt fishermen from the surface marking requirements under fishery management regulations. The gear would not be truly ropeless, but would still require rope in the groundline between pots in the trawls on the ocean floor. Most designs also include rope buoy lines that are stored on the bottom until retrieved by a vessel operator when on site to haul 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 it was clear 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 meetings, NMFS identified the need for a 60 percent to 80 percent risk reduction in U.S. entanglement-related mortality and serious injury in order to achieve a PBR of, at the time, 0.9 right whales (PBR is currently 0.8; see Section 2.1.5). Additionally, the Northeast Fisheries Science Center created a preliminary DST (see Section 3.1.4 and Appendix 3.1), for use during the in-person April 2019 meeting to model and analyze the contribution of various proposal elements (whale density, gear density, etc.) towards the target risk reduction. The draft version of the preliminary DST was presented to the Team a week before the April 2019 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 related to 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 unobserved mortalities are likely to be caused by the same human interactions. However, there is no way to definitively apportion unobserved 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 unobserved 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 Team focused on recommendations to achieve the 60 percent, lower bound, target.

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 PBR 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 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 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) 3. NMFS conducted scoping in August and September of 2019, receiving over 89,000 written comments and including eight public meetings attended by over 800 stakeholders.

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.
- Update the right whale model used for rulemaking to account for regime shift

Specific Recommendations by Area

- For Maine, LMA 1
    - 50 percent buoy line reduction
    - The top ¾ length of buoy lines made of weakened rope (toppers) on all gear outside of 3 miles (5.6 kilometers); 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 1
    - 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 2
    - Buoy lines expected to be reduced by 18 percent in the next three years
    - Willing to use 1,700 pounds (771 kilograms) 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 1 (aggregate risk reduction of 58.5 percent)
    - 30 percent buoy line reduction
    - 1,700 pounds (771 kilograms) or sleeves or equivalent throughout fishery; expected to generate a 28-29 percent risk reduction
- For Offshore, LMA 3
    - Fishermen in principle agree to reducing risk through a combination of buoy line reductions (already underway) and other measures; LMA 3 responsible (like other LMAs) for meeting the 60 percent risk reduction goal
    - Ongoing LMA 3 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 pounds (771 kilograms) 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 pounds (771 kilograms) 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.

Proposals submitted to NMFS by the states can be found in Appendix 3.3. As described in the list of measures for Alternative 2 (Preferred), nearly all of the measures in the Preferred

Alternative were originally proposed by the states and modified in this FEIS based on state and public feedback during the public comment period. One measure, an area seasonally closed to buoy lines along the edge of LMA 1 about 30 miles (48.3 km) off shore of Maine, was included by NMFS though not in Maine's proposal to ensure LMA 1 achieved sufficient risk reduction. Another measure, proposed by Rhode Island, to require one weak buoy line for LMA 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 2. Measures discussed with LMA 3 participants, including the Atlantic Offshore Lobstermen's Association, are analyzed in both Alternatives 2 and 3. In sum, the alternatives analyzed in this FEIS were adapted from state proposals for risk reduction alternatives, where possible.

The Marine Mammal Protection Act directs NMFS to adopt as regulations take reduction team recommended plan modifications, or to identify and explain why measures different from what the team recommended were implemented. The alternatives proposed by the states, the alternatives analyzed in the Draft Environmental Impact Statement (DEIS), and the final regulatory alternatives detailed in Table 3.2 in this FEIS are not the same as the recommendations provided by the Team. The framework provided by the April 2019 meeting shaped the overarching goals and the scoping conducted by NMFS and the states to develop region specific approaches to risk reduction. However as a framework, the Team's recommendations were not directly translatable into implementing regulations. Additionally, these measures were refined based on stakeholder feedback, feasibility, improvement of risk reduction estimate modeling, public scoping, and extensive public comments on the DEIS. Additionally, improvements in the analytical tools being used to develop the alternatives, new weak insert data, and other details that were not yet in place at the time of the ALWTRT meeting, as well as safety or capacity-related concerns over longer trawls by smaller entities were considered in creating the final measures. However, Alternatives 2 and 3 align with the basic principles within the Team's framework recommendations: 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 as possible across jurisdictions, primarily using line reductions through trawling up and reduction of line strength through the use of weak rope or weak inserts. One large change is that Alternatives 2 and 3 include seasonal restricted areas, closed to lobster and Jonah crab buoy lines in areas where right whales are known to aggregate based on the best available data, which were added to ensure the sufficiency of other measures in meeting the risk reduction goal, as well as in response to public input related to areas of high whale use. Finally, Alternative 2 (Preferred) in the FEIS differs from the DEIS in the extent of the area being closed and weak inserts being required due to updates to the DST, especially a modification of the whale data, and associated new data analysis, as well as consideration of new measures being implemented by the state of Massachusetts. These changes in the FEIS led to a stronger Preferred Alternative with greater risk reduction to right whales than those in the DEIS.

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 (coastline to 3 miles/coastline to

5.6 km offshore). NMFS has management authority for the fishery in federal waters (3 to 200 miles/5.6-370.4 kilometers) 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 6) 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 2019 using baseline line data informed by the states participating in the PDT, but the DST was not sufficiently finalized at that time to inform an 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 FEIS, particularly including consideration of development of a line cap under the Non-preferred Alternative.

3.1.2 *Decision Support Tool Analyses*

The DST, a model designed to assess and compare the 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 the 60 to 80 percent risk reduction target provided to the team in 2019. This model calculates right whale entanglement risk based on three components: the density of lines in the water, the distribution of whales (as indicated by a habitat density model predicting right whale distribution from 2010 through 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 the risk of entanglements that result in serious injury or mortality.

An early DST model was used by the Team in April 2019. That model was modified in response to a peer review conducted in late 2019, so DST version two was used to assess risk for the DEIS. Subsequent modifications include a change in the Duke right whale habitat density model (right whale density model) to version 11 (Roberts et al. 2020), which consider right whale distribution after ecosystem shifts since 2010. DST version three was used in this FEIS to help select risk reduction scenarios for the Preferred and Non-preferred Alternatives that are predicted to sufficiently reduce right whale mortality and serious injury risk due to entanglement and to distribute risk across the proposed area as equitably as practicable, with extra protection in areas where higher density aggregations are most likely. Entanglement threat and risk reduction calculations are unchanged between DST versions two and three as used in this analysis. This section includes a brief summary of the model and how it was used in this FEIS. More thorough documentation of the model and its components are available in Appendix 3.1.

The line density component of the DST for all areas except LMA 3 is based on the peer-reviewed NMFS Vertical Line Model and Co-occurrence model developed by IEC. It estimates the number of buoy lines associated with trap/pot configurations within a given spatial area. The main model uses buoy line estimates from 2017, the latest data available and considered representative of current fishery management measures and associated effort. A separate line component for LMA 3 was developed by the NEFSC that was assessed to perform comparable to the IEc model in aggregate but to have finer spatial resolution. 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, and represented the most recent data available when the ALWTRT process was reinitiated. An additional model was included that uses older fishing effort data prior to the implementation of the MRA to determine the value of that closure since the ALWTRT recommended considering the value of MRA toward achieving the risk reduction target. The MRA in its current form was implemented in 2015 only a year and a half before the baseline year of 2017. Using the older line data that predated the MRA, DST analyses estimated how much risk reduction the closure likely accomplished that could be put towards a risk reduction credit.

A second layer in the model assesses the risk associated with different gear configurations, accounting for the use of lines 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. The model estimates uncertainty within the gear threat model and provides an upper and lower bound within the model output, if the option is selected. This uncertainty is calculated by bootstrapping the observed line strength data to generate a ratio of observed to expected line strengths and fitting the data to a binomial generalized linear model. See Appendix 3.1 for more detail about the development of the gear threat model and associated uncertainty.

The final layer is a right whale density model. The DST employs a right whale 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; Roberts et al. 2020). The right whale density model used oceanographic and habitat variables to create a map of likely whale presence using whale data from 2003 through 2018. There are three options for whale layers: one spans from 2003 through 2018, one from 2003 through 2009, and one from 2010 through 2018. The alternatives in this FEIS were all developed using the model for the most recent right whale data. The DST also includes a humpback density model and a fin whale density model for the period of 1999 through 2017 (Roberts et al. 2017). The fin whale density model currently does not support the use of a gear threat model and can only be used to examine co-occurrence.

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, line number, restricted areas with lines out and/or lines moved to adjacent fishing 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 of whales and fishing lines. 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. For example, risk reduced first by reducing line number reduces the risk landscape against which a weak line requirement would be measured; they are not directly additive. Uncertainty is estimated for the gear threat model but additional measures of model uncertainty are unavailable for each layer of the model at this time.

3.1.2.1 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/feature-story/decision-support-tool-helpful-those-finding-ways-reduce-whale-entanglement-fishing. 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 interim version of the DST used for the DEIS (version two) and the version of the DST (version 3) 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.

3.1.2.2 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 Lobster and Jonah crab trap/pot fisheries within each alternative package (Table 3.2). The target of 60 to 80 percent was presented 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 fisheries because they fish 93 percent of the buoy lines used in areas of the U.S. Atlantic where right whales occur. Regulating multiple fisheries coast wide is a more complex and lengthy process. Given the fact that unobserved mortality estimated in the population model was new, and the many sources of uncertainty in the 80 percent target related to both documented and unobserved mortalities and serious injuries, 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 Region. 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.

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

- 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 Atlantic Offshore Lobstermen's Association for LMA 3.
- Direct the most protection to areas of predictable high seasonal aggregations of right whales, including substantial risk reduction across areas of likely occurrence and precautionary measures in other areas to be resilient to ecosystem changes and associated changing whale distribution
- Consider conservation equivalencies proposed by the states or the Atlantic Offshore Lobstermen's Association
- Comments received during the public comment period for the Draft Environmental Impact Statement

- Development of lower bound estimates of the alternatives above the 60 percent risk reduction target to account for some uncertainty in risk reduction calculations.

Table 3.1: The total risk reduction estimated for the Preferred Alternative (Alternative 2) and Non-preferred Alternative (Alternative 3). 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 3.1.2.2, as was the uncertainty provided by the gear threat model within the DST. Elements that do not result in significant risk reduction (e.g. weak link and gear marking modifications) are not included.

Combination of Measures	Alternative 2 (Preferred)	Alternative 3*
Risk Reduction: Restricted Areas	53.3%	33.6%
Risk Reduction: Restricted Areas + Trawl Length	59.2%	34.4%
Risk Reduction: Restricted Areas + Trawl Length + Other Line Reduction**	61.8%	59.4%
Total Risk Reduction - lower: Restricted Areas + Trawl Length + Other Line Reduction + Weak Line: lower bound estimate for inserts (DST Gear Threat Uncertainty)	68.8% (65.9% - 70.2%)	72.5%*** (61.8% - 77.9%)
Total Risk Reduction - upper: Restricted Areas + Trawl Length + Other Line Reduction + Weak Line - upper bound estimate for inserts (DST Gear Threat Uncertainty)	72.7% (66.5% – 75.8%)	

*Alternative 3 uses a different baseline line model than the Preferred Alternative because it does not include the Massachusetts Restricted Area Credit.
** Other line reduction for Alternative 2 represents line reduction via trap reductions in LMA 2 and 3. Other line reduction for Alternative 3 represents the risk reduction from the line cap.
*** No bounds calculated because only full weak line was included and analyzed

3.1.2.3 Decision Support Tool Analyses

Each suite of measures were run through the DST (version three) to identify the estimated contribution to risk reduction across the Northeast Region. The summary of model runs that best estimate the risk reduction of the alternatives in this FEIS, taking into account the interactive effects of different measure types, are located in Table 3.1. Additional output of individual model runs is included in Appendix 3.2.

The model has several options to customize each run according to the assumptions being made. The following delineates how scenarios were run based on the different underlying assumptions of the different model options available.

- Alternatives were assessed using one buoy line and right whale density model to avoid combining non-additive model runs, as was necessary for the DEIS when we relied on version two of the DST. The use of a single model allows all analyses to be run on one model with a consistent baseline for all measures within the alternative.
- To get an idea of relative contribution of each measure type (e.g. trawl length, restricted area, or maximum line strength), measures of a particular type were added to progressive model runs until all measures for an alternative were combined in one final model run (see Table 3.1).
- All final estimates were run in high resolution with DST model version 3.1.0.
- The most updated lobster trap map was used for each region, line model version 3.0.0.

- All risk reduction estimates used the same gear threat model and assumed line strength would not increase for the trawl up scenarios selected based on feedback from the Maine DMR and offshore fishermen.
- All models were assessed with version 11 of the right whale density model provided to NMFS by Duke University in early 2021 (Roberts et al. 2020). All alternatives used the right whale density model timeframe that estimated density from 2010 to 2018 data to incorporate the most recent data available and ecosystem shifts, most evident in the area south of Cape Cod.
- The two alternatives in this FEIS were assessed using two line models with baseline buoy line data from 2017, both produced by IEc, according to the data needed to assess the impacts of each suite of measures within complete model runs.
    - Alternative 2 (Preferred) considered "credit" for the Massachusetts Restricted Area (MRA) agreed upon by the Team in April 2019 and so used a line model that estimated the line density and trap configurations within the MRA from February through April prior to the implementation of the MRA in 2015. All other line data in this model represented the 2017 baseline year.
    - Alternative 3 (Non-preferred) used the same 2017 line model as Alternative 2 but did not include the line data that pre-dated implementation of the MRA during the closure months. This is because the baseline year selected for this alternative was wholly 2017 and so this alternative did not consider the MRA credit.
- Weak insertion analyses: weak insertions in longer intervals than what is considered fully weak (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 (see Section 3.3.4 for a discussion the criteria used to evaluate weak inserts). To determine the risk reduction achieved from these scenarios, we calculated an upper and lower bound for the proportion of full weak line risk reduction offered by a weak insert configuration:
    - The lower bound represented the proportion of insertions in a weak line scenario to the number of insertions needed to be set at 40 foot (12.2 meter) intervals considering water depths and anticipated buoy line length. This measure was the best approximation based on the data available. The number of insertions needed for full weak rope equivalent was estimated using average depth in the area weighted by the number of lines in each sub-region, and adjusted for estimated scope ratio of the buoy lines in the area based on consultation with state managers or fishermen (McCarron & Tetreault 2012).
    - The upper bound estimate was equivalent to the proportion of the buoy line above the lowest weak insertion point since the lower the insertion, the more likely a whale will encounter and breakaway from above the insertion. Below the lowest insertion, no risk reduction value is given (see Knowlton et al. 2020).
    - The proportional risk reduction assigned to the lower and upper bound estimates were then included in the DST model runs to approximate risk reduction where full weak line was not included.

    - The lower bound weak line estimate was used to estimate whether an alternative met the required minimum risk reduction target of 60 percent to account for uncertainty given the lack of better quantitative data for these estimates.
    - The range presented is responsive to those comments on the DEIS that suggested either we should consider all the rope down to the lowest link to be the equivalent of weak rope (the upper bound) or that we should not consider rope weak unless it is engineered to break at 1,700 pounds (771 kilograms) or less or has the full suite of weak inserts (the lower bound
- For any alternatives that impacted vessels fishing within the overlap between LMA 2 and Three, we assumed half of the vessels in this area were impacted by LMA 2 measures and the remainder were assumed to fish according to LMA 3 measures. Under fishery management measures, dual permitted fishermen would have to fish under the more conservative permit requirements therefore LMA 3 fishermen fishing in the overlap area would have to fish under LMA 3 trawling up and weak rope requirements.
- Because of variability in the number of lines fished in particular months and by area, the 50 percent line cap analysis was estimated to achieve an average 45 percent reduction in line across the entire year, which varied by region from 37 to 49 percent. This was estimated by calculating half of the average number of lines fished across the year by area and how this might impact fishing effort by month in areas where the number of lines fished during some months in 2017 was less than the monthly average (i.e. the line cap). The most conservative estimate of average percent line reduction for each LMA was used to estimate risk reduction in the DST (see Section 3.5.5.5 for further details).

3.1.2.4 Identifying Areas for Seasonal Restrictions to Buoy Lines

Broad scale reduction in buoy lines across the proposed area is resilient to changes in whale distribution. However, NMFS identified areas and seasons where persistent aggregations of right whales appear to be seasonally predictable and to afford opportunity for additional risk reduction through seasonal closures to persistent buoy lines. To be effective, areas should 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. Hotspots 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 hotspot areas is discussed below.

3.1.2.5 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 of varying sizes and configurations were considered in this analysis (Figure 3.1). This area was also predicted as viable right whale habitat based on oceanographic models showing suitable habitat and prey availability (Pendleton et al.

2012). The Preferred Alternative analyzed for final rulemaking would implement a larger area closure than was identified in the Preferred Alternative in the DEIS but that was analyzed within the Non-preferred Alternative. Right, humpback, fin, minke, and sei whales were all sighted throughout the 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 of right whales were seen, within the 196 individuals identified. Thirty-five of the whales identified between 2011 and 2015 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). Though right whale occurrence peaks in winter and spring, there does appear to be some year round presence in this region (Oleson et al. 2020). The newest right whale density model from Duke University (version 11) captures the distribution shift in recent years (2010 to 2018) when compared to the previous nine year period (Roberts et al. 2020). Although the identification of this area as an important foraging area could partly be due to increased survey effort in this area due to wind energy development, it was predicted by models of copepod distribution (Pendleton et al. 2012).

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 LMA 2. Ultimately, three different shapes were selected for analysis in the DEIS based on the most recent five year NARWC sightings data (data downloaded in 2019). NMFS revisited these areas in selecting a Preferred Alternatives for the FEIS and for rulemaking based on public comment, an updated right whale density model within the DST that takes into account the most recent data from 2010 through 2018, and new sightings data that are not in the right whale density model but demonstrates high use of a broader area than was preferred in the DEIS. This area south of Cape Cod, Martha's Vineyard, and Nantucket represents an area where right whale aggregations have increased in recent years and therefore the most recent data is essential for delineating an area that is likely to have an impact on right whale entanglement risk.

The restricted area that was included in the Preferred Alternative in the DEIS was proposed by Massachusetts because it encompassed most of the sightings in the most recent two years when whale use of the area appeared to have shifted to the East. The restricted area bolstered the risk reduction that they were proposing for southern New England's LMA 2. However, updated aerial data collected between 2017 through 2021 demonstrate annual variation in habitat use in southern New England and that right whale aggregations are likely to shift to areas outside of the original preferred restricted area (Figure 3.1). The DST further estimated higher, more predictable risk reduction occurring within the larger restricted areas, therefore the area proposed by Massachusetts and in the Preferred Alternative in the DEIS was moved into the considered but rejected measures within this FEIS.

For the FEIS, we revisited the restricted areas included in the Non-preferred Alternative of the DEIS. One restricted area option in the DEIS 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 available for the FEIS (2017 through March 3, 2020). This shape was highly tailored to the areas where right whales have been frequently spotted from February through April, the proposed implementation months, between 2010 and 2020 but new 2021 data demonstrates that an overly surgical approach may not be robust to annual changes in aggregations in this area.

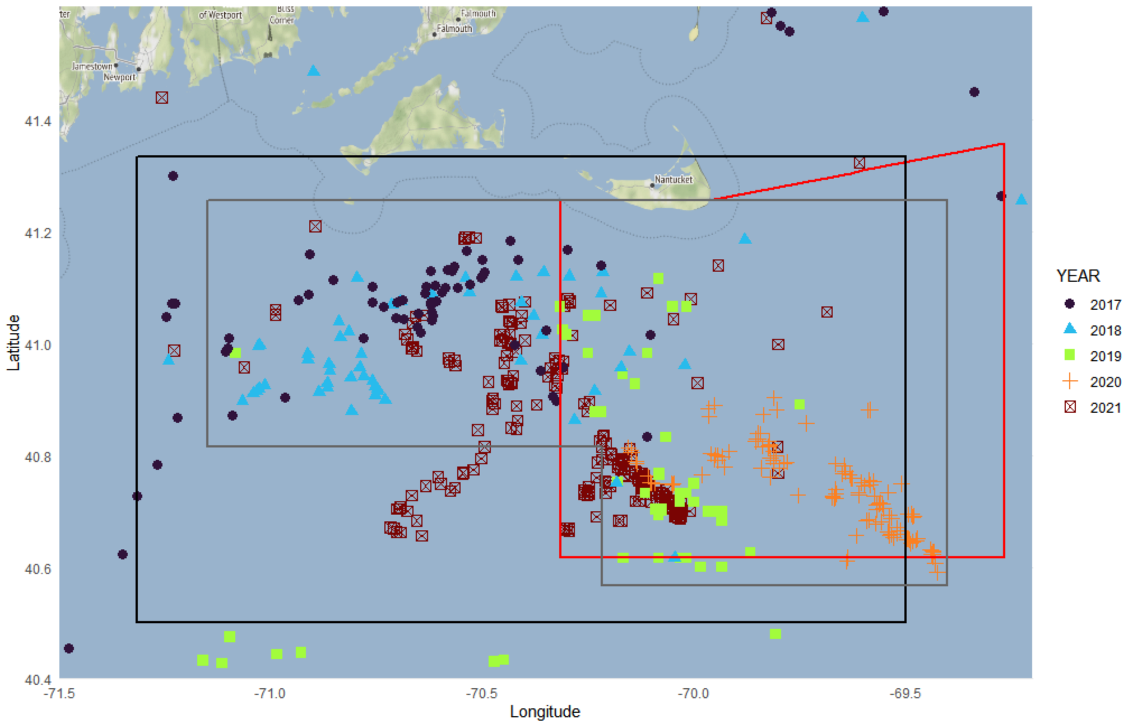


Figure 3.1: Right whale sightings data during February through April from 2017 through 2021 with the restricted areas analyzed in the DEIS. The area in the Preferred Alternative in the DEIS is in red, the area now in the FEIS Preferred Alternative is in black, and the grey area is in the Non-preferred alternatives in both the DEIS and FEIS. Aerial and shipboard survey data collected by NMFS, the New England Aquarium, and The Center for Coastal Studies and also includes opportunistic sightings data.

The largest area analyzed in the DEIS encompasses most of the recent right whales sightings since at least 2014. This area was included in the DEIS because it encompassed most of the smaller hotspot areas in the DST runs for the DEIS that were tested using various data sources and proposals. This area captures the majority of sightings in the most recent five year period during peak right whale presence according to aerial and shipboard survey data collected by NMFS, the New England Aquarium, and The Center for Coastal Studies and through opportunistic sightings data (February through April, Figure 3.1). This area provided over two times the risk reduction of the more tailored L-shaped area and, notably, encompasses dense right whale aggregations observed in spring of 2021 that would have been missed by the L-shaped area. This area better captures variability in habitat use, will be more resilient to environmental variability in the future, and prevents relocation of lines into areas of entanglement risk in adjacent areas. For these reasons, the larger closure analyzed in the DEIS was incorporated into Alternative 2 (Preferred) for this FEIS, and the L-shaped area was retained as an element of the Non-preferred Alternative 3.

3.1.2.5.1 Offshore Hotspot Analyses

A co-occurrence hotspot analysis was conducted in the offshore fishing habitats in LMA 1 and LMA 3 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, surveys are more rare in offshore areas compared to the coast but are occasionally conducted in response to reports of sightings. In order to identify offshore areas that could benefit from a restricted area during development of the DEIS, we used the right whale density model, version eight, within the DST to identify the individual pixels that represent forty to 50 percent of the cumulative risk in LMA 1 (assuming MRA is closed through May, see below identified as a “hotspot”) and in LMA 3 within the Northeast Region. Two areas were identified as having higher than average risk: one beyond 12 miles (22.2km) offshore of Maine during fall and winter months (Figure 3.2), which has been proposed for a seasonal buoy line closure in Alternatives 2 and 3, 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 3.3), proposed as a lobster trap/pot management area in Alternative 2 and a seasonal buoy line restricted area in Alternative 3. 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 1 restricted area, we also considered Maine’s fishing zone boundaries, and truncated the borders to align with the edges of the outermost two zones. Independent observations, as well as the physical and biological features of these “hotspots” identified by the DST confirm their relative importance. The inclusion of a new right whale density model into version three of the DST (right whale density model, version 11), still showed substantial risk reduction occurring in these hotspots suggesting these areas remain relatively important between 2010 and 2018.

LMA 1: The initial hotspot analyses were conducted with an older version (version eight) of the right whale density model that spanned from 1998 through 2017. The most updated version of the right whale density model (version 11) allows comparison of whale distribution before and after 2010 and suggests the Gulf of Maine, including this area, is slightly less important for right whales in recent years than previously but remains a potential hotspot for right whales during late fall and early winter months (Roberts et al. 2020). Though some research suggests the presence of the preferred prey species are shifting within the Gulf of Maine, acoustic data have still detected right whales in this area in recent years. 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 the boundaries selected with the DST. Humpback, fin, and sei whales were also detected (data available at dcs.whoi.edu, Baumgartner et al. 2019, Baumgartner 2020). Restricting buoy lines during this time period in this region will reduce existing entanglement risk as well as prevent movement of the prolific nearshore fishery further offshore into this hotspot. 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. But at the time of writing of this FEIS, acoustic recordings for this season had not been uploaded or analyzed.

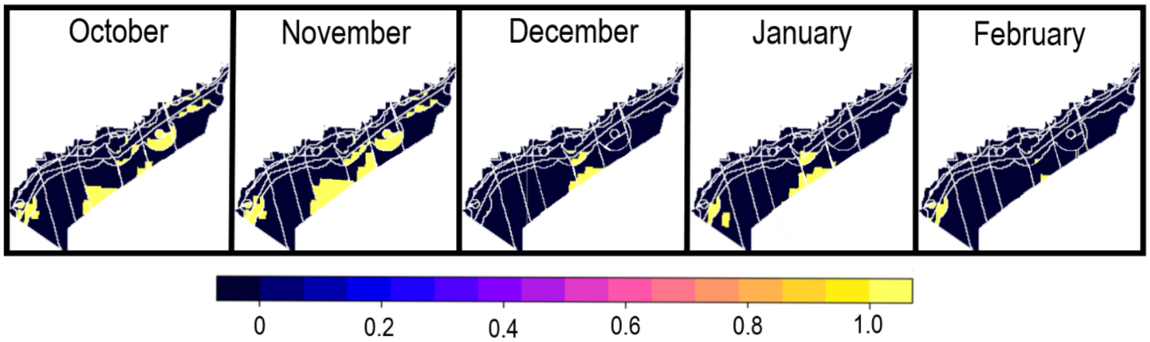


Figure 3.2: A hotspot analysis of the first 50 percent of risk characterized in the right whale density model version eight for LMA 1

<u>*LMA 3, Georges Basin:*</u> 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 in 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. However, co-occurrence model results included in the DEIS suggested that relocation of gear out of this area into adjacent productive fishing grounds would increase risk for several large whale species just outside of the boundaries of the area, possibly due to movement patterns through the entire region. In comments on the DEIS, the Atlantic Offshore Lobstermen's Association instead proposed a higher number of traps per trawl for this area as a conservation equivalency that would allow shorter trawl lengths than the 45 traps per trawl specified in the DEIS along the southern boundary of Georges Bank. Because of the importance of this Georges Basin hotspot to right whales, this FEIS adopted this as a Preferred Alternative. The measure offers a slightly higher line reduction measure for vessels fishing for lobster or Jonah crab in the Georges Basin area than the rest of LMA 3 in the Northeast without shifting co-occurrence into other potential hotspots.

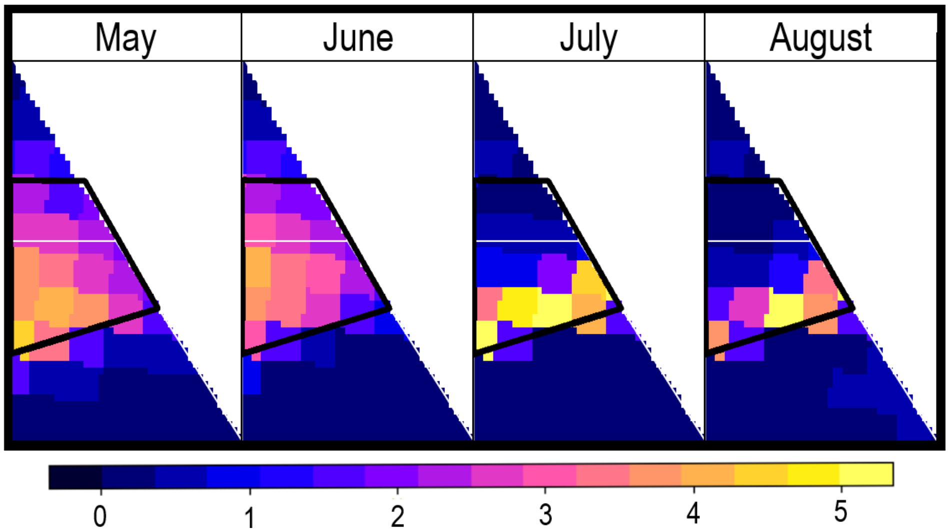


Figure 3.3: A hotspot analysis of the first 40 percent of risk characterized in the right whale density model version eight for LMA 3

3.1.2.5.2 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, Roberts et al. 2020). Thus, several options were analyzed that recognize the state's flexibility in reopening dates in certain areas at the end of the restricted period in case large aggregations are still present.

3.2 Alternatives Considered

The alternatives examined in this FEIS emphasize options that are designed to reduce the potential for entanglements or to minimize the severity of adverse impacts to right whales and other large whales if entanglements occur, with a goal of at least 60 percent risk reduction (Section 3.2.1). Regulatory options were combined based on a variety of factors including the spatial risk landscape, regional fishery characteristics, safety concerns, known areas of increased whale presence, and public input. Most of the regulatory elements within the Preferred Alternative in the FEIS and final rule combine risk reduction measures that achieve the principles identified by the Take Reduction Team of applying broad and resilient weak line and line reduction measures, but the Team's recommended relative weak rope and line reduction measures were modified as a result of further risk reduction assessment, modifications proposed by the New England states or the Atlantic Offshore Lobstermen's Association, and conservation equivalencies proposed during public comments on the DEIS and proposed rule.

In addition to Alternative 1 (baseline) NMFS analyzed two suites of regulatory alternatives for consideration and identified a Preferred Alternative in this FEIS for final rulemaking. This section delineates new risk reduction and gear marking alternatives for lobster and Jonah crab trap/pot fisheries already managed under the Plan within New England waters. The measures included in this FEIS were modified from the analyses in the DEIS based on comments received during the comment period on the DEIS but are all within the range of alternatives analyzed in the DEIS. Risk reduction estimates include the updated measures implemented by Massachusetts in recent months. Alternative 2 (Preferred) also adopts some of the conservation equivalency measures for vessels in Maine, LMA 2, and LMA 3 that offer alternative measures of equivalent or near-equivalent risk reduction that still achieve at least the minimum 60 percent target. Described in detail below, NMFS also proposed precautionary requirements, like additional gear marking and modifications to whale monitoring, that would apply across all the alternatives, with the exception of the No Action Alternative (Alternative 1, see section 3.2.2 for gear marking alternatives). 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 Team, as delineated in Table 3.1, the suites of measures developed for Alternative 2 and Alternative 3 include the risk reduction contribution of regulatory measures that will not be written into the Final Rule, 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 Three of the Interstate Fishery Management Plan for American Lobster
- Measures in Alternative 2 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 season (until May 15 with the option of opening if whales leave the area or extending if whales remain in the area), and weak insert requirements in Massachusetts State waters.
- “Credit” for the Massachusetts Restricted Area.
- Measures in both alternatives include Massachusetts Department of Marine Fisheries (DMF) extension of the Massachusetts Restricted Area north in Massachusetts State waters to the New Hampshire border, which would be included in the final rule modifying the Plan. Evaluation of the extension of the state water closure into May is also analyzed but would not be included in the federal regulations.
- Modifications of regulations implementing the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) at 50 CFR 697.21(b)2) requiring two buoy lines on trawls with more than three pots to accommodate Maine conservation equivalencies
- Though not related to risk reduction, the minimum trawl lengths proposed for both alternatives in LMA 3 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 nautical miles (2.78 kilometers) to 1.75 nautical miles (3.24 kilometers) in length.

Table 3.3: A summary of the risk reduction regulatory elements of the alternatives analyzed within the two action alternatives in this FEIS, arranged by LMA and geographic region (where appropriate). Dark gray shaded rows represent risk reduction elements that already exist or are reasonably foreseeable under state regulations or federal fishery management regulations and that contribute to the risk reduction goal but would not be implemented by Federal rulemaking to amend the Take Reduction Plan. Accommodations required in the ACFCMA and gear marking modifications are not listed. OC = Outer Cape

Component	Area	Alternative 2	Alternative 3
Restricted Areas	All existing and new 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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.	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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.
	LMA 1 Restricted Area, Offshore ME LMA 1/3 border, zones C/D/E	Oct – Jan	Oct – Feb
	South Island Restricted Area	Feb – April: Area from Non-preferred A in DEIS.	Feb – May: L-shaped area closed to buoy lines.
	Massachusetts Restricted Area	Credit for Feb-Apr, state water in MRA have a soft opening until May 15th, until no more than three whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA and LMA 1/OC state waters unless surveys confirm that right whales have left the area.
	Massachusetts Restricted Area North	Feb-Apr: Expand MRA north in MA state waters to NH border	Feb-Apr: Expand MRA north in MA state waters to NH border
	Georges Basin Restricted Area	-	Closed to buoy lines May through August.
Line Reduction	ME exemption line – 3 nm (5.6 km), Zones A, B, F, G	3 traps/trawl	-
	ME exempt area – 3 nm (5.6 km), Zones C, D, E	Status quo (2 traps/trawl)	-
	ME 3 (5.6 km) – 6 nm*, Zone A West**	8 traps/trawl per two buoy lines or 4 traps/trawl per one buoy line	Line allocations capped at 50 percent of average monthly lines in federal waters
	ME 3 (5.6 km) – 6 nm*, Zone B	5 traps/trawl per one buoy line	
	ME 3 (5.6 km) – 6 nm*, Zones C, D, E, F, G	10 traps/trawl per two buoy lines or 5 traps/trawl per one buoy line	Same as above
	ME 3 (5.6 km) – 12 nm (22.2 km), Zone A East**	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
	ME 6* – 12 nm (22.2 km), Zone A West**	15 traps/trawl per two buoy lines or 8 traps/trawl per one buoy line	Same as above

Component	Area	Alternative 2	Alternative 3
Buoy Line Reduction Continued	ME 6* – 12 nm (22.2 km), Zone B, D, E, F	10 traps/trawl per two buoy lines or 5 traps/trawl per one buoy line (status quo in D, E, & F)	Same as above
	ME 6* – 12 nm (22.2 km), Zone C, G	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
	MA LMA 1, 6* – 12 nm (22.2 km)	15 traps/trawl	Same as above
	LMA 1 & OC 3 – 12 nm (5.6 – 22.2 km)	15 traps/trawl	Same as above
	LMA 1 over 12 nm (22.2 km)	25 traps/trawl	Same as above
	LMA 3, north of 50 fathom line on the south end of Georges Bank	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)
	LMA 3, south of 50 fathom line on the south end of Georges Bank	Year-round: 35 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
	LMA 3, Georges Basin Restricted Area	Year-round: 50 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	-
	LMA 3	Existing and anticipated 12% reduction in buoy lines	-
Buoy Weak Link	Northeast Region	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system	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
Weak Line	ME Exempt State Waters	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exemption line – 3 nm (5.6 km)	1 weak insertion 50% down the line	Same as above
	MA State Waters	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	NH State Waters	1 weak insertion 50% down the line	Same as above
	RI State Waters	Weak inserts every 60 ft (18.3 m) in top 75% of line or full weak line	Same as above
	ME Zone A West**, B, C, D, E; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above
	ME Zone A East**, F, and G; federal waters 3 – 12 nm (5.6 – 22.2 km)	1 weak insertion 33% down the line	Same as above
	MA and NH LMA 1 , OC; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above

Component	Area	Alternative 2	Alternative 3
	LMA 1 & OC over 12 nm (22.2 km)	1 weak insertion 33% down the line	Same as above
	LMA 2	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	LMA 3	One buoy line weak year round to 75%	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" down to 20%

*Note that the 6 nautical mile line refers to an approximation, described in 50 CFR 229.32 (a)(2)(ii) and a similar approximation of the 50 fathom lines would be included in the final rule implementing the Preferred Alternative at 50 CFR 229.32 (a)(2)(iv).
**Maine Zone A East is the portion of Zone A that is east of 67°18.00' W and Maine Zone A is west of this longitude.

These existing or anticipated state and fishery management regulatory measures would not be included in the final rulemaking associated with this FEIS, with the exception of the inclusion of Massachusetts spatial extension of the MRA from February through April. The analysis still considers the risk reduction contributed by these measures toward achieving the lobster and Jonah crab trap/pot fishery's target of more than 60 percent. The measures not included for rulemaking are listed but shaded in Table 3.3. The economic impact of the measures that are not being implemented under this action are also not included in the estimated economic impacts of Alternatives 2 and 3, with the exception of gear marking measures in Maine exempt waters.

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 3.4 summarizes the comments received during the initial stages of rulemaking at the public scoping meetings. Even more extensive comments were received on the DEIS and proposed rules. Those comments are summarized in Appendix 1.1. These comments were taken into consideration with a new round of analyses described above in Section 3.1.2.3 and in the justification for alternatives in Section 3.3 below. The results of these analyses and the public comment period informed the final alternatives included in this FEIS. Modifications to the DEIS for the FEIS also prioritized estimating risk reduction for right whales and other large whales with the updated right whale density model, the updated right whale population information, feasibility of implementation and safety concerns (particularly for small entities) that were ameliorated by conservation equivalencies, and possible indirect effects of measures that may adversely increase co-occurrence between buoy lines and whales.

Gear marking alternatives analyzed for the FEIS are discussed in Section 3.2.2. Marking gear does not reduce risk but if marked gear is retrieved from entangled whales it can provide information about where entanglement incidents occur. This information can be used by the Team to improve future amendments to the ALWTRP. Alternative 2 (Preferred) and the Final Rule would increase the number of marks required in federal water compared to the Proposed Rule but are still within the scope of what was analyzed in Alternative 3 in the DEIS and retained as Alternative 3 in this FEIS.

A number of alternatives were considered in the development of the DEIS and FEIS, or as we considered information submitted in public comments. A list of considered but rejected alternatives can be found in Section 3.4 and some additional information about measures considered but rejected can be found in the responses to comments found in Appendix 1.1.

3.2.1 *Risk Reduction Alternatives*

This section describes the risk reduction regulatory elements of the analyzed Alternatives. Changes to each alternative from the DEIS to the FEIS are described in each section.

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 crab trap/pot fisheries in the Northeast Region in a number of ways varying by lobster management areas or distance from shore. These measures follow general principles agreed upon by the ALWTRT modified by measures proposed by each state or lobster management areas. Further modifications would allow the exempted fishing permits for the harvest of lobster and Jonah crab through fishing methods that do not use persistent buoy lines within most waters of existing and future seasonal restricted areas, and the addition of two new "ropeless" seasonal restricted areas implemented to reduce co-occurrence of whales and ropeless to improve the overall risk reduction of the modifications within the Preferred Alternative and final rule. Modifications to the risk reduction measures in Alternative 2 (Preferred) in this FEIS relative to the Alternative 2 in the DEIS includes:

- The proposed seasonal restricted area south of Cape Cod in this alternative is larger than the restricted area analyzed within the DEIS' Preferred Alternative, coming instead from a seasonal restricted area analyzed under DEIS Alternative Three.
- The removal of the requirement for a weak link at the buoy was analyzed as part of Alternative 3 in the DEIS.
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for LMA 2 exchanging new trawl length requirements with more expansive weak insert requirements throughout LMA 2
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for LMA 3 that would require more traps per trawl than in the DEIS within the Georges Basin area that was analyzed as a restricted area in Alternative 3 of the DEIS. This increase in number of traps per trawl was offset by a lower number of traps required within the Northeast Regions south of a curve representing the 50 fathom depth contour along the southern edge of Georges Bank.
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for Maine waters in LMA 1, including modification of regulations implementing the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) at 50 CFR 697.21(b)(2) requiring two buoy lines on trawls with more than three pots to accommodate Maine conservation equivalency options. This would allow the use of half the minimum number of traps required with two buoy lines if only one buoy line is used. Other differences in the FEIS Alternative 2 compared to the DEIS are trade-offs in the number of traps per trawl based on Maine fishery zones and distance from shore between the Maine exemption line and the 12 nautical miles line (22.2 kilometer line; see the description of conservation equivalencies). See Section 3.3.2 for a more detailed description of the complex trawl length and weak line requirements proposed and implemented in this FEIS.

Specific changes are summarized in Table 3.4. For more information on the comments received from the public see Appendix 1.1 and Volume 3, and for details on the state proposals see Appendix 3.3.

Table 3.4: A summary of changes to Alternative 2 from the DEIS to this FEIS

DEIS Alternative 2 (Preferred)	FEIS Alternative 2 (Preferred)
Trawl Length	
MA State Measures: no singles on vessels >29',	No longer being implemented by the state
LMA 2: Increase in trawl lengths over 3 nm	No Trawling up, only (additional) weak inserts (LMA 2 weakened rope conservation equivalency measures below)
LMA 3: 45 traps/trawl	50 traps per trawl in Georges Basin Core area,
	35 traps per trawl deeper than 50 fa south of Georges Bank,
	45 traps/trawl otherwise.
Maine LMA 1: Trawling up to three traps per trawl in state waters outside of exempt area	Trawling up most places by distance from shore and by zone outside exemption line. One string option with half the traps through most of three to12 nm.
Maine LMA 1: Trawling up everywhere between three to 12 nm by distance from shore (eight to 15 traps per trawl with two buoy lines)	Trawling up most places by distance from shore and by zone between 3 to 12 nautical miles. Some areas stay at status quo, others go farther than the DEIS for an equivalent risk reduction overall (five to 20 traps per trawl with two buoy lines). One string option with half the traps through most of three to12 nm.
Restricted Areas	
No expansion of MRA included	Expanded closure in MA state waters north of MRA to border, keep the area closed along with all other state waters from Outer Cape Cod through to NH border until May 15th, with soft opening option. Final Rule will include closure until April.
South Island area proposed by Massachusetts; closed Feb-Apr	Move DEIS closure to considered but rejected, include large South Island Restricted Area from Alternative 3 A in DEIS in Alternative 2, for same season of Feb-Apr
Weak Link	
Retain current weak link 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
Weakened Rope	
MA State waters: 1 weak insertion at 50%	Weak inserts or full weak line every 60 ft (18.3 m) to 75%
ME State Waters: 2 inserts in state waters outside of exempt area	One insert, consistent with exempt state waters
ME LMA 1, 3 to 12 nm: 2 weak insertions 25% and 50%	Maintain 2 weak lines except those increasing trawl lengths to 20 traps per trawl (one at 33% in these areas)
LMA 2, 3 to 12 nm: 2 weak insertions 25% and 50%	Weak insertions every 60 ft (18.3 m) or full weak line to 75%
LMA 2, Over 12 nm: 1 weak insertion in topper at 33%	Weak insertions every 60 ft (18.3 m) or full weak line to 75%

Trawling Up Modifications

These measures would increase the number of traps per trawl according to distance from shore. For waters offshore of Maine, these are largely taken from the conservation equivalency measures submitted as comments by Maine DMR and supported by many Maine fishermen and legislators; for LMA 2 these reflect Rhode Island Department of Environmental Management and fishermen comments about conservation equivalency and for LMA 3 these measures reflect comments from the Atlantic Offshore Lobstermen's Association.

Lobster Management Area 1

- Maine exempt area – 3 nautical miles (5.6 kilometers), Zones A, B, F, G: three traps per trawl
- Maine exempt area – 3 nautical miles (5.6 kilometers), Zones C, D, E: two traps per trawl (status quo)
- Maine 3 nautical miles (5.6 kilometers) – 6 nautical mile line, Zone A West**: eight traps per two buoy lines or four traps per one buoy line
- Maine 3 nautical miles (5.6 kilometers) – 6 nautical mile line, Zone B: five traps per one buoy line
- Maine 3 nautical miles (5.6 kilometers) – 6 nautical mile line, Zones C, D, E, F, G: 10 traps per two buoy lines or five traps per one buoy line
- Maine 3 (5.6 kilometer) – 12 nautical miles (22.2 kilometers), Zone A East**: 20 traps per two buoy lines or 10 traps per one buoy line
- Maine 6 nautical mile line – 12 nautical miles (22.2 kilometers), Zone A West**: 15 traps/ per two buoy lines or eight traps per one buoy line
- Maine 6 nautical mile line – 12 nautical miles (22.2 kilometers), Zone B, D, E, F: 10 traps per two buoy lines or five traps per one buoy line (status quo in D, E, and F).
- Maine 6 nautical mile line – 12 nautical miles (22.2 kilometers), Zone C, G: 20 traps per two buoy lines or 10 traps per one buoy line
- Outside of Maine, 3 nautical miles (5.6 kilometers) to the 6 nautical mile line: retain minimum 10 traps per trawl (status quo)
- All LMA 1, the 6 nautical mile line to12 nautical miles (22.2 kilometers): minimum 15 traps per trawl
- All LMA 1, outside of 12 nautical miles (22.2 kilometers): minimum 25 traps per trawl

Outer Cape Lobster Management Area

- 3 (5.6 kilometer) to 12 nautical miles (22.2 kilometers): minimum 15 traps per trawl

Lobster Management Area 3

- Georges Basin Management Area: minimum 50 traps per trawl
- Area south of a line representing the 50 fathom isobaths on the south edge of Georges Bank: minimum 35 traps per trawl
- Remaining Northeast Region LMA 3: Trawl up to minimum 45 traps per trawl
- Increase allowed maximum length of trawl between buoy lines: To accommodate trawling up modifications, increase allowable length of lobster trawl from 1.5 nautical miles (2.8 kilometers) to 1.8 miles (3.24 kilometers).

Seasonal Restricted Areas (Open to ropeless, closed to persistent buoy lines) (Figure 3.4)

- Modify current closures to allow fishing without persistent buoy lines; allow conditional EFPs for ropeless fishing in Massachusetts and Great South Channel Restricted Areas with the exception of the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.

- The LMA 1 Restricted Area in offshore waters (approximately 30 nautical miles/55.6 kilometers offshore) spanning Maine zones C, D, and E from Oct through January.
- Risk reduction credit for existing MRA closure.
- Expand MRA into Massachusetts State waters north to the New Hampshire border from February through April (MRA North).
- Consider risk reduction in the state measures that will not be implemented in the federal regulations: maintenance of the MRA in state waters until May 15 unless whales leave the area, soft opening or extension can be done under state authority.
- Establish a large new seasonal restricted area closed to persistent buoy lines south of Nantucket from February through April.

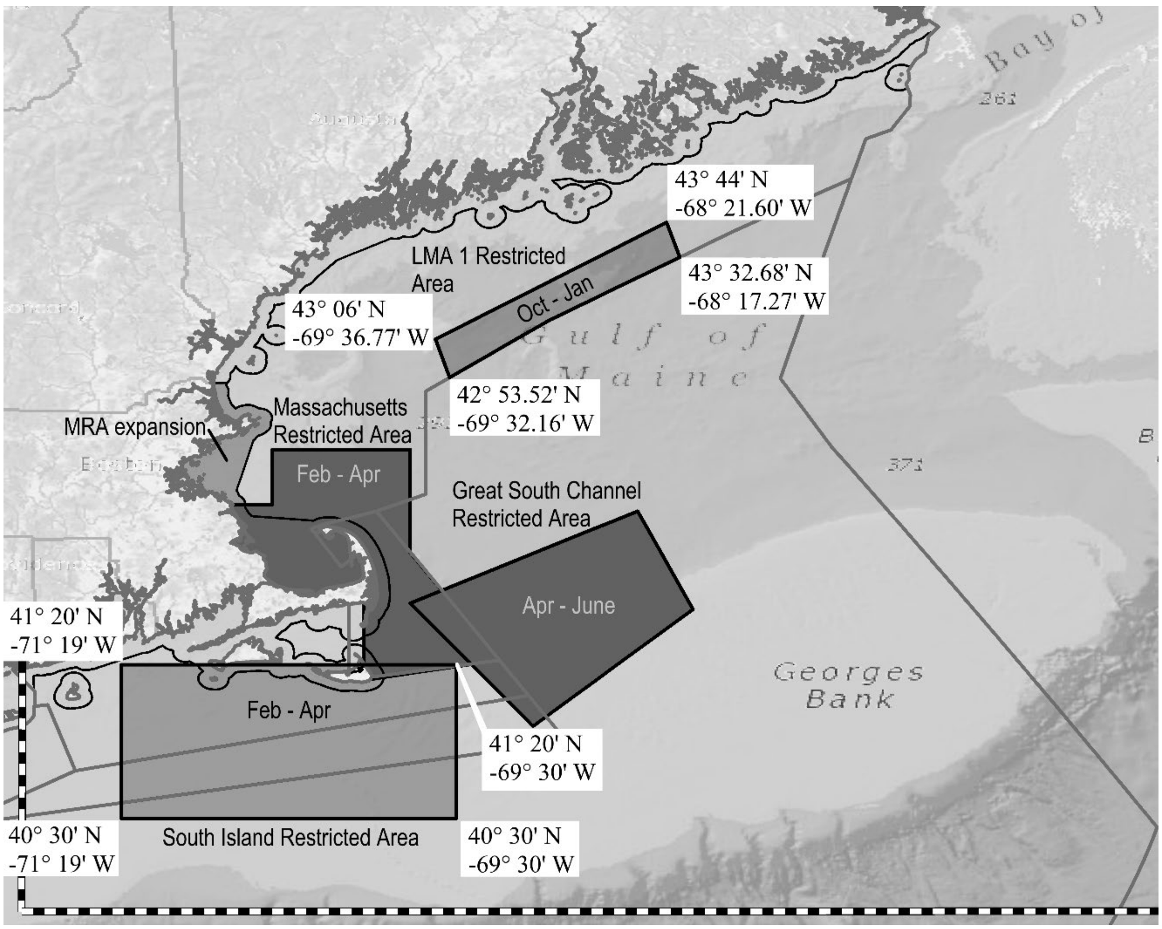


Figure 3.4: The trap/pot buoy line closure areas proposed in Alternative 2 (Preferred) shaded in light gray. LMAs are delineated by the grey lines. The new South Island Restricted Area is proposed as closed to trap/pot buoy lines from February through April and the LMA 1 Restricted area is proposed from October through January. An expansion of the MRA into Massachusetts State waters to the New Hampshire border (MRA North) and extended in state waters in LMA 1 and the Outer Cape through at least May 15th, with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape LMA.

Weak Line and Weak Insertion Modifications

Add weak inserts (break at less than 1,700 pounds (771 kilograms) at depths based on distance from shore or add full weak rope to same depth on line for added risk reduction:

Lobster Management Area One, Maine

- Coast to 3 nautical miles (5.6 kilometers): one insert halfway down the buoy line
- Zone A West**, B, C, D, E; federal waters 3 – 12 nautical miles (5.6 – 22.2 kilometers): two weak insertions, at 25 percent and 50 percent down line
- Zone A East**, F, and G; federal waters 3 – 12 nautical miles (5.6 – 22.2 kilometers): one weak insertion 33 percent down the line
- Over 12 nautical miles (22.2 kilometers): one insert 33 percent of the way down the buoy line

Lobster Management Area One, Outside of Maine & Outer Cape

- New Hampshire State Waters: 1 weak insertion 50 percent down the line
- Massachusetts State Waters: Weak inserts every 60 feet (18.3 meters) or full weak line in top 75 percent of line
- 3 to 12 nautical miles (5.6 – 22.2 kilometers): two inserts, one 50 percent and one 25 percent down the buoy line
- Over 12 nautical miles (22.2 kilometers): one insert 33 percent of the way down the buoy line

Lobster Management Area Two

- Weak inserts every 60 feet (18.3 meters) or full weak line in top 75 percent of line

Lobster Management Area Three

- Year round require one buoy line on each trawl to be weak rope on the top 75 percent of the buoy line.

Buoy Weak Link Modification

- Remove requirement for a weak link at the buoy.

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. This FEIS Alternative 3 is modified from the DEIS Alternative 3. The weak link at the buoy is retained with the option to place it lower, at the base of the surface system. Additionally, only one South Island Restricted Area closure is analyzed within the FEIS Alternative 3. Alternative 3 retained only the seasonal weak line option in LMA 3 because the other option is analyzed in the Preferred Alternative. Alternative 3 also includes the spatial expansion of the MRA to include the state waters north to New Hampshire, as implemented by state Regulations (see Table 3.5).

Figure 3.5: A summary of changes in Alternative 3 from the DEIS to the FEIS.

DEIS Alternative 3 (Non-preferred)	FEIS Alternative 3 (Non-preferred)
Restricted Areas	
No expansion of MRA included	Expanded MRA closure in MA state waters north to the border, keep the area closed along with all other state waters from the Outer Cape LMA through to NH border until May 15th, with soft opening option. Final Rule will include closure until April.
Two South Island Options (Feb - May): A) Large closure B) L-shaped closure	Move large area from Alternative 3 A in DEIS to Alternative 2 for Feb-Apr, keep only L-Shaped area from Feb - May in Alternative 3
Weak Link	
For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system	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
Weakened Rope	
LMA 3: two options for weak rope 1) fully weak line in the top 75 percent of one line, 2) May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak "toppers" to 20%	Keep seasonal option: May - August: one weak line to 75% and 20% on the other end. Sep – Apr: two weak "toppers" to 20%

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 3 and increase length of trawl:

Lobster Management Area Three

- Minimum 45 traps per trawl, May through August. To accommodate this modification, increase the allowable length of lobster trawl from 1.5 nautical miles (2.8 kilometers) to 1.8 miles (3.2 kilometers).

Seasonal Restricted Areas (Open to ropeless, closed to persistent buoy lines; Figure 3.5)

- Modify current closures to areas closed to buoy lines; allow conditional EFPs for ropeless fishing in Massachusetts and Great South Channel Restricted Areas. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing from February 1 through March 31 consistent with the ASMFC lobster FMP.
- The LMA 1 Restricted Area in offshore waters (approximately 30 nautical miles/55.6 kilometers offshore) spanning Maine zones C, D, and E from October 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.
- Extend the MRA into Massachusetts State waters north to the New Hampshire border February through May (MRA North)
- A buoy line closure in the core Georges Basin Restricted Area from May through August. L-shaped South Island Restricted Area from February through May (see Fig 3.2).

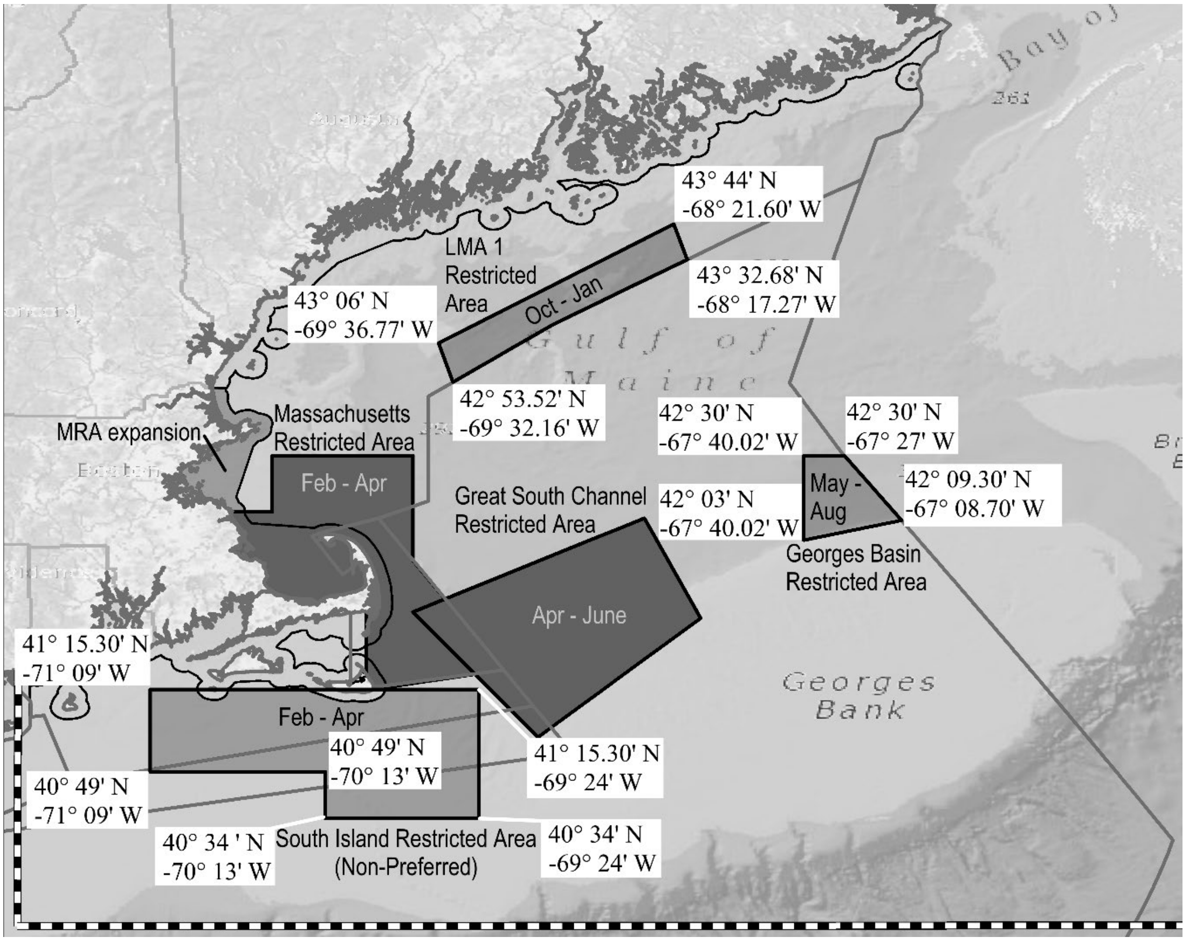


Figure 3.5: The restricted area options proposed in Alternative 3 (Non-preferred) shaded in light gray. The L-shaped South Island Restricted Area from February through April. The LMA 1 Restricted Area is proposed from October through February. The Georges Basin Restricted Area is proposed from May through August. An expansion of the MRA into Massachusetts State waters to the New Hampshire border and extended through at least May 15th (MRA North), with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape LMA.

Weak Line

Throughout Northeast Region

- Year round require one buoy line on each trawl to be weak rope (breaks at less than 1,700 pounds/771 kilograms) on the top 75 percent of both buoy lines, except in lobster management area three

Lobster Management Area Three

- Seasonally, May through August, one buoy line on each trawl would consist of a full weak rope on the top 75 percent of the line. The second buoy line would have a weak topper in the top 20 percent of the buoy line. The rest of the year both buoy lines will have a weak topper in the top 20 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 DMR has regulations, effective September 1, 2020, to require gear marking throughout Maine waters using purple as their unique color (DMR Chapter 75.02). Alternative 2 (Preferred) of this FEIS has a modified gear marking scheme compared to the DEIS. Additional 1 foot green marks would be required in federal waters under Alternative 2 (Preferred) for better discernment between fishing in U.S. and Canada and between state and federal waters and waters of the Northeast Trap/Pot Management Area.

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.

Table 3.6: The proposed gear marking alternatives by principle port state and/or management area. The surface system color designations are the same for both alternatives. The shaded portion (also represented by an *) represents an area that will be managed by a state agency rather than NMFS. The number of markings required represent a minimum number and length of marks.

Area	Alternative 2	Alternative 3
Entire Northeast Region	One 3 foot (91.4 cm) long state-specific (see color below) mark within 2 fathoms (60.96 cm) of the buoy. In federal waters, at least four additional 1 foot (30.5 cm) green marks within 6 inches (15.2 cm) of each state-specific mark.	One 3 foot (91.4 cm) 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 State Waters	**Purple**. At least two 1 foot (30.5 cm) marks (by depth) on top and bottom half of buoy line below the surface system, through state regulation only*	See "Entire Northeast Region"
Maine Federal Waters	**Purple**. In federal waters, at least three 1 foot (30.5 cm) state colored marks in the buoy line below the surface system: at top, middle and bottom of line. At least four additional 1 foot (30.5 cm) green marks within 6 inches (15.2 cm) of each state-specific mark.	See "Entire Northeast Region"
New Hampshire	**Yellow.** In state waters: at least two additional 1 foot (30.5 cm) marks in the buoy line below the surface system: on top half and bottom half of buoy line. In federal waters, at least three 1 foot (30.5 cm) state colored marks in the buoy line below the surface system: at top, middle and bottom of line and at least four additional 1 foot (30.5 cm) green marks within 6 inches (15.2 cm) of each state-specific mark.	See "Entire Northeast Region"
Massachusetts	**Red.** In state waters: at least two 1 foot (30.5 cm) marks in the buoy line below the surface system: on top half and bottom half of buoy line. In federal waters, at least three 1 foot (30.5 cm) state colored marks in the buoy line below the surface system: at top, middle and bottom of line and at least four additional 1 foot (30.5 cm) green marks within 1 inches (15.2 cm) of each state-specific mark.	See "Entire Northeast Region"
Rhode Island	**Silvery/Gray.** In state waters: at least two 1 foot (30.5 cm) marks in the buoy line below the surface system: on top half and bottom half of buoy line. In federal waters, at least three 1 foot (30.5 cm) state colored marks in the buoy line below the surface system: at top, middle and bottom of line and at least four additional 1 foot (30.5 cm) green marks within 6 inches (15.2 cm) of each state-specific mark.	See "Entire Northeast Region"
LMA 3	**Black.** Add at least four additional one foot (30.5 cm) green marks within 6 inches (15.2 cm) of each LMA 3 specific black mark.	See "Entire Northeast Region"

3.1.1.1 Alternative 2: Preferred Alternative

Under Alternative 2 (Preferred), NMFS would mirror the Maine regulations in all non-exempted state waters, and implement analogous marking for the other New England states (one state-specific 3 foot (91.4 centimeter) colored mark within two fathoms of the buoy, at least two additional 1 foot long (30.5 centimeter) marks in top and bottom half of gear in state waters, and at least three additional 1 foot long (30.5 centimeter) marks in federal waters. Additionally, gear in federal waters would be required to include at least four 1 foot long (30.5 centimeter) green marks within 6 inches (15.2 centimeter) of each state specific mark. The number of marks in federal waters has increased from the DEIS (four 1 foot marks instead of one six inch marks). This change is responsive to public comment, within the scope of the DEIS, and will likely be more effective at distinguishing state from federal waters than Alternative 2 in the DEIS (See table 3.7). This proposal would paint or tape for visibility in surface system markings but would continue to allow multiple methods for marking line below the surface system (paint, tape, rope tracers, etc.). Table 3.6 outlines the proposed gear marking colors.

Figure 3.7: A comparison of changes in gear marking Alternative 2 from the DEIS to the FEIS

DEIS	Alternative 2
Gear Marking	
State Colors in lower buoy line: 2 in buoy line below surface system in state waters, 3 in federal waters (top, middle and bottom)	At least two in below surface system in state waters and at least three in federal waters (top, middle and bottom)
Federal waters: 6 inch green mark within 1 foot of large surface system mark	Federal waters: Four 1 foot green marks adjacent to ALL state color mark

3.2.2.2 Alternative 3: Non-Preferred Alternative

Under Alternative 3 (Non-preferred) one 3 foot (91.4 centimeter) state specific color would be marked on the buoy line within two fathom of the buoy, as in the Preferred Alternative, but the entire buoy 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. This alternative is the same as Alternative 3 for gear marking in the DEIS.

3.3 Justification for Regulatory Options Considered

3.3.1 *Buoy Line Reduction*

There are multiple approaches to accomplish line reduction in areas where right whales occur, 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 reduced opportunity for encounters and entanglements, those rulemakings intended to reduce co-occurrence to reduce risk. Similar measures are considered for the alternatives analyzed in this FEIS.

Ongoing and imminent (RIN 0648-BF01) Lobster Plan fishery management modifications that result in line reductions relative to the 2017 baseline through trap restrictions 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 3.3), declines in the southern New England lobster stocks as well as lobster management measures have modified the fishery to reduce the number of permitted traps that could be fished in the fishery, known as latent effort. In LMA 2, actively fished traps and buoy lines have declined annually since measures were implemented in 2015. Buoy line numbers did not decline in LMA 3 but with fewer latent traps available for transfer, measures currently in development are anticipated to reduce the number of lines fished in LMA 3 (discussed further in section 3.3.5, Appendix 3.3, and in Section 5.2.1.1.1). Inclusion of fishery management risk reduction measures towards the risk reduction target was supported by the Team in their April 2019 recommendation.

3.3.2 *Conservation Equivalencies*

This FEIS analyzes conservation equivalencies submitted by states and fishermen, including the Atlantic Offshore Lobstermen's Association as comments on the DEIS Alternative 2 and associated Proposed Rule.

- Rhode Island suggested requiring weak line on the top 75 percent of the buoy lines fished in LMA 2 (analyzed in this FEIS as a weak insertion every 60 feet in the top 75 percent of the buoy line in line with Massachusetts State measures) in lieu of trawling up measures because some Rhode Island vessels do not have deck capacity to handle more traps. The risk reduction offered by this measure in this specific area was slightly greater for expanded weak inserts than for the trawling up proposed in the DEIS' Preferred Alternative. Most boats in this area already fish with the proposed trawl lengths except for a few smaller boats that are unequipped for longer trawls. Adding weak inserts to line that is stronger than 1,700 pounds (771 kilograms) provides more substantive risk reduction in this particular region (40 percent with the DEIS measures and 58 percent for the equivalency in this FEIS).
- The Atlantic Offshore Lobstermen's Association comments suggested a conservation equivalency that would alter trawl length by area, allowing variation based on where whale risk is highest but on the whole achieving similar risk reduction (47 percent with the DEIS and 48 percent for the equivalency in the FEIS; Figure 3.6). Other Atlantic Offshore Lobstermen's Association recommendations were not adopted primarily due to an inability to implement or analyze the effectiveness of their proposed measures.

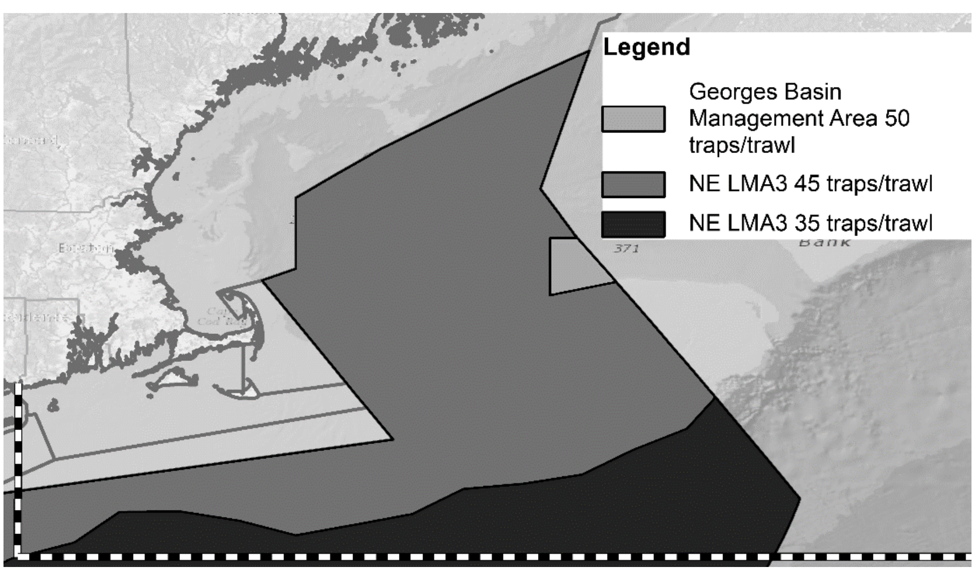


Figure 3.6: The conservation equivalency suggested by the Offshore Lobstermen's Association to vary trawl length based on specific areas within the Northeast Region

Table 3.8: The proposed trawl lengths and weak points proposed by Maine's Department of Marine Resources during the public comment period. Zone A, is split between three and twelve nautical miles from north to the south at 67º 18' longitude, south from Cross Island.

	DEIS	Distance (nm)	Zone G	Zone F	Zone E	Zone D	Zone C	Zone B	Zone A West	Zone A East
Traps Per Trawl	3	Exemption Line-3	3's per one buoy line	3's per one buoy line	2's per one buoy line	2's per one buoy line	2's per one buoy line	3's per one buoy line	3's per one buoy line	3's per one buoy line
	8	3-6	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line	4's per one buoy line; 8's per two buoy lines	10's per one buoy line; 20's per two buoy lines
	15	6-12	10's per one buoy line; 20's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	5's per one buoy line; 10's per two buoy lines	10's per one buoy line; 20's per two buoy lines	5's per one buoy line; 10's per two buoy lines	8's per one buoy line; 15's per two buoy lines	10's per one buoy line; 20's per two buoy lines
	25	12+	25's per two buoy lines	25's per two buoy lines	20's per two buoy lines	20's per two buoy lines	20's per two buoy lines	25's per two buoy lines	25's per two buoy lines	25's per two buoy lines
Weak Points		0 - 3	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line	1 weak point 50% down line
		3-12	1 weak point 33% down line	1 weak point 33% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	1 weak point 33% down line
		12+	Buoy line 1: 1 weak point 33% down line, Buoy line 2: 2 weak points at 25% and 50% down line	1 weak point 33% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	2 weak points 25% and 50% down line	1 weak point 33% down line	1 weak point 33% down line

- The Maine DMR proposed an equivalent line reduction and weak rope scenario than was in the DEIS that varied the trawling up and weak insertion combinations by state management zones and distance from shore (Table 3.8). A primary component of this change was the inclusion of conservation equivalencies that allow an individual to fish in configurations that vary by distance from shore and allow a different number of traps depending on the number of buoy lines fished. For example, where 20 traps would be the minimum number of traps with two buoy lines there would be an option to fish 10 traps with one buoy line. NMFS analyzed Maine's conservation equivalencies and found most of the proposed configurations to be an equivalent risk reduction in federal waters between 3 and 12 nautical miles (5.6 to 22.2 kilometers; 10.4 percent with the DEIS measures and 10.5 percent for the equivalency in the FEIS). Alternative 2 analyzes those equivalencies recommended in this area and they would be implemented by the Final Rule. However, there was less risk reduction in the proposal for some zones outside of 12 nautical miles (22.2 kilometers) and therefore Alternative 2 maintains the 25 traps per trawl analyzed in the DEIS and proposed in the Proposed Rule to maintain equivalent risk reduction in offshore waters nearby known right whale hotspots (Figure 3.7). There was also a smaller risk reduction inside state waters in non-exempt waters (4 percent with the DEIS measures and 1 percent in this FEIS) but the newly proposed trawl lengths in this area were maintained in the FEIS because of the lower risk predicted in Maine State waters.

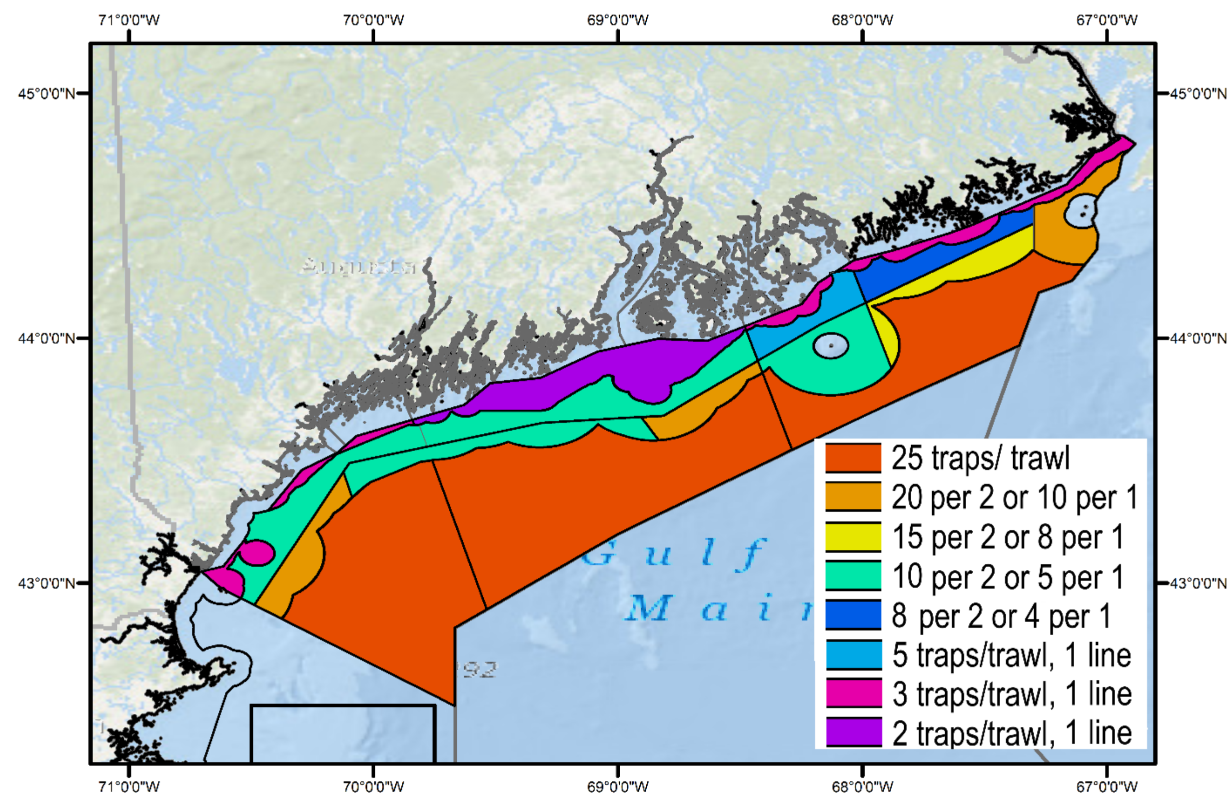


Figure 3.7: Alternative 2(Preferred) and Final Rule Maine traps/trawl requirements: The trawl length from Maine's Department of Marine Resources incorporated into Alternative 2 were within state waters and federal waters between 3 and 12 nautical miles (5.6 to 22.2 kilometers. Outside of 12 nautical miles (22.2 kilometers), a 25 trawl length was retained to maintain risk reduction near a predicted right whale hotspot.

3.3.3 *Seasonal Restrictions to Buoy Lines that Allow Ropeless Fishing*

The alternatives analyzed and the measures that would be implemented in the Final Rule do not require, or in themselves authorize, ropeless fishing. Rather, the analyzed measures would allow fishermen with the appropriate exemptions from surface marking requirements to harvest lobster and Jonah crab in the ALWTRP seasonal management areas. The intention of this modification from the former approach to closing these areas to harvest is to encourage the development of ropeless fishing technology in collaboration with fishermen under a variety of commercial fishing conditions. Operational challenges that fishing under exempted fishing permits would continue to address within and beyond seasonal restricted areas include improvements to sturdiness of gear to withstand commercial fishing operations, surface detection of bottom gear to reduce gear conflicts and enforcement detection, development of gear retrieval and reset options or other methods to allow gear inspection.

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 remotely inflating a bag that brings the trap and groundline 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, which is often done when buoys have been parted from fishing gear. Ropeless designs are usually not actually rope-free but it is a commonly used term. In addition to buoy lines that are often deployed for retrieval, groundlines would continue to connect traps in a “trawl” along the seafloor. However, if operationally feasible, “ropeless” fishing would allow fishermen to operate around whales with a greatly reduced risk of entanglement and would provide an alternative to closures.

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. The potential for an increase in gear conflict continues to be a major concern. In current trap/pot operations, persistent buoy lines are required; they 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 being fished on the bottom. Bottom fishing vessels which drag nets along the bottom, as well as gillnet and other trap/pot fishermen, can avoid trawling up or overlaying gear over the lobster and Jonah crab trawls. Ropeless fishing could also hamper enforcement as illegal trawls could be hidden and enforcement operations would not have an easy way to retrieve fishing gear for inspection or reset inspected gear.

Technology will be needed that allows mariners and enforcement to locate fishing gear on the seafloor, at some cost to vessel operators in fisheries that are not causing right whale entanglements. If developed and affordable or subsidized, technology and regulations requiring vessel operators to fish without buoy lines and to use technology to detect gear set on the bottom could replace current surface system regulations. Until then, fishermen developing ropeless fishing practices to harvest lobster and Jonah crabs without a surface system must obtain state or federal authorization exempting them from requirements to mark the ends of their trawls with visible surface systems. Technology to allow enforcement to inspect the gear is also needed.

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 right whale entanglements in partnership with relevant stakeholder. . ." NMFS, in partnership with fishermen, environmental organizations and other nonprofits, and whale and gear researchers, has developed and continues to expand a ropeless gear cache and partners are working under exempted fishing permits to pilot ropeless technology. This effort is expanding to include mobile gear fishermen working with technology already on their vessels to see if they can avoid gear that is fished without buoy lines. The goal of this effort is to address the current challenges under operational conditions so that ropeless fishing could allow trap/pot fisheries to continue while also preventing 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 the 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 Jonah crab traps and pots could accelerate ropeless testing and demonstrate efficacy. NMFS and collaborators have 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. NMFS anticipates that their gear cache will grow to about 300 ropeless units and sufficient onboard technology to support up to 30 vessels testing 10 trawls and adjacent mobile gear fishermen by 2025.

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.

Because ropeless fishing requires an exemption through authorizations or permits, ropeless in seasonal restricted areas can and would be conditioned to minimize impacts on right whales and to include monitoring and reporting requirements. We anticipate that applicants to fish in restricted areas (other than the Outer Cape LMA) will be required to:

- Assess up-to-date right whale survey data and constrain fishing to areas that avoid the most densely populated areas within the restricted areas (i.e. Cape Cod Bay within the MRA) at any given time.
- Use only acoustic releases, which provide participants with the ability to maintain control over the amount of time any buoy line remains in the water column as a potential entanglement risk. Using these systems, fishermen must be within a close distance of the gear in order for the signal to be received and the line released, which minimizes the time the line spends in the water column unsupervised. If the gear is released as intended, the risk posed by the released buoy line is minimal. Failures in tested acoustic release systems reported to date have been caused by failed release, not early release (NMFS gear team, pers comm, 2021). Relative to other release mechanisms (i.e. galvanized time release), acoustic release provides a minimal timeframe where the released buoy line will be left unattended.
- Use technology that has been tested elsewhere.
- Have previous experience using these new technologies.

Finally, reporting and monitoring conservation measures would ensure these experimental fishing efforts successfully contribute to the commercial development of this gear. To the extent that gear testing in these areas helps advance cost effective and operational solutions for ropeless fishing, long-term entanglement risk may be reduced more quickly by fishermen's development and use of these technologies under commercial fishing conditions, providing long-term positive impacts on these populations.

Based on outreach by the NMFS gear team, interest does not appear to be substantial among the commercial fishery in the Northeast Region, and participation within any restricted area can be limited through the authorization process. We anticipate that at least through 2025, ropeless fishing in these restricted areas is likely to be done primarily by collaborators borrowing gear from the NMFS gear cache, with up to an additional 10 percent of effort by other researchers and fishermen coast wide. The NEFSC gear team projects that by 2025 they expect to have about 300 ropeless units and enough deck controllers for about 30 vessels, as well as technology to support adjacent mobile fishing vessels. That is, at the most, coast wide, there would be up to 33 vessels fishing 10 ropeless trawls. If congressionally appropriated and private funding remains available, NMFS will continue to reimburse fishermen for some of their time and will provide the onboard and in-water technology so that costs to fishermen will be minimal. To incentivize participation, the alternatives consider modifying current seasonal restricted areas and defining new restricted areas as seasonal closures to trap/pot fishing that use persistent buoy lines.

3.3.3.1 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 (62 FR 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. The change would not include the Outer Cape Cod (OCC) Lobster Management Area (LMA), which would remain closed to the lobster and Jonah crab trap-pot fishery under Massachusetts and Federal regulations (32 Mass. Reg 6.02 paragraph(7)(a) and 50 CFR 697.7(c)(1)(xxx)) implementing the Atlantic State Marine Fisheries Commissions' Interstate Fishery Management Plan for American Lobster.

Under both Alternatives 2 and 3, 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 in existing ALWTRP closed areas. However, this will not lift the closure in the Outer Cape LMA, which would remain closed to all lobster fishing consistent with the Atlantic Lobster FMP. Exemptions to fishery management regulations that require the use of buoy lines would be needed (see Section 3.3.3.2). Fishing would continue as normal once the seasonal time frame of the restricted areas has passed. However, ropeless fishing may continue if the EFP or state authorization allows.

In the DEIS and proposed rule, reviewers that believe these additional restricted areas are not warranted to achieve PBR were asked to provide specific information or analyses in support of recommended removal of restricted areas from the Preferred Alternative. Comments were received suggesting that the LMA One Restricted Area was overvalued due to dated whale data that did not document the reduced use of the Gulf of Maine by right whales in recent years. As indicated, the initial hotspot analyses for the Gulf of Maine were conducted with a version (version two) of the right whale density model that spanned from 1998 through 2018. The model has since been updated (version 11) and allows comparison of whale distribution before and after 2010. As commenters indicated, the Gulf of Maine, including this area, is slightly less important for right whales. However, the more recent data confirms that this area remains a relative hotspot for right whales during late fall and early winter months (Roberts et al. 2020). Additionally, acoustic surveys have detected right whales in this area in recent years.

Without the seasonal restricted area, the risk reduction measures in Maine LMA One waters were not enough to achieve 60 percent reduction in risk in this area. Commenters suggested that rather than a default buoy line closure of the area, closure should be triggered by documented interactions in Maine LMA 1 waters. However right whale entanglements can rarely be identified to the incident location and 60 percent of right whale mortalities are unobserved, negating the practicality of a detection-dependent trigger. For that reason, Alternative 2 and 3 analyze an LMA 1 Seasonal Restricted Areas across two seasonal configurations and with an allowance for harvest without the use of a persistent buoy line with the proper authorization.

3.3.3.2 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.

If ropeless fishing develops further and methods are developed that support surface detection of bottom gear and that resolve gear conflicts and enforcement challenges, modifications to surface system regulations could be made to negate the need for exemptions. The development of operational solutions are the purpose of ongoing collaborative ropeless technology efforts 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 including those listed in Section 3.3.3 will be required to ensure safe and successful testing of the technology and reduce potential risk posed by ropeless fishing (Table 3.9). Applicants can adopt conservation measures (Table 3.9) for their EFP applications for buoy-lineless fishing in the restricted areas and the environmental analysis conducted here can be relied upon to support their EFP application process and environmental impact assessments. However, these conservation measures are not regulatory and applicants may choose to provide separate conservation measures with an EFP application. EFP applicants with alternative conservation measures will need to provide additional analyses to demonstrate their alternative conservation measures meet the EFP conservation measure objectives of minimizing environmental risks and ensuring successful research and development. Conservation measures will meet the risk reduction conservation objectives: maintain the ALWTRP standards, minimize risk to large whales and other protected species, as well as provide means to minimize the chances of gear malfunction, reduce impacts on other fisheries, and provide monitoring and reporting components. Applicants will also be required to adhere to the current closure to lobster fishing in federal Outer Cape LMA waters from February 1 through March 31.

Given that the current restricted areas represent areas of importance to large whales, ropeless gear should be tested in a manner that minimizes the likelihood that operations will contribute to entanglement or other risks to whales in these areas. As seen in Table 3.9, these include measures that ensure that existing ALWTRP and right-whale approach protections are known and followed, areas of high right-whale densities are avoided, and applicants are prompted to become actively involved in sighting and reporting of right whales. A number of measures also aim to reduce the likelihood of unattended buoy lines in the water by ensuring gear is pre-tested for potential technical malfunctions, operators are experienced using the gear, and that release of buoy lines is only activated by fishermen ready to immediately retrieve the gear. Given that mobile fisheries are not regulated under the Plan and are still active in the area, gear conflicts are important for EFP holders to address. To minimize gear conflict in these areas, measures also include documenting coordination with other EFP holders and mobile fishing fleets. Though coordination efforts may vary from one EFP to another depending on the discrete areas being fished and the likelihood of gear conflicts in the area, documenting these efforts for federal and state review during the application and authorization process will help identify if further coordination is needed. Lastly, several measures focus on monitoring and reporting specifications that will ensure these experimental fishing efforts successfully contribute to the development of this gear.

Table 3.9: Description of required EFP conservation measure objectives and conservation measures considered to meet objective

EFP conservation measures objective	**Conservation measures to help meet objective**
Minimize activity's impact on large whales	Adhere to the ALWTRP standards and restrictions, including but not limited to, gear marking, sinking groundline between traps, breaking strength restrictions, and trawl lengths requirements. Maintain a 500 yard buffer if right whales are sighted, unless in the act of setting, retrieving, or closely tending gear to maintain compliance with 50 CFR 224.104(c). Avoid discrete areas of highest right whale abundance within the restricted areas (i.e. Cape Cod Bay within the MRA) by assessing real time right whale sightings data prior to trip. Maintain vessel speeds not exceeding 10 knots. Avoid vessel operation between dusk and dawn. Report right whale sightings to ne.rw.survey@noaa.gov or to NOAA (866-755-6622) or U.S. Coast Guard and incidental take of non-endangered/threatened marine mammals through the Marine Mammal Authorization Program.
Minimize chances of gear malfunction or early release of stored buoy line	Crew must have prior experience setting and hauling gear being tested. Demonstrate that gear being tested has been successfully tested elsewhere, under comparable environmental conditions, by multiple fishermen over several days so basic safety and operational feasibility is understood, and malfunction (i.e. early release) rates are low. Acoustic or remote release devices are used to ensure that the applicant is in the area when buoy lines are released.
Reduce impacts on other fisheries	Coordination measures are documented to minimize gear conflicts with other EFP holders and mobile fishing fleets.
Monitoring and Reporting	Include unique buoy line identifiers, such as unique colored markings. Include details in application for how efforts will be monitored for compliance with

EFP conservation measures objective	Conservation measures to help meet objective
	application, EFP objectives, and other applicable regulations. Data collection objectives (i.e., data collection sheet) provided with application as required by the EFP process. Data collection example is provided in Appendix 3. Trip start and trip end hail requirements using vessel monitoring systems or Fish OnLine for federal permit holders. Submit final report no more than 6 months after project completion including information on sets/effort to support future efficacy of ropeless trap/pot gear.

Because EFP applications will vary in scale and location, several of the conservation measures noted above broadly call for EFP applicants to detail the methodology that they are planning on using to avoid environmental risks, rather than prescribing specific ways in which these risks may be avoided. For example, to avoid gear conflict, fishermen have noted that ropeless fishing may be ideal in areas where bottom habitat is not suitable for mobile gear. In these circumstances local coordination to provide notification to the mobile fleet about the areas that will be fished may be sufficient to avoid conflicts. Alternatively, in other circumstances coordination may include notifying a larger number of vessels of work being done in the area, or working directly with vessels in the mobile fleet to identify test location methods or devices that would help the mobile fleet avoid conflicts with ropeless gear that has been set. With documentation of the coordination methodology provided directly with the application, any necessary increased coordination can be identified in collaboration between the applicant by federal and state reviewers.

3.3.4 *Weak Links, Weak Inserts, and Weak Rope*

3.3.4.1 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 mortality and serious injury, and comments on the DEIS and proposed rule were solicited to inform final rulemaking.

Alternative 2 (Preferred) in this FEIS and the final rule would remove the requirement for a weak link at the buoy. This alternative was considered in Alternative 3 of the DEIS. Under the final rule, all ropes in the Northeast Trap/Pot Management Area will be weak or have weak insertions below the surface system. Knowlton et al. (2021) models whale interactions with weak ropes and weak insertions, and the model suggests that rope parts below where a whale's movement applies force on the rope. This model suggests the weak insertion at the buoy would not necessarily part the buoy from the rope quickly, and may not have much effect on entanglement severity. Some commenters indicated a preference for retaining the buoy on the rope so that in the event of an entanglement some additional information about the location of the incident could be obtained from the buoy. Additionally at Team meetings some Team members suggested that drag caused by the buoy could pull rope away from the whale and facilitate the shedding of gear, and suggested that the buoy could provide a disentanglement team with improved access to entangling rope. While retention of the buoy may be beneficial for some large whales, given right whale behavior in surface aggregations, buoys may be rubbed off of gear whether or not a weak link is present. Given the lack of confidence that a weak link in a surface system is effectively reducing risk to right whales and the potential benefit of buoy retention for some entangled large whales, the final rule will remove this requirement. Fishermen however would not be prohibited from retaining a weak link in the surface system.

Alternative 3 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.

3.3.4.2 Weak Inserts and Weak Rope

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 pounds/771 kilograms) 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 an adult 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).

The Team recommended risk reduction measures that included comprehensive weak rope (engineered rope that breaks at 1,700 pounds/771 kilograms or less) or weak insertions (e.g. sleeves, generally discussed by the Team as insertions every 40 feet (12.2 meters) along the buoy lines, although that was not explicit in the recommendations). A full buoy line of 1,700 pounds (771 kilograms) breaking strength would theoretically allow a whale to break free no matter where the whale encounters the line, though it is less clear where the rope would break than with a weak insertion. Insertion of weak sleeves or other weak configurations predictably break at the weakest point where they are attached to the line and may offer risk reduction depending on how they are configured (MEDMR 2020). Weak rope modeling suggest that there are several factors that contribute to likelihood a weak insert will break when a whale interacts with the line and the time it will take to break, including the number of traps on a trawl and the location of the weak point in relation to where the whale interacts with the rope (DeCew et al. 2017). Data from these simulations found that tensions caused by a whale moving the buoy line are greatest at, and part at, the weak insertions below where the whale encounters the line (DeCew et al. 2017, Knowlton et al. 2020). 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. The lower the lowest weak insert the greater the chance that there will be a weak insert below a whale that encounters the rope. Trawl configurations with over five traps are more likely to break with an insert and in a shorter amount of time than without an insert, assuming there is an insert between the whale and the traps and enough force is present to allow a whale to break free of the traps. It is less clear how a weak point would break if in the middle of a complex entanglement. Given the data available, inserts at regular intervals is optimal to reduce the amount or likelihood of trailing line and gear involved in an entanglement. NMFS evaluated 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 feet (12.2 meters), determined by the average adult right whale length), as equivalent to an engineered weak rope.

Configurations that are knot-free may also pose less risk, though an expert elicitation is currently being conducted to determine the safety of using knots as weak inserts. Currently, the Plan recommends the use of gear that is knot-free, and/or free of attachments, until the expert elicitation is complete due previous ALWTRT recommendations that considered 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 weaker side of a knot or splice (MEDMR 2020).

Knowlton et al. (2016) reviewed forces needed to retrieve gear and 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 pounds (771 kilograms; Knowlton et al. 2018, Maine DMR 2020, Maine DMR Proposal to NMFS 2019, Appendix 3.3 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 pounds (771 kilograms) breaking strength were required to retrieve gear, particularly for gear of 35 traps and more in waters greater than 50 fathoms (91.4 m; MEDMR 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 3.3). 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 pounds (771 kilograms) 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 pounds (771 kilograms) or less. Other options that would allow fishermen to use their existing gear include using weak insertions (e.g. the South Shore Sleeve, a braided sleeve fed over a parted line, or other 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 a weak rope or weak insertion to be a line or gear configuration that consistently breaks within 10 percent of 1,700 pounds (771 kilograms) with at least 10 trials. Weak insert configurations should be easily replicated, detectable, and enforceable. A few options have already been approved for use in Massachusetts State waters under regulations effective May 1, 2021 (322 CMR 12.00). The approved configurations include weak sleeves and engineered red and red and white weak line spliced into buoy lines (see Appendix 3.6 for detailed descriptions). NMFS is continuing to work with fishermen to explore new options for weak line and weak inserts as they are tested and will make these publicly available once they are tested and approved.

3.3.5 *Considering Existing Risk Reduction Credits*

Overall the goal of this FEIS is to evaluate new regulations to reduce entanglement risk to right whales by at least 60 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 ongoing effort reduction since 2017 should contribute toward the overall risk reduction analyzed here. Note that the economic analysis within this FEIS 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 increasing importance of the area for right whales, the take reduction team agreed that Massachusetts fishermen should get equivalent credit for maintaining the MRA 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 1 and the Outer Cape LMA. As summarized in the Massachusetts DMF proposal (MADMF 2020, Appendix 3.3), up to 65 percent of the known 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). Massachusetts DMF 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 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 2021 Massachusetts State Measures

Massachusetts DMF implemented new regulations in state waters to reduce entanglement risk to right whales (Division of Marine Fisheries 322 CMR 12.00, seehttps://www.mass.gov/doc/322-cmr-12-protected-species/download). They implemented an extension of the state waters portion of the MRA in LMA 1 north to the Massachusetts-New Hampshire border from February through May 15 (MRA North). State waters will restrict trap/pot fishing during this time period.

After May 1, they will implement a dynamic opening in all state waters within the new state waters MRA bounds between May 1st and May 15th where the area will remain closed until no more than three whales remain in the area. Additionally, lobster end lines in state waters will require weak rope or weak inserts year round, in the form of full weak rope or inserts every 60 feet (18.3 meters) in the top 75 percent of the line. This FEIS includes the risk reduction from both of these measures in Alternative 2 (Preferred) given their large contributions to right whale risk reduction. However, federal procedural requirements make the implementation of a soft opening a challenge and therefore the final rule will only be mirroring the extension of the closure in state waters, and will not extend the closure period in federal waters into May. Alternative 3 considered risk reduction from the state water extension of the MRA, but does not include weak line measures implemented by state regulations because the weak line measures in the Non-preferred Alternative offer more risk reduction than those in the Preferred Alternative.

3.3.5.3 Ongoing Effort Reduction

As described below, lobster fishery management efforts in LMA 2 and 3 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 2 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 2 identified within the Team recommendations will be achieved. LMA 3 is anticipated to achieve a 12 percent line reduction in the Northeast Region 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.

3.3.5.4 Planned Weak Insertion Risk Reduction in Maine Exempt Waters

Maine is planning 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 5). As 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.

3.3.5.5 Estimated Line Reduction in Response to a Line Cap

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. Table 3.10 describes how monthly line numbers might change as a result of a 50 percent line cap based on the average number of buoy lines currently being used across the Northeast Region. A cap in federal waters to 50 percent of the average lines fished would likely result in a buoy line reduction closer to 45 percent given the current level of fluctuation in buoy lines used throughout a fishing year. This estimate is the result of regional variation and our anticipation of a complex response by fishermen to a line cap. 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 to 45 percent due to areas with higher variation in monthly line numbers. For LMA 2 in particular, where some months had lower line numbers than half of the monthly average, we considered three scenarios (see below) 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. Low effort: 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. Medium effort: 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. High effort: 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.

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. The most conservative scenario was analyzed using the DST by using the average percent line reduction for each LMA, with different estimates for Maine and Massachusetts in LMA 1. The average of responses two and three above were used to estimate percent line reduction for LMA 2. Using these estimates, federal waters still achieved well over the 60 percent risk reduction target.

Table 3.10: 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 described 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). MA = Massachusetts, ME = Maine, OC = Outer Cape.

	LMA 2				OC				LMA 2/3		LMA 3		MA LMA1		ME LMA1		Federal Waters	
Month	**2017 Lines**	**Low**	**Med**	**High**	**2017 Lines**	**Low**	**Med**	**High**	**2017 Lines**	**%**	**2017 Lines**	**%**	**2017 Lines**	**%**	**2017 Lines**	**%**	**2017 Lines**	**%**
Jan	1,061	9%	9%	9%	156	0%	-10%	-19%	201	51%	3,036	44%	3,261	59%	47,728	52%	55,287	51%
Feb	701	0%	-19%	-37%	71	0%	-81%	-162%	251	61%	3,102	45%	1,834	27%	31,811	28%	37,699	28%
March	733	0%	-16%	-31%	43	0%	-167%	-333%	116	16%	2,791	39%	1,628	18%	34,704	34%	39,972	32%
April	1,416	32%	32%	32%	0	0%			99	2%	2,358	27%	1,869	28%	42,232	46%	47,974	44%
May	2,146	55%	55%	55%	167	0%	-6%	-12%	135	28%	3,029	43%	2,269	41%	41,213	44%	48,792	45%
June	2,684	64%	64%	64%	282	34%	34%	34%	170	43%	4,153	59%	2,026	34%	44,820	49%	53,853	50%
July	2,915	67%	67%	67%	339	45%	45%	45%	167	42%	3,913	56%	1,797	25%	44,742	49%	53,534	50%
Aug	3,165	70%	70%	70%	430	57%	57%	57%	179	46%	3,852	56%	2,331	42%	47,366	52%	56,893	53%
Sept	2,931	67%	67%	67%	521	64%	64%	64%	244	60%	3,807	55%	3,277	59%	54,484	58%	64,743	58%
Oct	2,266	58%	58%	58%	526	65%	65%	65%	317	69%	4,078	58%	3,644	63%	56,454	59%	66,759	60%
Nov	1,596	40%	40%	40%	578	68%	68%	68%	228	57%	3,307	48%	4,206	68%	57,176	60%	66,513	59%
Dec	1,452	34%	34%	34%	355	48%	48%	48%	233	58%	3,692	54%	4,035	67%	47,529	52%	56,941	53%
Average	**1,922**	**41%**	**38%**	**36%**	**372**	**32%**	**40%**	**39%**	**195**	**44%**	**3,427**	**49%**	**2,681**	**44%**	**45,855**	**49%**	**54,080**	**48%**
Line Cap	**961**				**186**				**98**		**1,713**		**1341**		**22,927**		**27,040**	

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 U.S. lobster gear (without information to further identify state or specific area within the U.S.), 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 2 (Preferred) and 3 (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 Jonah 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 (MEDMR Regulations 13 188 Chapter 75, as amended by a modification proposed February 19, 2020) consistent with the measures proposed in Alternative 2. Under their revised measures, Maine requires purple markings on lobster pot/trap buoy lines fished by all state permitted fishermen from the coast to the LMA 1/LMA 3 boundary. Buoy lines in Maine exempted water are also required to have one 3 foot (91.4 centimeter) mark within two fathoms of the buoy. For buoy lines less than 100 feet (30.5 meter) in length one additional mark 1 foot long would be required about half way down the line. Longer buoy lines in the exemption area are required to have the 3 foot mark and two additional 1 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 3 nautical mile line) and offshore throughout LMA 1, Maine permitted fishermen are required to mark buoy lines with a 3 foot mark within the top two fathoms and three additional 1 foot marks at the top third, middle and bottom third. 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. Three non-regulatory monitoring components are proposed to align with recommendations from the Team in April 2019:

1. **Enforcement and associated 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 U.S. Coast Guard and state enforcement personnel, has developed 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 (See appendix 3.5).

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. Along with annual presentations on right whale monitoring, the monitoring cycle report results will be considered 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 and 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 2022. 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. NMFS intends to work with the ASMFC, through their open and public process, to develop additional high resolution spatial data collection objectives and requirements, while balancing the financial burden to industry. Fishery data will be used to monitor effort and distribution of the lobster and Jonah crab fisheries and inform Team discussions.

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 northeast Atlantic coast.

While NMFS solicited and considered all input from stakeholders, a number of approaches were rejected in the formulation of alternatives. Table 3.11 summarizes these approaches and briefly explains why NMFS chose not to integrate the approach into the regulatory alternatives under consideration. Additional information on some of these may be found in the responses to comments in Appendix 1.1. 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 3.11: 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*
Line Reduction	LMA 3: In Georges Basin, trawl up to 70 traps per trawl, year round or seasonally	Less preferable to broader scale measures, insufficient risk-reduction
	LMA 1 Maine: Trap reductions	Given varied state landings reporting requirements and rates, measures that require documented vessel landings histories are difficult to design, assess and implement outside of a fishery management Commission/Council process
	LMA 1 Mass and NH : 30 percent line reduction	Less than the 50% line reduction analyzed within Alternative 3
	Only use one buoy line in LMA 3 year round	Unpopular with stakeholders, potential gear conflicts and safety concerns
	Outside 12 nm 1/2 of buoy lines ropeless	Unpopular with stakeholders, potential increased gear conflict and safety concerns
	Reduce all traps 50 percent	Direct line reduction preferred, considered in Alternative 3
	3-4 year phase-in of 400 traps/fisherman trap limit with commensurate reduced end lines	Given varied state landings reporting requirements and rates, measures that require documented vessel landings histories are difficult to design, assess and implement outside of a fishery management Commission/Council process
	Reduce trap tag limits by 50 percent commensurate with buoy line reduction.	Given varied state landings reporting requirements and rates, measures that require documented vessel landings histories are difficult to design, assess and implement outside of a fishery management Commission/Council process
	Reduced trap limits if fishing in modified Mass Restricted Area	Would add risk
	Do not change gear configurations in state waters	Insufficient risk reduction

Topic	Alternative Considered but Rejected	Rationale for Rejection
	Trap or line cap to include all fisheries including EFPs, gillnet, trap/pot, aquaculture, includes seines	Given varied state landings reporting requirements and rates, measures that require documented vessel landings histories are difficult to design, assess and implement outside of a fishery management Commission/Council process
	Requiring 15-25 traps per trawl in LMA 2, based on distance from shore	A conservation equivalency requested due to vessel capacity, economic, and safety concerns expanded weak inserts instead, and provided more risk reduction
	3 traps/trawl throughout Maine State waters outside the exempted area	Allowing an exemption in zones C, D, and E based on zone specific scoping and conservation equivalencies
	8 traps/trawl between 3-6 nautical miles in Maine LMA 1	Accepted a conservation equivalency that redistributed trawl length based on zone specific scoping
	15 traps/trawl between 3-6 nautical miles in Maine LMA 1	Accepted a conservation equivalency that redistributed trawl length based on zone specific scoping
Closures	Close statistical area 529	Too large, unpopular with stakeholders
	LMA 3 above 40.3 degrees Oct - Dec	Too large, unpopular with stakeholders
	LMA 1 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 unpopular with stakeholders
	Emergency action to close area south of Martha's Vineyard and Nantucket until ruling	Not a part of this FEIS, 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
	Buoy line trap/pot closures during the summer and fall in offshore waters east of Maine in LMA 1 and LMA 3	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
	Massachusetts' proposed South Island Restricted Area	Updated data suggest that the restricted area will push effort into adjacent waters with equally high whale density.

Topic	Alternative Considered but Rejected	Rationale for Rejection
	PEW Petition for three large closures in the Gulf of Maine and a year round closure south of Cape Cod.	In total, the risk reduction of the four areas proposed by PEW achieved a 9.3% risk reduction across the entire northeast. Some of these areas predicted large shifts in gear density in areas outside of the closure. Without more broad line reduction, these closures shift risk more than reducing it overall risk.
	CBD petition for emergency rulemaking in existing closures and the DEIS Massachusetts proposed SIRA	Emergency rulemaking does not exempt NMFS from the NEPA process. Initiating a new EIS for an emergency rulemaking suspend this rulemaking and restart the lengthy rulemaking clock. It would also dismiss the TRT process as well as the public input requirements of the APA. It would also be difficult to assess the effect of the rule given it is highly dependent on when it is implemented. For example, if NMFs implemented an emergency rule closing the Massachusetts South Island Restricted Area as requested starting in July, the first month would only reduce 0.3 percent to 1.9 percent of risk within a given month. Broader line reduction is needed to reduce overall risk.
Ropeless Fishing	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
	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 LMA 3	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
	LMA 3 Northeast (outside of N of Georges 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 lb (771 kg) on 3/4 toppers	Unpopular with stakeholders
	1,700 lb rope in top 2/3	Unpopular with stakeholders
	LMA 3: Sleeves top 500m	Unpopular with stakeholders
	Outside of 100m Toppers	Unpopular with stakeholders
	Inside of 100m 1,700 lb (771 kg) rope	Unpopular with stakeholders

Topic	*Alternative Considered but Rejected*	*Rationale for Rejection*
	Inside 100 ft isobaths, 1,700 lb rope, outside use add-ons	Unpopular with stakeholders
	Sleeves everywhere	Unpopular with stakeholders
	1,700 lb (771 kg) tag line everywhere >100m	Unpopular with stakeholders
	Area 537 full weak rope or equivalent	Unpopular with stakeholders
	Sub Area 537- 1,700 lb (771 kg) or sleeves	Unpopular with stakeholders
	Reduce breaking strength in all ropes used in depths of less than 300 feet to 1,700 lb (771 kg) or sleeves every 40 feet	Unpopular with stakeholders
	Tiered buoy line strength: 1,700 lb (771 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 lb (771 kg) breaking strength line for all fixed gear fisheries in Area 537	Unpopular with stakeholders
	Try 1,900-2,000 lb (862 – 907 kg) breaking strength	Insufficient risk reduction
	Use predetermined bleach soak time to weaken rope	Difficult to standardize
	Test reduced breaking strength gear beyond 300 feet (91 meters)	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
Gear Marking	Individual fishermen/permit numbers specific ID tape throughout buoy line	Unpopular with stakeholders
	Distinctively marked 1,700 lb (771 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
	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 U.S. gear	Increased marking should help distinguish U.S. gear
	Unique for exempted areas	Limited color options

Topic	*Alternative Considered but Rejected*	*Rationale for Rejection*
	Unique mark for sinking line in buoy line 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	Logistical challenges
	Require mandatory lost gear reporting for all trap/pot and gillnet gear not already required to report.	Unpopular with stakeholders
Monitoring	Effort along the U.S. east coast with increased effort south of the islands and in the mid-Atlantic more than once per month. Year-round throughout the U.S. east coast with increased effort in the mid-Atlantic region.	Unpopular with stakeholders
	Year round throughout U.S. 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, logistical challenges
	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 lb weak-link or 1,100 lb 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 lb to a lower level. Analyze options for a 600 lb 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

Topic	Alternative Considered but Rejected	Rationale for Rejection
	Reduce line in surface systems in Maine	Unpopular with stakeholders
	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 FEIS
	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

3.5 References

Arthur, L. H., W. A. McLellan, M. A. Piscitelli, S. A. Rommel, B. L. Woodward, J. P. Winn, C. W. Potter, and D. Ann Pabst. 2015. Estimating maximal force output of cetaceans using axial locomotor muscle morphology. Marine Mammal Science **31**:1401-1426.

Baumgartner, M. 2020. Robots4Whales. Woods Hole Oceanographic Institution.

Baumgartner, M. F., J. Bonnell, S. M. Van Parijs, P. J. Corkeron, C. Hotchkin, K. Ball, L. P. Pelletier, J. Partan, D. Peters, J. Kemp, J. Pietro, K. Newhall, A. Stokes, T. V. N. Cole, E. Quintana, S. D. Kraus, and O. Gaggiotti. 2019. Persistent near real-time passive acoustic monitoring for baleen whales from a moored buoy: System description and evaluation. Methods in Ecology and Evolution **10**:1476-1489.

Borggaard, D.L., D.M Gouveia, M.A. Colligan, R.Merrick, K.S.Swails, M.J.Asaro, J.Kenney, G. Salvador and J. Higgins. 2017. Managing U.S. Altlantic large whale entanglements: Four guiding principles. Marine Policy 84 (2017) 202–212

Cole, T., P. Hamilton, A. Henry, P. Duley, R. Pace, B. White, and T. Frasier. 2013. Evidence of a North Atlantic right whale *Eubalaena glacialis* mating ground. Endangered Species Research **21**:55-64.

Consortium, R. W. 2019. North Atlantic Right Whale Consortium Sightings Database 12/05/2019 (Anderson Cabot Center for Ocean Life at the New England Aquarium, Boston, MA, U.S.A.).

DeCew, J. 2017. Numerical Analysis of a Lobster Pot System. New England Aquarium, Boston, MA.

DFO. 2019. Review of North Atlantic right whale occurrence and risk of entanglements in fishing gear and vessel strikes in Canadian waters.38.

Ganley, L., S. Brault, and C. Mayo. 2019. What we see is not what there is: estimating North Atlantic right whale *Eubalaena glacialis* local abundance. Endangered Species Research **38**:101-113.

Grieve, B. D., J. A. Hare, and V. S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the U.S. Northeast Continental Shelf. Scientific Reports **7**:6264.

Knowlton, A.R., J. DeCew and T. Werner. 2020. Simulated performance of lobster fishing gear under different configurations. Presentation to the North Atlantic Right Whale Consortium. Accessed online at https://drive.google.com/file/d/1IEF6w-4yGUG5EMTVjO2mqo8k5jX8-UmC/view on February 1, 2021.

Knowlton, A. R., R. Malloy Jr., S. D. Kraus, and T. B. Werner. 2018. Development and Evaluation of Reduced Breaking Strength Rope to Reduce Large Whale Entanglement Severity. Anderson Cabot Center for Ocean Life, New England Aquarium, Boston, MA.

Knowlton, A. R., J. Robbins, S. Landry, H. A. McKenna, S. D. Kraus, and T. B. Werner. 2016. Effects of fishing rope strength on the severity of large whale entanglements. Conserv Biol **30**:318-328.

Leiter, S., K. Stone, J. Thompson, C. Accardo, B. Wikgren, M. Zani, T. Cole, R. Kenney, C. Mayo, and S. Kraus. 2017. North Atlantic right whale *Eubalaena glacialis* occurrence in offshore wind energy areas near Massachusetts and Rhode Island, USA. Endangered Species Research **34**:45-59.

Mayo, C. A., L. Ganley, C. A. Hudak, S. Brault, M. K. Marx, E. Burke, and M. W. Brown. 2018. Distribution, demography, and behavior of North Atlantic right whales (*Eubalaena glacialis*) in Cape Cod Bay, Massachusetts, 1998-2013: Right Whales in Cape Cod Bay. Marine Mammal Science **34**:979-996.

Mayo, C. A., B. H. Letcher, and S. Scott. 2001. Zooplankton filtering efficiency of the baleen of a North Atlantic right whale, *Eubalaena glacialis*. Journal of Cetacean Research and Management **3**:245- 250.

McCarron, Patrice and Heather Tetreault, Lobster Pot Gear Configurations in the Gulf of Maine, 2012.

MEDMR. 2020. An Assessment of Vertical Line Use in Gulf of Maine Region Fixed Gear Fisheries and Resulting Conservation Benefits for the Endangered North Atlantic Right Whale. Submitted to NMFS GARFO as mid year Progress Report, July 2019 – 2020, for Grant NA18NMF4720084.

Morano, J. L., A. N. Rice, J. T. Tielens, B. J. Estabrook, A. Murray, B. L. Roberts, and C. W. Clark. 2012. Acoustically Detected Year-Round Presence of Right Whales in an Urbanized Migration Corridor: Right Whales in Massachusetts Bay. Conservation Biology **26**:698-707.

Morin, D., A. Henry, J. Higgins, and M. Minton. 2018. ALWTRT entanglement summary, SI/M and gear analysis. Presentation to the ALWTRT October 9. 2018.

NMFS, 2020. National Report on Large Whale Entanglements Confirmed in the United States in 2018. Office of Protected Resources Marine Mammal Health and Stranding Response Program report retrieved August 2020 from: https://www.fisheries.noaa.gov/resource/document/national-report-large-whale-entanglements-confirmed-united-states-2018

Oleson, E.M, J. Baker, J. Barlow, J.E. Moore and P. Wade. 2020. North Atlantic Right Whale Monitoring and Surveillance: Report and Recommendations of the National Marine Fisheries Service's Expert Working Group. NOAA Technical Memorandum NMFSOPR-64 June 2020. Retrieved August 2020 from: https://www.fisheries.noaa.gov/resource/document/north-atlantic-right-whale-monitoring-and-surveillance-report-and-recommendations

Pendleton, D., P. Sullivan, M. Brown, T. Cole, C. Good, C. Mayo, B. Monger, S. Phillips, N. Record, and A. Pershing. 2012. Weekly predictions of North Atlantic right whale *Eubalaena glacialis* habitat reveal influence of prey abundance and seasonality of habitat preferences. Endangered Species Research **18**:147-161.

Plourde, S., C. Lehoux, C. L. Johnson, G. Perrin, and V. Lesage. 2019. North Atlantic right whale (*Eubalaena glacialis*) and its food: (I) a spatial climatology of Calanus biomass and potential foraging habitats in Canadian waters. **00**:19.

Roberts, J. J., B. D. Best, L. Mannocci, E. Fujioka, P. N. Halpin, D. L. Palka, L. P. Garrison, K. D. Mullin, T. V. N. Cole, C. B. Khan, W. A. McLellan, D. A. Pabst, and G. G. Lockhart. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports **6**:22615.

Roberts JJ, Mannocci L, Halpin PN (2017) Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2016-2017 (Opt. Year 1). Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts JJ, Schick RS, Halpin PN 2020. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018-2020 (Option Year 3). Document version 1.4. Report prepared for

Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Stone, K. M., S. M. Leiter, R. D. Kenney, B. C. Wikgren, J. L. Thompson, J. K. D. Taylor, and S. D. Kraus. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. Journal of Coastal Conservation **21**:527-543.

van der Hoop, J. M., P. Corkeron, A. G. Henry, A. R. Knowlton, and M. J. Moore. 2017. Predicting lethal entanglements as a consequence of drag from fishing gear. Marine Pollution Bulletin **115**:91- 104.

CHAPTER 4 AFFECTED ENVIRONMENT

This chapter describes the valued ecosystem components (VECs) 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 and is frequently entangled by fishing gear.

- **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 (lobster and Jonah crab trap/pot) 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 ALWTRP. 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 and critical habitat 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	**Marine Mammals**	North Atlantic Right Whale	Endangered
		Humpback Whale	Protected
		Fin Whale	Endangered
		Minke Whale	Protected
		Sei Whale	Endangered
		Sperm Whale	Endangered
	Sea Turtles	Loggerhead Sea Turtle (Northwest Atlantic Ocean 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	Bryde's Whale	Protected
		Harbor Porpoise	Protected
		Blue Whale	Endangered
		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
	Sea Turtles	Kemp's Ridley Sea Turtle	Endangered
		Green Sea Turtle (North Atlantic DPS)	Threatened
		Hawksbill Sea Turtle	Endangered

Potential Effect	Category	Species	Status
		Olive Ridley Sea Turtle	Threatened
	Critical Habitat	North Atlantic Right Whale	ESA (Protected)

The information here was compiled from a variety of sources including published literature and official reports. The abundances, potential biological removal levels (PBR), 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 (NEFSC) 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 (Hayes et al. 2020, Pace et al. 2021b).

4.1.1 *Atlantic Large Whales*

4.1.1.1 North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) is a baleen whale found in temperate and subpolar 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 or subsurface 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 distribution throughout the Gulf of Maine (Record et al. 2019) making it more challenging to predict aggregations in known hotspots. 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 right whale population grew at a rate of 2.8 percent from an estimated 270 in 1990 to high of 483, but has declined since 2010 (Pace et al. 2017) and is experiencing an unusual mortality event beginning in 2017 that is 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 percent of all serious injuries and mortalities documented between 2010 and 2019 (see Chapter 2). During this time frame, there were 185 documented incidents in the U.S. and Canada. The following is a broad overview of the incident data:

- Of all 185 incidents reported, 152 of those showed injuries confirmed as caused by entanglements or vessel strikes, 78 of which resulted in serious injury or mortality (Table 4.2).
- Eleven 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 ten mortalities were documented, including nine in the Gulf of St. Lawrence. Four of the six examined were caused by injuries compatible with blunt force trauma and attributed to vessel strikes. One individual was too decomposed to determine cause of death. One was last seen with a new entanglement in the Gulf of St. Lawrence shortly before stranding dead in New York where the cause of death was attributed to Canadian line.
- 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 best estimate of the right whale population at the end of 2019 is 368 whales with a strong male bias (approximately 60 percent male; Pace et al 2017, Pace 2021). 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 2021, with an additional three mortalities documented in 2018, 10 in 2019, two in 2020, and two as of April 2021. In 2020, 15 serious injuries were included in the Unusual Mortality event tally, including two in 2017, five in 2018, one in 2019, four in 2020, and three in 2021 (see: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event).

Table 4.2: The number of entanglement and vessel strike cases, 2010 – 2019, by country, that resulted in serious injury or mortality. This list includes individuals with prorated injuries where outcome was uncertain and assigned a probability of serious injury and where serious injury or mortality was averted through disentanglement.

Country	Cause	# of Cases
US	Entanglement	3
	Vessel Strike	7
First Seen US	Entanglement	28
	Vessel Strike	1
Canada	Entanglement	14
	Vessel Strike	8
First Seen Canada	Entanglement	16
	Vessel Strike	1
Total	**Entanglement**	**61**
	Vessel Strike	**17**

Based on the best available information, the greatest entanglement risk to large whales is posed by fixed gear used in trap/pot or sink gillnet fisheries (Angliss and Demaster 1998; Cassoff et al. 2011; Kenney and Hartley 2001; Knowlton and Kraus 2001; Hartley et al. 2003; Johnson et al. 2005;Whittingham et al. 2005a,b; Knowlton et al. 2012; NMFS 2014; Hamilton and Kraus 2019; Henry et al. 2016; Henry et al. 2021; Sharp et al. 2019; Pace et al. 2021). Specifically, while foraging or transiting, large whales are at risk of becoming entangled in buoy lines, or groundlines of gillnet and trap/pot gear, as well as the net panels of gillnet gear that rise into the water column (Baumgartner et al. 2017; Cassoff et al. 2011; Hamilton and Kraus 2019; Hartley et al. 2003; Henry et al. 2014; Henry et al. 2015; Henry et al. 2016; Henry et al. 2017; Henry et al. 2019; Johnson et al. 2005; Kenney and Hartley 2001; Knowlton and Kraus 2001;Knowlton et al. 2012; NMFS 2014; Whittingham et al. 2005a,b; Hayes et al. 2020). Large whale interactions (entanglements) with these features of trap/pot and/or sink gillnet gear often result in the serious injury or mortality to the whale (Angliss and Demaster 1998; Cassoff et al. 2011; Henry et al. 2014, Henry et al. 2015, Henry et al. 2016; Henry et al. 2017; Henry et al. 2019; Knowlton and Kraus 2001, Knowlton et al. 2012; Moore and Van der Hoop 2012; NMFS 2014; Pettis et al.

2019; Sharp et al. 2019; van der Hoop et al. 2016; van der Hoop et al. 2017). Many entanglements, including serious injury or mortality events, go unobserved, and the gear type, fishery, and/or country of origin for reported entanglement events are often not traceable. The rate of large whale entanglement, and thus, rate of serious injury and mortality due to entanglement, are likely underestimated (Hamilton et al. 2018; Hamilton et al. 2019; Knowlton et al. 2012; Pace et al. 2017; Robbins 2009).

Anthropogenic mortality has limited the recovery of the 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). While vessel strikes declined after vessel speed regulations were implemented (78 FR 73726; Conn and Silber 2013), both entanglement in fishing gear and vessel strikes remain a significant threat (Kraus et al. 2016, Sharp et al. 2019) and appear 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, and 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. In recent years, low birth rates are an increasing concern for right whale recovery, with the detection of only five births in 2017 (Pettis et al. 2018b), no births in 2018 (Pettis et al. 2018a), seven births in 2019 (Pettis et al. 2020), and ten births in 2020 (Pettis et al. 2021). This is well below the average: 12.8 calves per year from 2010 through 2019 or 22 per year from 2000 through 2009. More recently, there were 17 calves in the 2020/2021 calving season, as of March 29 (https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2021). While the number of births in the most recent season is encouraging, the persistent low births are insufficient to counteract current population mortality rates (Pace 2021), increasing concern regarding current levels of entanglement mortality. 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, Moore et al. 2021).

The resilience of the right whale to future stressors is considered very low given the existing threats (Hayes et al. 2018a) but would be improved by 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 right whale is listed as endangered under the Endangered Species Act (ESA). NMFS believes that the right whale is well below the optimum sustainable population level. NMFS determines a population's PBR 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 most recent abundance estimate suggests the average population size was 368 (± 11) in 2019 (Pace 2021). The PBR for the 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 0.8 per year for the 2019 stock assessment. (Hayes et al. 2020). During that same time frame, the minimum estimated annual mortality and serious injury value for right whales between 2014 and 2018 was 8.15, including 6.85 attributed to fishery interactions (Hayes et al. 2020, Henry et al. 2021), well above PBR.

4.1.1.2 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 east coast of North America 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. 2020).

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. 2020). 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 east of Cape Cod northward to Stellwagen Bank and Jeffreys Ledge (CETAP 1982). Acoustic detections of humpbacks indicate year-round presence in New England waters, including the waters of Stellwagen Bank (Davis et al 2020). 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. 2020) confirm similar seasonal humpback distribution trends.

Current data suggest that the Gulf of Maine humpback whale stock is increasing (Hayes et al. 2020). The most recent population estimate calculated an abundance of 1,396 animals in this stock and a minimum population estimate is 1,380. 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 for the Gulf of Maine humpback whale stock is 22 whales per year (Hayes et al. 2020).

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 percent of the North Atlantic population had entanglement scarring in 2003, encountering new scarring at an annual rate of 12.1 percent. From 2010 to 2019, 38.8 percent of all observed mortality and serious injury were attributed to entanglements from interactions with trap/pot, monofilament line, netting, and unidentified gear (see Chapter 2). From 2014 through 2018, observed human-caused mortality averaged 15.25 animals per year, with 9.45 incidental fishery interactions and 5.8 vessel collisions (Henry et al. 2021). These results include only observed mortality and serious injury. Unobserved anthropogenic impacts on humpback whales is likely but to date has not been calculated. 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, anthropogenic sound, 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).

4.1.1.3 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. 2020).

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 Services' (NMFS) best estimate of abundance is 7,418 individuals (Hayes et al. 2020, Palka 2012). The species' overall 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 6,029, 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 12 (Hayes et al. 2020).

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 anthropogenic sound. Experts believe that fin whales are struck by large vessels more frequently than any other cetaceans (Laist et al. 2001). Approximately 22.7 percent of all observed mortality and serious injury were attributed to entanglements between 2010 and 2019, 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 2014and 2018, was 2.35 per year, 1.55 of those from fishing entanglement, and 0.8 per year from ship strikes (All U.S.) (Hayes et al. 2020, Henry et al. 2021).

4.1.1.4 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. Minke whales are most frequently observed in New England waters from spring to fall and are largely absent by winter (Hayes et al. 2020). There is evidence of high acoustic occurrence during September through April in deep-ocean waters in the eastern North Atlantic (Risch 2013, Risch et al. 2014). Research conducted by Clark and Gagnon (2002) and Rish et al. (2014) confirmed winter distribution in the West Indies and in mid-ocean waters southeast of Bermuda.

Data are insufficient for determining a population trend for this species. The best estimate of population size is 24,202 (CV=0.30) minke whales in the 2019 stock assessment report, which is substantially higher than in the 2018 stock assessment report because it now includes updated survey data in Canadian waters. The minimum population size is calculated at 18,902 (Hayes et al. 2020). 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 189 (Hayes et al. 2020).

As with other large whales in this VEC, documented sources of anthropogenic mortality of minke whales include entanglement in commercial fishing gear and ship strikes. 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 2019, nearly 30 percent of all observed mortality and serious injury 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 2014 to

2018, the average annual human-caused mortality and serious injury was 10.15 minke whales per year (below the PBR of 189), which is the sum of 8.95 minke whales per year (unknown CV) from U.S. and Canadian fisheries using strandings and entanglement data, 1.2 per year from vessel strikes, 0.2 takes in observed U.S. fishing gear, and 0.2 non-fishery entanglement takes (Hayes et al. 2020).

4.1.2 *Other Protected Species*

4.1.2.1 Marine Mammals

4.1.2.1.1 Sei Whale

Sei whales (*Balaenoptera borealis*) are listed as endangered throughout their range under the ESA. The western North Atlantic sei whale population belongs to the Northern Hemisphere subspecies (*B. b. borealis*) and consists of two stocks, a Nova Scotian Shelf stock and a Labrador Sea stock (Baker and Clapham 2004, Mitchell and Chapman 1977). The Nova Scotian Shelf stock is the only sei whale stock within ALWTRP boundaries and range from the U.S. east coast to Cape Breton, Nova Scotia and east to 42°00'W longitude (Hayes et al. 2020). The Nova Scotia stock in the North Atlantic is estimated at 6,292 individuals with a minimum population size of 3,098 individuals (Hayes et al. 2020). 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.

Sei whales are often found in the deeper waters that characterize the edge of the continental shelf (Hain et al. 1985) but NMFS aerial surveys also found substantial numbers of sei whales south of Nantucket in spring and summer (Stone et al. 2017) and on Georges 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.

Current threats include vessel strikes, fisheries interactions (including entanglement), climate change, habitat loss, reduced prey availability, and anthropogenic sound. Between 2010 and 2019 eighteen serious injuries and mortalities were observed: eight with unknown causes, five vessel strikes (all confirmed US), two entanglements, and three non-human caused mortality. Based on Henry et al. (2021), the average annual rate of confirmed human-caused mortality and serious injury to sei whales, between 2014 and 2018, is 1.2 incidents per year. This value includes incidental fishery interaction records, 0.4, and records of vessel collisions, 0.8. Possible causes of natural mortality, particularly for compromised individuals, are shark attacks, killer whale attacks, and endoparasitic helminthes (Perry et al. 1999).

4.1.2.1.2 Sperm Whale

In the western North Atlantic, sperm whales 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 Georges 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 best recent abundance estimate for sperm whales is the sum of the 2016 surveys and is 4,349 (CV=0.28; Hayes et al. 2020). However, this is likely an underestimate given the data were not corrected for dive-time, which can be long for sperm whales (Watwood et al. 2006).

Few instances of injury or mortality of sperm whales due to human impacts have been recorded in U.S. waters. Recently, there were 38 sperm whale strandings counted between 2008 and 2020, one of which was determined to be from interaction with fishery gear (MMHSRP Database, queried, 2021). Human interaction was confirmed in four of the cases, only one that was found in U.S. waters (with no confirmed country of origin) and the other three were related to Canadian pelagic longline or trap/pot fisheries. No sperm whale mortalities or serious injuries were reported between 2013 and 2017, though unobserved mortalities have not been calculated (PBR is 3.9; Hayes et al. 2020). 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 ALWTRP regulations and have interacted with trap/pot fisheries, with interactions primarily associated with entanglement in buoy lines associated with this gear type. However, they can also become entangled in groundlines or surface system lines of trap/pot gear (Sea Turtle Disentanglement Network (STDN), unpublished data). 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).

4.1.2.2.1 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 NMFS designated nine distinct population segments (DPSs) of loggerhead turtles, with the Northwest Atlantic Ocean DPS 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 primary northern foraging habitats are in the mid-Atlantic (Braun-McNeill et al. 2020) and north through Massachusetts (NMFS and USFWS 2008; Conant et al. 2009). They arrive at foraging areas in the mid-Atlantic as early as mid-April and in the Gulf of Maine around June. In fall, the trend is reversed with most turtles leaving the region's waters by the end of November. Recent climate-driven changes in northeast U.S. Atlantic waters may increase the northern range and seasonal duration for loggerheads along the Northwest Atlantic shelf in future years (Patel et al. 2021).

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 to be loggerheads, the number increased to 801,000 (inter-quartile range of approximately 521,000–1,111,000) (NMFS 2011).

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 (NMFS and USFWS 2008). In assessing the population, Ceriani and Meylan (2017) and Bolten et al. (2019) 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 including target annual recovery rates have not yet been met (Bolten et al. 2019). At core index beaches in the Peninsular Florida Recovery Unit (the largest nesting aggregation in the DPS), nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (Figure 4.1). In 2020, more than 53,000 nests were documented. There have been three intervals observed in Peninsular Florida nesting: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2020) (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Nest counts at Florida Panhandle index beaches show an upward trend since 2010 (Figure 4.2). An analysis of Northern Gulf of Mexico Recovery Unit (which includes Florida Panhandle) nesting from 1997 to 2018 found that there has been a non-significant increase of 1.7 percent (Bolten et al. 2019). Nesting in the Northern Recovery Unit shows a 35 percent increase from 2009 through 2013 (Ceriani and Meylan 2017), but a longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3 percent (Bolten et al. 2019). In the trend analysis by Ceriani and Meylan (2017), a 53 percent increase for the Greater Caribbean Recovery Unit was reported from 2009 through 2013. No trend analysis is available for the Dry Tortugas Recovery Unit (Ceriani and Meylan 2017; Bolten et al. 2019).

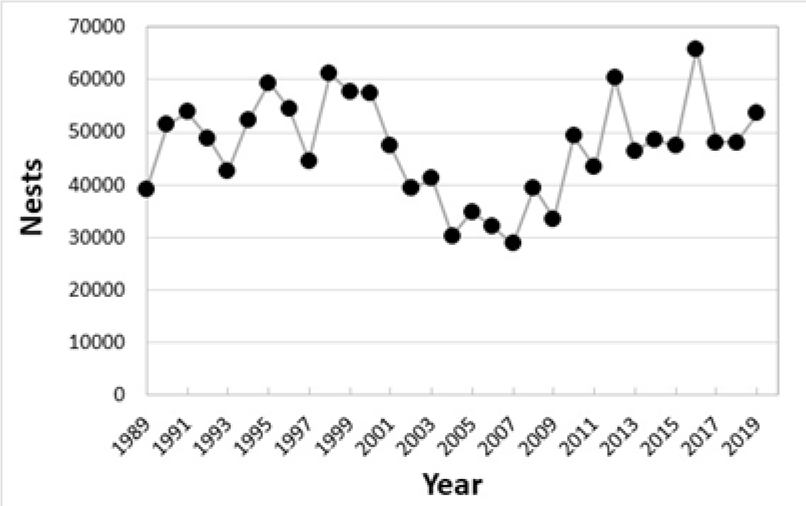


Figure 4.1: Annual nest counts for loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2019. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

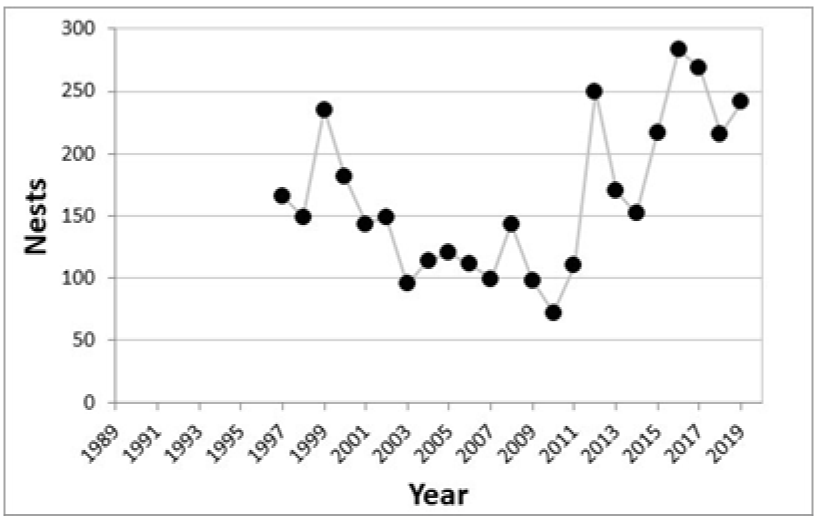


Figure 4.2: Annual nest counts on index beaches in the Florida Panhandle, 1989-2019. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

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 (Bolten et al. 2019, Murray 2020, NMFS and USFWS 2008). Stranding reports indicate that from 2010-2019, approximately 3,193 total loggerhead turtles stranded or were incidentally captured along the U.S. coast from Virginia through Maine (319 annually, on average) from a variety of causes, 144 of which were from entanglements or other fisheries interactions (NMFS STSSN database, 2021). Of the cases with evidence of vertical fishing line entanglement, crab, conch, and lobster gear were identified (Table 4.3).

Table 4.3: Loggerhead and leatherback buoy line entanglements by fishery between 2010 and 2019 (NMFS STSSN database, 2021).

Fishery	Leatherback	Loggerhead	Grand Total
Blue Crab	6	6	12
Conch	13	5	18
Conch and lobster	1		1
Fish	2		2
Lobster	82	1	83
Research	1		1
Unknown	151	3	154
Unknown VL and Lobster	1		1
Total	**257**	**15**	**272**

4.1.2.2.2 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. Leatherbacks range throughout the North Atlantic Ocean to 71 degrees North latitude. While the largest nesting aggregations occur in Trinidad, French Guiana, and Panama (NMFS and USFWS 2020), some nesting occurs in Florida and foraging habitats occur throughout U.S. coastal and pelagic Atlantic waters north to the Gulf of St Lawrence (James et al. 2006, Nordstrom et al. 2020). Leatherbacks occur in the Gulf of Maine from approximately 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 (Dodge et al. 2020).

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). 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). NMFS and USFWS (2020) also found decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance, suggesting a declining trend overall. The most recent, published IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation estimated 20,000 mature individuals and approximately 23,000 nests per year (estimate to 2017; The Northwest Atlantic Leatherback Working Group 2019). However, the leatherback status review estimated that the total index of nesting female abundance for the NW Atlantic is 20,659 females (NMFS and USFWS 2020).

NMFS and USFWS (2020) summarizes threats to the Northwest Atlantic leatherback across its range. These include threats on nesting beaches such as the harvest of nesting females and eggs, predation, and loss of nesting habitat due to development, erosion, 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 in the ocean.

Other marine threats include pollution (including ingesting marine debris), oil and gas activities, 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, erosion, and more frequent/severe storm events). The species' resilience to additional perturbation is low. Between 2010 and 2019 there were 744 strandings or incidental captures of leatherback turtles along the U.S. coast from Virginia through Maine (74 average annually), 323 of which had evidence of entanglement (NMFS STSSN database, 2021). Of these vertical fishing line entanglements, lobster, fish, crab, and conch were identified as gears involved (Table 4.3). While a large portion of leatherbacks are released from entanglements alive, sub lethal initial impacts can cause post interaction mortality, which was calculated between 57 and 62 percent for reported U.S. buoy line interactions from 2015 to 2019 (Memorandum from Carrie Upite, Sea Turtle Recovery Coordinator, to Jennifer Anderson, ARA for Protected Resources, April 26, 2021).

4.1.3 *Species and Critical Habitat Not Likely to be Impacted*

Based on the best available information, Table 4.1 provides a list of species not likely to be impacted by the proposed action. This determination has been made because either the occurrence of the species has limited to no overlap with the trap/pot fisheries operating in the proposed action area and/or interactions have never been documented or are extremely rare between the species and trap/pot gear (see Marine Mammal Stocks Assessment Reports at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; NMFS 2021; Sea Turtle Disentanglement Network, unpublished data; NMFS Observer Program, unpublished data; see OBIS-SEAMAP at https://seamap.env.duke.edu/). The proposed actions will not affect the essential physical and biological features of critical habitat designated for North Atlantic right whale, the Northwest Atlantic Ocean DPS of loggerhead sea turtle or Gulf of Maine DPS of Atlantic salmon; therefore, will not result in the destruction or adverse modification of either species critical habitat (NMFS 2014a; NMFS 2015a,b).

4.2 Habitat

Modification of the ALWTRP may affect EFH. Under the Magnuson-Stevens Act (MSA) (16 U.S.C. 1801), EFH 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 Fishery Management Councils (Councils) in the implementation of EFH provisions, regulations developed by NMFS encourages Councils to identify HAPC (50 CFR 600 Subpart J; 62 FR 66531; 67 FR 2343). HAPC are subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under the Magnuson-Stevens Act. However, federal projects with potential adverse impacts to HAPC must be more carefully scrutinized.

This section has three basic objectives:

- First, it defines the EFH and HAPC associated with the Atlantic trap/pot fisheries regulated by the ALWTRP.

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

- Finally, it discusses how the ALWTRP can influence habitat, with a particular focus on potential disturbances to benthic habitat.

4.2.1 *Identification of Essential Fish Habitat*

The 1996 reauthorization of the Magnuson-Stevens Act requires that NMFS and the regional Councils specifically describe and identify Essential Fish Habitat (EFH). In addition, the Magnuson-Stevens Act requires that fishery management plans minimize, to the extent practicable, adverse effects on EFH caused by fishing activities. According to the EFH regulations found at 50 CFR 600, information necessary to identify EFH 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, EFH includes the habitat for all non-target species during relevant life history stages that take place within the proposed area (Table 4.4). Because this action is not expected to affect pelagic habitats, the species and life stages listed below are all benthic. When viewed in the aggregate, across all species, EFH is all benthic habitat in the Atlantic Exclusive Economic Zone. It is important to note that corals are currently only listed as EFH in the Northeast Region Trap/Pot Management Area (Northeast Region) for one species, Acadian redfish. However, they are a component of complex hard bottom habitats where a variety 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

Species	Life Stage	Depth (meters)	Habitat Type and Description
			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
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

Species	Life Stage	Depth (meters)	Habitat Type and Description
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
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

Species	Life Stage	Depth (meters)	Habitat Type and Description
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
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

Species	Life Stage	Depth (meters)	Habitat Type and Description
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 EFH regulations developed by NMFS encourage regional Councils to identify Habitat Areas of Particular Concern (HAPC) and essential fish habitat areas (EFHAs) within areas designated as EFH (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).

HAPC 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 HAPC has been approached in various ways according to the discretion of the different Councils. The following sections summarize the HAPC designated by the Councils for

EFH 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).

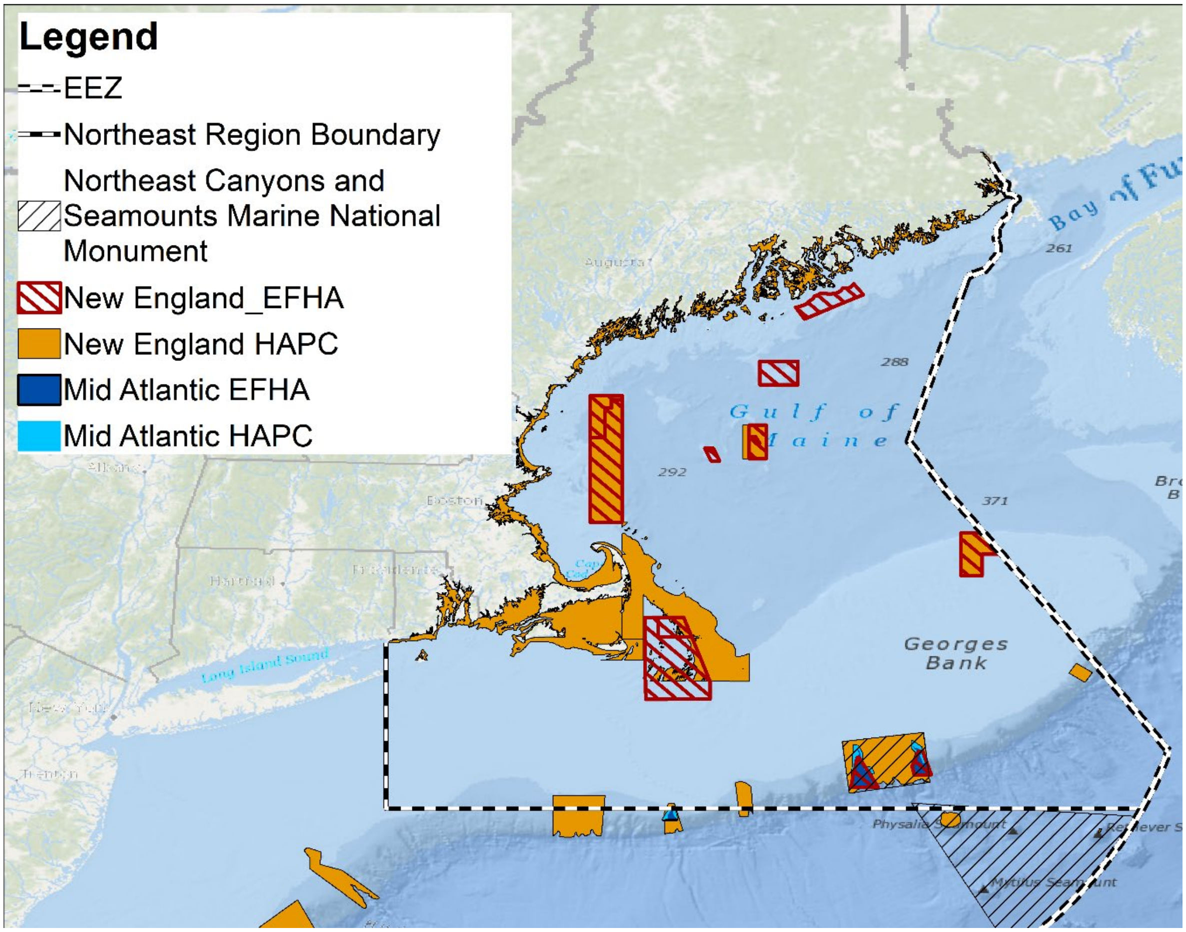


Figure 4.3: The Habitat Areas of Particular Concern (HAPC) and essential fish habitat currently protected from fishing (EFHA) within the proposed area, including those overseen by the Mid-Atlantic and New England Fishery Management Councils.

4.2.2.1 New England Fishery Management Council

The New England Fishery Management Council (NEFMC) previously designated discrete geographic areas as HAPC for two of its managed species (NEFMC 1998): Atlantic cod and Atlantic salmon. In 2018, NMFS approved the NEFMC's Omnibus Essential Fish Habitat Amendment 2, which revised EFH and HAPC in the region. Although corals are currently not listed as HAPCs in the northeast, they have been included as a component of HAPCs for managed species in the region that rely on complex hard bottom habitats where corals and other types of structure-forming organisms are found.

Atlantic Cod

For juvenile Atlantic cod, the NEFMC has designated a gravel/cobble bottom area on the northern edge of Georges Bank as HAPC. This area meets the first criterion for HAPC 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 HAPC criterion of sensitivity to human-induced environmental degradation, in that it is vulnerable to fishing practices that use mobile fishing gear.

Atlantic Salmon

The NEFMC has designated eleven rivers in Maine as HAPC 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 HAPC 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 HAPC: 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 HAPC 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.

Deep Sea Coral Amendment

Though not an HAPC, the Omnibus Deep Sea Coral Amendment will protect deep-water corals and their sensitive habitat off the continental slope and deep sea canyons south of Georges Bank beginning at a depth of 600 meters and extends to the 200-mile Exclusive Economic Zone limit by prohibiting the use of bottom tending gear within the designated area (red crab pots exempt). The new protection zone encompasses 25,153 square miles, including 82 percent of the Northeast Canyons and Seamounts Marine National Monument (see Monument Section). It also protects corals from bottom tending mobile gear at Outer Schoodic Ridge and Mt. Desert Rock in the Gulf of Maine, and establishes a designated research area in Georges Basin. Once implemented, lobster and Jonah crab trap/pots would be restricted from this area. The Amendment is currently under review at the Office of Management and Budget and could be implemented by late 2021.

4.2.2.2 Mid-Atlantic Fishery Management Council

The Mid-Atlantic Fishery Management Council (MAFMC) has designated HAPC for summer flounder and tilefish. HAPC have not been designated for other species under the MAFMC'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 HAPC 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 HAPC 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 HAPC 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).

4.2.2.3 Northeast Canyons and Seamounts Marine National Monument

On September 15, 2016, former President Barack Obama established the Northeast Canyons and Seamounts Marine National Monument (Monument) by Presidential Proclamation 9496 (81 FR 65159), under the authority of the Antiquities Act of 1906. The Monument consists of approximately 4,913 square miles (12,724 square kilometers) and is located about 130 miles east-southeast of Cape Cod (see Figure 4.3). Approximately the size of Connecticut, the monument includes two distinct areas, one that covers three canyons along the continental shelf and one that covers four seamounts. It is the first national marine monument in the Atlantic Ocean.

These undersea canyons and seamounts contain fragile and largely pristine deep marine ecosystems and rich biodiversity, including important deep sea corals, endangered whales and sea turtles, other marine mammals and numerous fish species. Relevant to this action, sperm whales are strongly attracted to the environments created by the submarine canyons, and fin and sei whales have been observed in both the canyons and seamounts areas. During aerial surveys, researchers have observed several marine mammals feeding, some accompanied by calves, indicating that this area is likely important as feeding and nursery habitat for many species of whales and dolphins. Marine mammal migration has also been noted to occur through the monument.

The submarine canyons and seamounts create dynamic currents and eddies that enhance biological productivity and provide feeding grounds. Because of the steep slopes of the canyons and seamounts, oceanographic currents that encounter them create localized eddies and result in upwelling. Currents lift nutrients, like nitrates and phosphates, critical to the growth of phytoplankton from the deep to sunlit surface waters. These nutrients fuel an eruption of phytoplankton and zooplankton that form the base of the food chain. Aggregations of plankton draw large schools of small fish and then larger animals that prey on these fish.

Under the original Presidential Proclamation, lobster and crab fishing in the Monument is allowed through September 15, 2023. In June 2020, former President Trump issued a Presidential Proclamation allowing all commercial fishing, as managed by the NEFMC, in the Monument. That decision is currently under review. Once the Deep Sea Coral Amendment is implemented (see Deep Sea Coral Amendment section), 82 percent of the Monument (waters 600 meters and deeper) will be protected from bottom tending gear (red crab pots exempt) if management remains the responsibility of the NEFMC.

4.2.3 *American Lobster Habitats*

With more than 1,926 actively fishing permit holders, the American lobster fishery accounts for the majority of affected vessels and gear regulated by the ALWTRP. Because lobster habitat may be influenced by the proposed ALWTRP 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 source in areas of intense fishing pressure ((Lawton and Lavalli 1995, Grabowski et al. 2010) cited in ASMFC 2015). Recent studies document and project future climate-driven changes in the northeast U.S. Atlantic waters that could shift lobster habitat to deeper offshore Gulf of Maine waters as nearshore and Southern New England waters warm to temperatures above lobster preferences (Tanaka et al., 2020).

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.

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.

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	0.0005-0.126	Adolescents and adults	Cooper et al., 1987

Habitat Category	*Habitat Subtypes*	*Lobster Densities (per sq. meter)*	*Lobster Sizes*	*Source*
	and at base of walls			
	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

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 Final Environmental Impact Statement includes a discussion of how the 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 seafloor. 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 negative 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 EFH 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 ALWTRP. 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 U.S. lobster and Jonah crab trap/pot fisheries in the Northeast Region.

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), 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. NMFS requires that dealers to 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.[3] Permit requirements are included as part of the Fishery Management Plans developed by the regional 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.

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

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 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 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.

4.3.1.3 Affected Fisheries

The American lobster (*Homarus americanus*) and Jonah crab (*Cancer borealis*) fisheries are the trap/pot fisheries in the Northeast Region that would be affected by the risk reduction measures identified in Alternatives 2 and 3, and are described in detail below. Other trap/pot fisheries would not be regulated by the Plan, and are not analyzed here. 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.

4.3.1.3.1 American Lobster

The American lobster 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 the U.S. waters, the species is most abundant from the inshore waters of 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 2019, 124 million out of 127 million pounds (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 nm/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 ASMFC's American Lobster Interstate Fishery 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 3 created seven lobster management areas (LMAs; Figure 4.4). These include the Inshore Gulf of Maine (LMA 1), Inshore Southern New England (LMA 2), Offshore Waters (LMA 3), Inshore Northern Mid-Atlantic (LMA 4), Inshore Southern Mid-Atlantic (LMA 5), New York and Connecticut State Waters (LMA 6), 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.

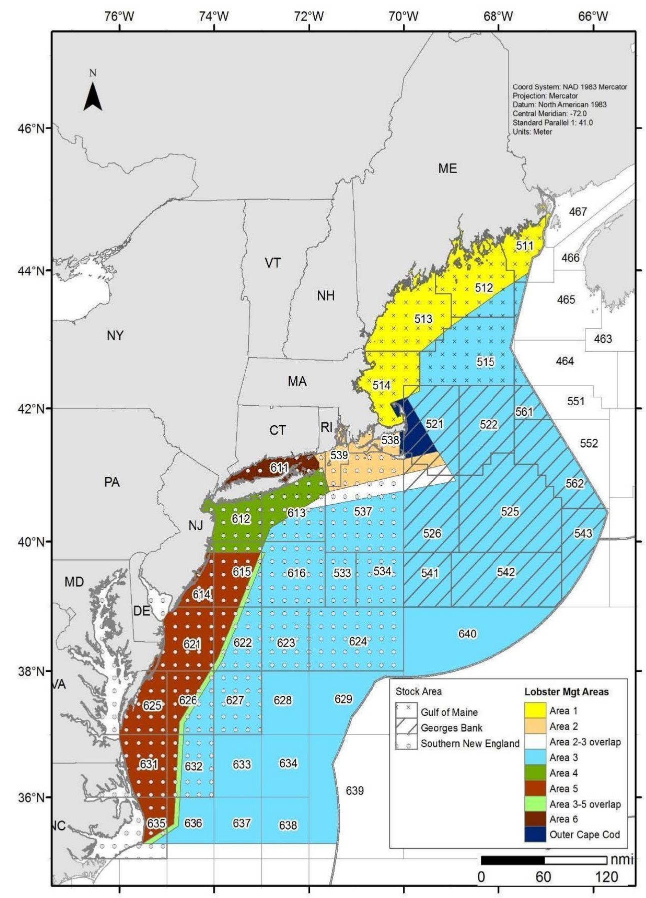


Figure 4.4: American lobster management areas and stock boundaries

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 1,926 vessels were issued federal commercial lobster permits in fishing year 2019 (not including for hire boats). 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 2019, dealer data shows total revenue of more than $637 million up from approximately $404 million in 2010. Additional detail on annual lobster landings and average ex-vessel revenue between 2010 and 2019 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 2019 of approximately 102 million pounds. Massachusetts, the second leading producer, had landings in 2019 of 17 million pounds. Together, Maine and Massachusetts accounted for about 94 percent of total national landings. Lobster landings by state for 2010 to 2019 are presented in Table 4.8.

Table 4.6: Federal commercial lobster trap/pot permits by LMA in fishing years 2010 – 2019. A single permit could be issued for more than one LMA. Permits that were issued by fishing year 2019 extend from May 1, 2019 to April 30, 2020 (GARFO permit data).

Year	Total	LMA 1	LMA 2	LMA 3	LMA 4	LMA 5	LMA 6	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
2019	1,926	1,569	147	91	60	40	35	16

Table 4.7: American lobster landings in the Northeast and Mid-Atlantic United States from 2010 to 2019. All values and prices are nominal (ACCSP Data Warehouse, 2021)

Year	Weight (million lb)	Value (million $)	Price ($/lb)
2010	117.6	$404.1	$3.4
2011	126.3	$422.9	$3.3
2012	150.7	$431.5	$2.9
2013	150.5	$460.8	$3.1
2014	148.0	$567.1	$3.8
2015	147.0	$622.1	$4.2
2016	159.5	$670.5	$4.2
2017	137.0	$567.4	$4.1
2018	148.0	$631.8	$4.3
2019	127.2	$636.7	$5.0

Table 4.8: Lobster landing weight (million pounds) by state from 2010 to 2019.

		ME	NH	MA	RI	CT-NC	Total
2010		96.2	3.6	12.8	2.9	2.0	117.6
2011		105.0	3.9	13.4	2.8	1.3	126.3
2012		127.5	4.2	14.5	2.7	1.5	150.4
2013		128.0	3.8	15.2	2.2	1.1	150.3
2014		125.0	4.4	15.3	2.4	1.0	148.0

		ME	NH	MA	RI	CT-NC	Total
2015		122.7	4.7	16.5	2.3	0.9	147.0
2016		132.7	5.8	17.8	2.3	0.9	159.4
2017		112.1	5.5	16.5	2.0	0.8	136.9
2018		121.3	6.1	17.7	1.9	0.5	147.5
2019		101.9	6.0	17.0	1.8	0.5	127.2

Table 4.9: The top ten American lobster landing ports in 2019. Ports are listed in descending order based on the weight of total landings (ACCSP Data Warehouse, 2021).

Port	County	State	Weight (million lb)	Value (million $)
Stonington	Hancock	ME	10.3	$48.8
Vinalhaven	Knox	ME	7.6	$39.2
Beals	Washington	ME	6.0	$21.6
Friendship	Knox	ME	5.0	$26.6
Newington	Rockingham	NH	4.3	$26.6
Gloucester	Essex	MA	3.9	$22.4
Spruce Head	Knox	ME	3.8	$18.4
Jonesport	Washington	ME	2.9	$10.3
Portland	Cumberland	ME	2.8	$15.0
Milbridge	Washington	ME	2.8	$12.3
Top 10 Total			49.4	$241.2
Industry Total			127.2	$636.7
Top 10 ports %			39%	38%

Table 4.9 provides additional data on the distribution of lobstering activity, highlighting the top ten grossing ports for lobster in 2019. 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 49.4 million, accounting for 39 percent of the industry total landings in 2019.

4.3.1.3.2 Jonah Crab

Jonah crab 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 coast-wide 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 percent harvester reporting, and prioritizing the development of electronic harvester reporting. Federal regulations complementing the FMP and Addenda I and II became effective on December 12, 2019.

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 one percent of the catch are identified to come from dredges and trawls (ASMFC 2015). Table 4.10 shows that in 2019, 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: 2019 Jonah crab landings in pounds by gear type (ACCSP 2021)

Gear Type	Landing Pounds	Percentage
Pots and Traps	14,381,505	89.94%
Trawls	133,293	0.83%
Dredge	54,027	0.34%
Long Lines	4,179	0.03%
Gill Nets	1,938	0.01%
Other Gears	1402.5	0.01%
Hand Line	151	0%
Not Coded	1,413,151	8.84%
Total	15,989,645	100%

Table 4.11: Jonah crab landings by state from 2010 to 2019 (ACCSP 2021)

Year	MA Weight (million lb)	MA Value (million $)	RI Weight (million lb)	RI Value (million $)	Other weight (million lb)	Other Value (million $)	Total Weight (million lb)	Total Value (million $)
2010	5.7	$3.2	3.7	$1.9	2.3	$0.9	11.7	$6.0
2011	5.4	$3.6	3.2	$1.8	1.4	$0.6	9.9	$6.0
2012	7.5	$5.6	3.8	$2.6	1.2	$0.6	12.6	$8.8

Year	MA Weight (million lb)	MA Value (million $)	RI Weight (million lb)	RI Value (million $)	Other weight (million lb)	Other Value (million $)	Total Weight (million lb)	Total Value (million $)
2013	10.1	$9.1	4.7	$3.3	1.3	$0.8	16.1	$13.3
2014	11.9	$9.3	4.4	$3.3	1.1	$0.9	17.4	$13.5
2015	9.1	$6.9	4.3	$3.0	0.8	$0.5	14.3	$10.4
2016	10.7	$8.2	4.2	$3.3	1.2	$0.8	16.1	$12.3
2017	11.7	$11.5	4.1	$3.9	1.8	$1.3	17.6	$16.7
2018	13.3	$12.5	4.6	$4.3	2.2	$1.8	20.1	$18.5
2019	9.7	$8.1	4.2	$3.4	2.1	$1.6	16.0	$13.1

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 throughout the 1990s (ASMFC 2015). By 2005, landings increased to over seven million pounds and then to over 20 million pounds in 2018, and dropped to 16 million pounds in 2019. Landings in 2019 predominantly came from Massachusetts (61 percent), followed by Rhode Island (26 percent), New Hampshire and Maine (five percent). Connecticut, New Jersey, and Maryland accounted for a combined eight percent of landings. MA and RI together contribute more than 85 percent 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 2019 (ACCSP 2021).

Rank	State	Port	Weight (million lb)	Value (million $)
1	MA	New Bedford	7.5	6.1
2	RI	Newport	1.9	1.5
3	RI	Point Judith	1.7	1.3
4	MA	Sandwich	1.6	1.5
5	NJ	Point Pleasant	0.8	0.7

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 percent of all 2014 landings), Jonah crabs are primarily harvested from Statistical Area 537 (71 percent), followed by 526 (10 percent) and 525 (10 percent) (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.

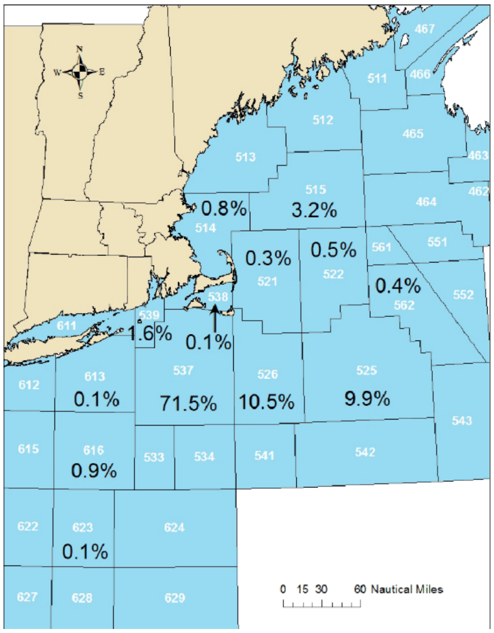


Figure 4.5: 2014 MA and RI Jonah crab landings by statistical area

4.4 Affected Communities

Appendix 4.4 describes the social and cultural setting of the communities potentially affected by the proposed modifications to the ALWTRP.

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 looking at the ports of landings, and by the distribution of lobster and Jonah crab 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 of trap/pot landings from LMAs 1, 2, 3, and Outer Cape Cod are 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 4.2. 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 4.3.

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 United States, 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.

4.5 References

ACCSP. 2010-2018. Data Warehouse, Confidential Data, Commercial Landings, Summary; generated by Chao Zou using Data Warehouse [online application].*in* C. Zou, editor., Arlington, VA.

Andrews, A. H., E. E. Cordes, M. M. Mahoney, K. Munk, C. K. H., G. M. Cailliet, and J. Heifetz. 2002. Age, growth and radiometric age validation of a deep-sea, habitat-forming gorgonian (*Primnoa resedaeformis*) from the Gulf of Alaska. Hydrobiologia **471**:101– 110.

Archer, F. I., R. L. Brownell, B. L. Hancock-Hanser, P. A. Morin, K. M. Robertson, K. K. Sherman, J. Calambokidis, J. Urbán R, P. E. Rosel, S. A. Mizroch, S. Panigada, and B. L. Taylor. 2019. Revision of fin whale Balaenoptera physalus (Linnaeus, 1758) subspecies using genetics. Journal of Mammalogy **100**:1653-1670.

ASMFC. 2015. American Lobster Stock Assessment Report for Peer Review. Atlantic States Marine Fisheries Commission, Stock Assessment Report. Atlantic States Marine Fisheries Commission.

Baker, C. S., and P. J. Clapham. 2004. Modelling the past and future of whales and whaling. Trends in Ecology and Evolution **19**:365–371.

Barshaw, D. E., and K. L. Lavalli. 1988. Predation upon postlarval lobsters *Homarus americanus* by cunners *Tautogolabrus adspersus* and mud crabs *Neopanope sayi* on three different substrates: eelgrass, mud, and rock. Marine Ecology Progress Series **48**:119-123.

Baumgartner, M., T. V. N. Cole, P. J. Clapham, and B. R. Mate. 2003. North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001. Marine Ecology Progress Series **264**:137-154.

Baumgartner, M., and B. Mate. 2003. Summertime foraging ecology of North Atlantic right whales. Marine Ecology Progress Series **264**:123-135.

Baumgartner, M., F. Wenzel, N. Lysiak, and M. Patrician. 2017. North Atlantic right whale foraging ecology and its role in human-caused mortality. Marine Ecology Progress Series **581**:165-181.

Best, P. B., J. Bannister, R. B. Jr, and G. Donovan. 2001. Right whales: worldwide status. **2**:309.

Black, K. P., and G. D. Parry. 1994. Sediment transport rates and sediment disturbance due to scallop dredging in Port Phillip Bay. Mem. Queensl. Mus. **36**:327-341.

Blaylock, R. A., J. W. Hain, L. J. Hansen, D. L. Palka, and G. T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. Page 211.

Bologna, P. A., and R. S. Steneck. 1993. Kelp beds as habitat for American lobster Homarus americanus. Marine Ecology Progress Series **100**:127-134.

Bolten, A. B., L. B. Crowder, M. G. Dodd, A. M. Lauritsen, J. A. Musick, B. A. Schroeder, and

B. E. Witherington. 2019. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta) Second Revision (2008): Assessment of Progress Toward Recovery.

Borrell, A. 1993. PCB and DDTs in blubber of cetaceans from the northeastern North Atlantic. Marine Pollution Bulletin **26**:146-151.

Braun McNeill, J., Avens, L., Goodman Hall, A., Fujisaki, I., and Iverson, A. (2020). Foraging and overwintering behavior of loggerhead sea turtles Caretta caretta in the western North Atlantic. *Mar. Ecol. Prog. Ser.* 641, 209–225. doi: 10.3354/meps13296

Ceriani, S. A., and A. B. Meylan. 2017. *Caretta caretta* (North West Atlantic subpopulation). The IUCN Red List of Threatened Species 2017: e.T84131194A119339029.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the USA outer continental shelf. Final Report #AA551-CT8-48 Cetacean and Turtle Assessment Program, University of Rhode Island, Bureau of Land Management, Washington, DC.

Christiansen, F., S. M. Dawson, J. W. Durban, H. Fearnbach, C. A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H. A. Warick, I. Kerr, M. S. Lynn, H. M. Pettis, and M. J. Moore. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Marine Ecology Progress Series **640**:1-16.

Christensen, I., T. Haug, and N. Oien. 1992. Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (Mysticeti) and sperm whales (Physeter macrocephalus) in Norwegian and adjacent waters. ICES Journal of Marine Science **49**:341-355.

Chuenpagdee, R., L. E. Morgan, S. M. Maxwell, E. A. Norse, and D. Pauly. 2003. Shifting gears: assessing collateral impacts of fishing methods in US waters. Frontiers in Ecology and the Environment **1**:517-524.

Churchill, J. H. 1989. The effect of commercial trawling on sediment resuspension and transport over the Middle Atlantic Bight continental shelf. Continental Shelf Research **9**:841-864.

Clapham, P. J., L.S. Baraff, C.A. Carlson, M.A. Christian, D.K. Mattila, C.A. Mayo, M.A. Murphy, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, *Megaptera novaengliae*, in the southern Gulf of Maine.

Clark, C.W., and Gagnon, G.C. 2002. Low-frequency vocal behaviors of baleen whales in the North Atlantic: Insights from IUSS detections, locations and tracking from 1992 to 1996. J. Underwater Acoust. (US Navy), 52 (3):609-640.

Coen, L. D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. South Carolina Department of Natural Resources, Marine Resources Research Institute.

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possaredt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite, and B. W. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere **4**:1-16.

Cooper, R. A., and J. R. Uzmann. 1980. Ecology of juvenile and adult Homarus americanus. Pages 97-142 *in* J. S. Cobb and B. F. Phillips, editors. The Biology and Management of Lobsters. Academic Press, New York, NY.

Cooper, R. A., P. Valentine, J. R. Uzmann, and R. A. Slater. 1987. Submarine Canyons. Pages 53-63 *in* R. H. Backus, editor. *Georges Bank*. MIT Press, Cambridge, MA.

Corkeron, P., P. Hamilton, J. Bannister, P. Best, C. Charlton, K. R. Groch, K. Findlay, V. Rowntree, E. Vermeulen, and R. M. Pace, 3rd. 2018. The recovery of North Atlantic right whales, Eubalaena glacialis, has been constrained by human-caused mortality. R Soc Open Sci **5**:180892.

Cowan, D. F. 1999. Method for assessing relative abundance, size distribution, and growth of recently settled and early juvenile lobsters (Homarus americanus) in the lower intertidal zone. Journal of Crustacean Biology **19**:738-751.

Daoust, P.-Y., É. L. Couture, T. Wimmer, and L. Bourque. 2018. Incident report: North Atlantic right whale mortality event in the Gulf of St. Lawrence, 2017. Report, Canadian Wildlife Health Cooperative, Marine Animal Response Society, and Fisheries and Oceans Canada, Ottawa, Canada.

Davies, K., M. Brown, P. Hamilton, A. Knowlton, C. Taggart, and A. Vanderlaan. 2019. Variation in North Atlantic right whale Eubalaena glacialis occurrence in the Bay of Fundy, Canada, over three decades. Endangered Species Research **39**:159-171.

Davis, G. E., M. F. Baumgartner, J. M. Bonnell, J. Bell, C. Berchok, J. Bort Thornton, S. Brault, G. Buchanan, R. A. Charif, D. Cholewiak, C. W. Clark, P. Corkeron, J. Delarue, K. Dudzinski, L. Hatch, J. Hildebrand, L. Hodge, H. Klinck, S. Kraus, B. Martin, D. K. Mellinger, H. Moors-Murphy, S. Nieukirk, D. P. Nowacek, S. Parks, A. J. Read, A. N. Rice, D. Risch, A. Sirovic, M. Soldevilla, K. Stafford, J. E. Stanistreet, E. Summers, S. Todd, A. Warde, and S. M. Van Parijs. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (Eubalaena glacialis) from 2004 to 2014. Sci Rep **7**:13460.

Davis, G.E., M.F. Baumgartner, P.J. Corkeron, J. Bell, C. Berchok, J.M. Bonnell, J.B. Thornton, S. Brault, G.A. Buchanan, D.M. Cholewiak, C.W. Clark, J. Delarue, L.T. Hatch, H. Klinck, S.D. Kraus, B. Martin, D.K. Mellinger, H. Moors-Murphy, S. Nieukirk, D.P. Nowacek, S.E. Parks, D. Parry, N. Pegg, A.J. Read, A.N. Rice, D. Risch, A. Scott, M.S. Soldevilla, K.M. Stafford, J.E. Stanistreet, E. Summers, S. Todd, and S.M. Van Parijs. 2020. Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. Glob Change Biol. 00:1-29.

Dobrzynski, T., and K. Johnson. 2001. Regional Council Approaches to the Identification and Protection of Habitat Areas of Particular Concern. NMFS Office of Habitat Conservation, Silver Spring, MD.

Dodge, K. L., B. Galuardi, T. J. Miller, and M. E. Lutcavage. 2014. Leatherback Turtle Movements, Dive Behavior, and Habitat Characteristics in Ecoregions of the Northwest Atlantic Ocean. PLoS ONE 9:e91726.

Eno, N. C., D. S. MacDonald, J. A. M. Kinnear, S. C. Amos, C. J. Chapham, R. A. Clard, F. P. D. Bunker, and C. Munro. 2001. Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science **58**:11-20.

Fossa, J. H., D. M. Furevik, P. B. Mortensen, and M. Hovland. 1999. Effects of bottom trawling on Lophelia deep water coral reefs in Norway.*in* Poster presented at the ICES meeting on Ecosystem Effects of Fishing.

Geraci, J. R., D. M. Anderson, R. J. Timperi, D. J. St. Aubin, G. A. Early, J. H. Prescott, and C. A. Mayo. 1989. Humpback Whales (Megaptera novaeangliae) Fatally Poisoned by Dinoflagellate Toxin. Canadian Journal of Fisheries and Aquatic Sciences **46**:1895-1898.

Grabowski, J. H., E. J. Clesceri, J. Gaudette, A. Baukus, M. Weber, and P. O. Yund. 2010. Use of herring bait to farm lobster in the Gulf of Maine. PLoS One **5**: e10188.

Grieve, B. D., J. A. Hare, and V. S. Saba. 2017. Projecting the effects of climate change on Calanus finmarchicus distribution within the U.S. Northeast Continental Shelf. Scientific Reports **7**:6264.

Hain, J. H. W., M. A. M. Hyman, R. D. Kenney, and H. E. Winn. 1985. The role of cetaceans in the shelfedge region of the northeastern United States. Marine Fisheries Review **47**:13-17.

Hall, S. J. 1999. Blackwell Science, Oxford.

Hayes, S. A., S. Gardner, L. Garrison, A. Henry, and L. Leandro. 2018a. North Atlantic Right Whales: evaluating their recovery challenges in 2018.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. NOAA Technical Memorandum NMFS-NE-258, NEFSC, NMFS, NOAA, DOC, Woods Hole, MA.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, B. Byrd, S. Chavez-Rosales, T. V. N. Col, L. Engleby, L. P. Garrison, J. Hatch, A. Henry, S. C. Horstman, J. Litz, M. C. Lyssikatos, K. D. Mullin, C. Orphanides, R. M. Pace, D. L. Palka, M. Soldevilla, and F. W. Wenzel. 2018b. TM 245 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2017. Page 371 *in* NMFS, editor, NOAA Tech Memo.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. Page 479. Northeast Fisheries Science Center, Woods Hole, MA.

Henry, A. G., T. V. N. Cole, L. Hall, W. Ledwell, D. Morin, and A. Reid. 2016. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2010-2014. Page 51.

Henry, A., M. Garron, A. Reid, D. Morin, W. Ledwell, and T. V. Cole. 2019. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2012-2016. US Department of Commerce, Northeast Fisheries Science Center.

Henry, A. G., M. Garron, D. Morin, A. Reid, W. Ledwell, and T. Cole. 2020. Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2013-2017. US Dept Commer.

Henry, A.G., M. Garron, D. Morin, A. Reid, W. Ledwell, and T. Cole. 2021. Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2014-2018. US Dept Commer.

Holsbeek, L., C. R. D. Joiris, V., I. B. Ali, P. Roose, J.-P. Nellissen, S. Gobert, J. M. Bouquegneau, and M. Bossicart. 1999. Heavy metals, organochlorines and polycyclic aromatic hydrocarbons in sperm whales stranded in the southern North Sea during the 1994/1995 winter. Marine Pollution Bulletin **38**:304±313.

Hunt, J. L. J. 1974. The geology of Gray's Reef, Georgia continental shelf. M.S. thesis. Univ. Georgia, Athens.

Hunt, K. E., N. S. J. Lysiak, C. J. D. Matthews, C. Lowe, A. Fernandez Ajo, D. Dillon, C. Willing, M. P. Heide-Jorgensen, S. H. Ferguson, M. J. Moore, and C. L. Buck. 2018. Multi-year patterns in testosterone, cortisol and corticosterone in baleen from adult males of three whale species. Conserv Physiol **6**:coy049.

ICES. 1992. Report of the Study Group on Ecosystem Effects of Fishing Activities, Copenhagen, 7-14 April. ICES CM 1992/G:11, International Council for the Exploration of the Sea, Study Group on Ecosystem Effects of Fishing Activities, , Copenhagen.

James MC, Sherrill-Mix SA, Martin K, Myers RA. 2006b. Canadian waters provide critical foraging habitat for leatherback sea turtles. Biological Conservation 133: 347-357.

Johnson, C., E. Devred, B. Casault, E. Head, and J. Spry. 2018. Optical, Chemical, and Biological Oceanographic Conditions on the Scotian Shelf and in the Eastern Gulf of Maine in 2016. Page 58.

Kaiser, M. J. 2000. The implications of the effects of fishing on non-target species and habitats. Pages 383-392 *in* M. J. Kaiser and S. J. de Groot, editors. The Effects of Fishing on Non- target Species and Habitats. Blackwell Science.

Kenney, R. D. 2001. Anomalous 1992 spring and summer right whale (Eubalaena glacialis) distributions in the Gulf of Maine. Journal of Cetacean Research and Management (Special Issue) **2**:209-223.

Kenney, R. 2018. What if there were no fishing? North Atlantic right whale population trajectories without entanglement mortality. Endangered Species Research **37**:233-237.

Kenney, R. D., H. E. Winn, and M. Macaulay. 1995. Cetaceans in the Great South Channel, 1979-1989: right whale (Eubalaena glacialis). Continental Shelf Research **15**:385-414.

Kraus, S. D., P. K. Hamilton, R. D. Kenney, A. R. Knowlton, and C. K. Slay. 2001. Reproductive parameters of the North Atlantic Right Whale. Journal of Cetacean Research and Management **2**:231–236.

Kraus, S. D., R. D. Kenney, C. A. Mayo, W. A. McLellan, M. J. Moore, and D. P. Nowacek. 2016. Recent Scientific Publications Cast Doubt on North Atlantic Right Whale Future. Frontiers in Marine Science **3**.

Kraus, S. D., and R. M. Rolland. 2007. Right whales in the urban ocean. Pages 1-38 *in* S. D. Kraus and R. M. Rolland, editors. The Urban Whale: North Atlantic Right Whales at the Crossroads. Harvard University Press, Cambridge.

Krumhansl, K. A., E. J. H. Head, P. Pepin, S. Plourde, N. R. Record, J. A. Runge, and C. L. Johnson. 2018. Environmental drivers of vertical distribution in diapausing Calanus copepods in the Northwest Atlantic. Progress in Oceanography **162**:202-222.

Krzystan, A., T. Gowan, W. Kendall, J. Martin, J. Ortega-Ortiz, K. Jackson, A. Knowlton, P. Naessig, M. Zani, D. Schulte, and C. Taylor. 2018. Characterizing residence patterns of North Atlantic right whales in the southeastern USA with a multistate open robust design model. Endangered Species Research **36**:279-295.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science **17**:35-75.

Lawton, P., and K. L. Lavalli. 1985. Postlarval, juvenile, adolescent, and adult ecology. Pages 47-88 *in* J. R. Factor, editor. Biology of the Lobster Homarus americanus. Academic Press, New Yorl, NY.

Lawton, P., and K. L. Lavalli. 1995. Postlarval, juvenile, adolescent and adult ecology. Pages 120 – 122 pp. *in* J. R. Factor, editor. Biology of the lobster, Homarus americanus.Academic Press, Inc.

Levin, L. A. 1984. Life history and dispersal patterns in a dense infaunal polychaete assemblage: community structure and response to disturbance. Ecology **65**:1185-1200.

Lien, J., R. Sears, G. B. Stenson, P. W. Jones, and I. H. Ni. 1989. Right whale, Eunbalaena glacialis, sightings in waters off Newfoundland and Labrador and the Gulf of St.

Lawrence, 1978-1987. The Canadian Field-Naturalist **103**.

Lincoln, D. 1998. Lobsters on the edge-essential lobster habitats in New England. Greenlite Consultants, Newton Highlands, MA.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 *in* P. L. Lutz and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Lysiak, N. S. J., S. J. Trumble, A. R. Knowlton, and M. J. Moore. 2018. Characterizing the Duration and Severity of Fishing Gear Entanglement on a North Atlantic Right Whale (Eubalaena glacialis) Using Stable Isotopes, Steroid and Thyroid Hormones in Baleen. Frontiers in Marine Science **5**.

MAFMC. 1998. Amendment 12 to the Summer Flounder, Scup, Black Sea Bass Fishery Management Plan.*in* M.-A. F. M. Council, editor, Dover.

MAFMC. 2003. Proposed and Final Federal Commercial Management Measures.

MAFMC. 2008. Amendment 1 to the Tilefish Fishery Management Plan, Volume 1.*in* M.-A. F. M. Council, editor.

Mate, B. R., S. L. Nieukirk, and S. D. Kraus. 1997. Satellite-Monitored Movements of the Northern Right Whale. The Journal of Wildlife Management **61**:1393.

Mayer, L. M., D. F. Schick, R. H. Findlay, and D. L. Rice. 1991. Effects of commercial dragging on sedimentary organic matter. Marine Environmental Research **31**:249-261.

Mayo, C. A., L. Ganley, C. A. Hudak, S. Brault, M. K. Marx, E. Burke, and M. W. Brown. 2018. Distribution, demography, and behavior of North Atlantic right whales (Eubalaena glacialis) in Cape Cod Bay, Massachusetts, 1998-2013: Right Whales in Cape Cod Bay. Marine Mammal Science **34**:979-996.

Mayo, C. A., and M. K. Marx. 1990. Surface behavior of the North Atlantic right whale, Eubalaena glacialis, and associated zooplankton characteristics. Canadian Journal of Zoology **68**:2214-2220.

Messieh, S. N., T. W. Rowel, D. L. Peer, and P. J. Cranford. 1991. The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shelf seabed. Continental Shelf Research **11**:1237-1263.

Meyer-Gutbrod, E., C. Greene, and K. Davies. 2018. Marine Species Range Shifts Necessitate Advanced Policy Planning: The Case of the North Atlantic Right Whale. Oceanography **31**.

Meyer-Gutbrod, E. L., and C. H. Greene. 2018. Uncertain recovery of the North Atlantic right whale in a changing ocean. Global Change Biology **24**:455-464.

Meyer-Gutbrod, E. L., C. H. Greene, P. J. Sullivan, and A. J. Pershing. 2015. Climate-associated changes in prey availability drive reproductive dynamics of the North Atlantic right whale population. Marine Ecology Progress Series **535**:243-258.

Mitchell, E., and D. G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*).

Mitchell, E. D. 1991. Winter records of the minke whale (*Balaenoptera acutorostrata* Lacépède 1804) in the southern North Atlantic.

MMHSRP Database. 2021 Marine Mammal Health and Stranding Response Program, NMFS, NOAA queried May 10, 2021

Monsarrat, S., M. G. Pennino, T. D. Smith, R. R. Reeves, C. N. Meynard, D. M. Kaplan, and A. S. Rodrigues. 2016. A spatially explicit estimate of the prewhaling abundance of the endangered North Atlantic right whale. Conserv Biol **30**:783-791.

Moore, M., T. Rowles, D. Fauquier, J. Baker, I. Biedron, J. Durban, P. Hamilton, A. Henry, A. Knowlton, W. McLellan, C. Miller, R. Pace, H. Pettis, S. Raverty, R. Rolland, R. Schick, S. Sharp, C. Smith, L. Thomas, J. van der Hoop, and M. Ziccardi. 2021. REVIEW Assessing North Atlantic right whale health: threats, and development of tools critical for conservation of the species. Diseases of Aquatic Organisms 143:205–226.

Morano, J. L., A. N. Rice, J. T. Tielens, B. J. Estabrook, A. Murray, B. L. Roberts, and C. W. Clark. 2012. Acoustically Detected Year-Round Presence of Right Whales in an Urbanized Migration Corridor: Right Whales in Massachusetts Bay. Conservation Biology **26**:698-707.

Murray, K.T. 2020. Estimated magnitude of sea turtle interactions and mortality in US bottom trawl gear, 2014-2018. NOAA Tech Memo NMFS-NE-260. 19pp

NEFMC. 1998. Final: amendment #11 to the northeast multispecies fishery management plan - amendment #9 to the Atlantic sea scallop fishery management plan - amendment #1 to the monkfish fishery management plan - components of the proposed Atlantic herring fishery management plan for Essential Fish Habitat incorporating the Environmental Assesment. Saugus, Massachusetts.

Newton, J. G., O. H. Pilkey, and J. O. Blanton. 1971. An oceanographic atlas of the Carolina and continental margin. North Carolina Dept. of Conservation and Development, Raleigh, NC.

NMFS. 1996. Harvesting the Value-added Potential of Atlantic Hagfish.

NMFS. 1999. Final Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks. NMFS, Washington, DC.

NMFS. 2002. Workshop on the effects of fishing gear on marine habitats off the Northeastern United States October 23-25, 2001 Boston, Massachusetts. National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts.

NMFS. 2003. Status of fisheries resources off Northeaster United States - Scup. Northeast Fisheries Science Center.

NMFS. 2004. Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat.

NMFS. 2005. A message from the NOAA Assistant Administrator for Fisheries, NMFS' Report on the Status of the U. S. Fisheries for 2004, 2005.

NMFS. 2011. Preliminary Summer 2010 Regional Abundance Estimate of Loggerhead Turtles (Caretta caretta) in Northwestern Atlantic Ocean Continental Shelf Waters.*in* N. M. F. S. Northeast and Southeast Fisheries Science Centers, National Oceanic and Atmospheric Administration, editor., Woods Hole, Massachusetts.

NMFS. 2013. North Atlantic Right Whale (Eubalaena glacialis) Source Document for the Critical Habitat Designation: A review of information pertaining to the definition of "critical habitat". December 2012.166pp.

NMFS. 2014. NMFS-Greater Atlantic Region (GARFO). Memo to the record: Determination regarding reinitiation of Endangered Species Act section 7 consultation on 12 GARFO fisheries and two Northeast Fisheries Science Center funded fisheries research surveys due to critical habitat designation for loggerhead sea turtles. Memo issued September 17, 2014.

NMFS. 2015a. Endangered Species Act Section 4(b)(2) Report: Critical Habitat for the North Atlantic Right Whale (Eubalaena glacialis). Prepared by National Marine Fisheries Service Greater Atlantic Regional Fisheries Office and Southeast Regional Office, December 2015. http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16narwchsection4_b__2_report012616.pdf

NMFS. 2015b. North Atlantic Right Whale (Eubalaena glacialis). Source Document for the Critical Habitat Designation: A review of information pertaining to the definition of "critical habitat" Prepared by National Marine Fisheries Service Greater Atlantic Regional Fisheries Office and Southeast Regional Office, July 2015.NMFS. 2017. 62nd Northeast Regional Stock Assessment Workshop (62nd SAW)

Assessment Summary Report.US Department of Commerce, Northeast Fisheries Science Center, Woods Hole, MA.

NMFS. 2017b. Process for Post-Interaction Mortality Determinations of Sea Turtles Bycaught in Trawl, Net, and Pot/Trap Fisheries, 02-110-21.

NMFS, and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision., National Marine Fisheries Service, Silver Spring, MD.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2020. Endangered Species Act status review of the leatherback turtle (Dermochelys coriacea). Report to the National Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service

NMFS 2021. Endangered Species Act Section 7 Consultation on the: (a) Authorization of the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and (b) Implementation of the New England Fisheries Management Council's Omnibus Essential Fish Habitat Amendment 2. NMFS GARFO May 28, 2021.

NMFS STSSN database. 2021. Sea Turtle Stranding and Salvage Network, NMFS, NOAA, queried May 11, 2021.

Nordstrom, B., M. C. James, and B. Worm. 2020. Jellyfish distribution in space and time predicts leatherback sea turtle hot spots in the Northwest Atlantic. PLOS ONE 15:e0232628.

Oedekoven, C., E. Fleishman, P. Hamilton, J. Clark, and R. Schick. 2015. Expert elicitation of seasonal abundance of North Atlantic right whales Eubalaena glacialis in the mid- Atlantic. Endangered Species Research **29**:51-58.

Pace, R. M., 3rd, P. J. Corkeron, and S. D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution **7**:8730-8741.

Pace, RM. 2021. Revisions and further evaluations of the right whale abundance model: improvements for hypothesis testing. NOAA Tech. Memo. NMFS-NE 269.

Pace, R. M., R. Williams, S. D. Kraus, A. R. Knowlton, and H. M. Pettis. 2021. Cryptic mortality of North Atlantic right whales:e346.

Palka, D. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Page 37 *in* N. F. S. C. R. D. US Dept Commer, editor.Palsbøll, P. J., J. Allen, M. Berube, P. J. Clapham, T. P. Feddersen, P. S. Hammond, R. R. Hudson, H. Jørgensen, S. Katona, A. H. Larsen, F. Larsen, J. Lien, D. K. Mattila, J. Sigurjonsson, R. Sears, T. Smith, R. Sponer, P. Stevick, and N. Øien. 1997. Genetic tagging of humpback whales. Nature **388**:767-769.

Paquet, D., C. Haycock, and H. Whitehead. 1997. Numbers and seasonal occurrence of humpback whales, Megaptera novaeangliae, off Brier Island, Nova Scotia. Canadian Field-Naturalist **111**:548–552.

Parker, R. O., A. J. Chester, and R. S. Nelson. 1994. A video transect method for estimating reef fish abundance, composition, and habitat utilization at Gray's Reef National Marine Sanctuary, Georgia. Fishery Bulletin **92**:787-799.

Parker, R. O., and S. W. Ross. 1986. Observing Reef Fishes from Submersibles Off North Carolina. Northeast Gulf Science **8**.

Patel, S.H., Winton, M.V., Hatch, J.M. *et al.* Projected shifts in loggerhead sea turtle thermal habitat in the Northwest Atlantic Ocean due to climate change. *Sci Rep* **11,** 8850 (2021). https://doi.org/10.1038/s41598-021-88290-9

Payne, P. M., J. R. Nicolas, L. O'Brien, and K. D. Powers. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, Ammodytes americanus. Fishery Bulletin **84**:271- 227.

Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. The Marine Fisheries Review **61**:74.

Pershing, A. J., and K. Stamieszkin. 2020. The North Atlantic Ecosystem, from Plankton to Whales. Annual Review of Marine Science **12**:annurev-marine-010419-010752.

Pettis, H. M., R. M. I. Pace, and P. K. Hamilton. 2018a. North Atlantic Right Whale Consortium 2018 Annual Report Card.

Pettis, H. M., R. M. I. Pace, and P. K. Hamilton. 2020. North Atlantic Right Whale Consortium 2019 Annual Report Card.

Pettis, H. M., R. M. I. Pace, R. S. Schick, and P. K. Hamilton. 2018b. North Atlantic Right Whale Consortium 2017 annual report card.

Pettis, H. M., R. M. Rolland, P. K. Hamilton, A. R. Knowlton, E. A. Burgess, and S. D. Kraus. 2017. Body condition changes arising from natural factors and fishing gear entanglements in North Atlantic right whales Eubalaena glacialis. Endangered Species Research **32**:237-249.

Pilskaln, C. H., J. H. Churchill, and L. M. Mayer. 1998. Resuspension of sediment by bottom trawling in the Gulf of Maine and potential geochemical consequences. Conservation Biology **12**:1223-1229.

Plourde, S., C. Lehoux, C. L. Johnson, G. Perrin, and V. Lesage. 2019. North Atlantic right whale (Eubalaena glacialis) and its food: (I) a spatial climatology of Calanus biomass and potential foraging habitats in Canadian waters. **00**:19.

Ramp, C., and R. Sears. 2013. Distribution, densities, and annual occurrence of individual blue whales (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada from 1980-2008. Page 37 *in* C. S. A. Secretariat, editor., Quebec Region, Canada.

Record, N. R., J. Runge, D. Pendleton, W. Balch, K. Davies, A. Pershing, C. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S. Kraus, R. Kenney, C. Hudak, C. Mayo, C. Chen, J. Salisbury, and C. Thompson. 2019. Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography **32**.Reeves, R. R., P. J. Clapham, and R. L. Brownell Jr. 1998. Recovery plan for the blue whale (Balaenoptera musculus). NMFS, National Marine Fisheries Service, Silver Spring, Maryland.

Risch, D., C.W. Clark, P.J. Dugan, M. Popescu, U. Siebert, S.M. Van Parijs. 2013. Mike whale acoustic behavior and multi-year seasonal and diel vocalization patterns in Massachusetts Bay, USA. Marine Ecology Progress Series **489**:279-295.

Risch, D., M. Castellote, C. W. Clark, G. E. Davis, P. J. Dugan, L. E. W. Hodge, A. Kumar, K. Lucke, D. K. Mellinger, S. L. Nieukirk, C. M. Popescu, C. Ramp, A. J. Read, A. N. Rice,

M. A. Silva, U. Siebert, K. M. Stafford, H. Verdaat, and S. M. Van Parijs. 2014. Seasonal migrations of North Atlantic minke whales: novel insights from large-scale passive acoustic monitoring networks. Movement Ecology **2**.

Risk, M. J., D. E. McAllister, and L. Behnken. 1998. Conservation of cold- and warm-water seafans: Threatened ancient gorgonian groves. Sea Wind **10**:2-21.

Robbins, J., A. R. Knowlton, and S. Landry. 2015. Apparent survival of North Atlantic right whales after entanglement in fishing gear. Biological Conservation **191**:421-427.

Robbins, J., S. Landry, and D. K. Mattila. 2009. Estimating entanglement mortality from scar- based studies. International Whaling Commission Scientific Committee, Madeira, Portugal.

Rodrigues, A. S. L., A. Charpentier, D. Bernal-Casasola, A. Gardeisen, C. Nores, J. A. P. Millán, K. McGrath, and C. F. Speller. 2018. Forgotten Mediterranean calving grounds of grey and North Atlantic right whales: evidence from Roman archaeological records. Proceedings of the Royal Society of London Series B Biological Sciences **285**.

Rogers, S. I., M. J. Kaiser, and S. Jennings. 1998. Ecosystem effects of demersal fishing: a European perspective. Pages 68-78 *in* E. D. Dorsey and J. Pederson, editors. Effect of Fishing Gear on the Sea Floor of New England. Conservation Law Foundation, Boston, Massachusetts.

Rolland, R. M., W. A. McLellan, M. J. Moore, C. A. Harms, E. A. Burgess, and K. E. Hunt. 2017. Fecal glucocorticoids and anthropogenic injury and mortality in North Atlantic right whales Eubalaena glacialis. Endangered Species Research **34**:417-429.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proc Biol Sci **279**:2363-2368.

Rolland, R. M., R. S. Schick, H. M. Pettis, A. R. Knowlton, P. K. Hamilton, J. S. Clark, and S. D. Kraus. 2016. Health of North Atlantic right whales Eubalaena glacialis over three decades: from individual health to demographic and population health trends. Marine Ecology Progress Series **542**:265-282.

Rumohr, H., and P. Krost. 1991. Experimental evidence of damage to benthos by bottom trawling with special reference to Arctica islandica. Meeresforschung **33**:340-345.

SAFMC. 1998. Final Comprehensive Amendment Addressing Essential Fish Habitat in the Fishery Management Plans of the South Atlantic Region: Amendment 3 to the Shrimp Fishery Management Plan; Amendment 1 to the Red Drum Fishery Management Plan; Amendment 10 to the Snapper Grouper Fishery Management Plan; Amendment 10 to the Coastal Migratory Pelagics Fishery Management Plan; Amendment 1 to the Golden Crab Fishery Management Plan; and Amendment 4 to the Coral, Coral reefs, and Live/Hard Bottom Habitat Fishery Management Plan (Including Final ES/SEIS, RIR, & SIA/FIS).*in*

S. A. F. M. Council, editor. Charleston.Schweitzer, C. C., R. N. Lipcius, and B. G. Stevens. 2018. Impacts of a multi-trap line on benthic habitat containing emergent epifauna within the Mid-Atlantic Bight. ICES Journal of Marine Science.

Sears, R. and J. Calambokidis 2002. COSEWIC Assessment and update status report on the blue whale Balaenoptera musculus, Atlantic population and Pacific poulation, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa 38 pp.

Sharp, S., W. McLellan, D. Rotstein, A. Costidis, S. Barco, K. Durham, T. Pitchford, K. Jackson, P. Daoust, T. Wimmer, E. Couture, L. Bourque, T. Frasier, B. Frasier, D. Fauquier, T. Rowles, P. Hamilton, H. Pettis, and M. Moore. 2019. Gross and histopathologic diagnoses from North Atlantic right whale Eubalaena glacialis mortalities between 2003 and 2018. Diseases of Aquatic Organisms **135**:1-31.

Short, F. T., K. Matso, H. M. Hoven, J. Whitten, D. M. Burdick, and C. A. Short. 2001. Lobster use of eelgrass habitat in the Piscataqua River on the New Hampshire/Maine border, USA. Estuaries **24**:277-284.

Steneck, R. S., and C. Wilson. 1998. Why are there so many lobsters in Penobscot Bay? Pages 72-75 *in* D. D. Platt, editor. Rim of the Gulf – Restoring Estuaries in the Gulf of Maine. The Island Institute, Rockland, ME.

Stephenson, F., A. C. Mill, C. L. Scott, N. V. C. Polunin, and C. Fitzsimmons. 2017. Experimental potting impacts on common UK reef habitats in areas of high and low fishing pressure. ICES Journal of Marine Science **74**:1648-1659.

Stone, K. M., S. M. Leiter, R. D. Kenney, B. C. Wikgren, J. L. Thompson, J. K. D. Taylor, and S. D. Kraus. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. Journal of Coastal Conservation **21**:527-543.

Tanaka KR, Torre MP, Saba VS, Stock CA, Chen Y. 2020. An ensemble high-resolution 634 projection of changes in the future habitat of American lobster and sea scallop in the Northeast 635 US continental shelf. Diversity and Distributions.

TEWG, (Turtle Expert Working Group). 2007. An assessment of the leatherback turtles population in the Atlantic ocean. Page 116. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

The Northwest Atlantic Leatherback Working Group, N. 2018. Northwest Atlantic Leatherback Turtle (*Dermochelys coriacea*) Status Assessment. Conservation Science Partners and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), Godfrey, Illinois.

The Northwest Atlantic Leatherback Working Group, N. 2019. *Dermochelys coriacea* (Northwest Atlantic Ocean subpopulation). The IUCN Red List of Threatened Species 2019: e.T46967827A83327767.

Theroux, R. B., and M. D. Grosslein. 1987. Benthic fauna. Pages 283-295 *in* R. H. B. a. D. W. Bourne, editor. *Georges Bank*. MIT Press, Cambridge, MA.

Theroux, R. B., and R. L. Wigley. 1998. Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States. . Page 240 *in* U. S. D. Commerce, editor.

Tiwari, M., B. P. Wallace, and M. Girondot. 2013. Dermochelys coriacea (Northwest Atlantic Ocean subpopulation). The IUCN Red List of Threatened Species 2013: e.T46967827A46967830.

van der Hoop, J., P. Corkeron, and M. Moore. 2017. Entanglement is a costly life-history stage in large whales. Ecol Evol **7**:92-106.

Waring, G. T., R. A. DiGiovanni Jr, E. Josephson, S. Wood, and J. R. Gilbert. 2015. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2014.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam, and M. Sano. 1993. Sperm whales associated with Gulf Stream features off the northceastern USA shelf. Fisheries Oceanography **2**:101- 105.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2010. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments 2010.Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2012. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2011.

Waring, G. T., J. M. Quintal, and C. P. Fairfield. 2002. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments: 2002. Northeast Fisheries Science Center, Woods Hole, Massachusetts.

Watkins, W. A., and W. E. Schevill. 1976. Right whale feeding and baleen rattle. Journal of Mammalogy **57**:58-66.

Watwood, S. L., P. J. O. Miller, M. Johnson, P. T. Madsen, and P. L. Tyack. 2006. Deep-diving foraging behaviour of sperm whales (Physeter macrocephalus). Journal of Animal Ecology 75:814–825.

Weinrich, M. T. K., R. D.; Hamilton, P. K. 2000. Right whales (Eubalaena glacialis) on Jeffreys Ledge: a habitat of unrecognized importance? Marine Mammal Science **16**:11.

Wigley, R. L., and R. B. Theroux. 1981. Atlantic continental shelf and slope of the United States – macrobenthic invertebrate fauna of the middle Atlantic bight region – faunal composition and quantitative distribution pp., 1981. Page 198.

Wikgren, B., H. Kite-Powell, and S. Kraus. 2014. Modeling the distribution of the North Atlantic right whale Eubalaena glacialis off coastal Maine by areal co-kriging. Endangered Species Research **24**:21-31.

Wishner, K. F., E. Durbin, A. Durbin, M. Macaulay, H. Winn, and R. Kenney. 1988. Copepod patches and right whales in the Great South Channel off New England. Bulletin of Marine Science **43**:825-844.

Wishner, K. F., J. R. Schoenherr, R. Beardsley, and C. Chen. 1995. Abundance, distribution and population structure of the copepod Calanus finmarchicus in a springtime right whale feeding area in the southwestern Gulf of Maine. Continental Shelf Research **15**:475-507.

Woodley, T. H., and D. E. Gaskin. 1996. Environmental characteristics of North Atlantic right and fin whale habitat in the lower Bay of Fundy, Canada. Canadian Journal of Zoology **74**:75-84.

CHAPTER 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 Final EIS (FEIS) 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 FEIS 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 (DST), 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 minimum of 60 percent risk reduction necessary to help reduce impacts to right whales to below the potential biological removal level of 0.8 serious injury or mortality per year.

Of foremost concern to this evaluation is the direct effect of the potential regulations on reducing the likelihood that North Atlantic right whales (hereafter referred to as right whale will be killed, seriously injured, or experience sub-lethal impacts as a result of entanglement in lobster and Jonah crab 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.

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) and is organized as follows:

- Section 5.1 discusses the changes to the Alternatives between the Draft Environmental Impact Statement (DEIS) to this FEIS. The discussion that follows presents an evaluation of these impacts using the NMFS DST (See Section 3.1.2 and Appendix 3.1 for model documentation). The DST assesses risk associated with an overlap between whale habitat density and Northeast Region lobster and Jonah crab trap/pot buoy lines to help characterize baseline entanglement risk and the impact of alternative management measures. For this analysis, 2017 represents the baseline for the number of lines and gear configurations because it represents the best available data for comparing the reduction entanglement risk and severity among all alternatives. The right whale habitat density model (right whale density model, version 11) used in this FEIS includes the most recent available data from 2010 to 2018 (Roberts et al. 2020).
- Section 5.2 provides a description of how the DST was used for the biological analysis.
- Section 5.3 evaluates the direct and indirect impacts of risk reduction alternatives. The effects of revised Plan regulations on Atlantic large whales, including right whales, are evaluated by comparing the potential impacts of each of the regulatory alternatives under

consideration, including NMFS' preferred alternative, against the 2017 risk reduction baseline (representing status quo; Section 5.3.1). The chapter also discusses other potential impacts on marine resources − including impacts on other protected species (Section 5.3.2) and essential fish habitat (Section 5.3.3) − and compares the alternatives with respect to these impacts.

- Section 5.4 evaluated the direct and indirect impacts of the gear marking alternatives.
- Section 5.5 provides a summary of impacts.

As described in Chapter 3, the ALWTRT 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. This includes ongoing buoy line reduction that is occurring as a result of fishery management actions (e.g. trap reductions) as well as state measures that will reduce right whale entanglement risk (e.g. state implemented measures). The value of Massachusetts Restricted Area which was implemented in 2015 is also considered. 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 Changes from the Draft Environmental Impact Statement

NMFS received numerous comments from a diverse set of interested parties during the public scoping and public comment periods on the DEIS. The comments included both formal written comments as well as oral comments offered at public hearings. Those comments are summarized in Appendices 1.1 and 3.4. These comments were taken into consideration with a new round of analyses described and justified in Chapter 3, Section 3.3. The results of these analyses and the public comment period informed the final alternatives included in this FEIS. Responsive to comments, the modifications to the DEIS for the FEIS prioritized use of an updated right whale density model to estimate risk reduction for right whales; the updated right whale population status including information on unobserved mortalities; feasibility of implementation and safety concerns (particularly for small entities) that could be ameliorated by conservation equivalencies; and consideration of indirect effects of measures that may adversely increase co-occurrence between buoy lines and whales.

Gear marking alternatives analyzed for the FEIS are discussed in Section 3.2.2. Marking gear does not reduce risk but if marked gear is retrieved from entangled whales it can provide information about where entanglement incidents occur. Alternative 2 (Preferred) and the Final Rule would increase the number of marks required in federal water compared to the Proposed Rule but have lesser impacts within the scope of impacts considered for the buoy line replacement analyzed in Alternative 3 in the DEIS and retained as Alternative 3 in this FEIS.

Modifications to the risk reduction measures in Alternative 2 in this FEIS relative to Alternative 2 in the DEIS includes:

- The proposed seasonal restricted area south of Cape Cod in this Alternative is larger than the restricted area analyzed within the DEIS Preferred Alternative, coming instead from DEIS Alternative 3.

- The removal of the requirement for a weak link at the buoy, which was analyzed as part of Alternative 3 in the DEIS.
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for LMA 2 exchanging new trawl length requirements with more expansive weak insert requirements throughout the LMA
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for LMA 3 that would require more traps per trawl than in the DEIS within the Georges Basin area that was analyzed as a restricted area in Alternative 3 of the DEIS. This increase in number of traps per trawl was offset by a lower number of traps required within the Northeast Region south of the 50 fathom depth contour on the south end of Georges Bank.
- Adoption of conservation equivalency recommendations submitted as public comments on the DEIS and Proposed Rule for Maine waters in LMA 1, including modification of regulations implementing the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) at 50 CFR 697.21(b)(2) requiring two buoy lines on trawls with more than three pots to accommodate Maine conservation equivalency options. This would allow the use of half the minimum number of traps required with two buoy lines if only one buoy line is used. Other differences in the FEIS Alternative 2 compared to the DEIS are trade-offs in the number of traps on a trawl based on Maine fishery zones and distance from shore between the Maine exemption line and the 12 nautical mile line (22.2 kilometer line, see the description of conservation). See Section 3.3.2 for a more detailed description of the complex trawl length and weak line requirements proposed and implemented in this FEIS.

Changes in Alternative 3 risk reduction elements analyzed in this FEIS relative to the DEIS Alternative 3 include retaining the weak link at the buoy or allowing it to be lowered to the base of the surface system and retaining only one South Island Restricted Area closure. Additionally, Alternative 3 retained only the seasonal weak line option in LMA 3 because the other option is analyzed in the preferred alternative and includes the special expansion of the MRA into state waters as implemented by state Regulations (see Table 3.5).

The only gear marking alternative that changed between the DEIS and FEIS is Alternative 2. The DEIS only required one 6 inch (15.2 centimeters) green mark to be included in state waters within the top two fathoms of the buoy. In the FEIS, gear in federal waters would be required to include at least four 1 foot long (30.5 centimeter) green marks within 6 inches (15.2 centimeters) of each state specific mark. The number of marks in federal waters has increased from the DEIS (four 1 foot/30.5 centimeter marks instead of one 6 inch/15.2 centimeter marks). This change is responsive to concerns about distinguishing state and federal buoy lines, identified during public hearings. Additionally, recently retrieved gear from a right whale included gear marks of 6 and 9 inches long (15.2 and 22.9 centimeters, inconsistent with current U.S. gear marking requirements but consistent with past Canadian gear marks. Use of a minimum of a 12 inch (30.5 centimeter) mark in U.S. commercial fisheries could help distinguish U.S. marks from Canadian gear. The change is within the scope of impacts analyzed within the DEIS, and would increase gear specialists' ability to distinguish state from federal waters than Alternative 2 in the DEIS. For more information on the details of the alternatives, changes from the DEIS, and on the comments received from the public see Chapter 3 and Appendix 1.1 and Volume 3.

5.2 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 similar to past analyses of Plan modifications and is necessary because, while the DST was designed to quantitatively analyze changes in entanglement risk as a result of different management actions, uncertainties in the underlying data sources prevent precise risk reduction estimates but provide a comparison of relative risk reduction between options. The DST does not provide a precise analysis of biological effects. The DST is also limited in its capacity to assess the impact of the alternatives on other protected species or marine habitats because it was built specifically for analyzing entanglement risk to right whales and other large whales. Some quantitative criteria from the DST can be applicable to entanglement risk for other species that are not built into the DST?, such as sea turtles, including percent reduction in lines but other criteria are species or VEC specific. Therefore the analysis of other protected species and habitats primarily rely upon qualitative data.

The analyses within this FEIS will use the same metrics used for previous analyses of ALWTRP modifications, including changes in line numbers and co-occurrence based on sightings data and vertical buoy line distribution data from the IEc Vertical Line Model. This analysis uses a right whale density model (version 11, Roberts et al. 2020) in lieu of a layer based on whale sightings per unit effort, which differs from the DEIS and previous analyses. The right whale density model is an improvement upon the whale distribution model used in the DEIS because it uses a more recent time frame (2010-2018) and provides better predictions of whale density in areas where there is lower monitoring effort. This also addresses the comments received during the comment period that requested the use of updated data for the analyses included in the FEIS. The DST also includes a humpback density model and a fin whale density model for the period of 1999 through 2017 (Roberts et al. 2017), though the fin whale density model currently does not support the use of a gear threat model and can only be used to examine co-occurrence. As such, the potential biological impacts of the alternatives on large whales were assessed primarily with the DST, described below, generating both qualitative and qualitative measures.

As indicated previously and endorsed by the Team, the Alternatives in this FEIS include line reduction that occurred as a result of fishery management actions (e.g. trap reductions) as well as state measures that will reduce right whale entanglement risk (e.g. state implemented measures). However, the analysis only includes measures implemented since 2017. This does not match the risk reduction estimates within the DEIS for Alternative 2 because it does not include the Massachusetts Restricted Area (MRA) credit. The risk reduction estimates for Alternative 3 already used the 2017 baseline because it did not include the MRA credit and therefore data in Chapter 5 match those presented in Chapter 3. This allows for a comparison between alternatives using the same baseline year, 2017. Additionally, Alternative 3 does not include state implemented measures if they are less conservative than Alternative 3 measures, such as weak rope measures. This alternative analyzed options that offered greater risk reduction for those specific measures and relied largely on new measures, with the exception of the extension of the MRA north into Massachusetts State waters to the New Hampshire border. The economic analysis in Chapter 6 only considers the economic impacts of only those measures that would be implemented to modify the Take Reduction Plan by federal rulemaking, though it does report the cost of new gear marking in Maine State waters.

Table 5.1: Criteria used to compare the risk reduction impact of the proposed alternatives on large whales.

Type	Measure	Species and/or VEC	Criteria
Entanglement Risk Reduction	Trawl up	Right, humpback, and fin whales	● Change in co-occurrence
		Right and humpback whales	● Relative risk reduction
		All VECs	● Relative reduction in lines
	Planned fishery management trap reductions	Right, humpback, and fin whales	● Change in co-occurrence
		Right and humpback	● Relative risk reduction
		All VECs	● Relative reduction in lines
	Time/area closures to buoy lines	Right, humpback, and fin whales	● Change in co-occurrence
		Right and humpback	● Relative risk reduction
		Right whales	● Recent sightings data
	Line cap	Right, humpback, and fin whales	● Change in co-occurrence
		Right and humpback whales	● Relative risk reduction
		All VECs	● Relative reduction in lines
Entanglement Severity Reduction	Weak insert	Right whales	● Mean line threat
		Right whales	● Total change in gear threat
		All VECs	● Change in overall line strength
		All VECs	● % of line above weak point
		Right and humpback whales	● Relative risk reduction
	Full length weak rope	Right whales	● Mean line threat
		Right whales	● Total change in gear threat
		All VECs	● Change in overall line strength
		All VECs	● % of line above weak point
		Right and humpback whales	● Relative risk reduction
Gear Marking	New marking scheme	All VECs	● % increase in new marks

The following analysis measures the impacts of the action alternatives relative to Alternative 1, the No Action Alternative, against the 2017 baseline conditions and provides the absolute impact of the Alternative (i.e. not in relation to Alternative 1) in the final comparisons of the measures. In some instances, and consistent with past practice, quantitative indicators of the impact of alternative regulations are provided, including percent changes in number of buoy lines, co-occurrence (for right, humpback, and fin whales only), as well as relative risk reduction (for right and humpback whales only) as proxies for indicators of risk of entanglement. Change in mean line strength for all VECs as well as change in mean line threat and total gear threat for the relative risk of mortality and serious injury to right whales. Quantitative measures that were possible for large whales are listed in Table 5.1 and described in more detail in sections 5.2.1 and 5.2.2. These indicators do not measure biological changes in entanglement risks or actual encounter rate, but offer useful information on factors that likely, based on expert opinion, correlate with such risks and allow comparison between alternatives. Percent reduction in buoy line and strength was also used to assess relative impact of the alternatives on other protected species, where no risk or 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.

5.2.1 *Use of NMFS Decision Support Tool*

The DST was created by NMFS in 2019 to assess the impact of management measures on entanglement risk in northeast waters of the U.S. This model built upon the co-occurrence model originally developed by Industrial Economics, Inc (see Appendix 5.1 for a description of the IEc Vertical Line Model). Improvements to the model were made after an independent peer review was conducted in late 2019 by the Center for Independent Experts. Documentation of the DST can be found in Appendix 3.1 and output from model runs are in Appendix 3.2. The DST addresses the following types of questions related to our biological analysis:

- Where and how do Northeast lobster and Jonah crab fisheries operate?
- Where are concentrations of buoy line the greatest?
- Which areas have the highest predicted overlap between whale density and the high concentrations of buoy lines?
- How much does the strength of buoy line and gear configuration impact the likely severity of an entanglement?
- What is the relative change in entanglement risk expected for different types of management measures?

Through the integration of information on fishing activity and gear configurations, this model characterizes geographic and temporal variations in fishing effort within the lobster and Jonah crab fisheries and the distribution of fishing line in the Northeast Region subject to the Plan. The DST also incorporates information on predicted whale densities (Roberts et al. 2020) and identifies areas and times when whales and commercial fishing gear are likely to co-occur. There are three options for whale layers: one spans from 2003 through 2018, one from 2003 through 2009, and one from 2010 through 2018. The alternatives in this FEIS were all developed using the most recent right whale data, 2010 through 2018. The DST also includes a humpback density model and a fin whale density model for the period of 1999 through 2017 (Roberts et al. 2017). The fin whale density model currently does not support the use of a gear threat model and can only be used to examine co-occurrence. The model has been updated since and analyses in this chapter were run in high resolution with DST model version 3.1.0, line model version 3.0.0, and the 2010 to 2018 right whale density model version 11 (Appendix 3.1, Roberts et al. 2020). See Chapter 3, Section 3.1.2.3 for more information on how the DST was used in this FEIS. The data in this chapter primarily differs from Chapter 3 in that it uses the same baseline line model (the 2017 line model without data within the MRA) in order to compare the impact alternatives with the same baseline.

The DST also contains a gear threat model that takes into account the strength of lines used in the fishery and how that relates to likely severity of entanglement. The DST'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, predicted whale density, resultant co-occurrence score, a gear threat score, and an overall risk reduction score for management scenarios, are assumed to represent the relative spatial and temporal risk and severity of entanglement. They provide a basis for comparing the impact of alternative management measures on the potential for entanglements to occur and the likely severity of the entanglement. Readers interested in additional information on the model's structure, data, assumptions, and methods should consult its documentation in Appendix 3.1.

5.2.2 *Evaluation of Weak Rope*

Alternatives 2 and 3 propose introductions of weak rope or weak inserts for lobster and Jonah crab 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 analyzed quantitatively and/or qualitatively, depending on the VEC. Lowering the strength of rope does not reduce the risk of encounter and interaction between whales and line nor does it change co-occurrence. The intention of these measures is to reduce the potential health impact an entanglement has on some large whale species, particularly right whales, 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 mortality and serious injury of right whales in lines with a breaking strength greater than 1,700 pounds (771 kilograms) and suggested that large scale introduction of weak rope across fisheries could reduce serious injuries and mortalities by up to 72 percent. 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, adult 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).

Alternatives 2 and 3 propose introductions of weak rope or weak inserts for lobster and Jonah crab 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.

The DST attempts to quantitatively estimate the benefit of weakened buoy lines by using a gear threat model for right and humpback whales and was developed from the data used in Knowlton et al. (2016). However, a similar model is not available for all species included in the FEIS. Furthermore, although empirical evidence supports the theory that weakened line would reduce mortality and serious injury of right whales, without additional quantitative data to estimate how different forms of weak rope or weak inserts will impact the outcome of an entanglement for different species or age classes, additional 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 1,700 pounds/771 kilograms).

This analysis uses the lower bound estimate calculated for weak rope measures that use inserts that are not considered the equivalent of full weak line, which for this analysis is considered a weak insert every 40 feet (12.2 meters, just below the average length and girth of a right whale). This is because of the uncertainty of the proportion to full weak line used in these calculations and how this approximates full weak line, but it also offers a better evaluation of whether this alternative passes the minimum 60 percent risk reduction target. When possible, relative reduction in mean line threat and total gear threat due to the addition of full weak line or the equivalents is provided to assess the estimated change in risk of severe entanglement. Also included is the average change in line strength in lobster and Jonah crab fisheries with each alternative across the Northeast Region.

5.2.3 *Impact Designation Descriptions*

Using the criteria outlined above and summarized in Table 5.1, this FEIS analyzes the expected impacts of the proposed alternatives for the biological VECs: large whales, other protected species, and habitat as defined in Chapter 4. The economic VEC (Human Communities) is discussed in Chapter 6 and integrated with the biological analysis in the summary of impacts in Chapter 7. For each alternative, impacts to each VEC will be evaluated against the current condition of the VEC (i.e., resource described in the affected environment), as well as relative to the other alternatives proposed. Impacts are described both in terms of their direction (negative, positive, or no impact) and their magnitude (slight, moderate, or high) based on the guidelines shown in Table 5.2 and Figure 5.1.

Table 5.2: A key of the direction and magnitude of the actions being assessed in the biological effects analysis. MMPA = Marine Mammal Protection Act. PBR = potential biological removal level

General Definitions

VEC	**Resource Condition**	**Direction of Impact**		
		Positive (+)	**Negative (-)**	**No Impact (0)**
Large Whales	For ESA listed species: populations at risk of extinction (endangered) or endangerment (threatened). For MMPA protected species: stock health may vary but populations remain impacted	For ESA listed species: alternatives that contain specific measures to ensure no interactions with protected species (i.e., no take). For MMPA protected species: alternatives that will maintain takes below PBR and approaching the Zero Mortality Rate Goal	For ESA listed species: alternatives that result in interactions/take of listed resources, including actions that reduce interactions. For MMPA protected species: alternatives that result in interactions with/take of marine mammals that could result in takes above PBR	For ESA listed species: alternatives that do not impact ESA listed species, For MMPA protected species: alternatives that do not impact marine mammals
Other Protected Species	Same as large whales	Same as large whales	Same as large whales	Same as large whales
Habitat	Many habitats degraded from historical effort	Alternatives that improve the quality or quantity of habitat	Alternatives that degrade the quality, quantity or increase disturbance of habitat	Alternatives that do not impact habitat quality
Human Communities (Socio-economic)	Highly variable but generally stable in recent years	Alternatives that increase revenue and social well-being of fishermen and/or communities	Alternatives that decrease revenue and social well-being of fishermen and/or communities	Alternatives that do not impact revenue and social well-being of fishermen and/or communities
	Magnitude of Impact			
A range of impact qualifiers is used to indicate any existing uncertainty	Negligible	To such a small degree to be indistinguishable from no impact		
	Slight	To a lesser degree / minor	e.g. Slight Negative or Slight Positive	
	Moderate	To an average degree (i.e., more than “slight”, but not “high”)	e.g. Moderate Negative or Moderate Positive	
	High	To a substantial degree (not significant unless stated)	e.g. High Negative or High Positive	
	Significant	Affecting the resource condition to a great degree, see 40 CFR 1508.27.		
	Likely	Some degree of uncertainty associated with the impact		

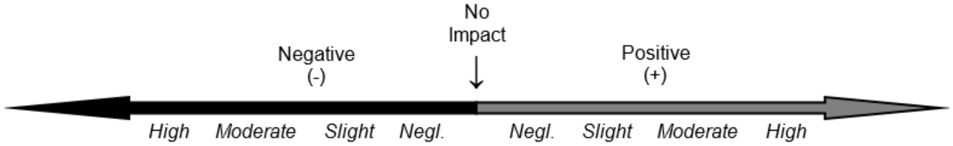


Figure 5.1: A depiction of the relative directional magnitude of impacts on VECs

Large Whales and Other Protected Species

The impacts of the alternatives on protected species take into account impacts to ESA-listed species, as well as impacts to non-ESA listed MMPA protected species in good condition (i.e., marine mammal stocks whose potential biological removal level (PBR) have not been exceeded) or poor condition (i.e., marine mammal stocks that have exceeded or are near exceeding their PBR). These impact descriptors apply to both the Large Whale and Other Protected Species VECs.

ESA-Listed Species

For ESA-listed species, any action that results in interactions or take is expected to have negative impacts, including actions that reduce but do not prevent interactions. Actions expected to result in positive impacts on ESA-listed species include only those that contain specific measures to ensure no interactions (i.e., no take). None of the alternatives considered in this document would ensure no interactions with ESA-listed species. By definition, all ESA-listed species are in poor condition and any take can negatively impact their recovery.

MMPA Protected Species

The stock conditions for marine mammals not listed under the ESA varies by species; however, all are in need of protection. For non-ESA listed marine mammal stocks, negative impacts would be expected from alternatives that result in the potential for interactions between fisheries and those stocks. For species with PBR that have not been exceeded, alternatives not expected to increase fishing behavior or effort may positively benefit the species by maintaining takes below the PBR and approaching the zero mortality rate goal. However, none of the alternatives considered in this document ensure no interactions with MMPA protected species, and therefore would be expected to have negative impacts.

Habitat

Alternatives that improve the quality or quantity of habitat are expected to have positive impacts on habitat. Alternatives that degrade the quality or quantity, increase disturbance of habitat, or allow for continued fishing effort are expected to have negative impacts. A reduction in fishing effort is likely to decrease the time that fishing gear is in the water, thus reducing the potential for interactions between fishing gear and habitat.

Human Communities

Socioeconomic impacts are considered in relation to potential changes in landings, prices, revenues, fishing opportunities. Alternatives which could lead to increased availability of target species and/or an increase in catch per unit effort (CPUE) could lead to increased landings. Increased landings are generally considered to have positive socioeconomic impacts because they could result in increased revenues; however, if an increase in landings leads to a decrease in price or a decrease in future availability for any of the landed species, then negative socioeconomic impacts could also occur. Conservation measures that drastically reduce catch and revenue may have negative impacts in the short term, but could ensure access to the fishery in the future, potentially with fewer restrictions.

On the other hand, similar conservation measures could have different impacts on communities depending on their vulnerability and resilience. Communities with lower income and higher fishery dependency, like some island fishing villages in Northern Maine, would be more sensitive to stricter restrictions. It takes longer for them to respond to changes than communities with higher business diversity, like those in Southern Maine and Massachusetts.

5.3 Direct and Indirect Impacts of Risk Reduction Alternatives

To determine the biological impacts of all alternatives on all VECs, we used the impact designations outlined in Table 5.11. This section analyzes the impacts of the proposed alternatives for the biological VECs: large whales, other protected species, and habitat as defined in Chapter 4. The economic VEC (Human Communities) is discussed in Chapter 6 and integrated with the biological analysis in the summary of impacts in Chapter 7.

5.3.1 *Large Whales*

As noted in Chapter 2, entanglements are a primary source of anthropogenic mortality and serious injury for the right whale. The primary threat that Northeast Region Lobster and Jonah crab 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 Jonah crab buoy lines make up an estimated 93 percent of the buoy lines offshore of the U.S. east coast where right whales occur. 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 reduce the number of buoy lines and line strength as well as through time/area closures to commercial lobster and Jonah crab fishing with persistent buoy lines.

The discussion below examines the impact of these measures on large 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 1, status quo) would not achieve the objectives listed above. If Alternative 1 were chosen, there would likely be continued incidents of mortality and serious injury to large whales due to entanglement in commercial fishing gear at rates that exceed PBR, 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.

5.3.1.1 Buoy Line and Co-occurrence Reduction

Fixed buoy lines (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) have been identified as an entanglement threat to Atlantic large whales (Johnson et al. 2005). Reduction in buoy lines, therefore, has the potential to reduce encounter and therefore entanglement risk to these species. As provided below, buoy line reduction can be taken by numerous means (e.g., trawling up, line caps, or seasonal line reductions through restricted areas). 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 1 would maintain the status quo fishery. Under Alternative 1, high negative impacts are expected because there would be high risk of entanglement as the number of buoy lines in the water would remain the same (i.e. an average of 511,369 lines but a maximum of 925,924 at a given time in the Northeast Region). Relative to Alternative 1, Alternatives 2 and 3 (Preferred and Non-preferred) include several buoy 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 in areas and seasons where right whales are present. As a result of public input during federal and state scoping as well as the public comment period, 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 risk reduction and line reduction includes those areas, the description of buoy line reduction in this FEIS relevant to these alternatives only includes line reduction in areas outside of Maine exempt waters. Alternative 2 (Preferred) within this FEIS analyzes many of the conservation equivalency provisions proposed by Maine during the public comment period. Those were incorporated into Alternative 2 for areas within 12 nautical miles (22.2 kilometers) in Maine LMA 1. This included the use of one or two buoy lines depending on the number of traps on a trawl, where half the maximum number of traps could be included on a trawl with the use of only one buoy line for trawls of up to ten traps. For the purposes of this analysis, these two scenarios were considered to be equivalent and thus discussed interchangeably with all trawl length measures.

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 2 (Preferred) and Alternative 3 (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 2 and 3.

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 2 (Preferred) line reduction requirements differ slightly from Alternative 3 (Non-preferred). The former relies more on

[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.

trawling up measures along with new buoy line closures, and the latter includes a universal line cap and more extensive restricted areas. Line reduction measures, including both trawling up and localized seasonal line reduction through restricted areas, have changed in this FEIS from the DEIS to address public comments but remain within the scope of the DEIS. Changes in Alternative 2 include modifications to Massachusetts State measures and the use of conservation equivalencies in LMA 2, LMA 3, and Maine's LMA 1. Additionally the options considered for the South Island Restricted Area have changed in both action alternatives: the original area included in Alternative 2 in the DEIS was removed and replaced with the larger area in Alternative 3.

5.3.1.1.1 Gear Modifications: Trawl Length and Line Caps

5.3.1.1.1.1 Direct

5.3.1.1.1.1.1 Trawling Up

The alternatives analyzed would in several cases institute restrictions designed to reduce the number of buoy lines that are fished in the lobster and Jonah crab fishery. Table 5.3 identifies the estimated monthly line reductions under Alternatives 2 and 3. Alternative 2 would limit the number of lines in the Northeast Region by enacting new minimum trap/trawl requirements based on area and distance to shore, with increasing traps/trawl with increasing distance from shore. Differing from Alternative 2 in the DEIS, trawl length modifications are no longer included in LMA 2 because broader use of weak line offered greater risk reduction in this specific area and was substituted in lieu of minimum trawl requirements as a conservation equivalency.

For LMA 3, both year-round (Alternative 2) and seasonal (Alternative 3) trawling up provisions are analyzed. Relative to the analysis in the DEIS, Alternative 3 in this FEIS analyzes an LMA 3 conservation equivalency that changes the number of traps per trawl required by area, with longer traps on trawls inside the Georges Basin Area (proposed as a seasonal restricted area in Alternative 3), and shorter trawl lengths in the canyons south of Georges Bank deeper than 50 fathoms. The DEIS required a uniform 45 traps per trawl across the Northeast Region LMA 3. This equivalency maintains an average trawl length of 44 traps in LMA 3 but get 1 percent more in risk reduction due to the increased traps per trawl in the higher risk area of Georges Basin; therefore it is considered to have an equivalent impact on entanglement risk reduction, with a greater reduction occurring in an area identified as a hotspot.

Alternative 3 (Non-preferred) would also institute a buoy line allocation in federal waters set at half the average monthly buoy lines in use by fishermen in 2017. This FEIS differs from the DEIS as the analysis better estimates the relative reduction in buoy lines from a line cap only in federal waters, whereas the data within the DEIS estimated line reduction for the entire Northeast Region. While the line reduction estimate in Alternative 3 for this FEIS is lower than the estimate that was in the DEIS, it is closer to the estimated reduction that would likely be observed with these measures.

The Maine Department of Marine Resources (DMR) developed the distance-from-shore trawling up scenarios analyzed in the preferred alternative in the DEIS and proposed in the proposed rule based on public input and safety concerns, while recognizing that offshore of Maine whale co-occurrence and associated risk increases with distance from shore. They included increases in traps per 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 and mitigating concerns about the introduction of stronger and riskier buoy lines for longer trawl configurations. However, during the public comment period, Maine DMR modified their recommendations informed by numerous stakeholder meetings held during 2020, and offered conservation equivalencies. Alternative 2 (Preferred) analyzed within this FEIS retains the same trawl length requirements in LMA 1 in Maine outside of 12 nautical miles (22.2 kilometers) but has changed within 12 nautical miles (22.2 kilometers) to include trawl length configurations based on Maine lobster management zone and distance from shore. Greater trawl lengths are included in the areas farthest east and west within Maine waters. Although not obvious from the DST results, reducing lines in these two areas may reduce more risk in the western Gulf of Maine and waters closest to the Bay of Fundy than the trawling up configurations analyzed in the DEIS. However, some areas within 12 nautical miles (22.2 kilometers), outside of Maine exempt waters, will maintain status quo or shorter required trawl lengths than was analyzed in the DEIS and proposed in the proposed rule. Overall, the analysis suggests that the risk reduction of Maine DMR's proposed conservation equivalencies in federal waters within 12 nautical miles (22.2 kilometers) offers the same risk reduction and is therefore considered equivalent to what was analyzed in the DEIS. The modifications Maine DMR has identified demonstrates less risk reduction within the sliver of non-exempt Maine State waters in the FEIS Alternative 2, but right whale aggregations are far less likely this close to shore in Maine and weak insertions maintained in all buoy lines within state waters continue to provide precautionary benefits (see section 5.3.1.3 for a discussion of weak line).

Table 5.3: Monthly percent buoy line reduction of Alternatives 2 and 3 compared to Alternative 1 (i.e. status quo). Note that the percentages are relative to the number of lines within that month and therefore not additive. All changes in line numbers include the combined changes due to gear configurations and areas closed to persistent buoy lines. Buoy line closures were assumed to relocate lines outside of the restricted area boundaries unless they were in state waters. MRA "credit" for seasonal line reduction is not included.

Month	Alternative 2	Alternative 3
January	-9%	-16%
February	-6%	-5%
March	-6%	-6%
April	-7%	-10%
May	-12%	-19%
June	-13%	-20%
July	-12%	-15%
August	-15%	-15%
September	-7%	-6%
October	-6%	-4%
November	-6%	-4%
December	-6%	-4%
Total	-7%	-7%

Associated with the LMA 3 trawling up requirement, NMFS would extend the allowable distance between buoy lines in LMA 3 to 1.75 miles (3.24 kilometers). Currently, lobster fishermen are restricted to fishing ground lines of no more than 1.5 miles (2.78 kilometers). 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 3 vessels to optimize distance between traps, under both Alternative 2 and 3, the maximum length between the buoy lines would be extended from 1.5 miles (2.78 kilometers) to 1.75 miles (3.24 kilometers).

Cumulatively, all line reductions estimated for Alternatives 2 and 3 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 approximately 7 percent compared to the 2017 annual baseline (Table 5.3). This does not include the estimated seasonal line reduction “credit” of the MRA, and is substantially lower than the line reduction estimated in the DEIS because the line reduction reported in the DEIS did not include Maine exempt waters and the change in the Alternative 3 line cap analysis to more accurately reflect that it occurs only in federal waters. The goal of these different buoy line reduction approaches is to reduce the number of lines, co-occurrence, and associated encounter rates of large whales with vertical trap/pot buoy lines (e.g., North Atlantic right, humpback, and fin whales; see Table 5.5 for changes in co-occurrence). Alternative 2, which includes the most trawling up measures, two new restricted areas and a spatial extension of the MRA, would have a similar overall reduction in the number of buoy lines compared to the aggressive line cap in federal waters that would be set under Alternative 3, though this varies by month. Greater reductions are observed during the summer months in both alternatives, with a monthly reduction from 6 to 15 percent under Alternative 2 and 4 to 20 percent under Alternative 3. Alternative 3 gets higher line reduction in summer because it retains seasonal trawling up measures in LMA 3 in addition to line relocation through the seasonal closure in Georges Basin from May through August. Alternative 2 gets marginally higher line and risk reduction in September through December and in February, though the difference is relatively small.

Trawling up 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, including adults but particularly calves and juveniles that may be more likely to survive an interaction with a single trap than with a trawl made up of multiple traps. This concern, that trawling up could create more severe interactions with right whales of all ages, was voiced by Team members as well as at stakeholder meetings by fishermen and members of the public. 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. Similarly, minke whales are more likely to be impacted negatively by an interaction with a long, heavy trap trawl compared to larger whale species. However, the decrease in the number of buoy lines decreases overall risk of becoming entangled specifically in areas of high co-occurrence, likely mitigating some of the possible increased risk from serious injury or death if entangled. Additionally, in combination with weak rope or weak inserts, longer trawls are more likely to allow a whale to break free of a trawl that is anchoring it in place. DeCew et al. (2017) found that, in simulations of weak inserts with different weak points, longer trawls more consistently broke free during an entanglement within a shorter period of time compared to shorter trawls. This requires that there is a weak insert below the point where a whale becomes entangled in the line given this is the area that would be most likely to break in the case of an entanglement. This means that the location of the lowest weak insert is an important factor in reducing the severity of an entanglement and is discussed further in Section 5.2.1.3. Finally, input from fishermen at stakeholder meetings suggested that the trawling up requirements included in the FEIS are less economically egregious because they can use their existing buoy lines, suggesting that wholescale replacement of buoy lines for stronger rope is not necessary and unlikely. Trawling up measures are likely to reduce entanglements and overall risk assuming weak inserts reduce line strength and entanglement severity, as predicted.

5.3.1.1.1.1.2 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 1 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 3, 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 5.3).

1. Relative to 2017 effort in LMA 2 and LMA 3, 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 2 and LMA 3, effective May, 2016, under Addendum XVII to Amendment Three 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 3.3),

latency in these two LMAs does appear to be greatly reduced. In their proposal, Massachusetts documents a reduction in fishermen actively fishing across their states, which includes LMA 1 and the Outer Cape LMA (MADMF 2020, Appendix 3.3).

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 1. 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) demonstrates the relative stability of latent licenses (Maine DMR proposal, 2019; Appendix 3.3. As discussed in Maine's proposal and above, these latent permits are unlikely to be activated if they were not used during recent lucrative fishing years (see Appendix 3.3).

3. The average age of New England lobster and Jonah crab fishermen is increasing. Massachusetts Department of Marine Fisheries (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.

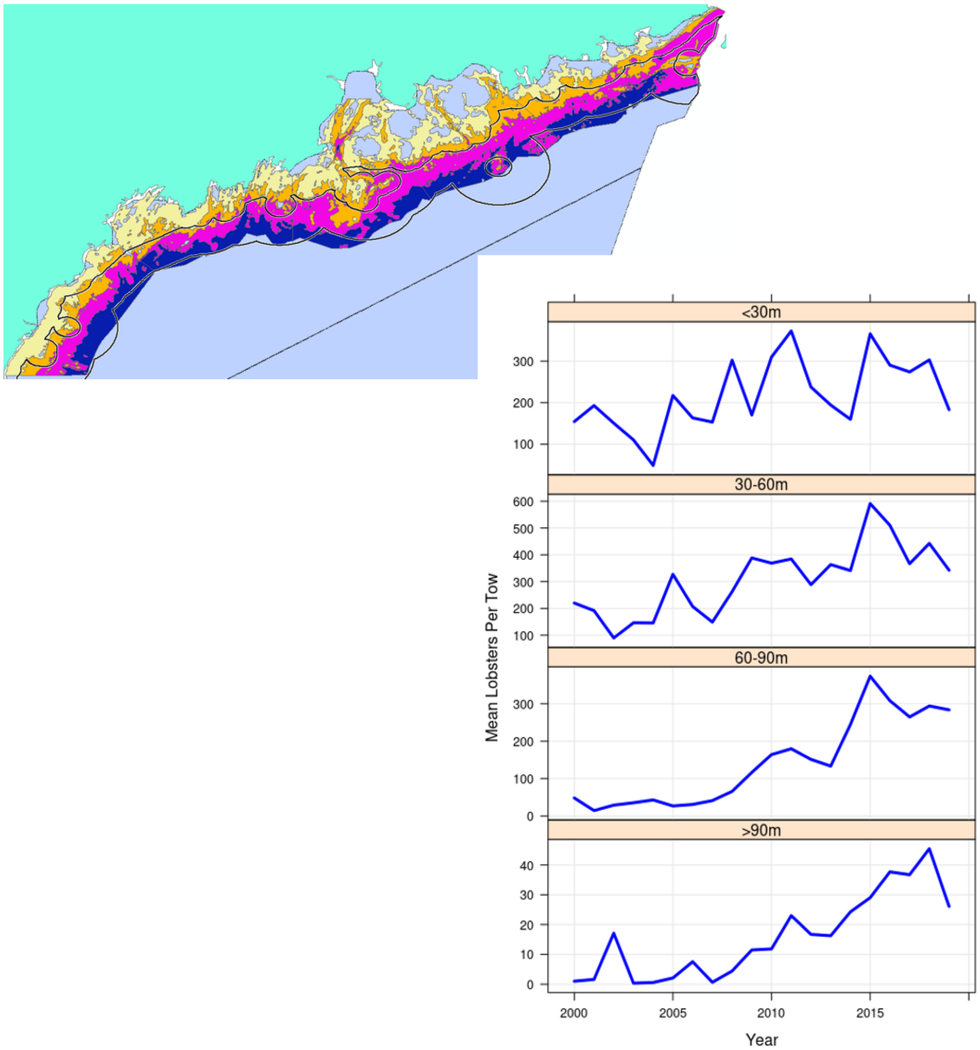


Figure 5.2: Mean lobster abundance in the Maine/New Hampshire trawl survey. Top left panel: map of coastal Maine with sampling strata with reference lines for 3 and 12 miles from shore and the LMA 1/3 boundary. Bottom right panel: survey indices by depth strata for the Fall survey.

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 2 would, as estimated, reduce the percent of buoy lines fished relative to 2017 estimates, as detailed in Table 5.3.

Offshore of the Maine coast within LMA 1, the likelihood of encountering a right whale increases with distance from shore (Roberts et al. 2016), as Maine DMR observed in their proposal (ME DMR, 2019, Appendix 3.3). For this reason, reducing buoy line numbers more substantially with increasing distance from shore provides better risk reduction for right whales.

Table 5.4: Trends in landings and fishing effort with distance from shore from Maine DMR.

Distance from shore (nm)	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**	**(lb)**	**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 98 yards (90 meters) deep, which is mostly inshore of about 6 nautical miles (12.2 kilometers; Figure 5.2). 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 the Maine portion of LMA 1 (Table 5.4). 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 nautical miles (24.3 kilometers) or outside of 12 nautical miles (24.3 kilometers) within LMA 1. 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 LMA 1. 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 percent harvester reporting in the lobster fishery and even more so once vessel tracking systems are deployed in federal waters (Maine proposal 2019, see Appendix 3.3). While measures to implement vessel tracking have not yet been developed, Addendum XXVI to Amendment Three 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 were presented to the ASMFC in Fall 2020 and Spring 2021 and the ASFMC has formed a working group to expedite implementation of this technology, perhaps within the next two years.

5.3.1.1.1.1.3 *Buoy Line Cap in Federal Waters*

As mentioned previously, this FEIS differs from the DEIS because the analysis of the line cap included here better estimates the relative reduction in buoy lines from a line cap only in federal waters, whereas the DEIS only had line cap reduction estimates for the entire Northeast Region. As such, the line reduction estimates in Alternative 3 in the FEIS are lower than the DEIS estimates but likely closer to the reduction that would likely be achieved with these measures. This results in a far lower line reduction than Alternative 3 as it was included in the DEIS. The majority of lines in the Northeast Region are fished in state waters and therefore a line cap in only federal waters has a limited impact on the overall line numbers being fished in the lobster and Jonah crab trap/pot fishery.

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. Given the complexity of interstate fishery management, this measure would be restricted to lobster and Jonah crab fishermen when fishing in federal waters. State waters would still achieve risk reduction in both alternatives due to targeted buoy line closures. Additionally, Maine DMR (2019) considered a 50 percent 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.

Allocation of 50 percent of the lines fished in 2017 to fishermen fishing in federal waters through a line cap in a way that results in an actual reduction in the number of buoy lines requires data that are not currently collected by the lobster fishery. Fair distribution of line allocations requires documentation of vessel fishing histories or other commonly used metrics and detailed knowledge of the amount of fishing effort by sector or individual vessel. Allocation decisions in effort control management of capped resources (lines or traps) are also usually informed by iterative public fishery management processes and include appeal options that are administratively burdensome. Because the lobster fishery has variable reporting requirements across states, only about 10 percent of Maine fishermen have been required to report in any year and federal reporting is variable, there are no data to easily determine effective trap and line cap measures. It was assumed that a trap cap would require work with the Commission and New England states to qualify the number of buoy lines, and to this end the Commission instituted an April 29, 2019 control date (84 FR 43785, August 22, 2019). That control date put 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 Jonah crab permit holders. However that control date does not reduce the time- and labor-intensive workarounds for the data gaps caused by inconsistent reporting requirements. The Commission process, including soliciting public feedback, requires, at a minimum, approximately 6 months to develop an adaptive management action. Larger, more controversial actions can take eight to 18 months. Once approved by the Commission, additional time would be required for NMFS to develop a rulemaking and associated analysis to implement measures to distribute allocations of line tags to fishermen; envisioned as one tag to be affixed to buoy, one to the end trap attached to each buoy line. States and fishermen could use allocations according to their unique fishing operations and capacity, through trap reductions, trawling-up scenarios, single buoy line trawls, 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.

Chapter 3 goes into greater detail regarding how a 50 percent line cap would reduce buoy lines based on the average number of buoy lines currently being used in federal waters across the Northeast Region. In sum, 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. A cap in federal waters to 50 percent of the average lines fished would likely result in a buoy line reduction closer to a 45 percent average reduction given the current level of fluctuation in buoy lines used throughout a fishing year. Our estimate of a 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. The line cap would likely be implemented at a regional scale as well as across all federal fisheries in the Northeast Region. 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 to 45 percent due to areas with higher variation in monthly line numbers. For LMA 2 in particular, where February and March had lower line numbers than half of the monthly average, we considered three scenarios (see Chapter 3 for the calculations) to capture a range in responses. 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.

Since line caps result in a very large reduction of lines during high effort months, particularly in the summer, 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 2 when right whales are likely to be in the area. However, the line cap would only be implemented with a restricted area in LMA 2 during peak right whale occurrence and during months where line numbers fall below the average monthly number of lines in LMA 2. The implementation of a closure in this area during this time would likely mitigate this potential risk. Though the Outer Cape also has a low number of lines during these months, this area is largely closed during months of high right whale density and likely will not be impacted by a line cap during spring. 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 DST (Chapter 3) with an estimated 44 to 49 percent reduction in lines depending on the LMA. Using this conservative estimate of actual line reduction from a line cap in federal waters, Alternative 2 still achieved well over the 60 percent risk reduction target.

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. 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 buoy 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.

5.3.1.1.1.2 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 higher risk of mortality and serious injury to calves and juveniles, if entangled 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 fishers using stronger buoy lines 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 3 could affect gear loss are inconclusive but suggest it is unlikely to increase substantially with the proposed measures.

LMA 3 fishermen requested an extension of the distance between buoy lines from 1.5 nautical miles (2.78 kilometers) to 1.75 miles (3.24 kilometers) to allow them options to trawl up to 35 to 50 pots, 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 (2.78 kilometers) 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 kilometers) 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 kilometers). 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 (2.78 kilometers) to 1.75 miles (3.24 kilometers) appears to be within standards acceptable with current technology and this measure is not anticipated to increase incidents of gear conflict or gear loss.

It is possible that other areas may also observe an increase of groundline length with the combination of increased trawl lengths and the use of full weak rope or inserts. Fishers may increase the distance between the first and second traps in order to reduce the amount of force being placed on the line during hauling and the likelihood of the line breaking. This could increase entanglement risk to right whales that use the entire water column and interact with the seafloor (Baumgartner et al. 2017, Hamilton et al. 2019). Right whales have not been observed entangled in groundlines since the Plan restricted the use of floating groundline, effective in 2009, so this regulation may minimize the risk of entanglement in groundlines. Buoy lines are found on right whales more frequently than groundlines (Johnson et al. 2005). The reduction in the number of vertical buoy lines is likely greater than the risk of any potential addition of groundlines under Alternative 2.

5.3.1.1.2 Seasonal Restricted Areas Changed To Buoy Line Closures

Currently, under Alternative 1, two new areas in the Northeast Region are seasonally closed to trap/pot fishing: the Massachusetts Restricted Area and the Great South Channel Restricted Area. Alternative 2 and Alternative 3 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. The Outer Cape LMA would remain closed for lobster management purposes.

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 Jonah 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 (See Section 3.3.3). 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 Massachusetts 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, although the using ropeless retrieval or other ropeless systems under an exempted fishing permit or state authorization that includes risk reduction conditions.

Based on outreach by the NMFS gear team, interest does not appear to be substantial among the commercial fishery in the Northeast Region, and participation within any restricted area can be limited through the authorization process. We anticipate that at least through 2025, ropeless fishing in these restricted areas is likely to be done primarily by collaborators borrowing gear from the NMFS gear cache, with up to an additional 10 percent of effort by other researchers and fishermen coast wide. The Northeast Fisheries Science Center gear team projects that by 2025 they expect to have about 300 ropeless units and enough deck controllers for about 30 vessels, as well as technology to support adjacent mobile fishing vessels. That is, at the most, coast-wide, there would be up to 33 vessels fishing ten ropeless trawls. If congressionally appropriated and private funding remains available, NMFS will continue to reimburse fishermen for some of their time and will provide the onboard and in-water technology so that costs to fishermen will be minimal. To incentivize participation, the alternatives consider modifying current seasonal restricted areas and defining new restricted areas as seasonal closures to trap/pot fishing that use persistent vertical buoy lines.

5.3.1.1.2.1 Direct

5.3.1.1.2.1.1 Decrease in Co-Occurrence of Whales and Buoy Lines

Both Alternatives 2 and 3 propose additional seasonal management areas which would allow ropeless fishing but be closed to lobster and Jonah crab trap/pot fishing with persistent buoy lines; allowing fishing with ropeless gear under an exempted fishing permit and significantly minimizing the risk of entanglement from buoy lines by large whales. 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 right whales.

Table 5.5: Right, humpback, and fin whale co-occurrence scores by month for each alternative scenario, including Alternative 1 (i.e. status quo). All changes in co-occurrence include the combined changes due to gear configurations and areas closed to persistent buoy lines.

Month	**Right Whale** Alternative 2	Alternative 3	**Humpback Whale** Alternative 2	Alternative 3	**Fin Whale** Alternative 2	Alternative 3
January	-37%	-39%	-11%	-23%	-15%	-30%
February	-30%	-45%	-14%	-25%	-17%	-33%
March	-36%	-51%	-17%	-29%	-19%	-34%
April	-55%	-67%	-18%	-29%	-20%	-29%
May	-92%	-95%	-18%	-27%	-19%	-24%
June	-30%	-62%	-13%	-21%	-13%	-16%
July	-32%	-70%	-13%	-19%	-13%	-14%
August	-15%	-22%	-11%	-18%	-12%	-13%
September	-17%	-23%	-10%	-16%	-13%	-14%
October	-39%	-44%	-10%	-15%	-13%	-13%
November	-47%	-46%	-11%	-19%	-13%	-15%
December	-23%	-23%	-11%	-13%	-13%	-21%
Total	**-54%**	**-60%**	**-12%**	**-19%**	**-14%**	**-17%**

The seasonal buoy line closure areas proposed in Alternative 2 are more extensive in space than Alternative 3, though a few areas in Alternative 3 are closed for a longer period of time. As indicated in Table 5.5, the spatial and temporal risk reduction measures considered in the alternatives achieve co-occurrence reduction scores with right whales of greater than approximately 54 percent. Although co-occurrence reduction scores are higher in Alternative 3 (approximately 60 percent), both Alternatives appear to reduce co-occurrence significantly in the months and areas where right whales and lines are most likely to overlap. These estimates are lower than those in the DEIS because the line cap analysis in this FEIS is updated to only include federal waters, as was intended, and because co-occurrence was estimated with the right whale density model from 2010 to 2018 instead of the DEIS use of sightings per unit effort. The use of the right whale density model includes more recent data and was modified to smooth issues related survey gaps and inter-annual variability. 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 reduction scores are also provided in Table 5.5, demonstrating some co-occurrence reduction and resulting favorable protection, although to a lesser extent than for right whales. These species would likely benefit from co-occurrence reduction in spring when several of the analyzed seasonal restricted areas would reduce the use of buoy lines (Table 5.5).

Alternative 2 and Alternative 3 both propose several new seasonal buoy line restricted areas. Alternative 3 would require more closures to fishing with persistent buoy lines for longer periods of time and therefore, offers the greatest reduction of co-occurrence, assuming lines are not relocated. Alternative 3 would require an additional buoy line closure area in Georges Basin core area (May through August) that is not included in Alternative 2.

Alternative 2 included consideration of state measures proposed by Massachusetts that would seasonally close state waters in LMA 1 and the Outer Cape LMA during the MRA restricted period, from February through April, expanding the MRA north to the New Hampshire border (MRA North). NMFS will be including the addition of the MRA North waters from February through April in the Final Rule. Expansion of the MRA into Massachusetts State waters in both Alternatives is largely assumed to result in lines being removed from the water instead of relocation into federal waters because many state fishermen do not have federal permits. Other Massachusetts State water measures that will not be implemented in the Final Rule have been implemented by the state, including a closure of state waters in LMA 1 and the Outer Cape LMA by monitoring the areas through at least May 15th, potentially extending to the end of May or until no more than three whales remain in those areas. However, Massachusetts and NMFS enforcement personnel are investigating the apparent storage of trap/pot gear in waters remaining open in Massachusetts Bay between the state's new closed waters and the northwest border of the MRA to determine whether the new closure area includes dual permitted fishermen that would move rather than remove gear. However, as seen in Figure 5.3, in spring of 2021 there was gear observed outside of state waters in between the original MRA and MRA North and also in close proximity to right whale aggregations, so there may be unintended consequences of these closures that need further investigation. Future rulemaking would be needed to close that unintended gear storage area, which during 2021 resulted in high observed co-occurrence of right whales and vertical buoy lines.

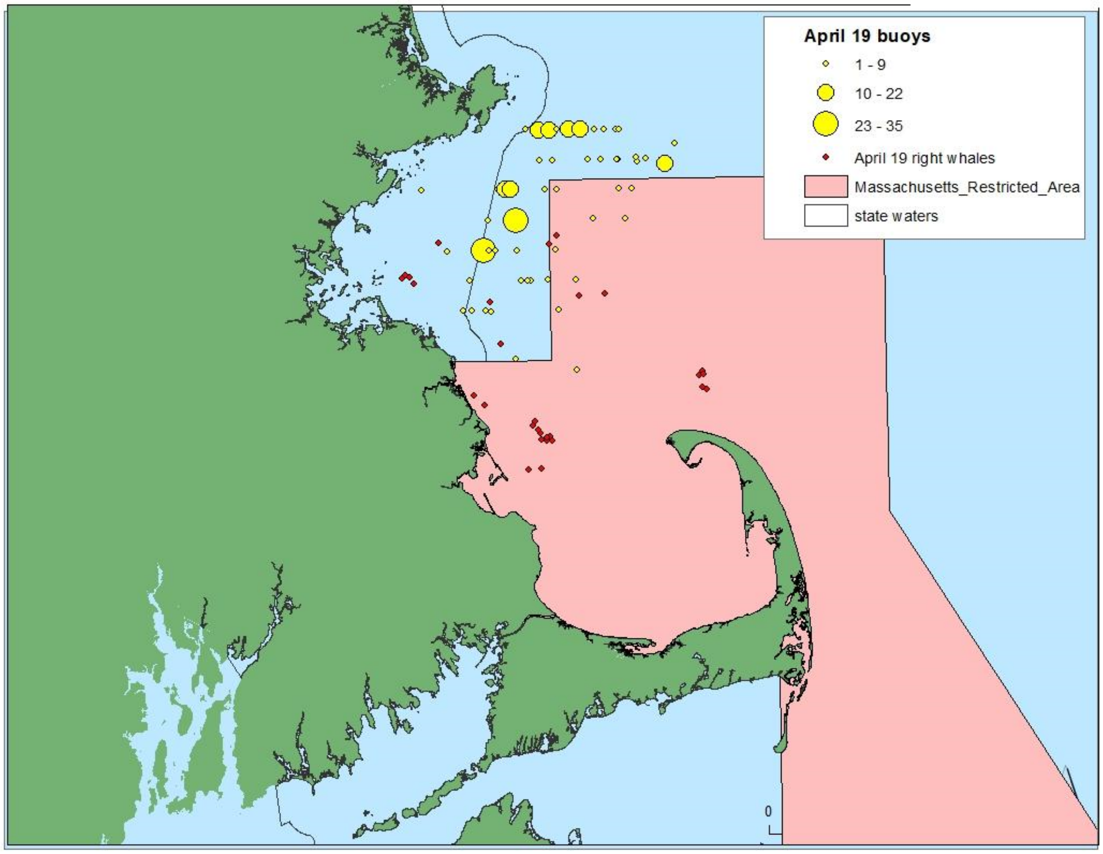


Figure 5.3: April 19, 2021 Aerial survey observations of buoys and whales in closed state and MRA waters and in the area that remained open (Robert Glenn, MA DMF).

Though not included in the baseline for the analysis in this chapter, the risk reduction estimates in Chapter 3 include a credit for the MRA as well because it was implemented relatively recently and maintaining this area is invaluable for reducing co-occurrence between right whales and trap/pot buoy lines, providing an additional 9 to 12 percent risk reduction and 13 percent reduction in co-occurrence with right whales. Since right whales frequently and increasingly (Ganley et al. 2019) aggregate in the MRA during the closure period, and because Massachusetts State will be extending the buoy line restrictions beyond the April 31 end date included in the proposed rule if whales remain in state waters, this restricted area is likely to have a large impact on right whale co-occurrence. Some of the highest reductions of right whale co-occurrence are predicted between February and May, with greater reductions in Alternative 3 due to an extension of the entire MRA. Alternative 3 proposes an extension of the federal closure to buoy lines throughout the MRA through May in addition to the state measures considered in Alternative 2. A soft extension adds an additional 3 percent reduction in co-occurrence beyond the state water closure in Alternative 2, for a 95 percent reduction in risk for the month of May, though this would require a monitoring and enforcement mechanism to be in place for this to be effective.

Both alternatives include an LMA 1 Restricted Area during fall and winter months (October through January) with a month-long extension (through February) in Alternative 3. The LMA 1 Restricted Area was identified as a hotspot in the DEIS, and remained an area of concern with the updated right whale density model using data from 2010 to 2018. Though this area may have declined in importance since 2010 compared to 2003 through 2009 (Record et al. 2019, Roberts et al. 2020), the right whale density model (version 11) still predicts higher whale densities relative to other regions and higher entanglement risk due to the number of buoy lines used in this area. Additionally, right whales are known to return to areas after years of low use and it may return to pre-2010 frequency in this area in the future. As described in section (5.3.1.1.1), the fishery in Maine may, and has the potential to, be fishing farther offshore than in previous years, with the threat of increased buoy lines in offshore areas increasing entanglement risk for whales that return to that area. An offshore restricted area here would prevent further increase in lines in this offshore area that right whales have been known to use. Similar to the soft opening in the MRA, Alternative 3 would close the LMA 1 Restricted Area 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.

In this FEIS, there are two options between the two action alternatives for a seasonal buoy line closure from February through April south of Cape Cod, the South Islands Restricted Area. The restricted area proposed in Alternative 2 (Preferred) in this FEIS now includes a larger area south of Cape Cod, which is an area that has seen an increase in right whale aggregations throughout the year with the majority in spring months (black outline, Figure 5.4). This area provides greater risk reduction than the restricted area proposed in the FEIS Alternative 3. A smaller area was previously included in Alternative 2 as proposed by the state of Massachusetts but was ultimately rejected due to public comment and observed (red outline, Figure 5.4) and predicted movement of lines outside of the restricted area into right whale hotspots. Both options analyzed in this FEIS are core areas where whales have frequently been sighted by Northeast Fisheries Science Center surveys between 2017 and 2021 (Figure 5.4). The option offered in Alternative 2 is the larger of the two and was created using sightings and habitat data available to encompass all of the likely hotspots based on whale presence as well as the presence of suitable right whale habitat. 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. Alternative 3 includes a slightly smaller L-shaped restricted area that encompasses the densest area of whales sighted between 2017 through March 3, 2020. However, Figure 5.4 shows this medium sized area in gray also mapped with aerial survey data from early 2021 to check for robustness to annual variation and missed key right whale aggregations. The L-shaped restricted area option likely offers an intermediate to large protection for right whales because, though it is not as large as the Preferred Alternative, it did encompass the areas of high right whale density across several years and is somewhat robust to annual variation.

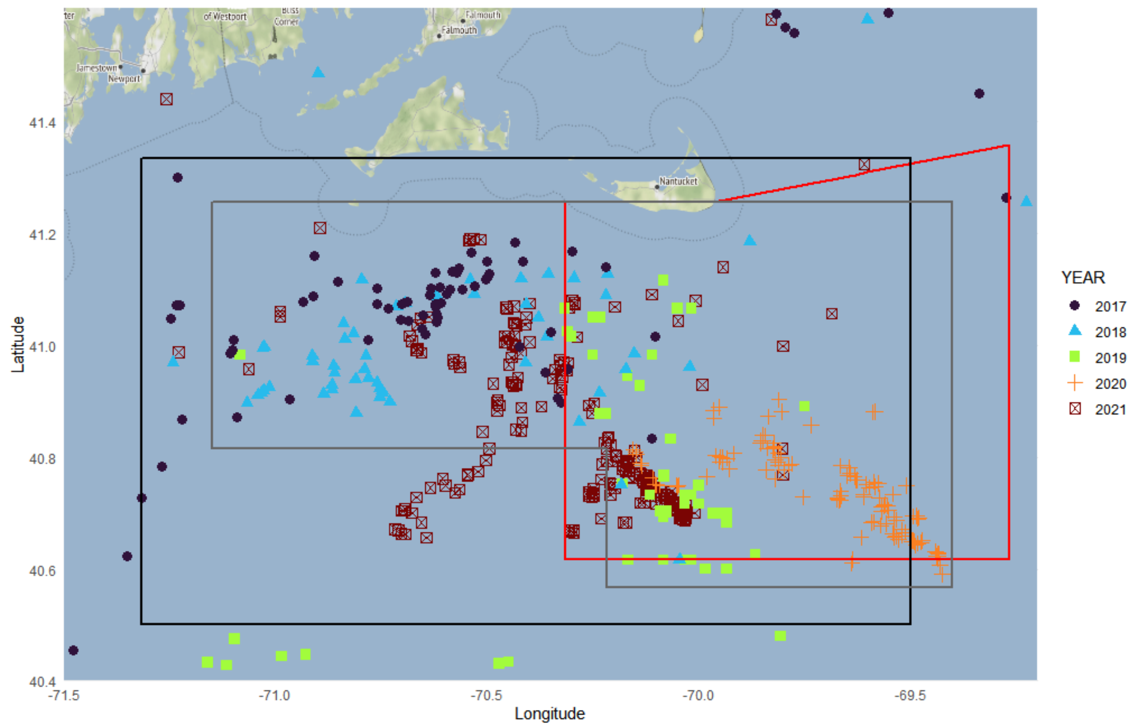


Figure 5.4: Right whale sightings data during February through April from 2017 through 2021 with the restricted areas analyzed in the DEIS. The area in the preferred alternative in the DEIS is in red, the area now in the FEIS preferred alternative is in black, and the grey area is in the non-preferred alternatives in both the DEIS and FEIS. Aerial and shipboard survey data collected by NMFS, the New England Aquarium, and The Center for Coastal Studies and also includes opportunistic sightings data.

The effects of additional seasonal buoy line closure areas in Alternatives 2 and 3 vary. All would benefit right whales but are less likely to benefit fin whales and humpbacks. Restricted areas were analyzed two ways, depending on the location and likely behavior in these areas. First, it was assumed that 100 percent of the vessels would suspend fishing within the Massachusetts Restricted Area and in the state water extensions (although see above for 2021 observations). We know from existing closures that this is more likely for nearshore restricted areas, particularly the MRA, when fishermen would have a long transit 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 and could increase risk outside of restricted areas as occurred in 2021. Co-occurrence analysis off restricted areas farther from shore assumed that vessels would continue to fish and would relocate lines to nearby available areas. The effects of each of these two assumptions of response to a restricted area 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, such as was predicted for the Georges Basin Restricted area in the DEIS, exacerbated with the use of the newer whale data in the updated DST (version 11). Restricted areas were picked based on scenarios that are more likely to result in a net decrease in 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. A longer trawl option offered risk reduction in Alternative 2 in lieu of a restricted area and likely avoids increasing co-occurrence in areas adjacent to this hotspot.

The multiple restricted areas proposed in Alternatives 2 and 3 could result in local conservation benefits to other large whales, though to a lesser degree than 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, Davis et al. 2020). As described in Chapter 3, the restricted areas were designed and selected using either estimates of right whale density model based on a long time series of sightings normalized over the area applying oceanographic characteristics (version eight) or using more recent sightings per unit effort data between 2014 and 2018 (NARWC 2019). The current analysis uses a newer version of the right whale density model (version 11) that captures more recent data after the regime shift that started in 2010 (Pace et al. 2017). Despite the direct intention to focus on right whale hotspots, fin, humpback, and minke whales may 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), though these areas are not necessarily hotspots for these species so any benefit is likely less beneficial than broad scale line reduction. Co-occurrence of humpback and fin whales is predicted to decrease throughout the year in Alternatives 2 and 3 (Table 5.5), with a larger reduction predicted with Alternative 3. Restricted areas where lines are fully removed would likely have the most beneficial impact on overall entanglement risk, such as those in Massachusetts State waters. 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.

5.3.1.1.2.1.2 Impacts of Allowing Ropeless Gear in Restricted Areas

Impacts caused by modifying the definition of the existing seasonal restricted areas (Massachusetts and Great South Channel Restricted Areas) to include ropeless fishing are anticipated to be very small because fishing under the new definition would be limited and conditional under exemptions to gear marking requirements. The Outer Cape LMA would not be open to ropeless fishing because it was originally closed for lobster management purposes. Exempted fishing permits would likely also restrict access to Cape Cod Bay where the highest density of right whale aggregations are most common. After the ANPR was published in September 2018, 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. At this time, we expect the number of individuals testing ropeless fishing to be constrained by the high cost of ropeless technology and to use gear borrowed from other entities, such as the Northeast Fisheries Science Center or NGOs. Given plans for gear caches being developed for this purpose, it is estimated that participants could be expanded from approximately five vessels and 50 trawls in 2021 to about 33 vessels fishing 330 trawls using 330 stored buoy lines (with one system per trawl). Gear would also be available for participating mobile gear fishermen working to ensure affordable methods of detecting gear fished on the bottom and preventing gear conflicts.

By permitting ropeless trap/pot fishing in seasonally Restricted Areas during the period of time they have traditionally been entirely closed to trap/pot fishing (with persistent buoy lines), this Alternative introduces some level of interaction risk to protected species that previously did not exist in both areas during the seasonal closures. Even though participants will not be using persistent buoy lines, they will be using sinking groundlines, and therefore, some level of entanglement risk remains from introducing gear into areas with high densities of feeding whales. As mentioned in Chapter 2, large whales are at risk of becoming entangled not just in buoy lines, but entanglement may also occur in groundlines of trap/pot gear. Bottom foraging increases the risk of whale interaction with groundlines. Evidence of right whale bottom feeding in all feeding habitats and all months indicates that even sinking groundline may pose some risk to right whales, though the frequency of these dives and interactions is uncertain (Hamilton and Kraus 2019) and sinking groundline rules implemented in 2009 reduces groundline threats.

While the groundline of any trap/pot gear may pose some risk (Hamilton and Kraus 2019), conservation measures adopted under Alternative 2 and Alternative 3 would require participants to utilize areas that will minimize their interactions with large whales, especially right whales, the large whale species likely to be present in greatest numbers at the time participants will be permitted to fish ropeless. By assessing the most up-to-date right whale survey data, applicants may avoid the most densely populated areas within the restricted areas (i.e. Cape Cod Bay within the MRA) at any given time. Therefore, the risk of right whale entanglement, even in groundline, has the potential to be minimized. In addition, in alignment with right whale reporting conservation measures, participants may support whale disentanglement efforts by reporting entangled right whale sightings sooner than they would have been reported otherwise, therefore helping to provide some benefit to the health of an entangled whale.

In addition to the entanglement risk posed by sinking groundlines, entanglement risks are also introduced during the deployment of buoy lines during retrieval; however the level of risk differs between ropeless systems. For example, time-released ropeless devices have a higher risk of encountering and incidentally entangling a protected species because it may be released prior to the fisherman's presence due to weather or other factors that would prevent the fishermen from being present at the time that the surface system is released from storage.

By incorporating the full suite of conservation measures addressed in Section 3.3.3 through surface buoy exemption authorization processes, it is expected that entanglement risk will be minimized to the maximum extent practicable. The conservation measure that limits retrieval mechanism to acoustic release allows participants to maintain control over the amount of time any buoy line remains in the water column as a potential entanglement risk. Fishermen must be within a close distance of the gear in order for the signal to be received and the line released, which minimizes the time the line spends in the water column unsupervised. If the gear is released as intended, the risk posed by the released buoy line is minimal. Relative to other release mechanisms (i.e. galvanized time release), acoustic release provides a minimal timeframe where the released buoy line will be left unattended.

Furthermore, failure rates (defined here as premature or failed release of the stored buoy line or retrieval systems) of the technologies are minimized through the use of technology that has been tested elsewhere, and that are set and hauled by crews with experience using these new technologies, as recommended by the conservation measures in Alternative 2 and Alternative 3.

5.3.1.1.2.2 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. A concern that arose during the public comment period was the potential loss of ropeless gear trawled up by mobile fishermen. Given the expected low volume of participants testing ropeless as well as anticipated exemption collaboration recommendations, increased ghost gear and gear conflicts from interactions with mobile gear is not expected to be noticeably higher than what currently occurs in the fishery. Furthermore, fishermen would be required to call in and out of exempted fishing trials and report locations precisely, so that effort can be easily monitored. Additional effort will be made to communicate with the mobile fleet in the area to alert other vessels of locations where ropeless gear is being fished.

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 entanglement risk as whales move in and out of these management areas. For this reason, the Georges Basin Restricted Area is not preferred due to the potential to push gear outside the area into equally risky habitat and the originally preferred South of Island closure recommended by Massachusetts has been rejected as a seasonal closure area.

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 LMA 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 right whales. Based on discussions with fishermen, we do not anticipate more than a few fishermen would operate in the Restricted Area in Massachusetts Bay, outside of Cape Cod 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.

5.3.1.2 Changes to Weak Link Requirements

5.3.1.2.1 Direct

As discussed in Chapter 3, 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. The effectiveness of weak links attaching buoys to the trap/pot buoy lines are less clear. As discussed below, weak inserts lower down on the line are more likely to have a risk reduction benefit. Under Alternative 2 (Preferred) and the final rule, all ropes in the Northeast Trap/Pot Management Area would be weak or have weak insertions below the surface system. Knowlton et al. (2020) models whale interactions with weak ropes and weak insertions, and the model suggests that rope parts below where a whale's movement applies force on the rope. This model suggests the weak insertion at the buoy would not necessarily part the buoy from the rope quickly, and may not have much effect on entanglement severity. Some commenters indicated a preference for retaining the buoy on the rope so that in the event of an entanglement some additional information about the location of the incident could be obtained from the buoy. Additionally at Team meetings some Team members suggested that drag caused by the buoy could pull rope away from the whale and facilitate the shedding of gear, and suggested that the buoy could provide a disentanglement team with improved access to entangling rope. While retention of the buoy may be beneficial for some large whales, given right whale behavior in surface aggregations, buoys may be rubbed off of gear whether or not a weak link is present. Given the lack of confidence that a weak link in a surface system is effectively reducing risk to right whales and the potential benefit of buoy retention for some entangled large whales, Alternative 2 of this FEIS and the final rule would remove this requirement. Fishermen however, would not be prohibited from retaining a weak link in the surface system.

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 pers. comm., 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, the measure included in Alternative 2 that would remove the weak link requirement for lobster/crab trap buoy lines that use weak rope or weak insertions further down on the buoy line likely has a negligible impact on entanglement risk and a potential positive impact on future determinations of gear type and set location. 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 3 would make the use of weak links optional. 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.

5.3.1.2.2 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 remove the weak link at the buoy if weak rope or weak inserts are introduced to the buoy line lower down (Alternative 2), or make the use of a weak link optional (Alternative 3) 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.

5.3.1.3 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 (Knowlton et al. 2016, Sharp et al. 2019). The requirement to weaken the strength of buoy 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 or attached to a long, heavy trawl), will cause the force to increase until the rope or weak insertions break the line, allowing whales to break free of some gear. Replacing buoy lines with rope that breaks at less than 1,700 pounds (771 kilograms), 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 2 and 3 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 meters) intervals would ensure sufficient breaking points to allow a whale to break free. The proposed distance of every 40 feet (12.2 meters) is just less than the average length of an adult 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 1,700 pounds (771 kilograms) that they can rapidly splice into a buoy line, and proposed inserts at every 40 feet (12.2 meters). 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 meters) 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 2 (Preferred) and 3 (Non-preferred) would require the use of weak line or weak inserts with breaking strengths of 1,700 pounds (771 kilograms) or less. Engineered weak line that breaks at 1,700 pounds (771 kilograms) or less are available in commercial quantities at line diameters of 3/8ths (0.95 centimeters) and 5/16ths inches (2.1 centimeters), commonly used in lobster and Jonah 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 and enforcement of engineered weak line since much stronger line is also available at these diameters. NMFS has also been collaborating with Maine DMR and Massachusetts DMF to determine what weak insertions, gear configurations, or full weak options reliably break at 1,700 pounds (771 kilograms, within a 10 percent range). Weak insertions can be as simple as splicing in the South Shore Sleeve, or splicing in a length of manufactured 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). The state of Massachusetts is requiring the use of full weak line or weak inserts every 60 feet (18.3 meters) in the top 75 percent of the line as of May 2021 and has approved a few options that use a manufactured red rope spliced into 3/8ths inch line (0.95 centimeter line; see Chapter 3 and Appendix 3.6). Offshore vessels are configured to use lines of larger diameters. The Atlantic Offshore Lobstermen's Association is working with NMFS and gear manufacturers to find engineered line of 5/8ths inch (1.6 centimeters) or other larger diameters that breaks at 1,700 pounds (771 kilograms) 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 1 (No Action), Alternatives 2 and 3 would reduce the average maximum breaking strength of buoy lines in the Northeast Region from an estimated 2,162 pounds to an estimated 1,976 pounds (896 kilograms) in Alternative 2 and 1,753 pounds (795 kilogram) in Alternative 3 (Table 5.6). This relies on the estimated proportion of the weak insert configurations in Alternative 2 to full weak line. The analysis in this Chapter relies on the lower bound estimate of risk reduction, which assumes that the equivalent to full weak line is an insert at least every 40 feet (12.2 meters) and relies upon the depth data and scope ratio used to estimate line length in Chapter 3. The depth data used a weighted mean depth according to the number of lines fished at depths in a particular area and scope ratio was estimated from McCarron and Tetrault (2021), both of which represent the best available data at the time of this FEIS. Scope ratio ranged from 1.1 to two times the depth of the area being fished.

Chapter 3 also included an upper bound estimate that only considered the proportion of line above the lowest weak insert, which takes into account the depth of an insert but without considering the number or frequency of inserts as with the lower bound estimate. Weak insert simulations found that entanglements were more likely to part a line when a weak insert was below where a whale interacted with the line and when the trawl was longer (e.g. greater than five traps per trawl; DeCew et al. 2017, Knowlton et al. 2020). Thus, the lower down an insert, the more likely it would break when on a longer trawl in the event of an entanglement, though this may differ if there is only one insert and it may vary with distance from the entanglement point. The use of weak inserts at regular intervals on a buoy line or a full length of weak rope to reduce the likelihood that interactions between whales and commercial fishing gear will likely result in entanglements that cause serious injury or mortality. Alternative 1 would maintain the status quo, and the potential for entanglements to result in mortality and serious injury would not be decreased. The primary difference between weak rope requirements in Alternative 2 (Preferred) and Alternative 3 (Non-preferred) is that Alternative 2 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 feet/12.2 meters) and therefore does not quite achieve an average line strength of 1,700 pounds (771 kilograms) across the northeast; whereas Alternative 3 requires more weak insertions or the use of lengths of engineered weak rope and the average line strength achieved with these measures is estimated at 1,753 pounds (795 kilograms). The weak line measures included in Alternative 2 in this FEIS provide greater conservation benefits than those analyzed in the DEIS, with broader use of weak line through state measures in Massachusetts and throughout LMA 2.

Table 5.6: A comparison of mean line strength and change in gear threat under each alternative.

Alternative:	*1 (No Action)*	*2 (Preferred)*	*3*
Mean Line Strength	2,162 lb/ 981 kg.	1,976 lb/ 896 kg.	1,753 lb/ 795 kg.
Change in Line Strength		8.6%	18.9%
Change in Gear Threat		17.2%	28.6%

5.3.1.3.1 Direct

The alternatives included in this analysis were selected based on the approximate risk reduction estimated for weak line in the DST, 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). These findings are in line with similar analyses showing no entangled adult right whales found in line that break at 1,700 pounds (771 kilograms) or below (Knowlton et al. 2016). Thus, broader use of line with a maximum breaking strength of 1,700 pounds (771 kilograms) 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. Knowlton et al. (2016) found stronger average rope strength on entangled adults than juveniles, suggesting adults are better able to break out of weaker gear under a certain breaking strength. Given this, calves and juveniles may not experience the same benefit given they may be less able to break line of the same breaking strength as adult whales.

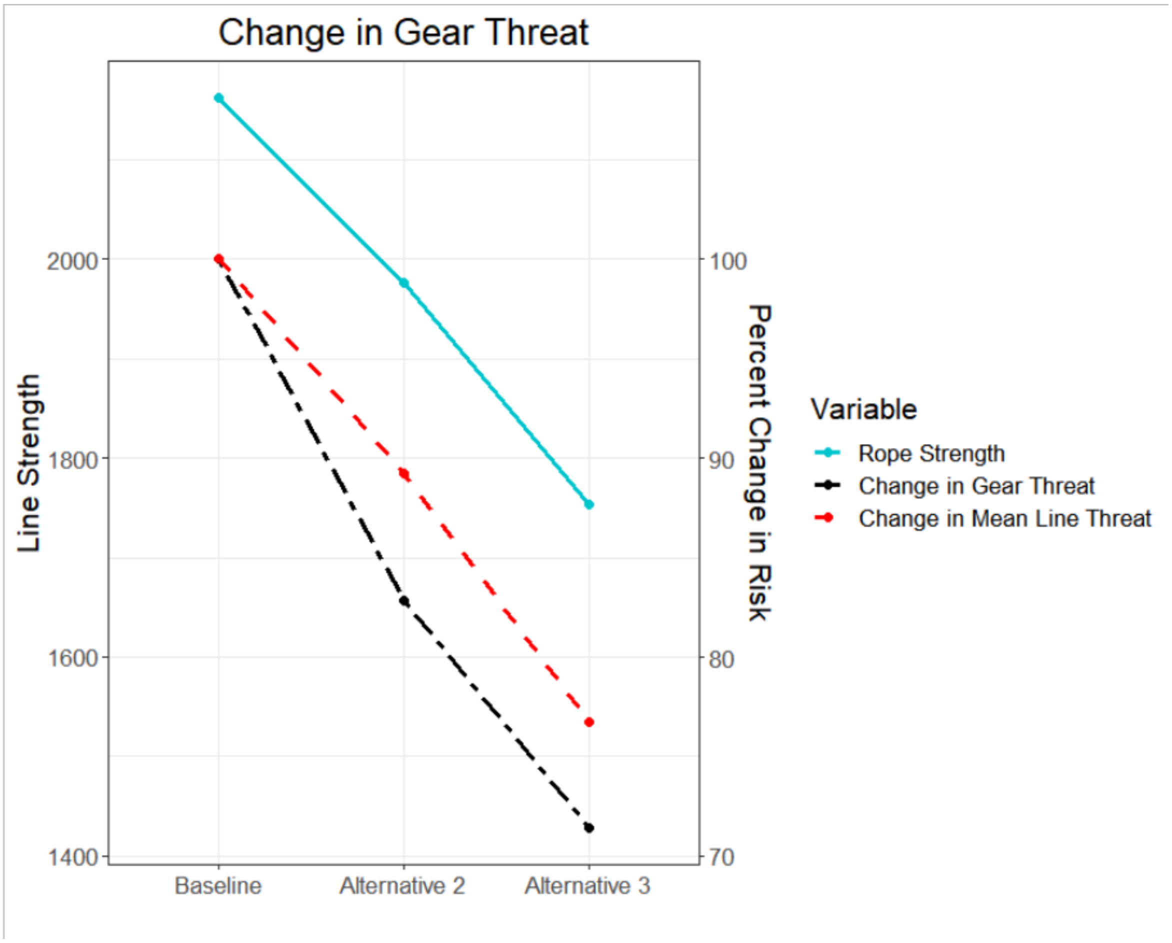


Figure 5.5: The relative mean rope strength, relative gear threat, and mean line threat for each alternative, including the baseline (baseline represents Alternative 1).

Figure 5.5 shows the change in average breaking strength of buoy lines between the baseline and Alternatives 2 and 3 as well as the associated change in mean line threat (i.e. threat of a single line) and total combined gear threat for the entire northeast. The weak line measures in Alternatives 3, which would require greater use of full weak rope or the equivalent (weak insertions every 40 feet/12.2 meters), offers the most direct benefit to whales by reducing likely entanglement severity compared to Alternative 2.

Weak buoy lines, particularly in areas with deep waters, waters with high currents, storm waves, large tidal ranges, or high chance of gear conflicts, have a high likelihood of breaking upon retrieval or snapping due to other conditions. Thus, 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 2 in areas outside of 12 nautical miles/22.2 kilometers), 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 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 33 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 mortality and serious injury (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 kilometers), co-occurrence is higher between buoy lines and right whales relative to nearshore Maine waters, further reducing the risk reduction benefit in these areas.

The depth of the lowest weak point in Alternative 2 ranges from 33 percent to 75 percent. There is an option for full manufactured weak line only in Massachusetts State waters, though it is anticipated that most fishermen will choose the use of weak inserts every 60 feet (18.3 meters) in the top 75 percent of the buoy line. Under Alternative 2, LMA 3 would only have one weak buoy line topper in the top 75 percent of the line. Conversely, Alternative 3 includes broader use of full weak line or the equivalent in the top 75 percent of all buoy lines outside of LMA 3, which is more extensive than the nearshore options in Alternative 3. However, weak line measures are less extensive in LMA 3, which includes only a 20 percent weak rope topper year round with one end weakened in the top 75 percent only from May through June. This configuration may have more risk than the LMA 3 option in Alternative 2, particularly during summer months when right whales are more likely to be found in offshore waters.

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 is needed before adding knotted configurations to a list of approved weak insertions. NMFS is currently seeking input through an expert elicitation from scientists investigating Large Whale Unusual Mortality Events to determine the safety of approving knots as weak inserts and, if so, if there are particular knots that are less likely to complicate an entanglement.

Both Alternatives 2 and 3 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 1), particularly for 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 3 may offer higher risk reduction from weak rope than Alternative 2 (Table 5.6), they both offer some precautionary benefit to some large whales in some life stages in the event of an entanglement. Alternative 2 likely reduces the strength of more line in offshore waters in LMA 3 where gear is also stronger and more likely to cause serious injury or mortality if they were to become involved in an entanglement.

5.3.1.3.2 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. This may depend on which weak rope or weak insertion solution fishermen elect to use, although over time they would be expected to select for the solutions that cause the least gear loss. 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 percent of hauls relative to 8.5 percent 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 1,700 pounds (771 kilograms) breaking strength were required for some configurations, particularly for trawls of 35 traps and more in waters greater than 50 fathoms (91.4 meters, 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 3.3). 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 3 Alternative 2), a weak insert at 33 percent down (12 nautical miles /22.2 kilometers to LMA 3 border), or a weak topper at 20 percent down on one end on trap/pot trawls set in deeper waters (LMA 3 Alternative 3). Alternative 2, with limited weak inserts half way or 33 percent 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.

The broad requirement to use weak lines or inserts may make disentanglement more difficult. Disentanglement teams rely upon added floatation or drag to slow the whale down and provide an opportunity to safely release the whale from the lines. Weak inserts or line may prevent this additional drag from being applied thus potentially making the effort more dangerous and difficult. Colorful or contrasting weak inserts that are easily recognized would help disentanglement responders recognize these potential obstacles and adjust accordingly. Chapter 2 includes the number of whales for which serious injury or mortality was averted because they were disentangled, demonstrating disentanglement's positive impacts on entanglement outcomes. However, disentanglement is not always possible or feasible so prevention of serious entanglements is likely to be more beneficial to the population in the long term.

5.3.1.4 Enforceability

The measures described above for Alternatives 2 and 3 would only provide a conservation benefit if they are broadly adhered to and result in a measurable change in entanglement risk and severity. This requires the measures to be enforceable by NOAA's Office of Law Enforcement (OLE) as well as the U.S. Coast Guard and especially state enforcement agencies. The impact of trawling up measures was discussed briefly in 5.3.1.1.1. Agencies already do their best to enforce current measures, including restricted areas and minimum trawl lengths as well as other gear configurations. Enforcement has been a particular challenge in LMA 3 offshore waters, where fishing operations are largely unobserved and deep sets of long trawls are beyond the haul capabilities of prevent enforcement vessels. OLE has successfully tested the use of remotely operated vehicles to aid in enforcement in offshore waters when hauling gear is not possible. This technology has the capabilities of improving enforcement of the current and FEIS measures in offshore waters.

The conversion of seasonal closures to buoy line closures where ropeless fishing is allowed with an EFP provides an additional enforcement challenge. Enforcement boats will need to have access to the locations of all ropeless gear in order to properly enforce their use and ensure they are not within areas where ropeless fishing is not allowed (e.g. in Cape Cod Bay during spring). Currently, the testing of ropeless fishing with an EFP is limited and conducted in close collaboration with NOAA or other entities with strict adherence to conditions including location reporting (outlined in Chapter 3). NOAA has been developing standards for the technology used to locate and retrieve gear to ensure the development of industry standards and the ability of law enforcement to have access to gear locations and configurations. Testing of ropeless gear in restricted areas will allow testing of these technologies and collaboration with enforcement officials to develop protocols for enforcement of ropeless fishing. This testing phase allowed under both Alternatives 2 and 3 will prepare enforcement agencies for broader use of ropeless fishing.

Weak inserts are also an area where enforcement may be a challenge. Comments on the DEIS expressed a concern with the ability of agencies to enforce the use of weak rope or inserts. Enforcement of weak rope or weak inserts requires the gear to be configured such that they are detectable by enforcement agencies. This is a challenge given it requires fully manufactured rope to look distinct from other fishing line and for weak insert configurations to be identifiable. Furthermore, areas where regular weak inserts are required in lieu of full manufactured weak line will be difficult to detect and enforce without the capability to measure length between inserts. NMFS is working with OLE and other fishery enforcement agencies to ensure the approved weak inserts are identifiable and enforceable. In this FEIS, the line cap in Alternative 3 would be particularly challenging to enforce, even if a mechanism for implementation was identified. The use of gear configurations and restricted areas that rely on enforcement are not expected to differ between Alternatives 2 and 3. For more information on enforcement plans see Appendix 3.5.

5.3.1.5 Analysis of Direct and Indirect Impacts of the Alternatives on Large Whales

The biological impacts described in the previous section focus on impacts to the 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 5.7 compares the annual impacts of the alternatives using a variety of indicators that are likely to correlate with reduced large whale entanglement risk and severity. The change in line numbers, co-occurrence, and gear threat for the impact alternatives, compared to Alternative One, were summed to provide an annual total for the purpose of comparing the alternatives. This analysis evaluates the impact of alternatives to modify the ALWTRP requirements relative to the status quo Alternative 1 (the No Action baseline that assumes no change in existing Plan requirements). As previously stated, it is important to note that the No Action Alternative (Alternative 1) would not achieve the objective of reducing mortality and serious injury of right whales below PBR. If Alternative 1 were chosen, the current rate of mortality and serious injury to large whales due to U.S. entanglements in commercial fishing gear would continue to exceed PBR, rather than be reduced.

The risk of an interaction is associated with the quantity of gear in the water (e.g., number of buoy lines), gear soak duration, and the temporal and spatial overlap of the gear and protected species. Increases in any of these factors equates to elevated interaction risk to protected species, while decreases in these factors equates to a lower interaction risk. As the lobster and Jonah crab fisheries use trap/pot gear, and the distribution of protected species of large whales (North Atlantic right, humpback, minke, fin) overlaps with the fisheries, interactions with protected species are possible and some level of negative impacts to protected species is likely.

Table 5.7: The annual summary of all quantitative measures for each alternative, including the change in annual buoy line numbers (summed across months), co-occurrence, and total annual conversion to weak line. The risk reduction and co-occurrence estimates from Chapter 3 are also shown, which include the credit for the implementation of the MRA with the upper and lower bound estimates provided for weak inserts)

Alternative:	1 (status quo)	2 (Preferred)	3 (Non-preferred)
Line Reduction		**% Reduction**	**% Reduction**
Risk Reduction		60%	72%
Risk Reduction (with MRA Credit)		69% – 73%	
Line Reduction		7%	7%
Co-Occurrence		**% Reduction**	**% Reduction**
Right Whale		54%	60%
Right Whale (with MRA Credit)		65%	
Humpback Whale		12%	19%
Fin Whale		14%	17%
Weak Line			
Mean Line Strength	2,162 lb/ 981 kg.	1,976 lb/ 896 kg.	1,753 lb/ 795 kg.
Change in Line Strength		9%	19%
Change in Gear Threat		17%	29%

Alternatives 2 and 3 are similar in geographic range and requirements. As such, each alternative reduces co-occurrence and, by proxy, predicted entanglement risk within the 60 to 80 percent target (Figure 5.6). 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 2 (Preferred) would reduce co-occurrence with less impact on total fishing effort (e.g. the number of trap/pots fished or the number of restricted areas) than Alternative 3 and with less of an impact on line strength. Alternative 2 additionally considers the risk reduction credit offered by the maintenance of the MRA, which results in equal re 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 3 (Non-preferred) due to the combination of the most proposed closures to persistent buoy lines and the broadest requirement for full weak rope.

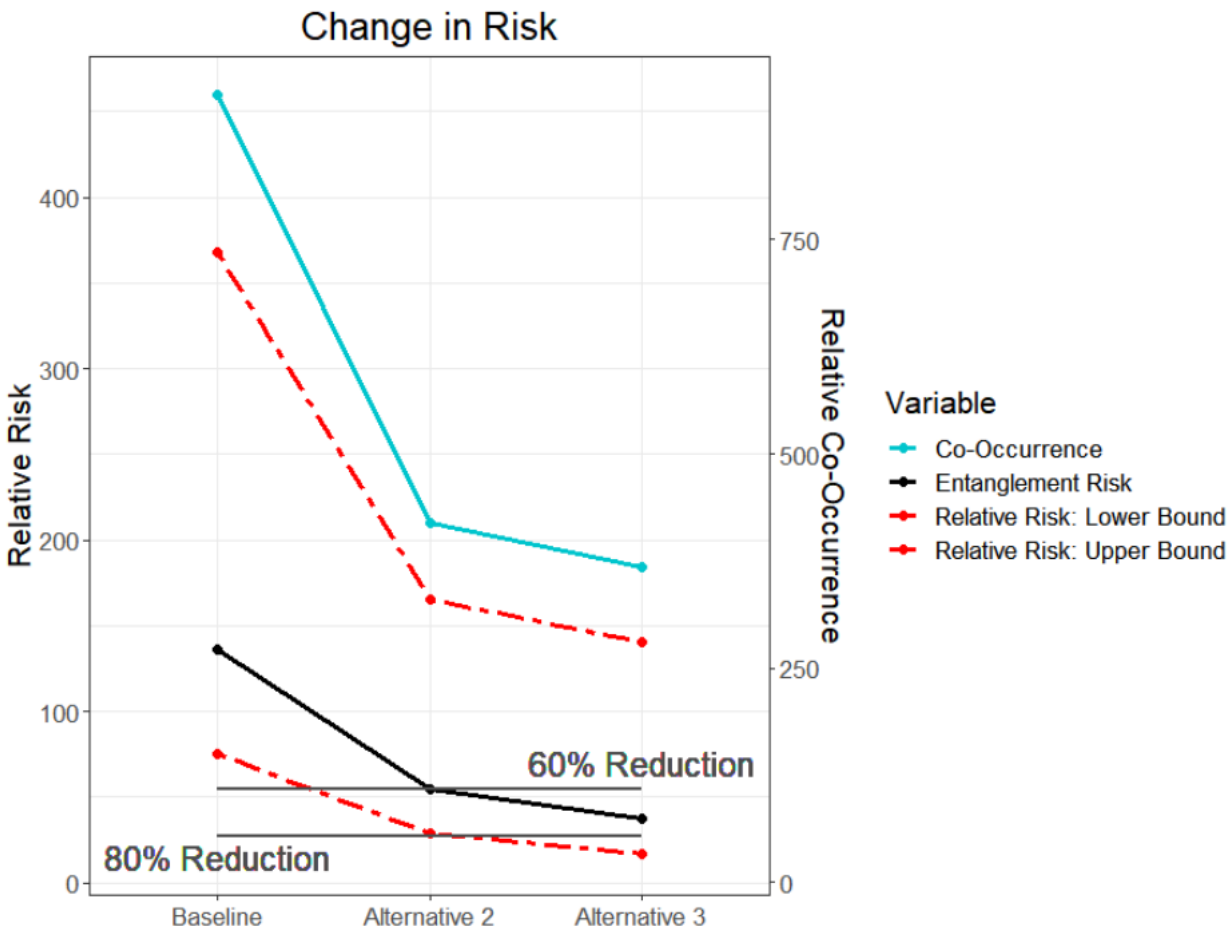


Figure 5.6: The relative change in right whale risk and co-occurrence from Alternative 1 (represented by baseline, i.e. status quo) to Alternative 2 (Preferred) and 3, relative to the risk reduction targets.

An average of 511,369 lines are fished monthly, with a maximum of 925,924, in the Northeast Region. 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. Alternatives 2 and 3 reduce the number of lines by roughly the same proportion across the entire Northeast Region (7 percent, Table 5.8). This includes Maine Exempt Waters where there will be no line reduction, which 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 but considered here for their precautionary risk reduction benefit. The reduction in buoy lines in these alternatives 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.

Table 5.8: Monthly percent risk reduction for right and humpback whales compared to Alternative 1 (i.e. status quo). Since a gear threat model is not currently available for fin whales, there are no risk reduction estimates for this species. Relative risk includes the combined changes due to gear configurations, areas closed to persistent buoy lines, and maximum line strength.

	Line Reduction		Relative Risk			
			Right Whale		Humpback Whale	
Month	Alternative 2	Alternative 3	Alternative 2	Alternative 3	Alternative 2	Alternative 3
January	-9%	-16%	-46%	-61%	-18%	-45%
February	-6%	-5%	-53%	-66%	-22%	-48%
March	-6%	-6%	-60%	-69%	-25%	-51%
April	-7%	-10%	-65%	-79%	-27%	-52%
May	-12%	-19%	-89%	-96%	-25%	-48%
June	-13%	-20%	-49%	-80%	-22%	-44%
July	-12%	-15%	-50%	-83%	-22%	-42%
August	-15%	-15%	-23%	-43%	-21%	-41%
September	-7%	-6%	-24%	-43%	-19%	-38%
October	-6%	-4%	-42%	-64%	-18%	-37%
November	-6%	-4%	-50%	-65%	-20%	-44%
December	-6%	-4%	-40%	-48%	-19%	-36%
Total	-7%	-7%	-60%	-72%	-21%	-41%

Alternative 3 predicts greater reduction in large whale co-occurrence compared to Alternative 2 (Table 5.8). This is because of the more extensive reduction of lines 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 3. Alternative 3 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 2. The line reduction and co-occurrence measures proposed in Alternative 2 (Preferred) and Alternative 3 both substantially reduce right whale co-occurrence. Though Alternative 3 will likely reduce co-occurrence between large whales and buoy lines to a larger degree than Alternative 2, significantly decreasing entanglement risk for large whales, Alternative 2 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 is more enforceable.

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 3 proposes a larger percentage of full weak rope to be required on vertical buoy lines across the proposed areas. While Alternative 2 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 2, the proposed insertions within nearshore shallow waters are very close to a full weak line equivalent (an insertion every 40 feet/12.2 meters). In deeper waters within nearshore trap/pot management 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 2 would provide some risk reduction benefit across the entire Northeast Region, providing a precautionary measure resilient to changes in right whale distribution.

The combination of line reduction, co-occurrence reduction, and line weakening measures are estimated to reduce the overall risk of severe entanglement by approximately 60 percent in Alternative 2 and 72 percent in Alternative 3. This estimate does not take into account additional risk reduction achieved by maintaining the Massachusetts Restricted Area (MRA) in Alternative 2. Because of the increasing value of the MRA over time (Ganley et al. 2019), the Take Reduction Team recommended including the MRA risk reduction in the overall risk reduction score. Including the risk reduction value of the MRA results in an estimated 69 to 73 percent risk reduction to right whales under Alternative 2 (Preferred) and the associated Final Rule.

Likewise, Alternative 3 does not take into account estimated line reduction through state or fisheries management actions not being implemented by NMFS. The effectiveness of Alternative 2 and 3 both depend on the past effectiveness of these measures on line and risk reduction. Expected line reduction measures in these alternatives would 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, or in areas with longer trawl lengths, such as in LMA 3, provides an additional important precautionary measure to reduce entanglement severity.

Based on the information above, Alternative 1 is expected to have high negative to moderate negative impacts to large whales. Current ALWTRP regulations will be maintained, providing no incentive for vessels to change effort or fishing behavior, new or elevated entanglement risks to protected species are not expected. For ESA-listed species of large whales, the risk of interactions with trap/pot gear remains, and the current rate of mortality and serious injury will likely continue and U.S. entanglements in commercial fishing gear would continue to exceed PBR, resulting in moderate negative to high negative impacts. Moderate negative impacts are expected for other MMPA protected species of large whales because, while the PBR for these species has not been exceeded while the fishery has operated and the ALWTRP regulations have been in place, interactions may still occur. Because observed mortality and serious injury only represents a fraction of observed cases, some of these species may be experiencing human caused injuries at a rate above PBR once unobserved mortality is taken into account (see Chapter 2).

Considered independently, the fishery under Alternative 2 and Alternative 3 are expected to result in moderate negative to slight negative impacts for ESA-listed and MMPA-protected species of large whales. While entanglement risk for large whales will likely be lessened by reducing co-occurrence (i.e., additional seasonal restricted areas restricting buoy lines) and introducing gear modifications that would increase the likelihood that a whale could break free of gear before becoming seriously injured or killed (i.e., trawling up, end line restrictions, and weak link requirements), the risk of entanglement remains (i.e., entanglement in groundlines and the continued presence of buoy lines), albeit less so than under Alternative 1. Therefore, ESA-listed and MMPA-protected species of large whales are expected to have slight negative to moderate negative impacts. Relative to Alternative 1, Alternative 2 and Alternative 3 both substantially reduce right whale co-occurrence due to line reduction and co-occurrence measures proposed, therefore are expected to have slight positive to moderate positive impacts to ESA-listed and MMPA-protected species of large whales, depending on the species.

Relative to Alternative 2, Alternative 3 impacts are expected to be negligible to slight positive (i.e, a larger percentage of full weak rope to be required on vertical buoy lines across the proposed areas and predicts greater reduction in large whale co-occurrence). Alternative 3 likely reduces entanglement risk to a slightly greater degree than Alternative 2 with a slightly higher decrease in co-occurrence and the strength of lines. A larger decrease in co-occurrence and strength will likely offer more benefits, particularly to right whales. Though this analysis does not take into account the MRA risk reduction credit, which achieved a higher co-occurrence reduction than Alternative 3 and Alternative 2 likely contains fewer regulations that would lead to uncertain outcomes that could potentially increase line in some areas. Minke whales are less likely to benefit from line strength reduction and are more likely to be negatively impacted by long trawl lengths. Therefore, compared to Alternative 2, Alternative 3 is likely to have negligible to slight positive impacts in large whales. Meanwhile, relative to Alternative 3, Alternative 2 impacts will be slight negative to moderate negative, because it will be less likely to increase co-occurrence in the Northeast Region.

5.3.2 *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 2 and 3 to the ALWTRP on other ESA-listed species of marine mammals, including sei and sperm whales as well as ESA-listed sea turtles, including loggerhead and leatherback (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 other potentially affected ESA-listed species of large whales and sea turtles.

5.3.2.1 Buoy Line and Co-occurrence 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 2 (Preferred) requirements differ slightly from Alternative 3 (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.

5.3.2.1.1 Gear Modifications: Trawl Length and Line Caps

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. 2021). Alternative 1 (No Action) would not result in additional conservation gain for other ESA-listed protected species of large whales and sea turtles 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 2 (Preferred) and 3 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 2, fishermen would be required to use trawls of from two to 50 trap per trawl, depending on area and season, contributing to an estimated 7 percent reduction of line. Alternative 3 cuts the number of buoy lines nearly in half using a line cap in federal waters also contributing to a similar estimated 7 percent reduction of line with added flexibility with how vessels implemented the line cap.

5.3.2.1.1.1 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 ESA-listed large whales (i.e., sei and 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, sei and sperm whales have the potential to be impacted by the proposed regulations. Although the commercial fisheries regulated under the Plan may affect sperm whales, there seems to be significant separation between the known feeding/or breeding range of this species and primary fishing areas. Therefore, the gear modifications in the commercial fisheries regulated under the Plan may be less beneficial for this 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.

5.3.2.1.1.2 Indirect

The indirect effects of reducing buoy lines are similar to those for large whales described above depend upon predicted changes in gear loss, enforceability, 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.

5.3.2.1.2 Seasonal Restricted Areas Closed to Persistent Buoy Lines

Alternatives 2 and 3 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 minimal 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 1.

5.3.2.1.2.1 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 Georges 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.

Given that the majority of known entanglements for these species in trap/pot gear occur in the buoy line and surface systems, entanglement risk to sea turtles in ropeless trap/pot gear is considered negligible because the potential for new unattended buoy line into the water column would be limited if the recommended conservation measures, or their equivalent, are implemented.

The restricted areas described above could have a beneficial impact on 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 sperm whales is the Georges Basin 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 Georges 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 1 Restricted Area.

Sei whales may also benefit from fishery restricted areas proposed closer to shore (Davis et al. 2020). 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 3) and summer (Stone et al. 2017), and Georges 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 Georges Basin.

5.3.2.1.2.2Indirect

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.

5.3.2.2 Changes to Weak Link Requirements

5.3.2.2.1 Direct

Changes in weak link requirements are not likely to have a significant direct impact on other protected species. Similar to large whales, sperm 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.

5.3.2.2.2 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.

5.3.2.3 Weak Rope

Both proposed alternatives, would require conversion of a certain proportion of line to weak rope or the equivalent (see section 5.3.1.3 for more details).

5.3.2.3.1 Direct

Regulations reducing the breaking strength of rope, or requiring weak inserts in rope, are more likely to benefit other ESA listed species of large whales. Data from Arthur et al. (2015) suggest larger whale species, such as sperm and sei whales could be able to exert a high enough force to exceed 1,700 pounds (771 kilograms) line. Protected marine mammal species (e.g. sperm and sei whales) are estimated to exert lower maximum forces than right 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. The use of weak inserts lower down on the line may allow other large whales to avoid getting anchored if the entangled whale could generate sufficient force. Similar to large whales, Alternative 3 may provide slightly greater reduction in potential entanglement severity to other protected whale species compared to Alternative 2 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 1,700 pounds (771 kilograms). 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.

5.3.2.3.2 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.

5.3.2.4 Comparison of Alternatives

There were few quantitative criteria available to compare the biological effect of the alternatives on other protected species. As noted above, the No Action (Alternative 1) maintains current ALWTRP regulations, and therefore, provides no incentive for vessels to change effort or fishing behavior, new or elevated entanglement risks to protected species are not expected. Under Alternative 1, impacts are expected to be moderately negative. As discussed in Chapter 4, ESA-listed species of large whales and sea turtles are at risk of interacting with trap/pot gear, specifically via the entanglement in buoy lines or groundlines associated with this gear type.

Alternative 2 and Alternative 3 are expected to have a slight negative impacts to other ESA-listed species. Other ESA-listed species of large whales (i.e., sei and sperm whales) may not benefit from the closed areas due to limited co-occurrence and may have increased elevated entanglement risks outside closure areas due to relocation of fishing lines, though these impacts would occur close to the restricted area where these species are not commonly sighted. . Other ESA-listed species of large whales (e.g. sperm and sei whales) are less likely to break out of weak rope, and therefore not able to benefit. ESA-listed species of 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. Relative to Alternative 2, Alternative 3 is expected to have negligible to slight positive impacts to sea turtles due to closures in areas of possible co-occurrence.

Based on the information above, relative to Alternative 1, Alternative 2 and Alternative 3 impacts are expected to be negligible (i.e. little change in line where these species are commonly sighted) to slight positive (i.e., reducing co-occurrence of buoy lines protected species, weak links requirements, and line reduction provisions) for ESA-listed protected species. Therefore, compared to Alternative 2 and Alternative 3, Alternative 1 is expected to have slight negative to negligible impacts to ESA-listed species.

Relative to Alternative 2, Alternative 3 is expected to have negligible to slight positive impacts to ESA-listed species (i.e., reduced co-occurrence of buoy lines and sea turtles, use of more full weak line to lessen entanglement severity for large whales, weak line requirements, and line reduction provisions). However these provisions will likely not benefit whales that spend more time in deeper waters, such as sperm whales, and there is a greater risk of an increase in lines outside of Georges Basin Restricted Area into important habitat. Therefore, compared to Alternative 3, Alternative 2 is expected to have negligible to slight negative impacts to ESA-listed species.

5.3.3 *Habitat*

As noted in Chapter 4, 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.

5.3.3.1 Buoy Line and Co-occurrence Reduction

5.3.3.1.1 Gear Modifications: Trawl Length and Line Caps

With the exception of Alternative 1 (No Action, i.e. status quo), 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 2 and 3 (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 1 would maintain the current levels of biological impact of trap/pot fishing on benthic habitats.

5.3.3.1.1.1 Direct

It is likely that in total, the amount of sinking groundline that may be used will not be substantially different from Alternative 1. Fewer trawls will be fished with an increase to the minimum number of 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 3 from 1.5 miles (2.78 kilometers) between buoy lines to 1.75 miles (3.24 kilometers) 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 35 to 50 trap trawls. Fishermen choose to add additional traps to their trawls to ensure that LMA 3 fishermen can achieve an average of 45 trap trawls, compensating for vessels that cannot be configured to accommodate longer 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 in Alternative 2 and 3 result in increased amount of sinking groundline along the bottom, there will be increased line contact with the seafloor, 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 traps or pots per buoy line (one to three) 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 2, longer trawls will primarily occur beyond 12 nautical miles (22.2 kilometers) in deeper waters. In Alternative 3, 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 in Alternative 2 and Alternative 3 would be temporary but slightly higher offshore where longer trawls are being fished.

5.3.3.1.1.2 Indirect

As with other VECs, an increase in ghost gear is possible if trawling up led to the loss of more gear, but this is not expected to occur in higher numbers than the baseline given the trawl configurations proposed in Alternative 2. There is some uncertainty regarding the impact of a line cap on trawl configurations in Alternative 3, 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 Alternative 2 and Alternative 3 are expected to have a negligible impact on habitat, and expected to have negligible impacts in comparison to Alternative 1 and to each other.

5.3.3.1.2 Seasonal Restricted Areas Closed to Persistent Buoy Lines

Both proposed alternatives, with the exception of Alternative 1 (No Action), include seasonal restricted areas that would further reduce the use of persistent buoy lines during times when right whales are more likely to aggregate (see section 5.2.1.1.2 for more details).

5.3.3.1.2.1 Direct

The seasonal restricted areas proposed in Alternatives 2 and 3 could lead to additional habitat protections where fewer lines and traps are coming into contact with the bottom, 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. Although the implementation of seasonal restrictions would limit bottom contact to certain times of year, the overall impacts to biological communities would be the same since most affected organisms would require more than a few months to recover from disturbance.

5.3.3.1.2.2 Indirect

Seasonal restricted areas where no lobster or Jonah crab trap/pot trawls are fished are not likely to have many indirect impacts other than any potential beneficial effects that result from protection of benthic habitats from bottom tending gear, 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 systems 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.

5.3.3.2 Changes to Weak Link Requirements

5.3.3.2.1 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.

5.3.3.2.2 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.

5.3.3.3 Weak Rope

Both proposed alternatives, with the exception of Alternative 1 (No Action), would require conversion of a certain proportion of line to weak rope or the equivalent (see section 5.2.1.2 for more details).

5.3.3.3.1 Direct

The use of weak rope, as required by regulatory Alternatives 2 and 3 (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.

5.3.3.3.2 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.

5.3.3.4 Comparison of Alternatives

No quantitative criteria are available to formally compare the biological effect of the alternatives on habitat. Alternative 1 will maintain baseline levels of biological impacts on benthic habitats, slight direct negative impacts to habitat due to disturbance to benthic habitat to indirect negligible impacts on habitat due to ghost gear.

Alternative 2 and Alternative 3 would result in negligible to slight negative direct impacts on habitat. This possible impact is likely limited to offshore environments with Alternative 2 and could impact offshore and nearshore environments with Alternative 3 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 (i.e., 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. If ropeless fishing is implemented widely in closed areas, it is not expected that Alternative 2 or 3 will significantly change the amount of gear that comes into contact with the seafloor.

Given the information above, in comparison to Alternative 1, Alternative 2 and Alternative 3 are expected to have negligible to slight negative direct impacts on the Northeast Region habitat. Negligible due to the minimal addition of lines for ropeless fishing and unlikely significant biological impacts due to weak rope and slightly negative due to the presence of groundline that is not present under Alternative 1 and the potential increase in risk posed by long trap/pot trawls in contact with the sea floor. Compared to Alternative 2 and Alternative 3, Alternative 1 is expected to have negligible impacts on affected fish habitats. There may be some additional impact on habitat under Alternative 2 compared to 3 because trawl lengths will likely be longer throughout the year under Alternative 2 compared to 3 but these impacts are likely not measurable and thus impacts between the two alternatives is likely negligible.

5.4 Direct and Indirect Impacts of Gear Marking Alternatives

When compared to Alternative 1 (No Action), Alternatives 2 and 3 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 inches (30.5 centimeters in length, with exemptions in inshore waters in some areas.

Both alternatives would modify gear markings to add state-specific colors. Both alternatives include at least one 3 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 requirements for state permitted fishermen, including a 3 foot (0.9 meter) mark within two fathoms of the buoy, effective September 2020. ALWTRP modifications will mirror Maine's regulations outside of the exemption area. Massachusetts implemented gear marking regulations in state waters that require frequent state specific red marks, consistent with measures in this FEIS.

The goal of the long mark near the buoy is to increase the marks 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 at least three marks that are already required, and at least four 1 foot (0.3 meter) long green marks would also be required within 6 inches (15.2 centimeter) of each state specific mark for gear set in federal waters. This is an increase from the one 6 inch (15.2 centimeter) mark required in Alternative 2 in the DEIS, more than doubling the minimum number of marks required on federal lobster and Jonah crab trap/pot gear in the northeast. Additionally, New England waters that are currently exempt from the gear marking requirements would be required to follow the same marking scheme as the principle port with at least one 3 foot (0.9 meter) mark and at least two 1 foot (0.3 meter) marks lower on the buoy line. Alternative 3 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, instead of an increase in number of marks on the line. The No Action Alternative 1 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.

5.4.1 *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 2). No gear is retrieved and/or the fishery of origin or type of fishing gear are not identifiable for a majority of entanglements, including 80 percent 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 U.S. management area (Table 5.9; 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 U.S. marks and from 69 to 92 percent of all cases did not have U.S. marks and could not be identified as Canadian gear. Only three of 62 right whale cases with gear present had gear with marks from U.S. 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 contribute to 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 is not retrievable.

Table 5.9: 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 U.S. 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	-	-	-	-

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.

5.4.1.1 Direct

While existing gear marking requirements, under Alternative 1, have increased the amount of retrieved gear with marks, it does not provide sufficient entanglement location information. Both Alternatives 2 and 3 include gear marking schemes expected to increase the number of marks present by over 50 percent in federal waters, independent of line numbers. Alternative 2 (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 3 would require the addition of fewer new marks but would also require an identification tape throughout the buoy line denoting home state and trap/pot fishery. Alternative 2 shows a higher number of marks than Alternative 3 because a larger number of lines are expected to remain active in the region. However, Alternative 3 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, though gear is not retrieved in a majority of entanglement incidents. 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.

5.4.1.2 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.

5.4.2 *Other Protected Species*

5.4.2.1 Direct

With the exception of Alternative 1 (No Action), all of the regulatory alternatives under consideration would impose new gear marking requirements. Alternative 1 would maintain the current gear marking scheme that is inadequate for identifying the gear related to many entanglements to the ideal specificity. Alternatives 2 and 3 would expand the current gear marking scheme for New England lobster and Jonah crab 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 ESA-listed protected species becoming entangled in commercial fishing gear. Nor would these requirements affect the severity of an entanglement if one occurs.

5.4.2.2 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 ESA-listed 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 ESA-listed protected species of large whales and sea turtles.

5.4.3 *Habitat*

5.4.3.1 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 VEC.

5.4.3.2 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. The type of marking material could have a small impact on habitat if there was degradation of the materials used, though it this is likely negligible relative the background levels of contamination.

5.4.4 *Comparison of Alternatives*

Alternative 1 would result in no changes to current rates of gear identification and would have negligible (gear marking has no immediate direct impact on reducing entanglement risks to ESA listed or MMPA protected species or habitat) to slight negative (indirectly not providing a mechanism to help NMFS to target and improve its efforts to protect ESA-listed and MMPA protected large whales) impacts.

Alternatives 2 and 3 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 2 and 3. It is notable that Alternative 3 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 but it would require gear to be retrieved for this to be beneficial, which currently occurs in approximately 20 percent of entanglement cases. Alternative 2 has more external marks and, though this marking scheme would require a marked portion to remain on an entanglement, there are likely to be more marks that are identifiable from a survey platform without retrieval. Given the information above, the impacts of Alternative 2 and 3 are expected to be negligible (gear marking would not impact the direct risk of entanglement or impact habitat) to slight positive (indirectly providing a mechanism to help NMFS to target and improve its efforts to protect ESA-listed and MMPA protected large whales in the long term). Based on the information above, Alternative 2 and 3 have negligible to slight positive impacts compared to Alternative 1, and negligible impacts when compared to each other.

5.5 Summary of Impacts

Alternative 1 (No Action) would maintain the current levels of impact trap/pot fishing currently has on the VECs. Under this alternative, the impact of trap/pot fishing will remain high negative to moderate negative because the rate of mortality and serious injury of right whales is well above PBR and unsustainable for the population. While observed mortality and serious injury of other MMPA protected species (i.e., minke whales and humpback whales) is above PBR, entanglements remain a significant threat to fin whales (an ESA listed species) as well as humpback and minke whales, particularly for humpback whales because undocumented mortality could be occurring above PBR given the current levels of human caused incidents (see Chapter 2). The impact of trap/pot entanglement would remain moderate negative for other ESA listed and protected species as well under this alternative. The impacts to habitat will maintain the status quo as defined in Chapter 4; negligible to slight negative impacts to habitat from the use of trap/pot gear would continue. When assessed individually, Alternative 2 and Alternative 3 would each have a moderate negative to slight negative impact on large whales, slight negative to negligible impacts on other protected species and a negligible to slight negative impact on the habitat (Table 5.10).

As the discussion above suggests, there are a few significant differences between Alternatives 2 and 3 (preferred and non-preferred, respectively), relative to Alternative 1, with respect to impacts on large whales, other protected species, and habitat. The impacts from Alternatives 2 and 3 are generally expected to be slightly positive to moderately positive when compared to the No Action Alternative (Alternative 1) because the other large whale species likely benefit from these alternatives to a lesser degree than right whales. All of the Alternatives (with the exception of Alternative 1) 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 of reducing the proportion of buoy lines, size or season of closures to persistent buoy lines, and the extent of the use of weak rope or weak insertions with a maximum breaking strength of 1,700 pounds (771 kilograms) Large whales are expected to positively benefit from the regulations proposed in both Alternatives 2 and 3 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 3 likely reduces entanglement risk to a slightly greater degree than Alternative 2 with a slightly higher decrease in co-occurrence and the strength of lines. Though this analysis does not take into account the MRA risk reduction credit, which achieved a higher co-occurrence reduction than Alternative 3. A larger decrease in co-occurrence and strength will likely offer more benefits, particularly to right whales, but compliance is expected to be greater for Alternative 2, rather than 3, given that it was developed with the states and fishermen and takes into account safety concerns. Furthermore, Alternative 2 likely contains fewer regulations that would lead to uncertain outcomes that could potentially increase line in some areas and is also more implementable and enforceable. Minke whales are less likely to benefit from line strength reduction and are more likely to be negatively impacted by long trawl lengths. Therefore, compared to Alternative 2, Alternative 3 is likely to have negligible to slight positive impacts relating to large whales.

In comparison to Alternative 1, Alternative 2 and 3 will likely have slight indirect positive impacts on other protected species prone to entanglement in trap/pot gear , with Alternative Three offering negligible to slightly greater positive benefits relative to Alternative 2. Any additional indirect impacts of Alternatives 2 and Three on habitat are expected to be negligible compared to Alternative 1 and relative to each other.

Table 5.10: The direct and indirect impacts of the alternatives on the three biological VECs.

Alternatives	Large Whales	Other Protected Species	Habitat
Risk Reduction			
Alternative 1 (No Action)	**High Negative to Moderate Negative**– Mortality and serious injury would continue to occur and impact ESA listed species' population health. More so for right whales and other large whales to a lesser degree other ESA listed or MMPA protected species.	**Moderate Negative** – Injury and mortality due to entanglement would continue to harm ESA listed species.	**Negligible to Slight negative** – Areas with trawls above 15 traps per trawl may have a short-term impact.
Alternative 2 (Preferred)	**Moderate Negative to Slight Negative** – Would reduce entanglement risk for ESA listed and MMPA protected species. However risk of interactions will not be entirely eliminated by the proposed action.	**Slight Negative**– Would reduce entanglement risk for ESA listed species. However risk of interactions will not be entirely eliminated by the proposed action.	**Negligible to Slight negative** – Trawling up to trawls above 15 traps per trawl may have a short-term impact.
Alternative 3 (Non-preferred)	**Moderate Negative to Slight Negative**– Would reduce entanglement risk for ESA listed and MMPA protected species. However risk of interactions will not be entirely eliminated by the proposed action.	**Slight Negative** – Would reduce entanglement risk for ESA listed species. However risk of interactions will not be entirely eliminated by the proposed action.	**Negligible to Slight 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**

5.6 References

AMAPPS. 2015. 2015 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean – AMAPPS II.

Arthur, L. H., W. A. McLellan, M. A. Piscitelli, S. A. Rommel, B. L. Woodward, J. P. Winn, C. W. Potter, and D. Ann Pabst. 2015. Estimating maximal force output of cetaceans using axial locomotor muscle morphology. Marine Mammal Science **31**:1401-1426.

Baumgartner, M. F., F. W. Wenzel, N. S. J. Lysiak, and M. R. Patrician. 2017. North Atlantic right whale foraging ecology and its role in human-caused mortality. Marine Ecology Progress Series **581**:165-181.

Black, B., K. Bunting, N. Manderlink, B. Morrison, and I. Inc. 2019. Benefit-Cost Analysis of Ropeless Exemption in Select Closure Areas. Memorandum to Allison Rosner, NMFS/GARFO 7 February 2019.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the USA outer continental shelf. Final Report #AA551-CT8-48 Cetacean and Turtle Assessment Program, University of Rhode Island, Bureau of Land Management, Washington, DC.

Chuenpagdee, R., L. E. Morgan, S. M. Maxwell, E. A. Norse, and D. Pauly. 2003. Shifting gears: assessing collateral impacts of fishing methods in US waters. Frontiers in Ecology and the Environment **1**:517-524.

Davis, G. E., M. F. Baumgartner, P. J. Corkeron, J. Bell, C. Berchok, J. M. Bonnell, J. Bort Thornton, S. Brault, G. A. Buchanan, D. M. Cholewiak, C. W. Clark, J. Delarue, L. T. Hatch, H. Klinck, S. D. Kraus, B. Martin, D. K. Mellinger, H. Moors-Murphy, S. Nieukirk, D. P. Nowacek, S. E. Parks, D. Parry, N. Pegg, A. J. Read, A. N. Rice, D. Risch, A. Scott, M. S. Soldevilla, K. M. Stafford, J. E. Stanistreet, E. Summers, S. Todd, and S. M. Van Parijs. 2020. Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. Global Change Biology 26:4812–4840.

DeCew, J., P. Lane, and E. Kingston. 2017. Numerical analysis of a lobster pot system. Page 61. New England Aquarium.

Dodge, K. L., B. Galuardi, and M. E. Lutcavage. 2015. Orientation behaviour of leatherback sea turtles within the North Atlantic subtropical gyre. Proc Biol Sci **282**:20143129.

Dodge, K. L., B. Galuardi, T. J. Miller, and M. E. Lutcavage. 2014. Leatherback turtle movements, dive behavior, and habitat characteristics in ecoregions of the Northwest Atlantic Ocean. PLoS One **9**:e91726.

Eno, N. C., D. S. MacDonald, J. A. M. Kinnear, S. C. Amos, C. J. Chapham, R. A. Clard, F. P. D. Bunker, and C. Munro. 2001. Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science **58**:11-20.

FAO. 2016. Report of the Expert consultation on the Marking of Fishing Gear, Rome, Italy, 4–7 April 2016. Rome, Italy.

Ganley, L.C., Brault, S., Mayo, C.A. 2019. What we see is not what there is: estimating North Atlantic right whale Eubalaena glacialis local abundance. Endangered Species Research 38:101-113. https://doi.org/10.3354/esr00938

GMRI. 2014. Understanding opportunities and barriers to profitability in the New England lobster industry.

Hain, J. H. W., M. A. M. Hyman, R. D. Kenney, and H. E. Winn. 1985. The role of cetaceans in the shelfedge region of the northeastern United States. Marine Fisheries Review **47**:13-17.

Hamilton, P., and S. Kraus. 2019. Frequent encounters with the seafloor increase right whales' risk of entanglement in fishing groundlines. Endangered Species Research **39**:235-246.

Hayes, S. A., S. Gardner, L. Garrison, A. Henry, and L. Leandro. 2018. North Atlantic Right Whales: evaluating their recovery challenges in 2018.

Henry, A., T. V. N. Cole, L. Hall, W. Ledwell, D. M. Morin, and A. Reid. 2016. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States, United States East Coast and Atlantic Canadian Provinces, 2010-2014.957-KB.

Henry, A., M. Garron, A. Reid, D. Morin, W. Ledwell, and T. V. Cole. 2019. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2012-2016. US Department of Commerce, Northeast Fisheries Science Center.

Henry, A. G., T. V. N. Cole, M. Garron, W. Ledwell, D. Morin, and A. Reid. 2017. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2011-2015. Page 57.

James, M. C., C. A. Ottensmeyer, S. A. Eckert, and R. A. Myers. 2006. Changes in diel diving patterns accompany shifts between northern foraging and southward migration in leatherback turtles. Canadian Journal of Zoology **84**:754-765.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science **21**:635-645.

Knowlton, A.R., J. DeCew and T. Werner. 2020. Simulated performance of lobster fishing gear under different configurations. Presentation to the North Atlantic Right Whale Consortium. Accessed online at https://drive.google.com/file/d/1IEF6w-4yGUG5EMTVjO2mqo8k5jX8-UmC/view on February 1, 2021.

Knowlton, A. R., and S. D. Kraus. 2001. Mortality and serious injury of northern right whales (*Eubalaena glacialis*) in the western North Atlantic Ocean. Journal of Cetacean Research Management (Special Issue) **2**:193-208.

Knowlton, A. R., R. Malloy Jr., S. D. Kraus, and T. B. Werner. 2018. Development and Evaluation of Reduced Breaking Strength Rope to Reduce Large Whale Entanglement Severity. Anderson Cabot Center for Ocean Life, New England Aquarium, Boston, MA.

Knowlton, A. R., J. Robbins, S. Landry, H. A. McKenna, S. D. Kraus, and T. B. Werner. 2016. Effects of fishing rope strength on the severity of large whale entanglements. Conserv Biol **30**:318-328.

McCarron, Patrice and Heather Tetreault, Lobster Pot Gear Configurations in the Gulf of Maine, 2012.

MEDMR. 2020. An Assessment of Vertical Line Use in Gulf of Maine Region Fixed Gear Fisheries and Resulting Conservation Benefits for the Endangered North Atlantic Right Whale. Submitted to NMFS GARFO as mid year Progress Report, July 2019 – 2020, for Grant NA18NMF4720084.

Moore, M. J., and H. Browman. 2019. How we can all stop killing whales: a proposal to avoid whale entanglement in fishing gear. ICES Journal of Marine Science **76**:781-786.

Moore, M. J., and J. M. van der Hoop. 2012. The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales. Journal of Marine Biology **2012**:1-4.

NEFMC. 1986. Amendment #1 to the Fishery Management Plan for American Lobster, Incorporating an Environmental Assessment and Regulatory Impact Review.

NMFS. 2001a. Authorization of fisheries under the Monkfish Fishery Management Plan, Biological Opinion, Consultation No. F/NER/2001/00546 Northeast Region Protected Resources Division.

NMFS. 2001b. Authorization of fisheries under the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan, Biological Opinion, Consultation No. F/NER/2001/01206. Northeast Region Protected Resources Division.

NMFS. 2001c. Endangered Species Act – Section 7 Consultation Biological Opinion, Issuance of Exempted Fishing Permit to Maine Department of Marine Resources to Develop and Test a species-specific Jonah Crab, Cancer borealis, Trap in Federal Lobster Management Area 1, Consultation No. F/NER/2001/01251.

NMFS. 2001d. Reinitiation of Consultation on the Federal Lobster Management Plan in the Exclusive Economic Zone, Biological Opinion, Consultation No. F/NER/2001/00651. Northeast Region Protected Resources Division.

NMFS. 2002a. Large Whale Gear Research Summary, Prepared by the Gear Research Team. National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2002b. Workshop on the effects of fishing gear on marine habitats off the Northeastern United States October 23-25, 2001 Boston, Massachusetts. National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts.

NMFS. 2003. Supplement to the Large Whale Gear Research Summary, Prepared by the Gear Research Team. National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2004. Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat.

NMFS. 2014. Final Environmental Impact Statement for Amending the Atlantic Large Whale Take Reduction Plan: Vertical Line Rule Volume I of II. NOAA, DOC.

Pace, R. M., P. J. Corkeron, and S. D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution 7:8730–8741.

Record, N., J. Runge, D. Pendleton, W. Balch, K. Davies, A. Pershing, C. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S. Kraus, R. Kenney, C. Hudak, C. Mayo, C. Chen, J. Salisbury, and C. Thompson. 2019. Rapid Climate-

Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography 32.

Roberts, J. J., B. D. Best, L. Mannocci, E. Fujioka, P. N. Halpin, D. L. Palka, L. P. Garrison, K. D. Mullin, T. V. N. Cole, C. B. Khan, W. A. McLellan, D. A. Pabst, and G. G. Lockhart. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports 6:22615.

Roberts JJ, Mannocci L, Halpin PN (2017) Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2016-2017 (Opt. Year 1). Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts JJ, Schick RS, Halpin PN 2020. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018-2020 (Option Year 3). Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Schweitzer, C. C., R. N. Lipcius, and B. G. Stevens. 2018. Impacts of a multi-trap line on benthic habitat containing emergent epifauna within the Mid-Atlantic Bight. ICES Journal of Marine Science.

Sea Turtle Disentanglement Network (STDN), unpublished data

Stephenson, F., A. C. Mill, C. L. Scott, N. V. C. Polunin, and C. Fitzsimmons. 2017. Experimental potting impacts on common UK reef habitats in areas of high and low fishing pressure. ICES Journal of Marine Science **74**:1648-1659.

Stone, K. M., S. M. Leiter, R. D. Kenney, B. C. Wikgren, J. L. Thompson, J. K. D. Taylor, and S. D. Kraus. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. Journal of Coastal Conservation **21**:527-543.

Thomas, P. O. T., S. M. 1984. Mother-Infant Interaction and Behavioral Development in Southern Right Whales, *Eubalaena australis*. Behaviour **88**:42-60.

van der Hoop, J., D. Nowacek, M. Moore, and M. Triantafyllou. 2017a. Swimming kinematics and efficiency of entangled North Atlantic right whales. Endangered Species Research **32**:1-17.

van der Hoop, J. M., P. Corkeron, A. G. Henry, A. R. Knowlton, and M. J. Moore. 2017b. Predicting lethal entanglements as a consequence of drag from fishing gear. Marine Pollution Bulletin **115**:91-104.

van der Hoop, J. M., P. Corkeron, J. Kenney, S. Landry, D. Morin, J. Smith, and M. J. Moore. 2016. Drag from fishing gear entangling North Atlantic right whales. Marine Mammal Science **32**:619-642.

Wenzel, F., D. K. Mattila, and P. J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Marine Mammal Science **4**:172-175

CHAPTER 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 Jonah 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, and state regulations, including gear marking and weak insertion regulations within Maine exempted waters and Massachusetts additional weak insertions, gear marking, and the extension of the Massachusetts Restricted Area into May, are considered to be part of the baseline, and are 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, this analysis presents these costs on an accumulated and annualized basis. The model develops a series of potential costs year by year within the effective time of this rulemaking, which is assumed to be 6 years. Six years represents an average replacement cycle for rope in buoy lines, and is also the typical length of time between ALWTRP regulatory changes based on past actions. Then yearly costs are accumulated first and then annualized, which provides an estimate of costs as if they were constant for each year during the effective time of the new rules. We apply both 7 percent and 3 percent discount rates to calculate the annualized value.

All costs in this analysis—except for those in cited literature and documents—are converted into 2020 dollars by using price indexes for Gross Domestic Product (BEA 2021). The year 2020 was selected to follow the Office of Management and Budget (OMB) guidelines to reflect the most

[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 risk reduction measures are treated as part of the economic baseline.

recent available price inflation. Economic impacts described in this chapter represent the difference between the impacts of the proposed rule relative to the regulatory landscape in 2017.

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 the 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 dependent on the commercial fishing industry. At the end, a summary of accumulated values and annualized values of each measure is 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 developed by Industrial Economics (IEc);
- 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 1, 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 IEc, which provides an estimate of the number and distribution of lines as they were fished in 2017 (see Vertical Line Model documentation in Appendix 5.1). As discussed earlier in this document, 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

There are two major risk reduction gear configuration modifications considered in both Alternative 2 (Preferred) and Alternative 3 (Non-preferred). Trawling-up would reduce the number of buoy lines by establishing a the minimum trawl length requirement–i.e., prohibiting trawls of less than a specified number of traps or pots between buoy lines 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) and by Alternative. The other important risk reduction gear configuration component of the alternatives is a requirement for using weakened, whale safe rope/weak rope. Measures analyzed would limit 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: Costs of compliance with the trawling up requirements include:

- 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" in this analysis refers to the lobster and Jonah crab harvested, 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

[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-

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.

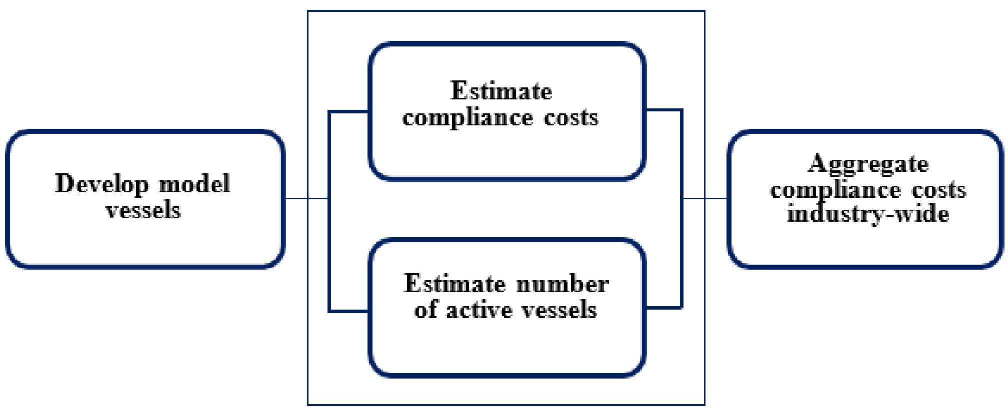


Figure 6.1. Economic impact assessment methodology

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

---

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.

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.

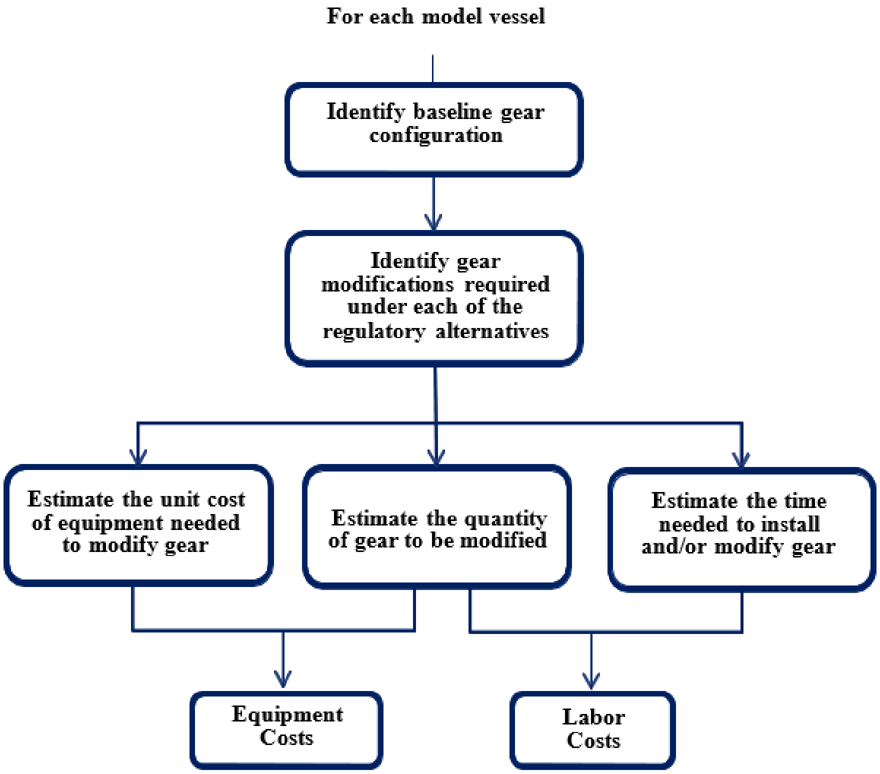


Figure 6.2. Methodology used to calculate gear conversion costs

6.2.2.1 Equipment Costs for Trawling up

Vessels that switch to longer trawls because of new ALWTRP requirements would 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 2, the use of trawls shorter than five in the 3-6 nautical miles (5.6-11.1 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 five traps. The analysis assumes that the affected vessels would fish the same number of pots, and switch to the minimum set length of the new requirements–in this case, five traps per trawl. For vessels that previously fished triples, this implies an increase in the quantity of groundlines 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 diameters;
- 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 diameters.[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 for the 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.

6.2.2.2.1 Labor for Gear Conversion

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

---

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

- 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 National Marine Fisheries Service (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 five-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 the time estimated for the suite of considerations and steps (listed above) required to convert from current to new 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.

6.2.2.2.2 Labor Cost

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

[8] Pers. comm. with NMFS gear specialists, September 24, 2012.

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 document.

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 as a result 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

Alternative Occupation	Percent of Respondents That Identified Alternative	Normalized Distribution of Responses	Average Wage Rate	BLS Occupational Categories Incorporated into Average Wage Rate
				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	
Retire	2%	N.A.	Average:	
Don't Know	16%	N.A.	$25.75	

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 (Maine 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 (Massachusetts 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 landing value would be reached between five and seven years after implementation and baseline value would be exceeded in subsequent years[11]. 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:

---

[9] Pers. comm. with Massachusetts DMF, November 7, 2012.

[10] Pers. comm. 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.

[11] Pers. comm. with NEFSC lobster stock assessment scientist on May 9, 2020.

Lower Bound – In the lower bound scenario, the analysis assumes that vessels in Category A experience a 5-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 5-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 2 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 reduction. Table 6.3 summarizes the savings and costs for different areas.

Under Alternative 2, catch reduction impacts account for the biggest costs, ranging from $5 million to $11.8 million. After offsetting the cost saving from buoy lines and surface systems, the total cost is between $1.5 million and $8.3 million for the first year. For Alternative 3, the trawling up cost is around $0.9 million to $1.9 million. It is much lower than Alternative 2 because the major buoy line reduction measure for Alternative 3 is the buoy line cap reduction, which is described later.

Table 6.2: Parameters for assessing yearly landing value reduction for vessels converting to longer trawls

Fishery	Area	Annual Catch per Trap (lb)	Ex-Vessel Price ($/lb)	Gross Revenue per Trap ($)	5% Revenue Reduction per Trap ($)	10% Revenue Reduction per Trap ($)
Lobster	ME LMA1	42.5	5.3	225.3	11.3	22.5
	ME LMA3	4.4	5.3	23.4	1.2	2.3
	NH LMA1	32.0	6.0	192.6	9.6	19.3
	NH LMA3	26.4	6.0	158.5	7.9	15.8
	MA LMA1	36.7	5.7	208.8	10.4	20.9
	MA LMA2	18.1	5.7	102.8	5.1	10.3
	MA LMA3	18.5	5.7	105.5	5.3	10.5
	MA OCC	33.0	5.7	187.6	9.4	18.8
	RI LMA2	13.1	6.1	79.3	4.0	7.9
	RI LMA3	43.5	6.1	264.2	13.2	26.4
Jonah Crab	MA LMA2	13.5	0.9	11.9	0.6	1.2
	MA LMA3	146.2	0.9	129.5	6.5	12.9
	RI LMA 2	12.0	0.9	10.5	0.5	1.1
	RI LMA3	123.5	0.9	108.1	5.4	10.8

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 2020 U.S. 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	1,671,259	886,847	111,316	409,511	1,171,931	3,229,184	-865,348	1,191,905
ME B	165,350	314,689	54,411	164,217	483,001	1,323,999	221,590	1,062,587
ME C	118,119	567,681	24,282	177,347	704,757	1,521,291	220,586	1,037,120
ME D	98,005	359,989	22,505	152,677	618,008	1,419,169	335,197	1,136,358
ME E	45,151	169,211	8,905	70,592	281,236	641,517	146,371	506,653
ME F	46,749	181,953	9,877	63,205	421,869	919,145	266,250	763,526
ME G	78,311	210,743	23,108	101,696	355,016	939,743	190,766	775,492
MA	179	7,100	457	4,856	25,989	51,977	24,022	50,011
LMA3 (Alt 2)	38,149	157,505	2,135	81,343	1,176,756	2,353,512	1,064,581	2,241,337
LMA3 (Alt 3)	36,993	153,177	2,071	74,976	1,066,603	2,133,205	953,480	2,020,082
Total (Alt 2)	2,261,273	2,855,718	256,996	1,225,445	5,238,564	12,399,537	1,604,015	8,764,988
Total (Alt 3)	36,993	153,177	2,071	74,976	1,066,603	2,133,205	953,480	2,020,082

Notes: 1. All values are adjusted to 2020 U.S. dollars.

2. Fishermen would save some costs in buoy lines 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. For the purposes of this document, weak inserts are considered equivalent to weak rope if they are placed in the traditional rope every 40 ft, the average length and girth of an adult North Atlantic right whale. For example, a 90-foot buoy line would need two weak points to be considered equivalent to a fully weak rope.

In Alternative 2 (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 except in Maine Zones A East, F, and G which would have one weak insertion 33 percent of the way down the rope. Buoy lines outside 12 nm (> 22km from shore) to the LMA 1 border are required to have one weak insertion at top 33 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 3 (Non-preferred), buoy lines in all but LMA 3 waters would be required to have a fully engineered weak line or equivalent in the top 75 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 August) 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.

Vessels fishing in inshore (state waters) or nearshore (within 12 nm) waters usually use 3/8 inch (1 cm) diameter ropes. Offshore vessels (beyond 12 nm) use 1/2 (1.3 cm) or 9/16 inch (1.4 cm) ropes. 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,[12] 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 6 years.[13]

There are a few other ways to make a buoy line weak, and the costs vary: The first one is to splice a three ft 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 weak 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 3-ft hollow sleeve, designed by South Shore fishermen, to the original rope. Two cut 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 $2 with an average life span of four years (Knowlton et. al. 2018).

---

[12] Pers. comm. with Shippagan Ltd on March 17, 2020.

[13] Detailed gear price and life span can be found at Appendix.

In this analysis we adopt the costs of the South Shore sleeves as a proxy for weak insertion, and for LMA 3 where fully weak rope will be required, we use 3/4 in. (2 cm) weak rope as a proxy. The sleeves manufactured by Novatec Braid Ltd. have been tested by the South Shore Lobster 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 $6.10 including labor cost, and the cost of 3/8 weak rope is $0.15 per foot. The price for 3/4 in. 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 $2.1 million for Alternative 2. For Alternative 3, the total cost would be $10 million due to the requirement to replace half of the buoy lines with fully weak ropes.

Table 6.4: Affected buoy lines and annual costs of weak lines by alternative in the first year

	Affected Vessels	Affected Buoy Lines	Weak Rope Cost Alternative 2 ($)	Weak Rope Cost Alternative 3 ($)
ME A	545	47,247	234,564	1,939,267
ME B	256	25,731	154,779	1,014,326
ME C	439	60,137	306,502	2,076,992
ME D	432	52,503	270,033	1,409,119
ME E	209	17,531	96,780	568,358
ME F	233	16,277	70,299	1,086,206
ME G	187	14,064	60,744	713,151
NH	241	14,814	63,982	147,619
MA	1,216	100,695	465,453	1,145,628
RI	134	6,824	40,572	72,788
LMA 3	81	3,886	479,651	400,055
Total	3,973	359,709	2,243,359	10,573,507

Notes: 1. All dollar values are adjusted to 2020.
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; and
- 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. This could be exacerbated by the Maine conservation equivalencies which will allow fishermen to fish trawls of up to 10 traps with only one buoy line. Overlain gear can cause one party to 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 up 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 vessel propellers or mobile fishing gear. Furthermore, in areas where trawling up requirements necessitate addition of a second buoy line (e.g., for configurations greater than 20 traps or a vessel going from triples to 10-trap trawls), the second buoy line may make it easier to locate and retrieve gear in case 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 Maine 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 7- and 10-trap trawls fished with a single buoy line (an intentional feature of the project design). This gear configuration was identified as a conservation equivalency in some Maine Zones, although outside of Maine waters it does not occur in normal practice. The conservation equivalency measures were developed by Maine DMR through an iterative collaborative process with the Maine Zone Councils. As fishermen within the Zones provided the measures, there is likely some confidence that gear conflict and associated loss can be avoided in those areas where more than three traps are fished on a trawl with only one end marked with a buoy. In the Maine DMR (2012) study, 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 up or single end lines 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 LMA 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 (Massachusetts 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.

6.2.6.2.1 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 crew members, 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**

6.2.6.2.2 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 NMFS cost survey for lobster vessels (Zou, Thunberg and Ardini 2021). 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 U.S. 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+	15	275,800	752,497	37%

Source: NEFSC Cost Survey (Zou, Thunberg and Ardini 2021)

6.2.6.2.3 Conclusions

As indicated above, the addition of a sternman is a major economic decision for a vessel operator, and is dependent upon many factors. Given the costs, an operator who fishes alone is not likely to alter that practice due to trawling up requirements. 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.[14] Anecdotal discussions with fisheries managers also indicate that trawls are routinely fished by vessel operators working alone.[15] Finally, the trawling up configurations proposed in Alternative 2 are based on measures proposed by Maine DMR after extensive scoping with Maine lobstermen and were described as 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 up 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

[14] Based on analysis of Massachusetts DMF permit and 2009 Catch Report data.

[15] Pers. comm. with Maine DMR (August 30, 2012) and Massachusetts DMF (November 7, 2012)

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.[16] 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 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 with the exception of the Outer Cape Cod LMA; South of Islands (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. How a 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 the 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 when the restricted area ends. For example, if a vessel only holds a state permit, while during the restricted period no other state waters is available, this vessel will be assumed to 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 techniques such as remote retrieval of buoy line that is stored on the bottom. Given the need for an exemption to buoy line requirements and the high costs of ropeless fishing units and deck technology, fishermen interested in using ropeless technology within seasonal restricted areas are likely to be limited to those participating in

[16] Pers. comm. with Maine DMR, August 30, 2012

collaborative gear research and borrowing gear from the NMFS NEFSC gear cache. Given the existing and anticipated ropeless units available, fewer than 35 fishermen across the Northeast Region fishing up to 10 trawls each are likely to be able to participate until the technology is more affordable and operationally feasible under commercial fishing conditions.

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.

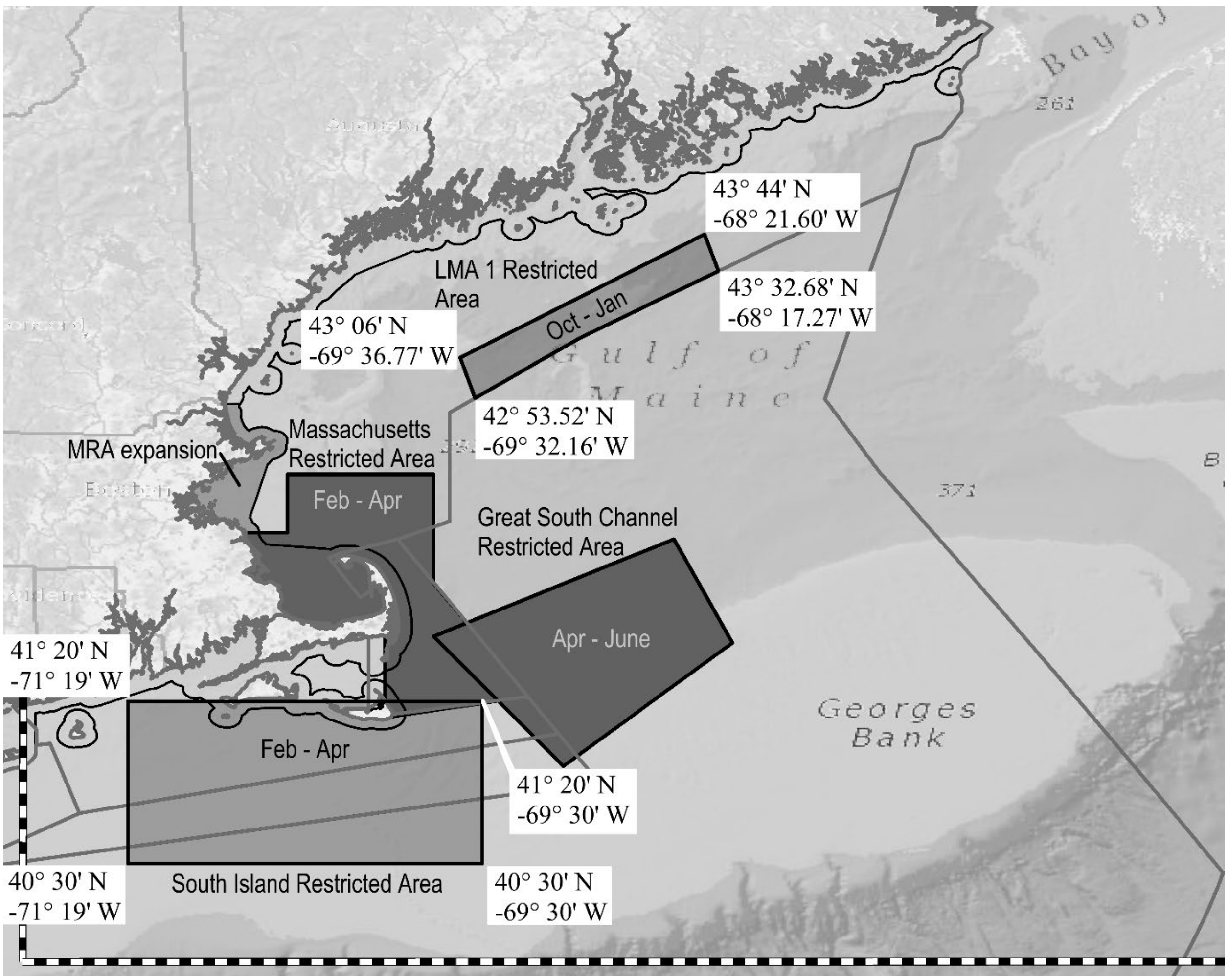


Figure 6.3: The trap/pot buoy line seasonal restricted areas proposed in Alternative 2 (Preferred). LMAs are delineated by the gray lines. The new South Island Restricted Area is proposed as closed to trap/pot buoy lines from February through April and the LMA 1 Restricted area is proposed from October through January. An expansion of the MRA into Massachusetts state waters to the New Hampshire border and under state regulations, extended in state waters in LMA 1 and the Outer Cape through at least May 15, with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape Cod LMA, which would remain closed to lobster harvest from February through March. This change is intended to encourage ropeless gear testing and accelerate the development of commercially feasible ropeless fishing and associated long-term benefits to right whales. The area north and east of the checked line and west of the EEZ encompasses the Northeast Region.

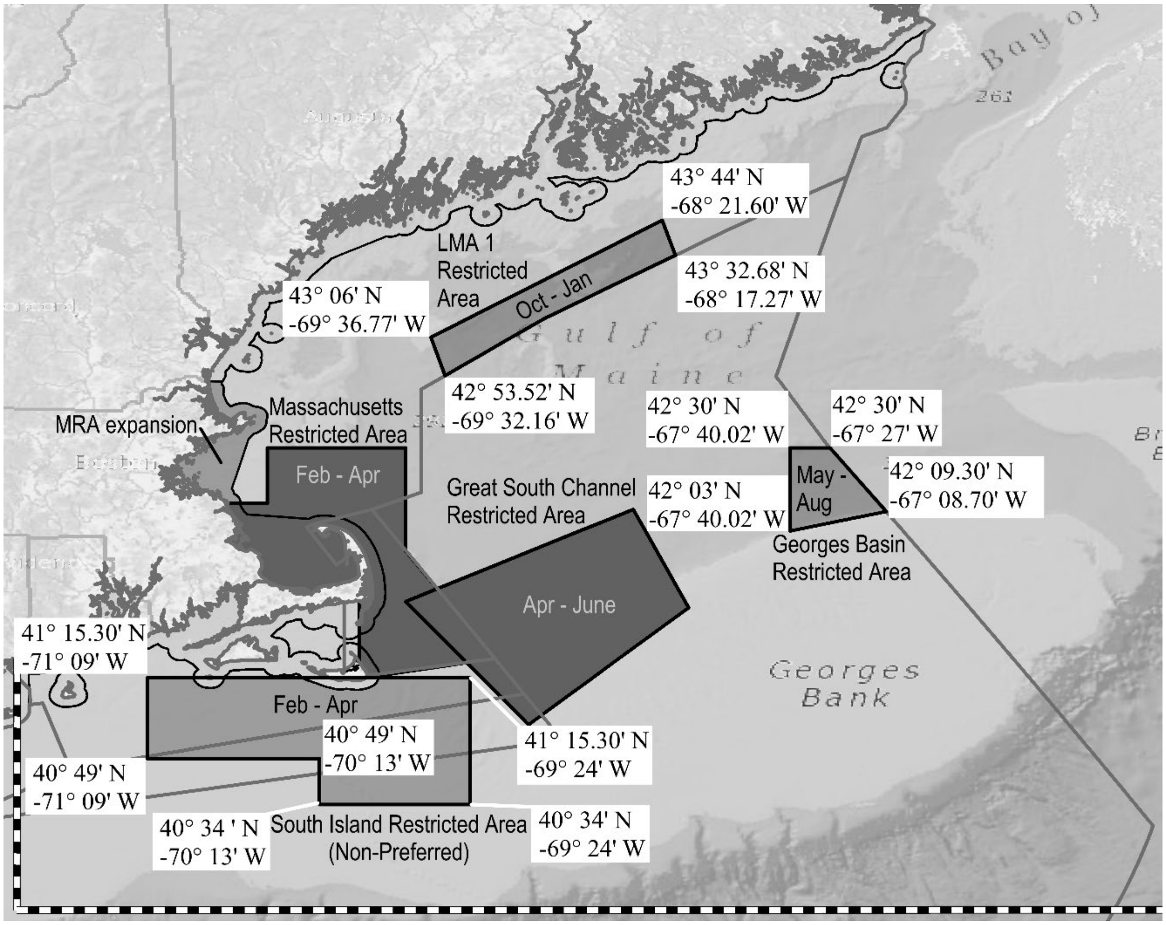


Figure 6.4: The buoy line restriction options proposed in Alternative 3 (Non-preferred). The LMA 1 Restricted Area is proposed from October through February. The South of Island Restricted Area from February to April is L-shaped and covers most LMA 2 waters and a small portion of LMA 3. The Georges Basin Restricted 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. The MRA North is included in Alternative 3 as well. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape Cod LMA, which would remain closed to lobster harvest from February through March. This change is intended to encourage ropeless gear testing and accelerate the development of ropeless fishing and associated long-term benefits to right whales. The area north and east of the checked line and west of the EEZ encompasses the Northeast Region.

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 (2,505 km^2)	0	62
MRA North	2	Feb - Apr	497 (1,287 km^2)	106	0
South Island	2	Feb - Apr	5,468 (14,162 km^2)	16	11
ME LMA1	3	Oct - Feb	967 (2,505 km^2)	0	62
MRA North	3	Feb - May	497 (1,287 km^2)	193	0
MRA	3	May	3,566 (9,326km^2)	138	21
Georges Basin	3	May - Aug	557 (1443 km^2)		16
South Island	3	Feb - May	3,506 (9080 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 NEFSC. On average, vessels less than 35 ft have an annual operation cost of $68,858; the operation cost for medium-sized vessels (35-44 ft) is $120,704. For large (45-54 ft) and extra-large (55+ ft) vessels, the operation costs are $182,137 and $718,034 respectively. (Zou, Thunberg, and Ardini 2021). 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.

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 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 closure 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 its traps during the closed period, it may 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 in 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 travel 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 trips 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 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 (25.9 km/hr). 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. In calculating the change in costs attributable to each regulatory alternative, average diesel price data from 2017 to 2019 from the American Petroleum Institute for the New England Area were used. The adjusted price for all areas is $3.11 per gallon in 2020 U.S. 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)	$3.11 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 that 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 10 percent is the upper bound. Unlike catch reduction from trawling up measures, 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 expressed concerns that restricted areas to protect whales would cause a "curtain effect" resulting from fishermen lining up to surround a restricted area. Curtain effects have been observed around finfish closure areas that were 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.

Though movement of gear to productive fishing grounds closest to a restricted area is anticipated, and it is important to properly place a restricted area to avoid increasing line density in areas of high whale density, actively fishing fishermen are unlikely to overcrowd gear because of the impacts on catch rates. To functionally create a fence or curtain of vertical buoy lines, gear would need to be set up close enough to adjacent gear for the buoy lines to have a non-additive effect. It is unclear how close gear would have to be to have this non-additive effect but it seems improbable that offshore fishers would set their gear this close to adjacent gear on a broad scale. However, in response to comments like these, the analyses in the FEIS reconsidered areas where gear would be moved into areas of high risk. As a result, a different South Island Restricted Area was chosen and the Georges Basin Restricted Area was not selected in the Preferred Alternative based on their tendency to push gear into high risk areas in the DEIS. Please see Chapters 3, 5, and 6 for more details.

Until 2021, no curtain effects were observed around existing seasonal restricted areas. However in 2021, Massachusetts modified their regulations to close state waters to lobster fishing into mid-May. Between the northwest MRA closure and state waters, a narrow band of Massachusetts Bay was still open to fishing. Dual permitted fishermen apparently moved their gear out of state waters and federal permit holders began moving gear from the beach to stage outside of MRA to prepare for the May 1 opening. NMFS and Massachusetts DMF are investigating and an extension of the MRA closure to the beach will be considered for further rulemaking to prevent that in the future. Outside of that incident, however, and despite heavy surveillance, similar concentration of gear along a seasonal restricted area has not been documented and is not anticipated.

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, Northeast Region lobster and Jonah crab 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 current laws. The gear would still require ropes between pots in the trawls on the ocean floor. Most designs also include buoy lines, but they are stored on the bottom until retrieved acoustically by a vessel operator. Team members disagreed about further consideration of “ropeless fishing” for multiple reasons, including but not limited to: 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 modifications to the closed areas to allow ropeless fishing, 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 adopters. Through these efforts, and associated outreach by the NMFS gear team, interest does not appear to be substantial among the commercial fishery in the Northeast Region, and participation within any restricted area can be limited through the authorization process. We anticipate that at least through 2025, ropeless fishing in these restricted areas is likely to be done primarily by collaborators borrowing gear from the NMFS gear cache, with up to an additional 10 percent of effort by other researchers and fishermen coast-wide. The NEFSC gear team projects that by 2025, they expect to have about 300 ropeless units and enough deck controllers for about 30 vessels, as well as technology to support adjacent mobile fishing vessels. That is, coast-wide, there would be up to 33 vessels fishing ten ropeless trawls. If congressionally appropriated and private funding remains available, NMFS will continue to reimburse participating fishermen for some of their time and will provide the onboard and in-water technology so that costs to fishermen will be minimal and could be offset by higher catch rates within an area closed to most fishermen. To incentivize participation, the alternatives consider modifying current seasonal restricted areas and defining new restricted areas as seasonal closures to trap/pot fishing that use persistent vertical buoy lines. The economic impacts of ropeless fishing is expected to be primarily borne by NMFS and collaborators, and costs to fishermen are expected to be negligible over the next few years.

The costs of converting to ropeless are described as high at this time (estimated to range from over \$55,000 to over \$240,000 per vessel; Black et al. 2019). Participating vessels may still incur some costs with transitioning gear to ropeless fishing within these areas. For example, switching to ropeless gear takes time. Additionally, participants in research note that it takes additional time to set and haul the gear, due in part to logistical differences from traditional gear and crew familiarity with ropeless gear, which improves over time. Researchers are working on quantifying this difference in operational costs, but currently are unable to estimate how this difference may impact revenue opportunities.[17]

Generally, participants are expected to benefit due to the revenue they gain from ropeless fishing in these areas during seasonal restriction, in comparison to suspending fishing activities due to the seasonal restrictions. Because of the uncertainty regarding the operational differences in tending this gear, we are unable to estimate how monthly revenue may differ between traditional trap/pot and ropeless gear. However, we expect that ropeless participants will be able to gain a portion of the revenue that is currently estimated to be lost due to inactivity during the closures.

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.

As 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 DST and the NMFS/IEC co-occurrence model. In Alternative 2, the proposed season is from October to January, and in Alternative 3, one more month of restricted area in February is proposed.

As shown in Figure 6.3, the entire 967 square miles (2,505 km^2) of closed area is located in federal waters offshore of LMA 1. All vessels fishing in this area are required to have a federal permit with a designated fishing area of LMA 1. Using VTRs, the analysis in the DEIS identified

[17] Pers. comm. with NEFSC gear specialist Henry Milliken.

about 45 vessels that would be affected by the LMA 1 seasonal restricted area. However, public comment from Maine fishermen suggested that this estimate was very low, likely in part because reporting is not mandatory for all Maine and federally permitted vessels. As a result of public comment, for this analysis, the Maine DMR harvester report and dealer report data, we estimated that at least 123 vessels fished outside 12 nm in Zone C, D, and E, where half of the area is covered by the proposed restricted area. Without further detailed location information of these vessels, we assume a uniform distribution and assign half of them to the restricted area. We also assume these vessels within the restricted area would re-locate all their traps within the same zone but closer to shore for two reasons: firstly, vessels with only LMA 1 permit are not able to get over the Eastern border of the restricted area to fish in LMA 3. Secondly, even though vessels in Zone C and E could move a portion of their traps into adjacent zones, the trap numbers and available fishing grounds are limited. It is unlikely to be economically efficient to tend traps in two distant areas.

Based on the assumptions above, fuel costs for affected vessels 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 distance from relocation is 10 miles (16 km) per round trip and the upper bound is 20 miles (32 km).

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	36.2	12,542	25,085
Nov	8.9	43.8	18,258	36,514
Dec	5.2	50.5	11,125	22,249
Jan	3.6	61.5	11,822	23,644
Feb	2.5	43.1	4,935	9,870
Oct-Jan (Alt 2)			53,747	107,492
Oct-Feb (Alt 3)			58,681	117,362

Offsetting fuel savings is reduced catch. We assume vessels that fish in the closed area choose it as primary fishing ground based on their gear setup. Therefore, it is reasonable to assume catch reduction if they have to relocate their gears to secondary ground. Additionally, the crowding effects created by the relocated vessels would also reduce landings for other vessels outside 12 nm in Zone C, D, and E. From the dealer report data, we could assess the monthly landings in each zone; and from the harvester report data, we could estimate the proportion of landings by distance from shore. Combining results from these two data sources, we could provide an estimate of landings in areas outside 12 nm (22.2 km) from October to February (Table 6.12). With assumptions from the previous section, we apply a 5 percent to 10 percent catch reduction on all traps fished in the closed area.

Table 6.12: Catch impacts outside 12 nm (22.2 km) in Maine Zone C, D, and E by month

Month	Price ($/lb)	Total Catch (lb)	5% Value ($)	10% Value ($)
Oct	3.9	552,871	107,810	215,620
Nov	3.9	1,135,207	221,365	442,731
Dec	4.1	843,463	172,910	345,820
Jan	4.8	555,956	133,430	266,859
Feb	6.4	193,725	61,992	123,983
Oct-Jan (Alt 2)		3,087,497	635,515	1,271,030
Oct-Feb (Alt 3)		3,281,222	697,507	1,395,013

6.3.4.2 Massachusetts Restricted Areas

The Massachusetts Restricted Area (MRA) has been closed from February through April since 2015, with extensions of the state water closure into May by Massachusetts when right whales remain in the area. Modifications to the seasonal restricted areas are analyzed as part of Alternative 2 and 3. In 2021, Massachusetts DMR expanded the MRA in Northern state waters to the New Hampshire border (Code of Massachusetts Regulations 322 Section 12) and extended the closure to May 15, with the option of opening early or delaying the opening of state waters when right whales have left the area. Under Alternative 2 (Preferred), the Plan would adopt the extension of the MRA in state waters to the New Hampshire border, mirroring the state regulations. The seasonal extension into May would not be included. In Alternative 3 extension of the entire MRA into May is analyzed, with possible reopening if surveys demonstrate that right whales have left the restricted area. In addition, Alternative 3 includes the expansion of the MRA in northern state waters.

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 restricted areas. MRA North (Massachusetts state waters north to New Hampshire), Cape Cod Bay, and Outer Cape Cod are state waters; we assume all vessels will suspend fishing during the seasonal restriction. In the federal waters, both relocation and suspending fishing are analyzed. Considering both lost revenue and saved operation costs, Alternative 2 would have the total cost of $0.3 million, and Alternative 3 would have a total cost of $1.8 million.

Table 6.13: Cost for affected vessels in Massachusetts Restricted Area

	Alt 2	Alt 3	Alt 3	Alt 3	Alt 3	Total (Alt 2)	Total (Alt 3)
Area	MRA North	MRA North	MRA	MRA	MRA	MRA North	MRA
Month	Feb-Apr	Feb-May	May	May	May	Feb-Apr	Feb-May
Action	Lines Out	Lines Out	Lines out	Relocation	Relocation		
Cost Type	Catch impacts	Catch impacts	Catch impacts	Catch impact	Extra Fuel		
Affected Vessels	106	193	137.6	20.5	20.5	106	351
Catch per Trap (lb)	0.8-1.3	2.4	2.2	2.2			
Average Trip per	3.3-5.7	8.6	8.1	8.1	8.1		

	Alt 2	Alt 3	Alt 3	Alt 3	Alt 3	Total (Alt 2)	Total (Alt 3)
Month							
Price ($/lb)	5.9-7.4	5.9	5.9	5.9			
Total Traps	75,859	82,765	70,507	12,603			
Total Landing Value ($)	618,289	1,221,589	1,008,462				
5% Lost Revenue Lower Bound ($)				9,013			
10% Lost Revenue Upper Bound ($)				18,026			
Cost Saving($)	305,504	210,207	573,810				
Lower Total Cost ($)	312,784	1,324,165	434,652	9,013	10,610	312,784	**1,778,440**
Upper Total Cost ($)	**312,784**	**1,324,165**	**434,652**	**18,026**	**15,916**	**312,784**	**1,792,758**

6.3.4.3 Massachusetts South Island Restricted Area

In recent years, right whale aggregations have appeared in the waters south of Martha's Vineyard and Nantucket. Two different seasonal restricted areas to buoy lines are analyzed in Alternative 2 and 3 as shown in Figure 6.3 and Figure 6.4. Consistent with the restricted area in MRA, the period for the South Island Restricted Area would be from February through April in the Preferred Alternative and February through May in the Non-preferred.

Table 6.14: Number of affected vessels by area and month

Alternative	Month	Affected vessels (lines out only)	Affected vessels (relocated)	Total
2	Feb	9.19	8.92	18.11
	Mar	9.02	8.16	17.18
	Apr	15.03	11.14	26.17
3	Feb	1.14	3.73	4.87
	Mar	1.14	3.76	4.89
	Apr	2.27	6.96	9.23
	May	2.92	7.25	10.18

The seasonal buoy line closed area in Alternative 2 is a large rectangle area that covers both most LMA 2 waters and a small portion of LMA 3 waters. The Vertical Line Model suggests that 17 to 26 vessels fish in this area during the months it would be closed.

Table 6.15: Costs of suspending fishing in the South Island Restricted Area

	Total Traps	Catch per Trap Lobster (lb)	Price Lobster ($/lb)	Value Lobster ($)	Catch per Trap Jonah Crab (kg)	Price Jonah Crab ($/kg)	Value Jonah Crab ($)	Operation Cost Savings	Total Cost
	Alternative	2							
Feb	13,389	0.6	6.2	55,637	10.8	0.8	122,626	25,326	
Mar	11,764	1.0	6.9	81,398	8.6	0.8	85,270	37,395	

	Total Traps	Catch per Trap Lobster (lb)	Price Lobster ($/lb)	Value Lobster ($)	Catch per Trap Jonah Crab (kg)	Price Jonah Crab ($/kg)	Value Jonah Crab ($)	Operation Cost Savings	Total Cost
Apr	15,618	1.9	7.4	233,046	2.7	0.8	37,284	150,189	
Sum				370,081			245,179	212,910	**381,557**
	Alternative	3							
Feb	3,679	0.6	6.2	15,289	10.8	0.8	33,696	3,135	
Mar	3,568	1.0	6.9	24,685	8.6	0.8	25,859	4,719	
Apr	5,894	1.9	7.4	87,944	2.7	0.8	14,070	22,722	
May	5,522	2.4	5.8	79,376	2.5	0.8	12,063	52,905	
Sum				**207,294**			**85,689**	**83,480**	**209,503**

Given the size and proximity to shore, for both restricted areas in Alternative 2 and 3, some vessels may suspend fishing and some vessels may relocate their gears depending on the type of permits they hold. 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 on 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 to 10 percent of their catch due to the loss of their primary fishing location. Both alternatives capture important winter fishing grounds for Jonah crab, which has become an important target species in winter months and a major contributor to revenue for Southern New England fishermen. While a seasonal closure would likely increase lobster catch rates once an area opens, making up for lost landings during the closure, Jonah crab landings are limited only by trap and vessel capacity. Catch cannot be made up during the open fishing season. Because Jonah crabs are normally caught together with lobsters, for this analysis they are added 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 2 and 3.

Table 6.16: Costs of relocation in the South Island Restricted Area

	5% Lobster Value ($)	10% Lobster Value ($)	5% Jonah Crab Value ($)	10% Jonah Crab Value ($)	5% Total Value ($)	10% Total Value ($)	Lower Fuel Cost ($)	Upper Fuel Cost ($)	Total Lower Cost ($)	Total Upper Cost ($)
	Alternative	2								
Feb	1,629	3,258	3,591	7,181	5,220	10,440	2,798	3,730		
Mar	2,162	4,323	2,265	4,529	4,427	8,854	3,218	4,291		
Apr	5,593	11,185	894	1,789	6,487	12,975	6,732	8,977		
Sum	9,384	18,767	7,573	15,147	16,956	33,914	12,749	16,997	29,705	50,911
	Alternative	3								
Feb	700	1,401	1,544	3,089	2,245	4,489	780	1,172		
Mar	1,154	2,307	1,208	2,417	2,362	4,725	988	1,482		
Apr	3,877	7,755	620	1,241	4,497	8,995	2,802	4,202		
May	3,297	6,594	501	1,002	3,798	7,597	4,288	6,431		
Sum	9,029	18,057	3,874	7,748	12,903	25,806	8,858	13,287	21,761	39,092

Table 6.17: Cost estimation of vessels in the South Island Restricted Area

	Catch Impact Lower($)	Catch Impact Upper ($)	Fuel Impact Lower ($)	Fuel Impact Upper ($)	Lines Out ($)	Total Lower ($)	Total Upper ($)
Alt 2	16,956	33,914	22,220	29,626	402,350	432,055	**453,261**
Alt 3	**12,903**	**25,806**	**8,858**	**13,287**	**209,503**	**231,264**	**248,595**

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 currently fish 35 traps per trawl. All vessels hold federal lobster permits and submit VTRs regularly.

The duration of the Georges Basin Restricted Area would be from May through August. Vessels would be required to remove gear from the area during the restricted season and are most likely to relocate their traps to productive 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 to 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 (lb)	Price ($/lb)	Total Traps	Total Landings (lb)	5% Value ($)	10% Value ($)
May	16.5	5.7	10,410	381,345	52,238	**104,476**
June	21.8	5.6	17,487	842,098	112,292	**224,586**
July	16.1	5.5	14,956	527,064	69,715	**139,430**
August	34.0	5.4	11,549	862,861	111,649	**223,298**
Sum					**345,895**	**691,789**

6.3.4.5 Summary

Table 6.19 summarizes the economic impact analysis of all proposed restricted areas in Alternative 2 (Preferred) and Alternative 3 (Non-preferred). The total cost of the seasonal restricted areas analyzed for Alternative 2 range from $1.2 to $1.9 million. The seasonal restricted areas analyzed in Alternative 3 would have economic impacts ranging from $2.8 to $3.9 million because there are more restricted areas and closures of longer duration.

Table 6.19: Summary of Economic Impact of Restricted areas

Restricted area	Alternative	Analysis period	Size (Square miles)	Max vessels-lines out	Max vessels-relocation	Lower Bound Cost ($)	Upper Bound Cost ($)
ME LMA1	2	Oct - Jan	967 (2,505 km^2)	0	62	562,656	1,232,804
MRA North	2	Feb - Apr	497 (1287 km^2)	106	0	312,784	312,784
South of Islands	2	Feb - Apr	5,468 (14,162 km^2)	16	11	432,055	453,261
Total	2		6,932 (17,954 km^2)	122	73	1,307,495	1,998,849
ME LMA1	3	Oct - Feb	967 (2,505 km^2)	0	62	618,156	1,353,674
MRA North	3	Feb - May	497 (1287 km^2)	193	0	1,324,165	1,324,165
MRA	3	May	3,566 (9,32649 km^2)	138	32	454,275	468,593
Georges Basin	3	May - Aug	557 (1,443 km^2)	0	16	345,895	691,789
South of Islands	3	Feb - May	3,506 (9,080 km^2)	3	7	231,264	248,595
Total	3		8,099 (20,976 km^2)	141	117	2,973,755	4,086,817

Commenters on the DEIS and Proposed Rule were asked to consider whether a trigger mechanism was feasible for the LMA 1 Restricted Area so that the area could remain open to fishing unless some trigger threshold was reached. The seasonal closure of LMA 1 is estimated to make up approximately 5 to 6 percent of the risk reduction achieved by the risk reduction elements of Alternative 2 (Preferred). Although some commenters expressed a preference for a trigger, no trigger thresholds were proposed that could ensure a similar level of right whale risk reduction. Maine DMR, for example, suggested a trigger based on right whale entanglement rates within Maine LMA 1, however, because right whale entanglements are often documented miles and months away from the original incident, this type of trigger could not be demonstrated to be an effective or protective measure on a year to year basis.

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 2 (Preferred), NMFS would mirror the Maine state regulations for all non-exempted waters, and would implement analogous marking for the other New England states. In state waters, the gear marking requirement would include one state-specific 3-foot (91cm) colored mark within 2 fathoms (3.7 m) of the buoy and at least two additional 1-foot (30 cm) marks in the top and bottom half of the gear. In federal waters, in addition to the top 3-foot (91 cm) mark, an additional green 1-foot (30 cm) mark would be required in the top 2 fathoms (3.7 m) of line, and at least three 1-foot (30 cm) marks would be required in the top, middle, and bottom of the buoy line below the surface system. Within 6 inches of each 1-foot state-colored mark, another 1-foot green mark would also be required to distinguish lines in federal waters from state waters. This Alternative would continue to allow multiple methods for marking line below the surface system (paint, tape, rope twine inserts, etc.), with highly visible paint required for the 3-foot mark in the surface system. Under Alternative 3 (Non-preferred) the 3-foot (91 cm) state-specific color would be marked on the buoy line within 2 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 that would be necessary to mark under Alternative 2 and 3. 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[18]:

1. The NMFS gear specialist indicated that fishermen replace external marks annually. That assumption is not the case for buoy line with inserted ID tape. So the time and cost burden are the same for each year in Alternative 2. In Alternative 3, markings are assumed to repeat every year, while ID tape lasts for six years.

2. Time for marking: 20 min per line + 2 min per mark if using taping or painting. For twines in federal waters, the time is estimated to be 10 min per mark. For example: a five-mark line with taping would cost 20+2*5=30 min; an eight-mark line with twines would cost 20+10*8=100 min. For dual-permitted vessels moving from state to federal waters, twine is the likely marking that will be used to insert the green federal water mark, because paint and tape are unlikely to be effective on wet rope. Note that this is an increase from past estimates based on observations during 2020 marking conducted by 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); the cost for enough twine to make a one foot mark once woven in is up to $0.5. Labor cost per hour is $25.15 in 2017 dollars ($26.52 in 2020 dollars, see table 6.1 for details).

ID tape ropes are not available at this time. Suppliers that have produced it in small batches could not provide an estimate of the price range. On a conservative basis, here we assume that the cost of ID tape rope will be twice as much as conventional rope, which costs $0.11 per foot for 3/8 in. rope and $0.26 per foot for 3/4 in. rope. Table 6.20 describes the gear marking cost for Alternative 2 and 3.

Table 6.20: The first year gear marking cost for Alternative 2 and 3

[18] Email correspondence with NMFS gear specialists from June 30, 2020 to May 9, 2021.

	Number of Affected Vessels	Number of Endlines	Total Lower Cost Alt 2 ($)	Total Upper Cost Alt 2 ($)	Marking Cost Alt 3 ($)	ID Tape Cost Alt 3 ($)	Total Cost Alt 3 ($)
ME	2,301	233,508	3,107,273	4,407,985	2,300,229	8,611,698	10,911,927
NH	241	14,815	173,382	173,382	145,939	144,339	290,278
MA	1,216	100,651	1,215,509	1,346,020	991,488	1,120,599	2,112,087
RI	131	6,525	88,260	129,581	64,276	71,170	135,446
LMA 3	81	4,119	55,835	122,088	40,575	977,683	1,018,259
			0	0	0	0	0
Total	3,970	359,618	4,640,260	6,179,056	3,542,507	10,925,490	14,467,997

Notes: 1. All dollar values are adjusted to 2020.
2. Gear marking is assumed to repeat every year except for ID tape. 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 3, 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 time, so each state could identify distribution methods and fishermen could choose their own line reduction measures 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 the economic impact of line cap reduction is difficult without knowing the exact measures of each area. Therefore, we estimate the more likely (and more expensive) situation to get an estimate of economic impact, by 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 costs would increase due to the need for more groundlines and the associated labor costs from 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, which assumes twice the 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

	Surface System Savings ($)	Buoy line Savings ($)	Groundline Material Cost ($)	Groundline Labor Cost ($)	5% Catch Impact Lower Bound ($)	10% Catch Impact Upper Bound ($)	Total Cost Lower Bound ($)	Total Cost Upper Bound ($)
ME A	2,324,719	1,023,539	53,130	557,086	1,892,903	3,785,805	-845,140	1,047,763
ME B	143,525	477,511	40,201	227,060	771,527	1,543,055	417,752	1,189,280
ME C	188,538	902,198	37,464	332,767	1,130,311	2,260,621	409,807	1,540,117
ME D	253,048	740,393	40,830	354,337	1,203,690	2,407,381	605,416	1,809,106
ME E	94,027	349,626	17,433	150,215	510,450	1,020,900	234,445	744,895
ME F	163,258	757,685	22,988	305,455	1,038,003	2,076,005	445,502	1,483,505
ME G	89,032	368,978	19,905	190,341	646,706	1,293,410	398,941	1,045,646
MA	38,123	206,765	13,738	391,554	1,107,742	2,215,485	1,268,146	2,375,889
RI	11,661	21,067	4,786	71,194	89,614	179,228	132,868	222,482
LMA3	134,823	547,795	7,544	284,607	1,176,756	2,353,512	786,290	1,963,046
Total	3,440,755	5,395,556	258,018	2,864,618	9,567,702	19,135,401	3,854,028	13,421,728

Notes: All values are adjusted to 2020 dollars.

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 line cap reduction approaches that were not analyzed for costs are briefly described below.

6.5.1.1 Trawling up to 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. In areas where two buoy lines 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. 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.

6.5.1.2 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. Reducing trap caps by half could also achieve a 50 percent reduction in buoy lines when paired with traps/trawl requirements. Fisheries managers that participated in public meetings of the Atlantic State Marine Fisheries Commission and the Team have expressed confidence that on productive fishing grounds, lobster trap reductions could occur without negative economic consequences. Described further below, a number of studies have demonstrated this, for example Myers and Moore (2020) and Acheson (2013). However, to be a reduction in the number of buoy lines actively being fished, and to be fairly distributed based on vessel fishing histories or other commonly used metrics, detailed knowledge of the amount of fishing effort by sector or individual vessel is required. Allocation decisions in effort control management of a capped resource (lines or traps) are also usually informed by iterative public fishery management processes and include appeal options that are administratively burdensome. Because the lobster/Jonah crab fishery has variable reporting requirements across states, and because only about 10 percent of Maine fishermen have been required to report in any year and federal reporting has not been mandatory, existing data are not available to easily determine effective trap and line cap measures. This was demonstrated by the failed attempt by the Atlantic States Marine Fisheries Commission to identify an effort limit addendum, described in Chapter 3 Section 3.1.1.2.

A line cap that would allow fishermen to choose could result in some choosing trap reductions. Trap reduction applications would likely 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 already, with the exception of a few small exempted areas outside of 3 nm (5.6 km) offshore of Maine. Common configurations in this area start at one to three traps per trawl and increase with distance from shore. 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 up 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 buoy lines currently used 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.

6.5.1.3 Ropeless on one end

One additional scenario available is the use of only one tagged buoy line on trap/pot trawls with no buoy line or the incorporation of a ropeless fishing device on the other end. Under Alternative 2 (Preferred), Maine DMR's conservation equivalency that would allow trawls of up to ten traps to be fished with one buoy line is analyzed. Those trawls would be fished without a ropeless retrieval unit on the buoyless end of the groundline. For longer trawls, a ropeless unit could be used. 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 an exemption to surface marking requirements under the Atlantic Coastal Act 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 are being developed to transmit location information, increased gear loss would not be anticipated. The primary costs would be those associated with purchasing and maintaining the equipment necessary to deploy, locate, and retrieve the buoy line.

6.5.2 *Potential Impacts:*

As discussed above, if the first scenario is widely adopted, the cost of the line cap comes 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 lines that need 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 $3.9 million to nearly $13.4 million, a range of 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 are 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. Myers and Moore (2020) also agree that reducing effort in the U.S. lobster fishery could lead to higher profits and more protection for right whales. 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 U.S. 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 where some trawling up is used to recoup traps and some traps become latent is far more likely. 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. Plan modifications conducted under the Marine Mammal Protection Act are not normally done to control fishing effort, but rather are more commonly a goal of fishery management measures under the Atlantic Coastal Act, As a result, there is likely to be more variation in how vessel operators respond to trap reduction. 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 50 percent line cap of 2017 buoy line estimates. Similar to first scenario, 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 $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 Final Rule 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 1 the economic burden attributable to the ALWTRP would be unchanged. 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, measures within Maine exempted waters, and the extension into May of a buoy line closure for state waters in the Massachusetts Restricted Area, are not analyzed.

The cost changes in Alternative 2 and 3 are displayed in Table 6.22. Three sets of values are presented: the first year costs, the total six year costs, and the annualized value using both 3 percent and 7 percent discount rates. In general, the largest cost changes originate from the assumed catch impacts associated with the gear configuration change. In Alternative 2, using a 7 percent discount rate (this rate applies to all annualized costs below) trawling up measures were estimated to cost between $2.5 million to $8.3 million annually, and in total $12.1 million to $39.8 million over six years. The full range of costs for the options under Alternative 3, including primarily the 50-percent buoy line reduction in federal waters, is estimated to be $5.5 million to $14.4 million annually, and $26.1 million to $68.6 million in total.

The total cost of all proposed measures for Alternative—including gear marking, weak rope, seasonal restricted areas, and gear conversion costs—ranges from $10.5 million to $19.1 million annually, and $50 million to $91.1 million in total. It is much lower than the Alternative 3, which ranges from $29.6 million to $40 million annually, and $141.3 million to $190.5 million in total.

Table 6.22: Summary of compliance costs by alternatives (in million $)

	Discount Rate	Gear Marking Lower	Gear Marking Upper	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		4.6	6.2	2.2	1.6	8.8	1.3	2.0	0.0	0.0	9.8	19.2
Alt 2 Total		27.8	37.1	2.2	12.1	39.8	7.8	12.0	0.0	0.0	50.0	91.1
Alt 2 AV	3%	5.1	6.8	0.4	2.2	7.3	1.4	2.2	0.0	0.0	9.2	16.8
Alt 2 AV	7%	5.8	7.8	0.5	2.5	8.3	1.6	2.5	0.0	0.0	10.5	19.1
Alt 3 Year 1		14.5	0.0	10.6	1.0	2.0	3.0	4.1	3.9	13.4	32.8	44.6
Alt 3 Total		86.8	0.0	10.6	3.1	7.4	17.8	24.5	23.0	61.3	141.3	190.5
Alt 3 AV	3%	16.0	0.0	2.0	0.6	1.4	3.3	4.5	4.2	11.3	26.1	35.2
Alt 3 AV	7%	18.2	0.0	2.2	0.6	1.5	3.7	5.1	4.8	12.9	29.6	40.0

Notes:
1. Year 1 values are in 2020 dollars
2. Total represents value of year 1 to year 6, in 2020 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.

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 identifies the number of affected vessels by each proposed measure, and 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 1, 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 the Northeast Region, not including Maine exempt waters. Most of them are fishing for lobster and a few in Southern New England waters also fish for Jonah crab. This rule will 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 2 would affect all vessels in the Northeast Region, except for those in Maine exempt waters, where Maine would be responsible for rulemaking. Maine has the most affected vessels, and Massachusetts has the second most. The minimum trap/trawl requirement in Alternative 2 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. Vessels in LMA 2 would not be required to trawl up; instead they could use weak rope as a conservation equivalency. Under Alternative 2, all LMA 3 vessels would be required to trawl up from 35 to 50 traps, depending on where they fish. Under Alternative 3, LMA 3 vessels are only required to trawl up to 45 traps from 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, most of them from Maine.

A number of vessels would be impacted by proposed seasonal buoy line restricted areas in Alternatives 2 and.3. Under Alternative 2, the Maine LMA 1 seasonal restricted area from

October through January would affect at least 123 vessels outside 12 nm in Zone C, D a,nd E. The MRA North expansion from February through April would affect 106 vessels, and the South Island Restricted Area would affect 27 vessels. Under Alternative 3, the Massachusetts Restricted Area extension in May would affect 159 vessels, most of which are state permit holders and have to suspend fishing during the seasonal restrictions. The Massachusetts Restricted Area would affect more vessels because of the larger closed area, including 138 vessels that fish in state waters and 21 in federal waters. The MRA North extension in May analyzed in Alternative 3 would affect 50 more vessels than the Preferred Alternative. A Georges Basin buoy line restricted area from May through August would affect 16 offshore vessels, most of which are from Rockingham County, New Hampshire. The L-shaped South Island Restricted Area analyzed in Alternative 3 would affect ten vessels in total. Table 6.24 shows the details of the number of affected vessels by restricted area under Alternatives 2 and 3.

Table 6.23: Number of affected vessels by measures and area

	Gear Marking, Weak Rope	Trawling up Alternative 2	Trawling up Alternative 3	Line Cap
ME A	545	376		281
ME B	256	178		129
ME C	439	137		189
ME D	432	122		191
ME E	209	74		107
ME F	233	103		179
ME G	187	129		109
NH	241	0		0
MA	1,216	7		187
RI	131	0		37
LMA 3	82	82	74	82
Total	3,970	1,206	74	1,491

Table 6.24: Number of affected vessels in different restricted areas

Restricted Area	Alternative	Restricted Period	Size (Square miles)	Max vessels-lines out	Max vessels-relocation
ME LMA1	2	Oct - Jan	967 (2,505 km^2)	0	62
Northern MRA	2	Feb - Apr	497 (1,287 km^2)	106	0
South Island	2	Feb - Apr	5,468 (14,162 km^2)	16	11
ME LMA1	3	Oct - Feb	967 (2,505 km^2)	0	62
Northern MRA	3	Feb - May	497 (1,287 km^2)	193	0
MRA	3	May	3,069 (7,949 km^2)	138	21
Georges Basin	3	May - Aug	557 (1443 km^2)		16
South Island	3	Feb - May	3,506 (9080 km^2)	3	7

The compliance costs for these vessels were 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.[19] 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.

This 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 2018 data shows 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.

[19] This discussion thus uses the terms "counties" and "communities" interchangeably

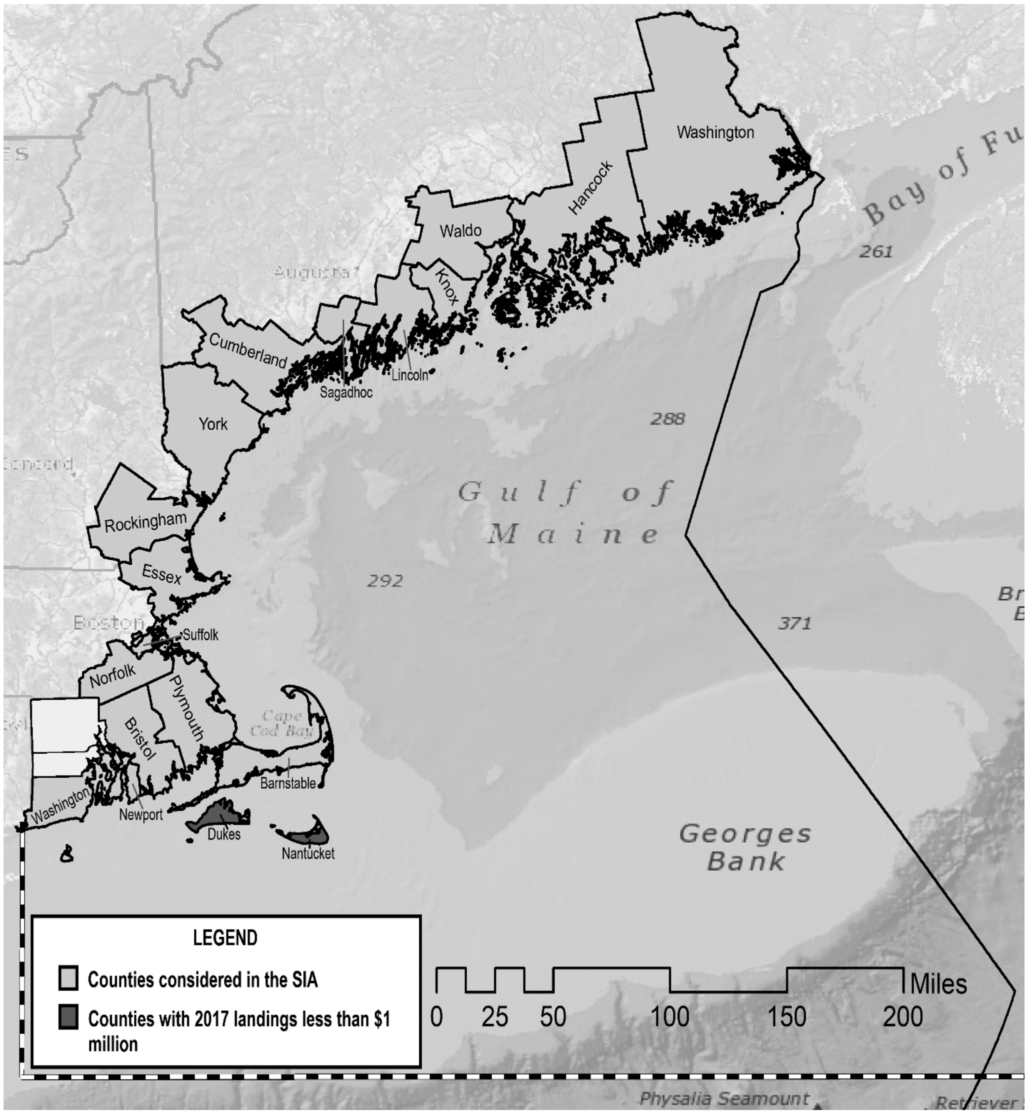


Figure 6.5: Counties considered in the social impact analysis

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.[20]

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 presents 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 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).

[20] Measures of fishing dependence and gentrification (see below) are based on Hall-Arber et al. (2001). At the time this 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

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 (Maine) 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. In addition to commercial fisheries, more entities along the industry supply chain could be affected by the Plan modification such as seafood wholesalers, distributors, processors, vessel and gear suppliers and maintenance businesses et al. Based on an economic impact analysis of the lobster distribution supply chain in Maine conducted by researchers from Colby College (Donihue and Tselikis 2018), the wholesale lobster distribution supply chain contributed more than $967 million to Maine's economy and supported over 5,500 workers in 2016.

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 (Massachusetts), Barnstable (Massachusetts), and Bristol (Massachusetts) 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 U.S; Census Bureau https://www.census.gov/quickfacts/fact/table/washingtoncountymaine,ME/INC110218 U.S. 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

State	County	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
ME	Washington	Lobster, softshell clam, sea scallop	81,003,814	81%	838	1,601	2,514
ME	Hancock	Lobster, American eel, softshell clam	156,154,329	89%	1158	2,221	3,472
ME	Waldo	Lobster, American eel, sea scallop	3,041,380	72%	113	196	322
ME	Knox	Lobster, softshell clam, Atlantic herring	136,413,697	92%	945	1,834	2,872
ME	Lincoln	Lobster, oysters, softshell clam	29,770,294	69%	465	859	1,374
ME	Sagadahoc	Lobster, worms, quahog	5,808,239	75%	210	375	621
ME	Cumberland	Lobster, pollock, cod	60,664,397	69%	646	1,204	1,950
ME	York	Lobster, bluefin tuna, cod	21,354,828	93%	261	479	770
NH	Rockingham	Lobster, cod, pollock	35,026,477	91%	179	396	574
MA	Essex	Lobster, cod, pollock	30,202,297	39%	277	579	856
MA	Suffolk	Cod, lobster, pollock	2,631,553	16%	28	18	25
MA	Norfolk	Lobster, softshell clam, bluefin tuna	1,916,586	99%	24	47	70
MA	Plymouth	Lobster, oysters, cod	13,502,085	49%	192	421	613
MA	Barnstable	Lobster, sea scallops, bluefin tuna	17,499,519	24%	173	346	519
MA	Bristol	Sea scallop, cod, lobster	26,829,026	6%	97	670	865
RI	Newport	Lobster, sea scallop, monkfish	7,313,508	60%	63	152	215
RI	Washington	Loligo squid, lobster, illex squid	5,923,447	81%	128	349	480

6.8 References

Acheson JM: Co-management in the Maine lobster industry: a study in factional politics. *Conserv Soc* 2013, 11: 60–71.

American Petroleum Institute, "Notes to State Motor Fuel Excise and Other Taxes," accessed online at: http://www.api.org/oil-and-natural-gas-overview/industry-economics/fuel-taxes.aspx.

BEA. 2021. Price Indexes for Gross Domestic Product [online Document]. URL https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&1921=survey&1903=11#reqid=19&step=3&isuri=1&1921=survey&1903=11 (accessed 5.25.21).

Black, R., N. Manderlink, B. Morrison. Benefit-Cost Analysis for Ropeless Exemption in Select Closure Areas Memorandum. February 7, 2019.

Bureau of Labor Statistics, Occupational Employment Statistics, accessed online at http://www.bls.gov/oes/, March 2020.

Christiansen, F., S. M. Dawson, J. W. Durban, H. Fearnbach, C. A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H. A. Warick, I. Kerr, M. S. Lynn, H. M. Pettis, and M. J. Moore. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Marine Ecology Progress Series 640:1-16.

Gulf of Maine Research Institute, Lobster Socioeconomic Impact Survey, prepared by Market Decisions, prepared for Laura Taylor Singer and Daniel S. Holland, November 16, 2006.

Dayton, A. 2018. Assessing Economic Performance of Maine's Lobster Fleet Under Changing Ecosystem Conditions in the Gulf of Maine. University of Maine. Knowlton, A. R., J. Robbins, S. Landry, H. A. McKenna, S. D. Kraus, and T. B. Werner. 2016. Effects of fishing rope strength on the severity of large whale entanglements. Conserv Biol 30:318-328.

Donihue M, Tselikis. A. 2018. From Lobsters to Dollars: An Economic Analysis of the Distribution Supply Chain in Maine. [Internet]. Waterville (ME): Colby College. [cited 2020 Feb 10]. Available from: http://colbycollege.maps.arcgis.com/apps/Cascade/index.html?appid=e0c247dcb1a34d8293d953f92f360eb9.

GMRI. 2014. Understanding Opportunities and Barriers to Profitability in the New England Lobster Industry.

Holland, D. S. 2011. Planning for changing productivity and catchability in the Maine lobster fishery. Fisheries Research 110:47-58.

Knowlton, A. R., R. Malloy Jr., S. D. Kraus, and T. B. Werner. 2018. Development and Evaluation of Reduced Breaking Strength Rope to Reduce Large Whale Entanglement Severity. Anderson Cabot Center for Ocean Life, New England Aquarium, Boston, MA.

Maine Department of Marine Resources, Gear Trawling Project: How Long is Too Long for a Trawl? A collaboration between the Department of Maine Resources, the Gulf of Maine Lobster Foundation, and the lobster industry, February 2012.

Maine Maritime Academy, "Lobster Boat Efficiency Project," CEI Fuel Efficiency Workshop, Vinalhaven, Maine, December 6, 2011.

Massachusetts Division of Marine Fisheries, Comparative Economic Survey and Analysis of Northeast Fishery Sector 10 (South Shore, Massachusetts), prepared by Dr. David Pierce, Brant McAfee, and Story Reed, November 2011.

Massachusetts Division of Marine Fisheries, Impact of Ghost Fishing to the American Lobster Fishery, 2011.

McCarron, Patrice and Heather Tetreault, Lobster Pot Gear Configurations in the Gulf of Maine, 2012.

Myers, H., Moore, M., 2020. Reducing effort in the U.S. American lobster (*Homarus americanus*) fishery to prevent North Atlantic right whale (*Eubalaena glacialis*) entanglements may support higher profits and long-term sustainability. Marine Policy 118, 104017. https://doi.org/10.1016/j.marpol.2020.104017

Myers, R. A., S. A. Boudreau, R. D. Kenney, M. J. Moore, A. A. Rosenberg, S. A. Sherrill-Mix, and B. Worm. 2007. Saving endangered whales at no cost. Curr Biol 17:R10-11.

Richardson, E. J., and J. M. Gates. 1986. Economic Benefits of American Lobster Fishery Management Regulations. Marine Resource Economics 2:353-382.

Schreiber, Laurie, “Lobster Catch-to-Trap Ratio Studied,” Fisherman’s Voice, Vol. 15, No. 4, April 2010.

Steinback, S. R., Allen, R. B., and Thunberg, E. 2008. The Benefits of Rationalization: The Case of the American Lobster Fishery. Marine Resource Economics 23:pp. 37–63.

Thunberg, E., Demographic and Economic Trends in the Northeastern United States Lobster (*Homarus americanus*) Fishery, 1970-2005, National Oceanic and Atmospheric Administration, Northeast Fisheries Science Center Reference Document 07-17, October 2007.

U.S. Council of Economic Advisors, Economic Report of the President, 2012.

Wang, S. D. H., and Kellogg, C. B. 1988. An Econometric Model for American Lobster. Marine Resource Economics 5:pp. 61-70.

Zou C, Thunberg E, Ardini G. 2021. Economic profile for American lobster (*Homarus Americanus*) fleets in the Northeastern United States. U.S. Dept Commer, Northeast Fish Sci Cent Ref Doc. 21-03; 24 p.

CHAPTER 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 Final Environmental Impact Statement (FEIS). In all cases, the analysis measures these impacts of the action alternatives relative to Alternative 1, the No Action Alternative, which considers the fishery as it was fished in 2017.

Alternative 1 would make no change in the requirements of the Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan), preserving the regulatory status quo under the Plan. Ongoing changes in management of the lobster and Jonah crab 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 baseline fishery management and state management, and no additional effects on social conditions in fishing communities. Alternative 1 would likely maintain 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 2 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, right whales in particular, under the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). Accordingly, the National Marine Fisheries Service (NMFS) is considering modifications to the Plan designed to meet the requirements of the ESA and MMPA. NMFS estimated that to reduce mortality and serious injury below the potential biological removal level (PBR), entanglement risk across U.S. fisheries needs to be reduced by 60 to 80 percent. The vast majority of buoy lines along the east coast belong to lobster and Jonah crab trap/pot fisheries in the Northeast Region Trap/Pot Management Area (Northeast Region). This FEIS focusses on these fisheries to speed up rulemaking. The Atlantic Large Whale Take Reduction Team (ALWTRT or Team) has been informed of the intention to consider all fixed gear fisheries coast-wide during the next Team deliberations. Large whale entanglement data and the rationale for the scope of the alternatives considered in this FEIS are also described in greater detail in Chapter 2: Purposes and Needs.

The modifications analyzed in this FEIS 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 Jonah crab trap/pot fisheries. The economic analysis considers only those measures that would be implemented to modify the Plan, with the exception of measures in Maine exempt waters. Measures analyzed include:

- Minimum trawl-length requirements (traps per trawl), which would apply to the certain regions of the Northeast lobster and Jonah crab trap/pot fisheries
- New gear configuration requirements including requiring weak rope or weak inserts in buoy lines and change in weak link requirements, which would apply to all lobster and Jonah crab trap/pot buoy lines in the Northeast Region except for Maine exempt 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 marking requirements, which would apply to all regulated lobster and Jonah crab trap/pot buoy lines in the Northeast Region except for Maine exempt waters
- Line cap allocation at 50 percent of the average monthly of 2017 buoy line numbers in federal waters

NMFS has specified two action alternatives – Alternatives 2 (Preferred) and 3 – 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 1, the No Action Alternative, the number of buoy lines in the water column would not change. Estimates of right whale mortalities and serious injuries in U.S. commercial fisheries would continue to exceed the population's PBR. Alternatives 2 (Preferred) and 3 incorporate various provisions that would reduce the number of trap/pot buoy lines fished by Northeast lobster and Jonah crab fishermen to levels below the 2017 buoy line estimate. Analysis using the NMFS Decision Support Tool (DST) (version three) indicates that the line reduction measures in the two alternatives, which include ongoing fishery management measures in lobster management areas (LMAs) 2 and 3 as well as state measures in Maine and Massachusetts, as well as a credit for the Massachusetts Restricted Area (MRA) in Alternative 2, would reduce the number of buoy lines in the Northeast Region by approximately seven percent under each alternative. By reducing the number of buoy 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. Though line reduction is similar between the two alternatives, co-occurrence is reduced more through more expansive closures in Alternative 3. However, both alternatives include additional risk reduction measures that accomplish substantial levels of co-occurrence reduction.

Under Alternative 2 (Preferred), exempt state waters would remain exempt from minimum trawl-length regulations. 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. Under Massachusetts state and federal regulations, the MRA will be expanded into coastal state waters in LMA 1 to reduce some of the risk in Massachusetts Bay and the closures will be extended through state regulations until at least May 15th if whales remain in the area, further mitigating the threat of buoy lines in coastal waters. NMFS believes that keeping state exemption areas from minimum trawl-length regulations would be unlikely to have a significant adverse impact on ESA-listed or MMPA-protected whales compared to Alternative 1, 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 2 (Preferred) and 3 would also allow ropeless fishing but seasonally close designated areas in the Northeast to persistent trap/pot buoy lines during months in which right whales are most likely to be present (Table 7.1). Ropeless fishing will only be tested outside of Cape Cod Bay and Outer Cape where whale densities are likely to be very high while the MRA is in place, which will further reduce the potential for interactions with groundlines. Buoy line closures of these areas further reduce co-occurrence to reduce the risk of entanglement compared to Alternative 1, the No Action Alternative. These seasonal restricted areas are expected to primarily benefit right whales; the co-occurrence model estimates a reduction in co-occurrence 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
Cape Cod Bay	2	May, until only 3 whales remain	644
Outer Cape State Waters	2	May, until only 3 whales remain	260
Large South Island Restricted Area	2	February - April	5,468
Massachusetts Restricted Area North	2 & 3	Feb – Apr, soft opening into May	497
Offshore Maine	3	October - February	967
Georges Basin Core Area	3	May - August	557
Massachusetts Restricted Area	3	May, possible early open	3,069
L-shaped South Island Restricted Area	3	February - May	3,506

Alternatives 2 (Preferred) and 3 would also introduce additional gear restrictions for lobster and Jonah crab vessels fishing trap/pot gear in the northeast. These restrictions would require weak rope or weak insertions, breaking at 1,700 pounds or less, to allow large whales to break free from gear before a mortality or serious injury 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 1, the No Action Alternative, no additional safeguards would be put in place. Alternative 3 reduces the strength of buoy lines closer to an average of 1,700 pounds, or the equivalent of Alternative 2, and though this provision does not reduce the risk of entanglement, it would provide additional protection against mortality and serious injury 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 2 and 3, the new requirements would apply to all lobster and Jonah crab trap/pot gear in the Northeast Region. Under Alternative 2 (Preferred), gear marking will be required under federal rulemaking except that Maine already implemented regulations for gear set in Maine exempted waters, which was effective September 2020. The new gear-marking provisions would have no immediate impact on entanglement risks.

In the long run, however, they may help 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 1, 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 (ESA-listed large whales and sea turtles) and habitat. Reductions in buoy 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. With similar line reduction it is unclear if either alternative is more advantageous for other protected species, though Alternative 3 would reduce more lines during summer months in offshore LMA 3 and may provide added benefit to species in offshore areas during that time.

Likewise, weak line requirements will result in a net positive impact on other protected species, particularly benefiting sei and sperm whales by reducing entanglement severity similar to the large whale Valued 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 2 (Preferred) and 3 (Non-Preferred) could reduce mortality and serious injury in other protected large whales compared to Alternative 1 (No Action), where Alternatives 3 may reduce entanglement severity to a greater degree than Alternative 2 (Preferred).

Alternative 2 (Preferred) does not require small vessels fishing in state waters to trawl up and reduce buoy 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 leatherback sea turtles.

The closure of designated areas in the Northeast Region 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 1, the No Action Alternative, these benefits are likely to be greatest under Alternative 3, which proposes larger restricted areas for longer periods of time, and lower under Alternative 2 (Preferred), which proposes the less extensive restricted areas for slightly shorter time periods (see Table 7.1).

There are not likely significant differences among Alternatives 2 (Preferred) and 3 with respect to impacts on habitat; any impacts on habitat from the presence of trap/pot gear, as well as proposed gear modifications, are generally expected to be slightly negative. Any possible impact is likely limited to offshore environments with Alternative 2 and could impact offshore and nearshore environments with Alternative 3 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. Areas too close to shore (i.e., 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. If ropeless fishing is implemented widely in closed areas, it is not expected that Alternative 2 or 3 will significantly change the amount of gear that comes into contact with the seafloor. Though there may be some additional impact on habitat under Alternative 2 compared to 3 because trawl lengths will likely be longer throughout the year under Alternative 2 compared to 2, these impacts are likely not measurable and thus impacts between the two alternatives is likely negligible.

7.1.3 *Comparison of Biological Impacts across Alternatives*

The biological impacts analysis presented in Chapter 5 relies primarily on NMFS' DST (version three) 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 right whale habitat density models to provide indicators of the potential for entanglements to occur and the potential severity of an entanglement if it occurred. The fundamental measures of change in entanglement potential are change in line numbers, co-occurrence, and estimated risk. The measures used to evaluate potential severity include change in mean line strength and total gear threat. 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 buoy line employed in trap/pot fisheries coincide in the waters subject to the Plan. Risk is an integration of the co-occurrence measure with the total gear threat. Biological impacts are characterized with respect to the percentage reduction in the overall co-occurrence indicator each alternative would achieve.

Table 7.2: The annual summary of all quantitative measures for each alternative, including the change in annual buoy line numbers, co-occurrence, and reduction in gear threat from conversion to weak line.

Alternative:	**1 (status quo)**	**2 (Preferred)**	**3 (Non-preferred)**
Line Reduction		**% Reduction**	**% Reduction**
Risk Reduction		60%	72%
Risk Reduction (with MRA Credit)		69% – 73%	
Line Reduction		7%	7%
Co-Occurrence		**% Reduction**	**% Reduction**
Right Whale		54%	60%
Right Whale (with MRA Credit)		65%	
Humpback Whale		12%	19%
Fin Whale		14%	17%
Weak Line			
Mean Line Strength	2,162 lb/ 981 kg.	1,976 lb/ 896 kg.	1,753 lb/ 795 kg.
Change in Line Strength		9%	19%
Change in Gear Threat		17%	29%

Table 7.2 summarizes the estimated change in co-occurrence, reduction in entanglement risk, and threat of gear according to the strength of buoy lines under each action alternative relative to the No Action Alternative (Alternative 1). Alternative 2, which includes trawling requirements, restricted areas, and broad use of weak inserts, is estimated to yield a reduction in co-occurrence of approximately 54 percent for right whales without the MRA credit recommended by the ALWTRT and 65 percent with the MRA credit. Alternative 2 will reduce line strength by nine percent for an average of 1,976 pounds per buoy line. Alternative 3 estimates a co-occurrence reduction of 60 percent and reduces line strength by 19 percent to an average 1,753 pounds. 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 MRA, will result in relocation of lines. Alternative 2 also includes conversion of less rope to fully weak buoy line and therefore would result in a higher mean line strength than Alternative 3, which does not directly reduce entanglement risk, and provides fewer positive benefits for other protected species. Though co-occurrence reduction is slightly greater in Alternative 3, there is greater uncertainty of how a line cap would 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, with Alternative 2 offering similar line reduction with fewer gear modifications and higher compliance rates. Both alternatives meet the minimum risk reduction target requirement.

7.2 Economic Impacts

Chapter 6 evaluates the economic and social impacts of Alternatives 2 and Alternative 3 relative to the status quo (Alternative 1), 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 2 including gear marking, weak rope, restricted areas, and trawling up costs range from $9.8 million to $19.2 million. As described in Chapters 6, 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 3 range from $32.8 million to $44.6 million. Thus, the costs associated with Alternative 2 are well under one third the Total costs associated with Alternatives 3.

Alternative 2 achieves less risk reduction than Alternative 3. The DST indicated Alternative 2 would likely achieve the 60 percent risk reduction, on average, for lobster and Jonah crab trap/pot buoys in the Northeast Region, within the target established for reaching right whale PBR. The co-occurrence model suggested right whale co-occurrence would be reduced by over 54 percent. The first year costs associated with the co-occurrence reduction (trawling up and buoy line closures) under Alternative 2 range from $2.9 million to $10.8 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 2 is estimated at $54,000 to $199,000.

Alternative 3 performed better at reducing risk than Alternative 2, achieving a risk reduction of nearly 72 percent from the DST, and co-occurrence reduction of approximately 60 percent. This alternative would increase the likelihood of achieving PBR, even when considering unobserved mortality of right whales. However, the first year costs associated with co-occurrence reduction in Alternatives 3 (trawling up, buoy line closures, federal water line caps) are substantially higher, ranging from $7.8 million to $19.5 million dollars; or $130,000 to $325,000 for each unit of co-occurrence reduction. That is, each risk reduction unit of Alternative 3 would cost about two to three times the cost per risk reduction unit in Alternative 2.

Analysis of the weak rope modification measures are similar, with Alternative 3 performing better but at a high cost. Proposed modifications in Alternative 2 would impact every buoy line in the Northeast Region lobster and Jonah crab trap/pot fishery outside Maine exempt waters, weakening mean line strength by nine percent, with an estimated cost of $2.2 million dollars, or about $250,000 for each percent of line strength weakened (Table 7.2). Alternative 3 would weaken line by approximately 19 percent of the buoy lines to weak rope, with an estimated cost of $10.6 million or about $557,000 for each percent of line strength weakened.

Table 7.3: A summary of first year initial compliance costs related to right whale co-occurrence (2020 dollars). Note: the lower and upper bounds of co-occurrence reduction score are based on the assumptions of 100 percent lines out and 100 percent relocation respectively.

	Alternative 2	Alternative 3
Trawling Up Lower	$1.6 million	$1.0 million
Trawling Up Upper	$8.8 million	$2.0 million
New Buoy Line Closure Lower	$1.3 million	$3.0 million
New Buoy Line Closure Upper	$2.0 million	$4.1 million
Line Cap Lower		$3.9 million
Line Cap Upper		$13.4 million
Total Lower	$2.9 million	$7.8 million
Total Upper	$10.8 million	$19.5 million
Co-occurrence Reduction	54% – 65%	60%

Chapter 6 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 2 meets the purposes and needs laid out in Chapter 2 of this FEIS while minimizing the potential economic impacts of the proposed modifications to the Plan.

7.3 Social Impact of Alternatives

The social impacts are analyzed in Chapter 6. The analysis estimates that 3,970 vessels in lobster and Jonah crab trap/pot fisheries in the 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 2 and 3, proposed gear marking and weak rope requirements would affect every lobster and Jonah crab vessel fishing in the Northeast Region outside Maine exempt waters. Line reduction measures (i.e. trawling up) under Alternative 2 would affect 1,206 vessels, slightly fewer than the 1,565 vessels affected by the Alternative 3 line reduction measures (line caps, trawling up in LMA 3). Federally regulated seasonal buoy line closures of Alternative 2 would affect up to 256 vessels, compared to more than 501 vessels affected by the buoy line closures under Alternative 3. Chapter 6 provides further details on the economic impacts of the alternatives.

Community impacts vary across the region, with more vulnerable communities in Downeast and mid-coast Maine, where the lobster fishery is a major economic driver. The value of 2020 lobster landings in Hancock and Knox Counties each exceeded $100 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 ALWTRP 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.

7.4 Integration of Results

7.4.1 *Comparison of Biological, Social, and Economic Analyses*

Because some of the value of the benefits of potential changes to the ALWTRP are qualitative, 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 7.4 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 DST. Nonetheless, the cost-effectiveness figures provide a useful means of comparing the relative impacts of the regulatory provisions that each alternative incorporates.

Table 7.4: The annual summary of all quantitative measures Alternatives 2 (Preferred) and 3, including the biological, economic, and social impacts expected compared to Alternative 1 (baseline). The risk reduction and right whale co-occurrence range represents the lower bound estimate of the measures with and without the MRA credit.

Alternative:	**2**	**3**
Biological Impacts	**Percent Reduction**	**Percent Reduction**
Risk Reduction	60% - 69%	72%
Line Reduction	7%	7%
Right Whale Co-Occurrence	54 - 65%	60%
Humpback Whale Co-Occurrence	12%	19%
Fin Whale Co-Occurrence	14%	17%
Change in Line Strength	9%	19%
Change in Gear Threat	17%	29%
Economic and Social Impacts		
Cost	$9.8 -19.2 million	$32.8 -44.6 million

Alternative:	2	3
Number of Vessels Impacted	3,970	3,970

Table 7.4 reveals several noteworthy findings:

- Co-occurrence reduction: Under Alternative 2, the costs associated with the co-occurrence reduction (trawling up and buoy line closures) range from $2.9 million to $10.8 million. For every unit of co-occurrence reduction, the costs are estimated at $54,000 to $199,000. Under Alternative 3, the costs associated with co-occurrence reduction in (trawling up, buoy line closures, federal water line caps) are substantially higher, ranging from $7.8 million to $19.5 million dollars; or $130,000 to $325,000 for each unit of co-occurrence reduction
- Weak Rope: Under Alternative 2 proposed modifications would reduce the mean strength of rope in all Northeast Region by nine percent in lobster and Jonah crab buoy lines outside of Maine exempt waters to weak, with an estimated cost of $2.2 million dollars, about $249,000 for each percent of line strength weakened. Alternative 3 weak line measures would reduce the mean strength of rope by 19 percent in Northeast Region trap/pot buoy outside of Maine exempted waters to weak rope, with an estimated cost of $10.6 million or about $557,000 for each percent of line converted.
- Both Alternatives reduce co-occurrence by 60 percent or more and modify all buoy lines to include some weak rope.
- Taking into account the value of the MRA in Alternative 2 achieves a substantially higher risk reduction.

NMFS believes that Alternative 2 (Preferred) offers the best option for achieving compliance with MMPA and ESA requirements. Alternative 2 (Preferred) provides substantial benefits to large whales, has more stakeholder buy in, and is less likely to have unintended consequences compared to the implementation of a line cap in Alternative 3. Based on these considerations, NMFS has identified Alternative 2 (Preferred) as its proposed approach to achieve the goals of the Plan.

7.4.2 *Final Impact Determinations*

Table 7.4 summarizes the results from the biological, economic, and social impact analyses from Chapters 5 and 6. To compare the biological, economic, and social impacts of all alternatives on all VECs we used the impact designations outlined in Table 7.5. Table 7.6 describes the direct and indirect impacts of the alternatives on the four VECs.

Alternative 1 (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 moderate to high negative because the rate of mortality and serious injury of right whales is well above PBR and therefore unsustainable for the population. While observed mortality and serious injury of other MMPA protected large whale species (i.e. minke whales and humpback whales) is above PBR, entanglements remain a significant threat to fin whales (an ESA-listed species) as well as humpback and minke whales, particularly for humpback whales because undocumented mortality could be occurring above PBR given the current levels of human caused incidents (see

Chapter 2). The impact of trap/pot fisheries would remain a slight to moderate negative for other protected species and negligible to slightly negative for habitat as defined in Chapter 4. Under Alternative 1, the impact of continuing the fishery in its current state would be mixed for Human Communities, with a moderate positive impact on harvesters but slight negative impacts to the intrinsic public benefits of healthy whale populations due to population declines. It is important to note that, when assessed individually, Alternative 2 and Alternative 3 would each have a moderate negative to slight negative impact on large whales, a slight negative impact on other protected species, and a negligible to slight negative impact on the habitat.

Table 7.5: A key of the direction and magnitude of the actions being assessed in the biological and economic effects analysis.

	General Definitions			
VEC	**Resource Condition**	**Direction of Impact**		
		Positive (+)	**Negative (-)**	**No Impact (0)**
Large Whales	For ESA listed species: populations at risk of extinction (endangered) or endangerment (threatened). For MMPA protected species: stock health may vary but populations remain impacted	For ESA listed species: alternatives that contain specific measures to ensure no interactions with protected species (i.e., no take). For MMPA protected species: alternatives that will maintain takes below PBR and approaching the Zero Mortality Rate Goal	For ESA listed species: alternatives that result in interactions/take of listed resources, including actions that reduce interactions. For MMPA protected species: alternatives that result in interactions with/take of marine mammals that could result in takes above PBR	For ESA listed species: alternatives that do not impact ESA listed species, For MMPA protected species: alternatives that do not impact marine mammals
Other Protected Species	Same as large whales	Same as large whales	Same as large whales	Same as large whales
Habitat	Many habitats degraded from historical effort	Alternatives that improve the quality or quantity of habitat	Alternatives that degrade the quality, quantity or increase disturbance of habitat	Alternatives that do not impact habitat quality
Human Communities (Socio-economic)	Highly variable but generally stable in recent years	Alternatives that increase revenue and social well-being of fishermen and/or communities	Alternatives that decrease revenue and social well-being of fishermen and/or communities	Alternatives that do not impact revenue and social well-being of fishermen and/or communities
	Magnitude of	**Impact**		
A range of impact qualifiers is used to indicate any existing uncertainty	Negligible	To such a small degree to be indistinguishable from no impact		
	Slight	To a lesser degree / minor	e.g. Slight Negative or Slight Positive	
	Moderate	To an average degree (i.e., more than "slight", but not "high")	e.g. Moderate Negative or Moderate Positive	
	High	To a substantial degree (not significant unless stated)	e.g. High Negative or High Positive	
	Significant	Affecting the resource condition to a great degree,	See 40 CFR 1508.27.	
	Likely	Some degree of uncertainty associated with the impact		

There are a few important differences between Alternatives 2 and 3 (Preferred and Non-Preferred, respectively), relative to Alternative 1, with respect to impacts on all four VEC's. All of the Alternatives (with the exception of Alternative 1) 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 of buoy line reductions, size or season of closures to persistent buoy lines, and the extent of the use of weak rope or weak insertions. Since both action alternatives effectively reduce the number of buoy lines and co-occurrence between whales and buoy line as well as reduce the mean line strength closer to the equivalent of 1,700 pounds breaking strength through engineered weak rope or weak inserts, impacts are assumed to be relatively positive for all large whales compared to the baseline. Large whales would see a slight to moderately positive benefit from implementation of either Alternative 2 or 3 compared to Alternative 1 because the other large whale species likely benefit from these alternatives to a lesser degree than right whales. Alternative 3 likely reduces entanglement risk to a slightly greater degree than Alternative 2 with a slightly higher decrease in co-occurrence and the strength of lines. Though this analysis does not take into account the MRA risk reduction credit, which achieved a higher co-occurrence reduction than Alternative 3. A larger decrease in co-occurrence and strength will likely offer more benefits, particularly to right whales, though compliance is expected to be greater for Alternative 2 rather than Alternative 3 because Alternative 2 reflects extensive state and stakeholder input and associated preferences as well as safety concerns. Furthermore, Alternative 2 likely contains fewer regulations that would lead to uncertain outcomes that could potentially increase line in some areas. Minke whales are less likely to benefit from line strength reduction and are more likely to be negatively impacted by long trawl lengths. Therefore, compared to Alternative 2, Alternative 3 is likely to have negligible to slight positive impacts on large whales.

Other protected species prone to entanglement in trap/pot gear would also positively benefit from the Plan modifications being considered. Compared to Alternative 1, Alternative 2 and 3 will provide negligible (i.e. little change in line where these species are commonly sighted) to slight positive (i.e., reducing co-occurrence of buoy lines protected species, weak links requirements, and line reduction provisions) for ESA-listed protected species. Relative to Alternative 2, Alternative 3 is expected to have negligible to slight positive impacts to ESA-listed species (i.e., reduced co-occurrence of buoy lines and sea turtles, use of more full weak line to lessen entanglement severity for large whales, weak line requirements, and line reduction provisions). Any additional indirect impacts of Alternatives 2 and 3 on habitat are expected to be extremely small and not measurable (i.e. negligible). Compared to Alternative 1, the impact of Alternative 2 and 3 on Human Communities are expected to be a slight negative and moderate negative, respectively, due to the initial gear modifications and anticipated short term catch impacts, though this impact may decline over time. Relative to Alternative 2, Alternative 3 would have slight negative impacts because it requires more costs for gear modifications and potentially greater catch losses.

Table 7.6: The direct and indirect impacts of the alternatives on the four VECs.

Alternatives	Large Whales	Other Protected Species	Habitat	Human Communities
Risk Reduction				
Alternative 1 (No Action)	**High Negative to Moderate Negative**– Mortality and Serious injury would continue to occur and impact ESA listed species' population health. More so for right whales and other large whales to a lesser degree other ESA listed or MMPA protected species.	**Moderate Negative** – Mortality and serious injury due to entanglement would continue to harm ESA listed species.	**Negligible to Slight Negative** – Areas with trawls above 15 traps per trawl may have a short-term impact.	**Slight Negative to Moderate Positive –** Positive in that there are no new impacts or costs to harvesters and markets but the lack of recovery of whale species has a slight negative impact on public welfare benefits due to whale population declines.
Alternative 2 (Preferred)	**Moderate Negative to Slight Negative** – Would reduce entanglement risk for ESA listed and MMPA protected species. However risk of interactions will not be entirely eliminated by the proposed action.	**Slight Negative**– Would reduce entanglement risk for ESA listed species. However risk of interactions will not be entirely eliminated by the proposed action.	**Negligible to Slight Negative** – Trawling up to trawls above 15 traps per trawl may have a short-term impact.	**Slight Negative –** Fisheries would experience extra costs and catch reduction in the short term term that could ease over the long term.
Alternative 3 (Non-preferred)	**Moderate Negative to Slight Negative**– Would reduce entanglement risk for ESA listed and MMPA protected species. However risk of interactions will not be entirely eliminated by the proposed action.	**Slight Negative** – Would reduce entanglement risk for ESA listed species. However risk of interactions will not be entirely eliminated by the proposed action.	**Negligible to Slight Negative** – Areas with trawls above 15 traps per trawl may have a short-term impact.	**Moderate Negative –** Costs of gear modifications and catch reduction would be significant.
Gear Marking				
Alternative 1 (No Action)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative –** Current gear marking costs would have a slight economic burden on fishermen.
Alternative 2 (Preferred)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative –** Gear marking requirements would generate economic burden to fishermen, but could lower the future regulatory costs.
Alternative 3 (Non-Preferred)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative to Negative –** Gear marking requirements would generate high economic burden to fishermen, but could lower the future regulatory costs.

CHAPTER 8 CUMULATIVE EFFECTS ANALYSIS

This chapter describes the cumulative effects analysis (CEA) and 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 (Plan or ALWTRP). It is organized as follows:

- Section 8.1 contains background information on the Cumulative Effects Analysis.
- Section 8.2 provides Valued Ecosystem Components (VECs) status and trends.
- Section 8.3 contains effects of past, present, and reasonably foreseeable future actions.
- Section 8.4 is a summary of the direct and indirect impacts of the alternatives covered in Chapters 5 through 8.
- Section 8.5 is a summary of the Cumulative Impacts of Alternatives for the Preferred Alternative (Alternative 2).

8.1 Introduction

Under the 1978 regulations this document is written under, 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.

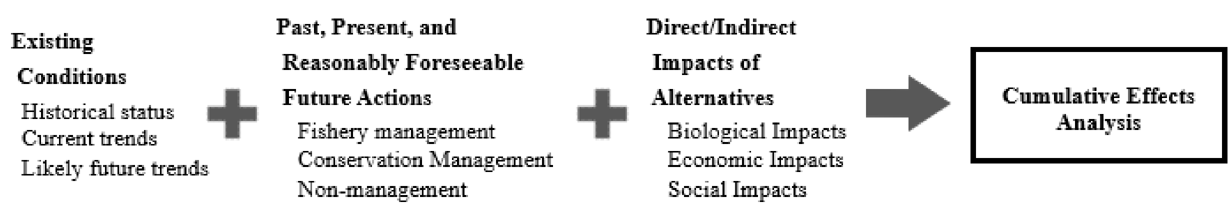


Figure 8.1: Cumulative effects analysis steps, and how they inform the cumulative effects analysis (adapted from Canter 2012).

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 (based on frequency of entanglement in ALWTRP fisheries):** North Atlantic right whale, fin whale, humpback whale, and minke whale
2. **Other protected species:** 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 and social aspects of the potentially affected fisheries

Table 8.1: Guidelines for defining the direction and magnitude of the impacts of alternatives on the VECs in the cumulative impacts analysis.

General Definitions

VEC	**Resource Condition**	**Direction of Impact**		
		Positive (+)	**Negative (-)**	**No Impact (0)**
Large Whales	For ESA-listed species: populations at risk of extinction (endangered) or endangerment (threatened). For MMPA protected species: stock health may vary but populations remain impacted	For ESA-listed species: alternatives that contain specific measures to ensure no interactions with protected species (i.e., no take). For MMPA protected species: alternatives that will maintain takes below PBR and approaching the Zero Mortality Rate Goal	For ESA-listed species: alternatives that result in interactions/take of listed resources, including actions that reduce interactions. For MMPA protected species: alternatives that result in interactions with/take of marine mammals that could result in takes above PBR	For ESA-listed species: alternatives that do not impact ESA listed species. For MMPA protected species: alternatives that do not impact marine mammals
Other Protected Species	Same as large whales	Same as large whales	Same as large whales	Same as large whales
Habitat	Many habitats degraded from historical effort	Alternatives that improve the quality or quantity of habitat	Alternatives that degrade the quality, quantity or increase disturbance of habitat	Alternatives that do not impact habitat quality
Human Communities (Socio-economic)	Highly variable but generally stable in recent years	Alternatives that increase revenue and social well-being of fishermen and/or communities	Alternatives that decrease revenue and social well-being of fishermen and/or communities	Alternatives that do not impact revenue and social well-being of fishermen and/or communities
	Magnitude of	**Impact**		
A range of impact qualifiers is used to indicate any existing uncertainty	Negligible	To such a small degree to be indistinguishable from no impact		
	Slight	To a lesser degree / minor	e.g. Slight Negative or Slight Positive	
	Moderate	To an average degree (i.e., more than "slight" but not "high")	e.g. Moderate Negative or Moderate Positive	
	High	To a substantial degree (not significant unless stated)	e.g. High Negative or High Positive	
	Significant	Affecting the resource condition to a great degree, see 40 CFR 1508.27.		
	Likely	Some degree of uncertainty associated with the impact		

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, Rhode Island 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 Exclusive Economic Zone (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 vessel 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, vessel 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 slightly 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 and sei 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	American Lobster	Total lobster landings	GOM lobster	Target species, lobster and

Affected Resource of Concern	*Historical Conditions*	*Current Conditions*	*Possible Future Conditions*	*Implications of Conditions Relative to Sustainability*
Communities	stocks have been abundant in GOM but depleted in SNE waters; Jonah Crab fishery was supplement of lobster fishery.	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.	landing will keep trending down and SNE stock stays depleted; more Jonah crabs will be landed from SNE.	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 Fishery Management Plan (FMP) and additional amendments and addenda that modify how the fishery is conducted. These amendments and addenda 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 XVII - Area 2 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	**Moderate Negative**	**Slight Negative to Moderate Negative**	**Negligible to Slight Negative**	**Slight Positive**
Northern Black Sea Bass	Amendment 9 harvest quotas Amendment 13 harvest quotas 2020-2021 implemented increased quota up to 60%	**Negligible to Moderate Negative**	**Slight Negative**	**Negligible to Slight Negative**	**Slight Positive**
Hagfish	State managed	**Negligible to Slight Negative**	**Negligible to Slight Negative**	**Negligible to Slight Negative**	**N/A**
Red Crab	Red Crab FMP harvest quota Amendment 3 (ACL/AM) Amendment 4 - bycatch reporting 2020-2023 new specifications implemented	**Slight Negative to Moderate Negative**	**Slight Negative**	**Negligible to Slight Negative**	**Slight Positive**

Fishery	Management Action	Large Whales	Other Protected Species	Habitat	Human Communities
Scup	Amendment 8 harvest quota Amendment 18 (review quota allocations) future action Addendum XXIX - quota periods 2020-2021 specifications implemented	**Negligible to Slight Negative**	**Slight Negative**	**Negligible to Slight Negative**	**Slight Positive**
Jonah Crab	Initial FMP, Addenda I and II Addendum III - the reporting and data collection	**Moderate Negative**	**Moderate Negative**	**Negligible to Slight Negative**	**Slight Positive**
Conch/ Whelk	State managed	**N/A**	**N/A**	**N/A**	**N/A**
Net Impact Summary		**Slight Negative to Moderate Negative**	**Slight Negative**	**Negligible to Slight Negative**	**Slight Positive**

While not specifically a fishery management action, 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, among others, as well as consultations on rulemakings to modify the Atlantic Large Whale Take Reduction Plan. Per an October 17, 2017, ESA 7(a)(2)/7(d) memo issued by NMFS, consultation has been reinitiated on the federally permitted Atlantic deep sea red crab and American lobster fisheries as well as other fisheries that use fixed gillnet and trap/pot gear. A Biological Opinion was issued on May 27, 2021, that considered the effects of the NMFS' authorization of ten fishery management plans (FMP), NMFS' North Atlantic Right Whale Conservation Framework, and the New England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2, on ESA-listed species and designated critical habitat

The 2021 Opinion determined that the proposed action may adversely affect, but is not likely to jeopardize, the continued existence of North Atlantic right, fin, sei, or sperm whales; the Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead, leatherback, Kemp's ridley, or North Atlantic DPS of green sea turtles; any of the five DPSs of Atlantic sturgeon; Gulf of Maine DPS Atlantic salmon; or giant manta rays. The Biological Opinion also concluded that the proposed action is not likely to adversely affect designated critical habitat for North Atlantic right whales, the Northwest Atlantic Ocean DPS of loggerhead sea turtles, U.S. DPS of smalltooth sawfish, Johnson's seagrass, or elkhorn and staghorn corals. An Incidental Take Statement (ITS) was issued in the Opinion. The ITS includes reasonable and prudent measures and their implementing terms and conditions, which NMFS determined are necessary or appropriate to minimize impacts of the incidental take in the fisheries assessed in this Opinion.

8.3.1.1 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 addenda 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 be an improvement compared to current conditions, improved reporting and monitoring would inform future management and may have an indirect 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 slight negative to moderate negative.

8.3.1.2 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 a slight negative.

8.3.1.3 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 slight negative.

8.3.1.4 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 slight 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 past, present, and foreseeable future actions are discussed below.

8.3.2.1 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 improve impacts on this VEC. U.S. vessel strike management measures may be effective (Conn and Silber 2013) but given changes in right whale distribution and status, they are being reviewed and evaluated and are expected to be modified to further reduce the impacts of vessels on right whales. Actions like speed reductions and observers would also benefit other large whale species. However, the risk of entanglement with vertical lines and vessel strikes remains, albeit less so after these mitigation measures are taken. Therefore, ESA-listed species of large whales are expected to experience moderate negative to slight positive impacts and MMPA-protected species of large whales are expected to have slight positive impacts (i.e., PBR not exceeded, see Table 8.1).

8.3.2.2 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 be beneficial to other protected species, similar to the large whale VEC. However, because there is still a risk of interaction with these other ESA-listed protected species, impacts are still moderate negative to slight positive.

8.3.2.3 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 Northeast Region, 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 vessel strike regulations, that are not expected to interact with the physical environment. However, continued fishing effort will continue to impact habitats. Therefore, the impacts of the fishery on the physical environment are not expected to change relative to the current condition under the preferred alternative (i.e., slight negative for the physical environment). The net impact of all actions is likely slight negative to slight positive.

8.3.2.4 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 slight 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*

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. The nature of these activities are listed in Table 8.4 with the predicted impact of past, present, and foreseeable future actions on each VEC.

Table 8.4: 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	**Moderate Negative**	**Moderate Negative**	**Negligible to Slight Negative**	**Slight 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**	**Slight Negative**
Noise	Sources of anthropogenic noise, including vessels, military exercises, seismic surveys, etc. (wind turbines discussed below)	**Slight Negative to Moderate Negative**	**Slight Negative to Moderate Negative**	**N/A**	**Negligible**
Offshore wind farm	Construction and operation of wind turbine structures in specified area	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**
Pollution/water quality	Land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification; Point-source and unpermitted discharges	**Slight Negative**	**Slight Negative**	**Slight Negative**	**Negligible**
Oil and gas	Prospecting for, construction of, and operation of oil and/or gas platforms in marine areas. Transport of oil. May include geological and geophysical surveys (e.g., certain seismic surveys).	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**
Prey availability	Changes in primary production and prey species (i.e. nutritional stress)	**Moderate Negative**	**Slight Negative**	**N/A**	**N/A**
Vessel Strikes	Injury or mortality from vessel collision	**High Negative**	**Moderate Negative**	**N/A**	**N/A**
Harmful algal blooms	Overgrowth of algal species that produce biotoxins and also contribute to oxygen-depletion	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**
Canadian Mortalities	Serious injury and mortality as a result of entanglement and vessel strike in Canadian waters as well as other unknown causes.	**High Negative**	**Slight Negative**	**N/A**	**N/A**
Net Impact Summary		**Moderate Negative**	**Moderate Negative**	**Moderate Negative**	**Moderate Negative**

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 longline mussel operation from 3 to 20 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.

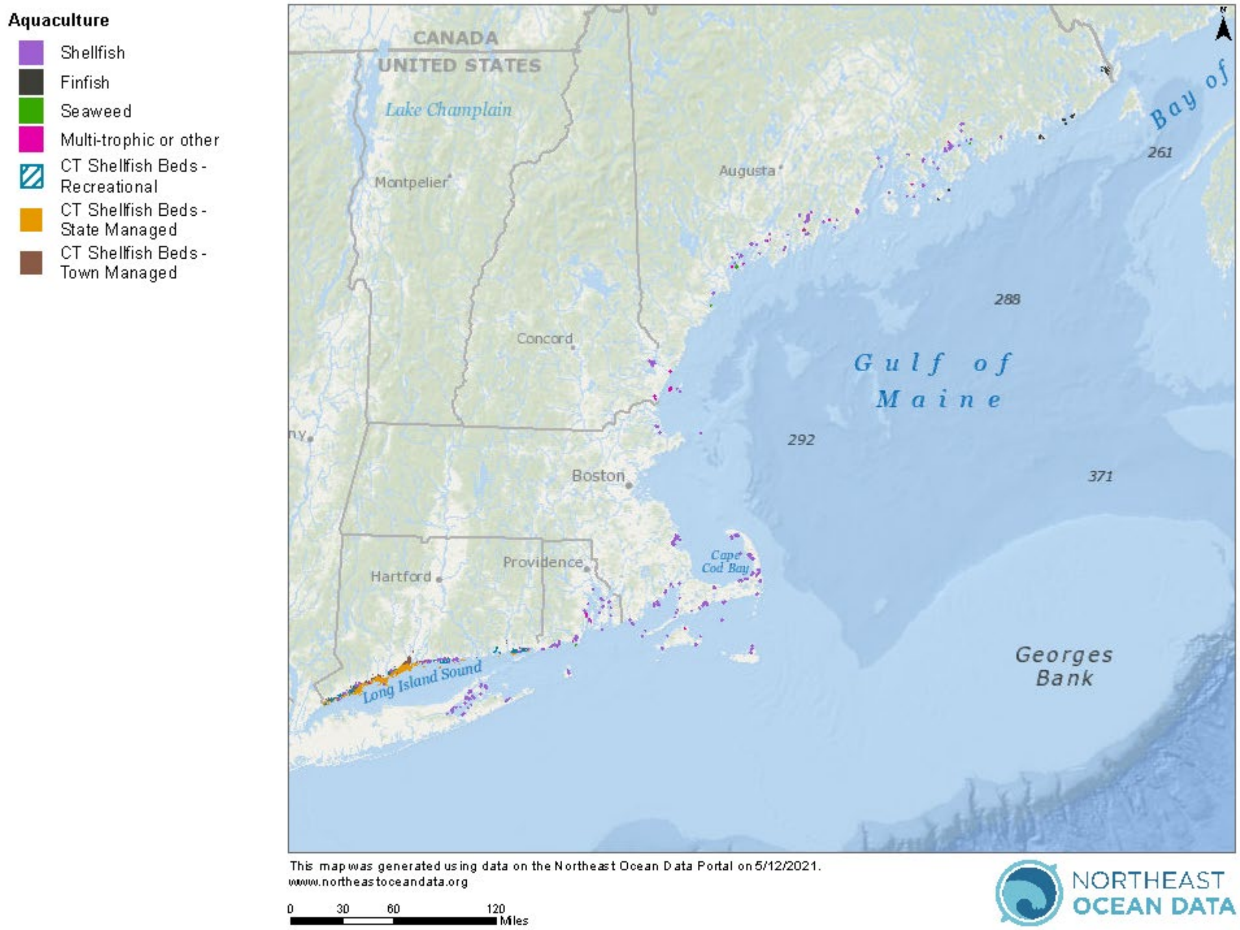


Figure 8.2: The aquaculture structures currently in place along the coast of New England by type (Northeast Ocean Data Portal, 2021).

8.3.3.1.1 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 (Chapters 2 and 5). 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. 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 moderate negative at current and reasonably foreseeable aquaculture operations within the geographic scope of this analysis.

8.3.3.1.2 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 that on large whales, moderate negative.

8.3.3.1.3 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. 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). As shellfish structures are more prevalent within the Northeast Region, it is likely that aquaculture would have a negligible to slight negative impact on water quality and other habitat changes within the scope of this analysis.

8.3.3.1.4 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 and block coastal access, thus causing 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. Combined, the impact is likely to be negligible to slight negative.

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 in 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.

8.3.3.2.1 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 movement of 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, the zooplankton *Calanus finmarchicus,* farther north as the Gulf of Maine has warmed (Meyer-Gutbrod et al. 2018, Meyer-Gutbrod and Greene 2018, Record et al. 2019a, Record et al. 2019b). In the Gulf of Maine, warming has been linked to a decline in the summer and fall abundance of *C. finmarchicus*, especially after 2010. During this time, right whales were observed spending more time in the Gulf of St. Lawrence (Pershing and Stamieszkin 2020). Increasing temperatures can decrease both the body size and egg production of *C. finmarchicus*, in addition to reducing the available nutrients and dissolved oxygen in the environment needed for their productivity (Grieve et al. 2017). Even if *C. finmarchicus* remains abundant in the region, climate-induced changes in the water column could disrupt their aggregations that right whales depend on to feed (Baumgartner et al. 2017). Increasing bottom temperatures in the Gulf of St Lawrence may also exceed the thermal optimum for *C. finmarchicus* in future years, which could push right whales into foraging areas continuously further north (Gavrilchuk et al. 2021). Decreases in prey abundance are known to impede reproductive success in this whale 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 and neutral for minke and humpback whales (MacLeod 2009). Overall sensitivity estimates have identified fin whales as more vulnerable to climate change 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.

8.3.3.2.2 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 and sei whales. However, sperm whales were identified as a sensitive marine mammal species based on low population sizes (Sousa 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 the impact of climate change on other protected species is likely moderate negative.

8.3.3.2.3 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 Essential Fish Habitat and Habitat Areas of Particular Concern, particularly those that are more sensitive to changes in temperature or physical disturbance.

8.3.3.2.4 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 percent decline in county-level fishing employment in New England, beyond the changes in employment attributable to management or other factors. Shellfish are particularly vulnerable to both changes in temperature and 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 a 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. Anthropogenic 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). The duration of the sound, the animal's physical condition, the activity at time of exposure, the context of exposure, and proximity to the source of the sound all influence impacts (United States Department of the Navy 2018). Since it is assumed that noise has a negligible impact on the physical environment or fish habitat, it will not be discussed here.

8.3.3.3.1 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). Whales can suffer from organ and tissue damage, hearing loss, or related trauma. 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). Extreme behavioral response could lead to stranding. 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 slight negative to moderate negative.

One noted cause for concern is the potential for Navy training activities to expose marine mammals, notably right whales, to multiple acoustic stressors. This is especially a concern in their calving areas in the Southeast Atlantic. To minimize the negative impacts of these stressors, the Navy's Atlantic Fleet is implementing the seasonal (November 15-April 15) Southeast North Atlantic Right Whale Mitigation area, encompassing right whale migration and calving areas and part of the species' critical habitat in the region. Mitigation measures include reporting total hours and counts of active sonar and in water explosives used in the area, not using sonar except as necessary for specific training activities, not expending explosive or non-explosive ordinances, obtaining the latest right whale data, implementing speed reductions in the case of right whale sightings or when operating at night or during periods of reduced visibility, and minimizing north-south transits as much as possible (United States Department of the Navy 2018).

8.3.3.3.2 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 percent 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 slight negative to moderate negative impacts from noise.

8.3.3.3.3 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 Energy Projects

This section describes offshore wind development activities that NMFS is considering reasonably foreseeable for the purpose of assessing cumulative effects in this FEIS. The impact of offshore wind farms on the VECs includes noise (discussed in further detail in Section 9.4.2.3) emitted during site assessment activities exploration, construction pile driving, 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. Large whales, other protected species, and potentially affected fisheries occur in southern New England at present and are expected to remain 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. BOEM has recently begun a planning process for the Gulf of Maine via a regional intergovernmental renewable energy task force (https://www.boem.gov/Gulf-of-Maine). It is not clear at this time where development might occur in the Gulf of Maine. Given the water depth in the region, floating turbines will likely be the primary type of wind turbine foundations to be deployed in the area. 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, intermittent or persistent, and 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 federal waters (only a two turbine pilot project off the coast of Virginia). Although projects exist in Europe, not all effects are transferable and there are many uncertainties as to how human, marine, and terrestrial resources will interact or be affected by offshore wind energy development. The wind energy areas are in a region of continental shelf that is undergoing climate change, changes in ecological dynamics, and fisheries stock status fluctuations. Regional scale changes may make it difficult to clearly identify local impacts that are directly attributable to offshore wind energy development (Petruny-Parker et al. 2015).

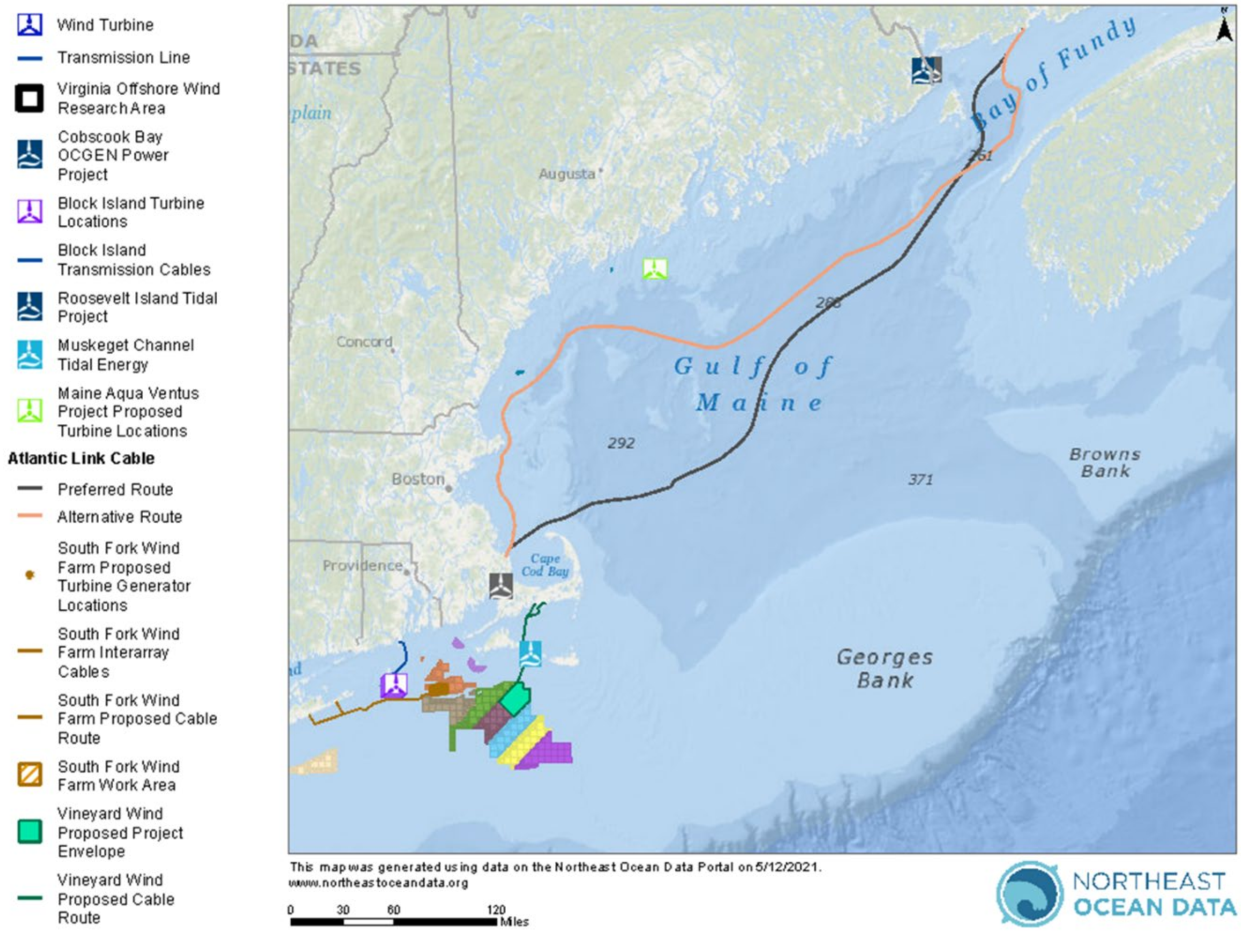


Figure 8.3: A map of the wind energy leases in the Southern New England region, namely the RI/MA Wind Energy Area, where construction is expected to start in the reasonably foreseeable future. (Northeast Data Portal, 2021)

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 164 feet (50 meters) 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 that 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 (effects depend on cable type, burial depth, and proximity to other cables)
- Long-term, increased vessel traffic
- Long-term, variable socioeconomic impacts
- Long-term, variable fishery displacement impacts, although 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 in the impacts to the VECs 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 removal and short-term, temporary fishery displacement. It is unlikely that decommissioning will occur 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.

8.3.3.4.1 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. Exposure to underwater noise can directly affect species via behavioral modification (avoidance, startle, spawning) or injury (sound exposure resulting in internal damage to hearing structures or internal organs) (Bailey et al. 2010; Bailey et al. 2014; Bergström et al. 2014; Ellison et al. 2011; Ellison et al. 2018; Forney et al. 2017; Madsen et al. 2006; Nowacek et al. 2007; NRC 2003; NRC 2005; Richardson et al. 1995; Romano et al. 2004; Slabbekoorn et al. 2010; Thomsen et al. 2006; Wright et al. 2007). Indirect effects are likely to result from changes to the acoustic environment of the species, which may affect the completion of essential life functions (e.g., migrating, breeding, communicating, resting, foraging) (Forney et al. 2017; Richardson et al. 1995; Slabbekoorn et al. 2010; Thomsen et al. 2006).

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 noise and additional risk of vessel strikes that could cause injury or mortality. Changes in fishing practices or displacement of fishing vessels from traditional areas, as well as changes in whale behavior and habitat due to the installation of wind turbines, could increase interaction and entanglement risks as well (Methratta et al. 2020).

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 moderate negative impact on large whales given the most impactful stage (i.e. construction) is planned to occur within the timeframe of this analysis (approximately 5 years), with a possible decline in the magnitude of the impact after construction.

8.3.3.4.2 Other Protected Species

The impact of wind farm development on other protected marine mammals 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, are less likely to be close to construction or operations and therefore will likely not be significantly impacted by offshore wind development , 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 moderate 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.

8.3.3.4.3 Habitat

There are several potential impacts of offshore wind farms 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. Other changes include sedimentation and scouring, high-relief habitat formation around turbines, shading, and the introduction of electromagnetic fields. These physical changes could impact other aspects of the habitat, including the biodiversity and food availability in the area and could influence important areas such as spawning and nursery habitats. (Gill 2005, Riefolo et al. 2016, Dannheim et al. 2019, Petruny-Parker et al. 2015), After construction, the turbines could add 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. For example, noise and vibration from pile driving as well as associated changes in ocean circulation and turbidity can affect the reproductive success of lobsters. They can injure or kill larvae or drive female lobsters away from suitable spawning grounds. There are also trends of female lobsters aggregating in Wind Energy Areas off of southern New England due to warming of inshore waters. Other concerns include impacts to migration routes due to interactions with cables (either during construction or if the cable is improperly buried or becomes uncovered), which also carry potential electromagnetic field exposure risks (Lipsky et al. 2016). Together, these suggest that offshore wind farms will have a moderate negative impact on habitat and indirectly, larval, juvenile, and adult fish and invertebrates, with a possible reduction in impact over time (i.e. after construction).

8.3.3.4.4 Human Communities

Both commercial and recreational fishing are important to the economy in the Northeast Region. In 2016, commercial fisheries contributed \$3.7 billion in value added to the economy and supported over 260,000 jobs (Methratta et al. 2020). Over 4,300 fishing vessels were federally permitted in the Northeast Region in 2017, landing fish in several major ports. These commercial fleets are tied to the overall economy in the region through direct employment and income, as well as through goods and services to maintain and operate vessels, seafood processors, wholesale/distributors, and retailers (BOEM 2020a). Relevant to this action, more than \$280,000 of lobster pot gear revenue comes from within the Massachusetts Wind Energy Area. Recreational fishing in the region added \$5.3 billion to the economy and supported more than 69,000 jobs in 2016 (Methratta et al. 2020).

It remains unclear how fishing or transiting to and from fishing grounds (whether or not those grounds are within a wind farm) might be affected by the presence of a wind farm. While no offshore wind developers have expressed an intent to exclude fishing vessels from wind turbine arrays once construction is complete, it could be difficult for operators to tow bottom-tending mobile gear or transit among the wind turbines, depending on the spacing and orientation of the array and weather conditions[21]. Radar interference and increased traffic could affect navigation as well. If vessel operators choose to avoid fishing or transiting within wind farms, effort displacement and additional steaming time could result in negative socioeconomic impacts to

[21] The United States Coast Guard has considered transit and safety issues related to the Massachusetts and Rhode Island lease areas in a recent port access route study, and has recommended uniform 1 mile spacing in east-west and north-south directions between turbines to facilitate access for fishing, transit, and search and rescue operations. Future studies in other regions could result in different spacing recommendations (UCSG 2020).

affected communities, including increased user conflicts, decreased catch and associated revenue, safety concerns, and increased fuel costs.

Wind farm survey and construction activities and turbine/cable placement will substantially affect NMFS scientific research surveys, including stock assessment surveys for fisheries and protected species and ecological monitoring surveys. Disruption of such scientific surveys could increase scientific uncertainty in survey results and may significantly affect NMFS' ability to monitor the health, status, and behavior of marine resources and protected species[22] and their habitat use within this region. Based on existing Mid-Atlantic Fishery Management Council's acceptable biological catch control rule processes and risk policies (e.g., 50 CFR §§ 648.20 and 21), increased assessment uncertainty could result in lower commercial quotas and recreational harvest limits that may reduce the likelihood of overharvesting and mitigate associated biological impacts on fish stocks. However, this would also result in lower associated fishing revenue and reduced recreational fishing opportunities, which could result in indirect negative impacts on fishing communities.

Turbine structures could increase the presence of and fishing for structure-affiliated species. Many recreational fishing trips in this region target a combination of species. For example, recreational trips that catch black sea bass often also catch tautog, scup, summer flounder, and Atlantic croaker (NEFSC 2017). For this reason, increased recreational fishing effort focusing on species such as black sea bass in wind farms could also lead to increased recreational catches of other species. This could lead to socioeconomic benefits in terms of increased for-hire fishing revenues and angler satisfaction in certain wind development areas. There could also be social and economic benefits in the form of jobs and investments associated with construction and maintenance of wind farms, and replacement of some electricity generated using fossil fuels with renewable sources (AWEA 2020). These data suggest that overall, offshore windfarms will have a moderate negative impact on human communities.

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 (Section 8.3.3.9).

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

---

[22] Changes in required flight altitudes due to proposed turbine height would affect aerial survey design and protocols (BOEM 2020a).

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 Region make it probable that industrial pollutants released into coastal waters will affect important feeding areas off the coast of Massachusetts and Cape Cod Bay.

8.3.3.5.1 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. 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 Northeast Region marine mammals are high relative to other ocean regions (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 slight negative risk in these species.

8.3.3.5.2 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 on 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 about 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 feed at a higher trophic level and have relatively high contaminant loads (Aguilar 1983, Pinzone 2015). There is concern this could impact the health of sperm whales. 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 also generally feed 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 slight negative impact to other protected species.

8.3.3.5.3 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 Northeast Region that suggests pollution has or will have large impacts on habitat features considered in this VEC, so it is assumed that the impact is slightly negative.

8.3.3.5.4 Human Communities

The economic stability of a fishery can be impacted by pollution when there is a fish mortality event or related closure related to a spill or other exposure. 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 Northeast Region 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 five 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 air guns 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, every five years BOEM must develop 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 developed 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 withdrew 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 memorandum 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 coast of North Carolina.[23] 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 Environmental Protection Agency-regulated discharge permits) and manual disruption of physical habitat structure. During exploration and production, there is a risk 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 within the timeframe of this analysis.

8.3.3.6.1 Large Whales

[23] 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."

As previously mentioned, several large whale species do respond behaviorally and physiologically to noise in the marine environment (see 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 severity of these behavioral or physiological impacts is based on the species' hearing threshold, the overlap of this threshold with the frequencies emitted by the survey, as well as the duration of time the surveys would operate, as these factors influence exposure rate (Ellison et al. 2011; Ellison et al. 2018; Finneran 2015; Finneran 2016; Madsen et al. 2006; Nelms et al. 2016; Nowacek et al. 2007; Nowacek et al. 2015; NRC 2000; NRC 2003; NRC 2005; Piniak 2012; Popper et al. 2014; Richardson et al. 1995; Thomsen et al. 2006; Weilgart 2013).

The effects of oil exposure can be difficult to study in the wild because oil is metabolized rapidly and therefore it can be a challenge to measure the level of oil exposure. However, there is plenty of evidence showing adverse impacts to marine mammals from 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). There is also a potential of vessel strikes from oil tankers. Thus, oil and gas activities are expected to have a moderate negative impact on large whales and other protected species.

8.3.3.6.2 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 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 Northeast Region 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 moderate negative impact on other protected species.

8.3.3.6.3 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 moderate negative impact on the habitat, but not continuously and would vary per stage.

8.3.3.6.4 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) that 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 percent 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 moderate negative from an oil spill, but there are slight positive implications for recreational fisheries and general survival rates.

However, if fishery resources are affected by seismic surveys, then the fishermen targeting these resources would be affected. However, such surveys could increase jobs, which may provide some positive effects on human communities (BOEM 2020b). It is important to understand that seismic surveys for mineral resources are different from surveys used to characterize submarine geology for offshore wind installations, and thus these two types of activities are expected to have different impacts on marine species.

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 contribute to 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 of some species farther to the north, nutritional stress affecting health and demographics could be more of an issue, particularly for species with less dietary flexibility or that have to travel farther for food (e.g. longer migration distances to optimal habitat). The seasonal movements of right whales in response to shifts in their prey highlight the importance of identifying these resource-rich areas and implementing measures that reduce potential anthropogenic impacts (Gavrilchuk et al. 2021).

8.3.3.7.1 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 seasonal aggregations of *Calanus finmarchicus,* the dominant mesozooplankton in the North Atlantic, to meet energetic demands (van der Hoop et al. 2019, Pershing and Stamieszkin 2020). 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). As prey density and quality shift (namely, reductions in copepod size and nutritional density, while expanding into the northern end of their range), whales need to spend more time foraging and finding areas that have higher quality aggregations of prey. *C. finmarchicus* has declined in the Gulf of Maine, Georges Bank, and Scotian Shelf since 2005. Since 2015, right whales have increased their summertime use of the Gulf of St. Lawrence, with decreased observations in the Gulf of Maine and Bay of Fundy. However, prey biomass in the Gulf of St. Lawrence still may not be enough to support North Atlantic right whales and their reproductive needs. The quantity and quality *C. finmarchicus* in the area fluctuates from year to year (Gavrilchuk et al. 2021, Hayes et al. 2018). Periods of low *C. finmarchicus* abundance coincide with periods of low right whale calving (Meyer-Gutbrod et al. 2015a). Low prey availability also leads to longer interval periods between births (Meyer-Gutbrod and Greene 2018). Lactating females, in particular, appear to be getting less energy than expected, which 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. Reproductively mature females may choose to remain in northern latitudes during the fall, winter, and spring to maximize potential feeding opportunities and improve body condition (Gavrilchuk et al. 2021). 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 slightly more resilient to changes in prey than those that are zooplanktivorous specialists, such as right whales, who likely cannot survive on the less lipid rich copepods of the North Atlantic that are smaller in size and population than *C. finmarchicus* (Baumgartner et al. 2017). Overall, data indicate a moderate negative impact on large whales.

8.3.3.7.2 Other Protected Species

Other large whales with more specialized diets, such as 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 slight negative impact on other protected species.

8.3.3.8 Vessel Strikes

8.3.3.8.1 Large Whales

All of the large whales included in this VEC have been casualties of vessel strikes. Historically, minke whales have been impacted less than larger species, followed by the humpback whale, right whale, and fin whale (in order of increasing mortality rate between 1970 and 2009 (Van Der Hoop et al. 2013). 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 percent of stranded right whales where the cause of death was determined to be a vessel strike (Sharp et al. 2019). Not all whales die after a vessel strike, but many can experience serious injury. At least 14 percent of humpback whales in the Gulf of Maine showed signs of one or more strikes, and this is likely an underestimate (Hill et al. 2017). Regulations to reduce vessel strikes were implemented in 2008 and contributed to a decline in lethal vessel strikes along the Atlantic coast of the U.S. (Laist et al. 2014, van der Hoop et al. 2015). However, some of these regulations are not mandatory, and simply shifts the threat of vessel strikes to other areas (Vanderlaan and Taggart 2009) or do not account for changes in whale behavior. Fatal vessel strikes have recently increased in occurrence as right whales shift north to locate their preferred prey species, *C. finmarchicus* into areas that 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.

8.3.3.8.2 Other Protected Species

There is limited information on vessel strikes for other large whale species that are infrequently spotted nearshore. Vessel 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 vessel 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 moderate negative impact is likely for protected species.

8.3.3.9 Harmful Algal Blooms

Harmful algal blooms (HABs) impact all U.S. coastlines 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.

8.3.3.9.1 Large Whales

Large whales are primarily exposed to the toxins from HABs 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 right whales (Durbin et al. 2002, Leandro et al. 2010, Doucette et al. 2012). Toxins associated with HABs 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). Right whales 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). HABs, and their predicted increase, will likely have a moderate negative effect on large whales.

8.3.3.9.2 Other Protected Species

Similar to the large whale species discussed above, other baleen and toothed whales are susceptible to the negative impacts of HABs. Less is known about the level of exposure of sei and sperm whales in the Northeast Region, 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).Very little is known about sperm whale exposure in the population off the East Coast. 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 HABs and can experience negative health impacts. Brevitoxin exposure in the Southeast is the primary documented toxin concern for loggerhead populations from the East Coast (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 may be 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 Northeast Region, 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, HABs will have a moderate negative effect on other protected species.

8.3.3.9.3 Habitat

HABs 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 HABs 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 HABs will have a moderate negative effect on the habitat.

8.3.3.9.4 Human Communities

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 millions of 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, HABs cost the commercial fishing industry tens of millions of dollars (Anderson et al. 2000, Hoagland et al. 2002). This suggests the overall impact of HABs on human communities is moderate negative.

8.3.3.10 Canadian Serious Injury and Mortality

8.3.3.10.1 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 earlier. Since 2010, there has been a documented change in right whales' prey distribution that has shifted right whales into new areas where there were previously no risk reduction measures, which contributed to an increase in 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 of origin for each incident, but several cases had snow crab gear that was identified as Canadian or were hit by vessels in Canadian waters. Given survey 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.

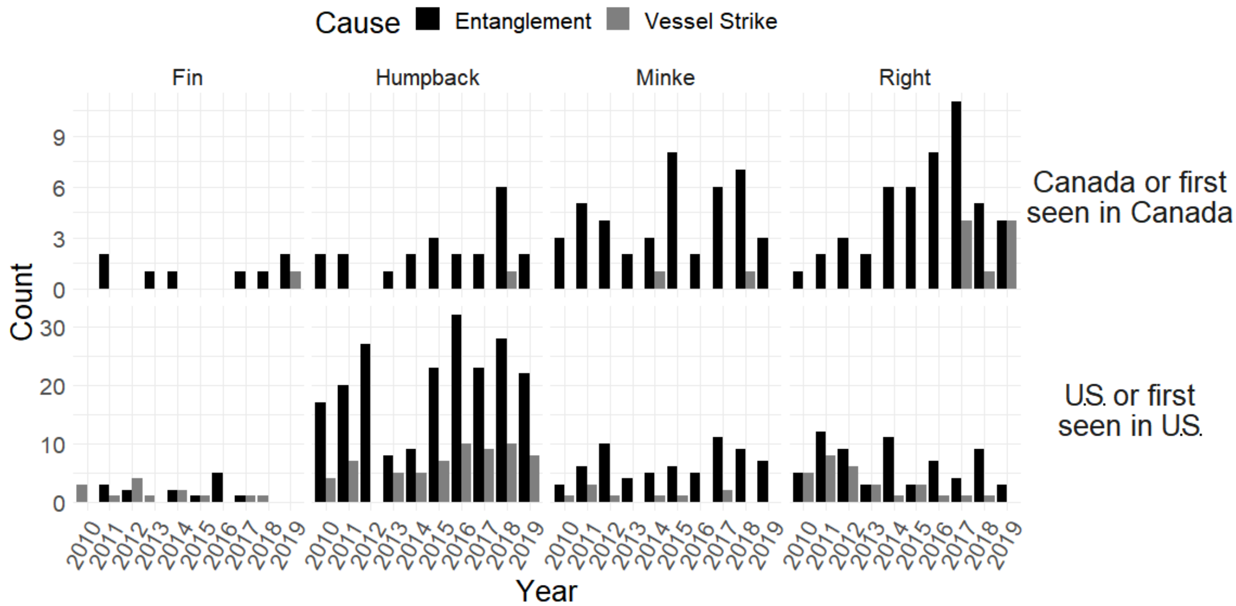


Figure 8.4: Serious injury and mortality cases (including those averted by disentanglement response or prorated injuries) caused by entanglements and vessel strikes according to the country where the incident occurred or, in the absence of that information, where the individual was first sighted.

Coast-wide, annual right whale serious injuries and mortalities caused by entanglement far exceed the PBR level for the population (0.8 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 each country is unsustainable. Furthermore, these 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 vessel 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 vessel 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, 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 promote recovery of right whales, and protect other Atlantic large whales. In sum, the impact of mortality in Canadian waters is considered to be high negative.

8.3.3.10.2 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. 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 have been no confirmed mortalities that occurred within 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, vessel strikes, or other causes. The level sustained outside of U.S waters may or may not be a threat to these species. It is unlikely to match the same threat observed in nearshore large whale species where whale density is higher, particularly right whale density.

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 slight negative for other protected species.

8.4 Direct and Indirect Impacts

The direct and indirect impacts of the alternatives were covered in Chapters 5 through 8 and are summarized in Table 8.5.

Table 8.5: The direct and indirect impacts of the alternatives on the four VECs.

Alternatives	*Large Whales*	*Other Protected Species*	*Habitat*	*Human Communities*
	Risk Reduction			
1 (No Action)	**High Negative to Moderate Negative** Serious injury and mortality would continue to occur and impact ESA-listed species' population health. More so for right whales and other large whales to a lesser degree other ESA-listed or MMPA protected species.	**Moderate Negative** Injury and mortality due to entanglement would continue to harm ESA-listed species.	**Negligible to Slight Negative** Areas with trawls above 15 traps per trawl may have a short-term impact.	**Slight Negative to Moderate Positive** Positive in that there are no new impacts or costs to harvesters and markets, but the lack of recovery of whale species has a slight negative impact on public welfare benefits due to whale population declines.
2 (Preferred)	**Moderate Negative to Slight Negative** Would reduce entanglement risk for ESA-listed and MMPA protected species. However risk of interactions will not be entirely eliminated.	**Slight Negative** Would reduce entanglement risk for ESA-listed species. However risk of interactions will not be entirely eliminated.	**Negligible to Slight Negative** Trawling up to trawls above 15 traps per trawl may have a short-term impact.	**Slight Negative** Fisheries would experience extra costs and catch reduction in the short term that could ease over the long term.
3 (Non-preferred)	**Moderate Negative to Slight Negative** Would reduce entanglement risk for ESA-listed and MMPA protected species. However risk of interactions will not be entirely eliminated.	**Slight Negative** Would reduce entanglement risk for ESA-listed species. However risk of interactions will not be entirely eliminated.	**Negligible to Slight Negative** Areas with trawls above 15 traps per trawl may have a short-term impact.	**Moderate Negative** Costs of gear modifications and catch reduction would be significant.
	Gear Marking			
1 (No Action)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative** Current gear marking costs would have a slight economic burden on fishermen.
2 (Preferred)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative** Gear marking requirements would generate economic burden to fishermen, but could lower the future regulatory costs.
3 (Non-preferred)	**Negligible**	**Negligible**	**Negligible**	**Slight Negative to Negative** Gear marking requirements would generate high economic burden to fishermen, but could lower the future regulatory costs.

8.5 Cumulative Impacts of Alternatives

A summary of the cumulative impacts on all VECs for Alternative 2 (Preferred Alternative) is summarized in Table 8.6.

Table 8.6: A summary of the final cumulative impacts analysis of the Preferred Alternative (Alternative 2) on all four VECs

Alternatives	Direct and Indirect Impacts	Existing Conditions	All Management Actions and Stressors	Cumulative Impacts
Large Whales	**Slight to Moderate Negative** Would reduce entanglement risk for ESA-listed and MMPA protected species. However interaction risk will not be entirely eliminated.	**Negative** Several protected species are still listed as endangered or threatened. Habitats have experienced degradation from human activities and are shifting as a result of climate change. Commercial fisheries are also shifting as a result of climate change.	**Moderate Negative to Slight Positive** Fisheries negatively impact large whale species, though some management actions may have mitigated the risk. Non-fishery management actions likely improved ocean quality and reduced gear encounters, which benefitted large whales. Anthropogenic and natural stressors have had negative impacts on the VECs and likely will continue to do so in the future.	**Slight Negative to Negligible** 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
Other Protected Species	**Slight Negative** Would reduce entanglement risk for ESA-listed species. However risk of interactions will not be entirely eliminated.		**Moderate Negative to Slight Positive** Fisheries negatively impact large whale species, though some management actions may have mitigated the risk. Non-fishery management actions likely improved ocean quality and reduced gear encounters, which benefitted large whales. Anthropogenic and natural stressors have had negative impacts on the VECs and likely will continue to do so in the future.	**Slight Negative to Negligible** 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
Habitat	**Negligible to Slight Negative** Areas with trawls above 15 traps per trawl may have a short-term impact		**Slight Negative to Slight Positive** Fishery management actions likely have negligible to slight negative impacts on habitat. Non-fishery management actions likely improved ocean quality, which benefitted habitats. Anthropogenic and natural stressors have had moderate negative impacts on habitats.	**Negligible to Slight Positive** Continued management is not expected to measurably change habitat quality and existing cumulative impacts.
Human Communities	**Slight Negative –** Fisheries would experience extra costs and catch reduction in the short term.		**Slight Negative to Slight Positive** Overall, fisheries management positively impacts human communities, though certain management actions may have had a short term negative effect. Non-fishery management actions likely improved fisheries. Anthropogenic and natural stressors have had negative impacts.	**Slight Negative to Slight Positive** Continued fishery management is expected to positively benefit Human Communities but conservation measures will likely negatively impact human communities, except for the positive social benefits expected from protecting whale species.

8.6 References

Ackleh, A. S., G. E. Ioup, J. W. Ioup, B. Ma, J. J. Newcomb, N. Pal, N. A. Sidorovskaia, and C. Tiemann. 2012. Assessing the Deepwater Horizon oil spill impact on marine mammal population through acoustics: endangered sperm whales. J Acoust Soc Am **131**:2306-2314.

Aguilar, A. 1983. Organochlorine pollution in sperm whales, *Physeter macrocephalus*, from the temperate waters of the eastern North Atlantic. Marine Pollution Bulletin **14**:349-352.

Aguilar, A., A. Borrell, and P. J. H. Reijnders. 2002. Geographical and temporal variation in levels of organochlorine contaminants in marine mammals. Marine Environmental Research **53**:425-452.

Alve, E., and F. Olsgard. 1999. Benthic foraminiferal colonization in experiments with copper-contaminated sediments. Journal of Foraminiferal Research **29**:11.

American Wind Energy Association (AWEA). 2020. U.S. Offshore Wind Power Economic Impact Assessment. https://supportoffshorewind.org/wp-content/uploads/sites/6/2020/03/AWEA_Offshore-Wind-Economic-ImpactsV3.pdf. 19 pp.

Anderson, D. M. 1995. Toxic red tides and harmful algal blooms: A practical challenge in coastal oceanography. Reviews of Geophysics **33**:1189-1200.

Anderson, D. M., S. B. Galloway, and J. D. Joseph. 1993. Marine biotoxins and harmful algae: a national plan. Woods Hole Oceanographic Institution, Woods Hole, MA.

Anderson, D. M., Y. Kaoru, and A. W. White. 2000. Estimated annual economic impacts from harmful algal blooms (HABs) in the United States. Technical Report WHOI-2000-11, Woods Hole Oceanographic Institution, Woods Hole, MA.

Andrés, E. D., B. Gomara, D. González-Paredes, J. Ruiz-Martin, and A. Marco. 2016. Persistent organic pollutant levels in eggs of leatherback turtles (*Dermochelys coriacea*) point to a decrease in hatching success. Chemosphere **146**:354-361.

Angell, C. M., J. Y. Wilson, M. J. Moore, and J. J. Stegeman. 2004. CYTOCHROME P450 1A1 EXPRESSION IN CETACEAN INTEGUMENT: IMPLICATIONS FOR DETECTING CONTAMINANT EXPOSURE AND EFFECTS. Marine Mammal Science **20**:554-566.

Atlas, R. M., R. J. B. Bartha, and Bioengineering. 1972. Degradation and mineralization of petroleum in sea water: limitation by nitrogen and phosphorous. **14**:309-318.

Attrill, M. J., J. Wright, and M. Edwards. 2007. Climate-related increases in jellyfish frequency suggest a more gelatinous future for the North Sea. Limnology and Oceanography **52**:480-485.

Avio, C. G., S. Gorbi, and F. Regoli. 2017. Plastics and microplastics in the oceans: From emerging pollutants to emerged threat. Marine Environmental Research **128**:2-11.

Baguley, J., P. Montagna, C. Cooksey, J. Hyland, H. Bang, C. Morrison, A. Kamikawa, P. Bennetts, G. Saiyo, E. Parsons, M. Herdener, and M. Ricci. 2015. Community response of deep-sea soft-sediment metazoan meiofauna to the Deepwater Horizon blowout and oil spill. Marine Ecology Progress Series **528**:127-140.

Bailey, H., K. L Brookes, and P. M. Thompson. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquatic Biosystems 10(8), 1-13.

Bailey, H., S. Fossette, S. J. Bograd, G. L. Shillinger, A. M. Swithenbank, J.-Y. Georges, P. Gaspar, K. H. P. Strömberg, F. V. Paladino, J. R. Spotila, B. A. Block, and G. C. Hays. 2012. Movement Patterns for a Critically Endangered Species, the Leatherback Turtle (*Dermochelys coriacea*), Linked to Foraging Success and Population Status. PLoS One **7**:e36401.

Bailey, H., B. Senior, D. Simmons, J. Rusin, G. Picken, and P. M. Thompson. 2010. Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. Marine Pollution Bulletin **60**:888-897.

Baker, A. N. 2005. Sensitivity of marine mammals found in Northland waters to aquaculture activities. Report to the Department of Conservation, Northland Conservancy. Report, Cetacean Biology Consultant, Kerikeri, New Zealand.

Barco, S., M. Law, B. Drummond, H. Koopman, C. Trapani, S. Reinheimer, S. Rose, W. Swingle, and A. Williard. 2016. Loggerhead turtles killed by vessel and fishery interaction in Virginia, USA, are healthy prior to death. Marine Ecology Progress Series **555**:221-234.

Barrios-Garrido, H., and M. G. Montiel-Villalobos. 2016. STRANDINGS OF LEATHERBACK TURTLES (DERMOCHELYS CORIACEA) ALONG THE WESTERN AND SOUTHERN COAST OF THE GULF OF VENEZUELA. Herpetological Conservation and Biology:9.

Barron, M. G., Vivian, D. N., Heintz, R. A., & Yim, U. H. (2020). Long-Term Ecological Impacts from Oil Spills: Comparison of Exxon Valdez, Hebei Spirit, and Deepwater Horizon. Environmental Science & Technology 54 (11), 6456-6467 DOI: 10.1021/acs.est.9b05020

Baumgartner, M., F. Wenzel, N. Lysiak, and M. Patrician. 2017. North Atlantic right whale foraging ecology and its role in human-caused mortality. Marine Ecology Progress Series **581**:165-181.

Becker, E. A., K. A. Forney, J. V. Redfern, J. Barlow, M. G. Jacox, J. J. Roberts, and D. M. Palacios. 2019. Predicting cetacean abundance and distribution in a changing climate. Diversity and Distributions **25**:626-643.

Bergeron, J. M., D. Crews, and J. A. McLachlan. 1994. PCBs as environmental estrogens: turtle sex determination as a biomarker of environmental contamination. Environmental Health Perspectives **102**:780-781.

Bergström, L., L. Kautsky, T. Malm, R. Rosenberg, M. Wahlberg, N. Å. Capetillo, and D. Wilhelmsson. 2014. Effects of offshore wind farms on marine wildlife—a generalized impact assessment. Environmental Research Letters 9(3), 1-12.

Berkenhagen, J., Döring, R., Fock, H.O., Kloppmann, M.H., Pedersen, S.A. and Schulze, T., 2010. Decision bias in marine spatial planning of offshore wind farms: Problems of singular versus cumulative assessments of economic impacts on fisheries. Marine policy, 34(3), pp.733-736.

Beauchamp, J., H. Bouchard, P. de Margerie, N. Otis, and J.-Y. Savaria. 2009. Recovery Strategy for the Blue Whale (Balaenoptera musculus), Northwest Atlantic Population, in Canada. Fisheries and Oceans Canada, Ottawa.

Beyer, J., H. C. Trannum, T. Bakke, P. V. Hodson, and T. K. Collier. 2016. Environmental effects of the Deepwater Horizon oil spill: A review. Marine Pollution Bulletin **110**:28-51.

Bik, H. M., K. M. Halanych, J. Sharma, and W. K. Thomas. 2012. Dramatic shifts in benthic microbial eukaryote communities following the Deepwater Horizon oil spill. PLoS One **7**:e38550.

Birchenough, S. N. R., H. Reiss, S. Degraer, N. Mieszkowska, Á. Borja, L. Buhl-Mortensen, U. Braeckman, J. Craeymeersch, I. De Mesel, F. Kerckhof, I. Kröncke, S. Parra, M. Rabaut, A. Schröder, C. Van Colen, G. Van Hoey, M. Vincx, and K. Wätjen. 2015. Climate change and marine benthos: a review of existing research and future directions in the North Atlantic. Wiley Interdisciplinary Reviews: Climate Change **6**:203-223.

Bjorndal, K. A., A. B. Bolten, M. Chaloupka, V. S. Saba, C. Bellini, M. A. G. Marcovaldi, A. J. B. Santos, L. F. W. Bortolon, A. B. Meylan, P. A. Meylan, J. Gray, R. Hardy, B. Brost, M. Bresette, J. C. Gorham, S. Connett, B. V. S. Crouchley, M. Dawson, D. Hayes, C. E. Diez, R. P. van Dam, S. Willis, M. Nava, K. M. Hart, M. Cherkiss, A. G. Crowder, C. Pollock, Z. Hillis-Starr, F. A. Muñoz Tenería, R. Herrera-Pavón, V. Labrada-Martagón, A. Lorences, A. Negrete-Philippe, M. M. Lamont, A. M. Foley, R. Bailey, R. R. Carthy, R. Scarpino, E. McMichael, J. A. Provancha, A. Brooks, A. Jardim, M. López-Mendilaharsu, D. González-Paredes, A. Estrades, A. Fallabrino, G. Martínez-Souza, G. M. Vélez-Rubio, R. H. Boulon, J. A. Collazo, R. Wershoven, V. Guzmán Hernández, T. B. Stringell, A. Sanghera, P. B. Richardson, A. C. Broderick, Q. Phillips, M. Calosso, J. A. B. Claydon, T. L. Metz, A. L. Gordon, A. M. Landry, D. J. Shaver, J. Blumenthal, L. Collyer, B. J. Godley, A. McGowan, M. J. Witt, C. L. Campbell, C. J. Lagueux, L. Bethel, and L. Kenyon. 2017. Ecological regime shift drives declining growth rates of sea turtles throughout the West Atlantic. Global Change Biology **23**:4556-4568.

Blair, H. B., N. D. Merchant, A. S. Friedlaender, D. N. Wiley, and S. E. Parks. 2016. Evidence for ship noise impacts on humpback whale foraging behaviour. Biol Lett **12**.

Blumer, M., and J. Sass. 1972. Oil Pollution: Persistence and Degradation of Spilled Fuel Oil. Science **176**:1120-1122.

Boavida-Portugal, J., R. Rosa, R. Calado, M. Pinto, I. Boavida-Portugal, M. B. Araújo, and F. Guilhaumon. 2018. Climate change impacts on the distribution of coastal lobsters. Marine Biology **165**:186.

Bureau of Ocean and Energy Management (BOEM). 2020a. Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement Volume 1. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS EIS/EA BOEM 2021-0012. 352pp.

BOEM. 2020b. Oil and Gas Energy Fact Sheet. https://www.boem.gov/sites/default/files/documents/oil-gas-energy/BOEM_FactSheet-Oil%26amp%3BGas-2-26-2020.pdf. 2 pp. Bomkamp, R. E., H. M. Page, and J. E. Dugan. 2004. Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms. Marine Biology **146**:201-211.

Borrell, A., and A. Aguilar. 1987. Variations in DDE Percentage Correlated with Total D DT Burden in the Blubber of Fin and Sei Whales. Marine Pollution Bulletin **18**:5.

Brakstad, O. G., & Bonaunet, K. (2006). Biodegradation of petroleum hydrocarbons in seawater at low temperatures (0–5 C) and bacterial communities associated with degradation. Biodegradation, 17(1), 71-82.

Brierley, A. S., and M. J. Kingsford. 2009. Impacts of Climate Change on Marine Organisms and Ecosystems. Current Biology **19**:R602-R614.

Brodie, E. C., F. M. D. Gulland, D. J. Greig, M. Hunter, J. Jaakola, J. S. Leger, T. A. Leighfield, and F. M. Van Dolah. 2006. Domoic Acid Causes Reproductive Failure in California Sea Lions (*Zalophus Californianus*). Marine Mammal Science **22**:700-707.

Bushra, S., and M. Ahmad. 2014. IMPACT OF ORGANOCHLORINES ON ENDOCRINE SYSTEM: A REVIEW. International Journal of Advances in Biology **1**:11.

Camacho, M., O. P. Luzardo, L. D. Boada, L. F. López Jurado, M. Medina, M. Zumbado, and J. Orós. 2013. Potential adverse health effects of persistent organic pollutants on sea turtles: Evidences from a cross-sectional study on Cape Verde loggerhead sea turtles. Science of The Total Environment **458-460**:283-289.

Campo, P., Venosa, A. D., & Suidan, M. T. (2013). Biodegradability of Corexit 9500 and dispersed South Louisiana crude oil at 5 and 25 C. Environmental science & technology, 47(4), 1960-1967.

Canter, L. W. 2012. Guidance on Cumulative Effects Analysis in Environmental Assessments and Environmental Impact Statements.*in* N. GARFO, NOAA, editor. NOAA, Gloucester, MA.

Capper, A., L. J. Flewelling, and K. Arthur. 2013. Dietary exposure to harmful algal bloom (HAB) toxins in the endangered manatee (Trichechus manatus latirostris) and green sea turtle (Chelonia mydas) in Florida, USA. Harmful Algae **28**:1-9.

Caut, S., E. Guirlet, and M. Girondot. 2010. Effect of tidal overwash on the embryonic development of leatherback turtles in French Guiana. Marine Environmental Research **69**:254-261.

Chang, S., F. Steimle, R. Reid, S. Fromm, V. Zdanowicz, and R. Pikanowski. 1992. Association of benthic macrofauna with habitat types and quality in the New York Bight. Marine Ecology Progress Series **89**:237-251.

Cheung, W. W. L., V. W. Y. Lam, J. L. Sarmiento, K. Kearney, R. Watson, D. Zeller, and D. Pauly. 2010. Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change: climate change impacts on catch potential. Global Change Biology **16**:24-35.

Christiansen, F., M. H. Rasmussen, and D. Lusseau. 2014. Inferring energy expenditure from respiration rates in minke whales to measure the effects of whale watching boat interactions. Journal of Experimental Marine Biology and Ecology **459**:96-104.

Clement, D. 2013. Literature review of ecological effects of aquaculture - effects on marine mammals. Ministry for Primary Industries. CLF. 2019. Vineyard Wind – NGO Agreement.

Colburn, L. L., M. Jepson, C. Weng, T. Seara, J. Weiss, and J. A. Hare. 2016. Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States. Marine Policy **74**:323-333.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere **4**:1-15.

D'Anna, L.M. and Murray, G.D., 2015. Perceptions of shellfish aquaculture in British Columbia and implications for well-being in marine social-ecological systems. Ecology and Society, 20(1).

Dannheim, J., L. Bergström, S. N. R. Birchenough, R. Brzana, A. R. Boon, J. W. P. Coolen, J.-C. Dauvin, I. De Mesel, J. Derweduwen, A. B. Gill, Z. L. Hutchison, A. C. Jackson, U. Janas, G. Martin, A. Raoux, J. Reubens, L. Rostin, J. Vanaverbeke, T. A. Wilding, D. Wilhelmsson, and S. Degraer. 2019. Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research. ICES Journal of Marine Science.

Davies, K. T. A., and S. W. Brillant. 2019. Mass human-caused mortality spurs federal action to protect endangered North Atlantic right whales in Canada. Marine Policy **104**:157-162.

Denkinger, J., M. Parra, J. P. Muñoz, C. Carrasco, J. C. Murillo, E. Espinosa, F. Rubianes, and V. Koch. 2013. Are boat strikes a threat to sea turtles in the Galapagos Marine Reserve? Ocean & Coastal Management **80**:29-35.

DeRuiter, S. L., and K. Larbi Doukara. 2012. Loggerhead turtles dive in response to airgun sound exposure. Endangered Species Research **16**:55-63.

Desforges, J.-P. W., C. Sonne, M. Levin, U. Siebert, S. De Guise, and R. Dietz. 2016. Immunotoxic effects of environmental pollutants in marine mammals. Environment International **86**:126-139.

Deutsch, C., A. Ferrel, B. Seibel, H. O. Portner, and R. B. Huey. 2015. Climate change tightens a metabolic constraint on marine habitats. Science **348**:1132-1135.

Di Iorio, L., and C. W. Clark. 2010. Exposure to seismic survey alters blue whale acoustic communication. Biology Letters **6**:51-54.

Doney, S. C., M. Ruckelshaus, J. Emmett Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science **4**:11-37.

Doucette, G. J., C. M. Mikulski, K. L. King, P. B. Roth, Z. Wang, L. F. Leandro, S. L. DeGrasse, K. D. White, D. De Biase, R. M. Gillett, and R. M. Rolland. 2012. Endangered North Atlantic right whales (*Eubalaena glacialis*) experience repeated, concurrent exposure to multiple environmental neurotoxins produced by marine algae. Environmental Research **112**:67-76.

Durbin, E., G. Teegarden, R. Campbell, A. Cembella, M. F. Baumgartner, and B. R. Mate. 2002. North Atlantic right whales, *Eubalaena glacialis*, exposed to paralytic shellfish poisoning (PSP) toxins via a zooplankton vector, *Calanus finmarchicus*. Harmful Algae **1**:243-251.

Elfes, C. T., G. R. VanBlaricom, D. Boyd, J. Calambokidis, P. J. Clapham, R. W. Pearce, J. Robbins, J. C. Salinas, J. M. Straley, P. R. Wade, and M. M. Krahn. 2010. Geographic variation of persistent organic pollutant levels in humpback whale (*Megaptera novaeangliae*) feeding areas of the North Pacific and North Atlantic. Environmental Toxicology and Chemistry **29**:824-834.

Ellis, J., G. Fraser, and J. Russell. 2012. Discharged drilling waste from oil and gas platforms and its effects on benthic communities. Marine Ecology Progress Series **456**:285-302.

Ellison, W.T., B.L. Southall, C.W. Clark, and A.S. Frankel. 2011. A new context-based approach to assess marine mammal behavioral responses to anthropogenic sounds. Conservation Biology **26**:21-28.

Ellison, W.T., B. L. Southall, A. S. Frankel, K. Vigness-Raposa, and C. W. Clark. 2018. Short Note: An Acoustic Scene Perspective on Spatial, Temporal, and Spectral Aspects of Marine Mammal Behavioral Responses to Noise. Aquatic Mammals 44(3), 239-243.

Engås, A., S. Løkkeborg, E. Ona, and A. V. Soldal. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*).12.

Fair, P. A., and P. R. Becker. 2000. Review of stress in marine mammals. Journal of Aquatic Ecosystem Stress and Recovery **7**:335-354.

Farmer, N. A., K. Baker, D. G. Zeddies, S. L. Denes, D. P. Noren, L. P. Garrison, A. Machernis, E. M. Fougères, and M. Zykov. 2018. Population consequences of disturbance by offshore oil and gas activity for endangered sperm whales (*Physeter macrocephalus*). Biological Conservation **227**:189-204.

Fauquier, D. A., L. J. Flewelling, J. Maucher, C. A. Manire, V. Socha, M. J. Kinsel, B. A. Stacy, M. Henry, J. Gannon, J. S. Ramsdell, and J. H. Landsberg. 2013. Brevetoxin in Blood, Biological Fluids, and Tissues Of Sea Turtles Naturally Exposed to Karenia Brevis Blooms in Central West Florida. Journal of Zoo and Wildlife Medicine **44**:364-375.

Finneran, J. J. 2015. Noise-induced hearing loss in marine mammals: a review of temporary threshold shift studies from 1996 to 2015. J. Acoust. Soc. Am. **138**:1702–1726.

Finneran, J.J. 2016. Auditory Weighting Functions and TTS/PTS Exposure Functions for Marine Mammals Exposed to Underwater Noise, Technical Report 3026, December 2016. San Diego: Systems Center Pacific

Fire, S. E., and F. M. V. Dolah. 2012. Marine Biotoxins: Emergence of Harmful Algal Blooms as Health Threats to Marine Wildlife. Pages 374-389 *in* A. A. Aguire, R. S. Ostfield, and P. Daszak, editors. New Directions in Conservation Medicine: Applied Cases in Ecological Health. Oxford Press, New York.

Fire, S. E., Z. Wang, M. Berman, G. W. Langlois, S. L. Morton, E. Sekula-Wood, and C. R. Benitez-Nelson. 2010. Trophic Transfer of the Harmful Algal Toxin Domoic Acid as a Cause of Death in a Minke Whale (*Balaenoptera acutorostrata*) Stranding in Southern California. Aquatic Mammals **36**:342-350.

Fire, S. E., Z. Wang, T. A. Leighfield, S. L. Morton, W. E. McFee, W. A. McLellan, R. W. Litaker, P. A. Tester, A. A. Hohn, G. Lovewell, C. Harms, D. S. Rotstein, S. G. Barco, A. Costidis, B. Sheppard, G. D. Bossart, M. Stolen, W. N. Durden, and F. M. Van Dolah. 2009. Domoic acid exposure in pygmy and dwarf sperm whales (Kogia spp.) from southeastern and mid-Atlantic U.S. waters. Harmful Algae **8**:658-664.

Flemming, R., and J. D. Crawford. 2006. Habitat protection under the Magnuson-Stevens Act: can it really contribute to ecosystem health in the Northwest Atlantic? Ocean and Coastal Law Journal **12**:43-89.

Forney, K., B. Southall, E. Slooten, S. Dawson, A. Read, R. Baird, and R. Brownell. 2017. Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity. Endangered Species Research **32**:391-413.

Fortune, S., A. Trites, C. Mayo, D. Rosen, and P. Hamilton. 2013. Energetic requirements of North Atlantic right whales and the implications for species recovery. Marine Ecology Progress Series **478**:253-272.

Fossi, M. C., L. Marsili, M. Baini, M. Giannetti, D. Coppola, C. Guerranti, I. Caliani, R. Minutoli, G. Lauriano, M. G. Finoia, F. Rubegni, S. Panigada, M. Bérubé, J. Urbán Ramírez, and C. Panti. 2016. Fin whales and microplastics: The Mediterranean Sea and the Sea of Cortez scenarios. Environmental Pollution **209**:68-78.

Frasier, K. E., Solsona-Berga, A., Stokes, L., & Hildebrand, J. A. (2020). Impacts of the Deepwater Horizon Oil Spill on Marine Mammals and Sea Turtles. In Deep Oil Spills (pp. 431-462). Springer, Cham.

Fu, F., A. Tatters, and D. Hutchins. 2012. Global change and the future of harmful algal blooms in the ocean. Marine Ecology Progress Series **470**:207-233.

Fuentes, M. M. P. B., D. A. Pike, A. Dimatteo, and B. P. Wallace. 2013. Resilience of marine turtle regional management units to climate change. Global Change Biology **19**:1399-1406.

Gallardi, D. 2014. Effects of Bivalve Aquaculture on the Environment and Their Possible Mitigation: A Review. Fisheries and Aquaculture Journal **05**.

Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997. Chlorinated organic contaminants in blubber biopsies from northwestern Atlantic balaenopterid whales summering in the Gulf of St Lawrence. Marine Environmental Research **44**:201-223.

Gavrilchuk, K., V. Lesage, C. Ramp, R. Sears, M. Bérubé, S. Bearhop, and G. Beauplet. 2014. Trophic niche partitioning among sympatric baleen whale species following the collapse of groundfish stocks in the Northwest Atlantic. Marine Ecology Progress Series **497**:285-301.

Gavrilchuk, K,. V. Lesage, S. Fortune, A. Trites, and S. Plourde. 2021. Foraging habitat of North Atlantic right whales has declined in the Gulf of St. Lawrence, Canada and may be insufficient for successful reproduction. Endangered Species Research **44**:113-136.

Geraci, J. R., D. M. Anderson, R. J. Timperi, D. J. St. Aubin, G. A. Early, J. H. Prescott, and C. A. Mayo. 1989. Humpback Whales (*Megaptera novaeangliae*) Fatally Poisoned by Dinoflagellate Toxin. Canadian Journal of Fisheries and Aquatic Sciences **46**:1895-1898.

Gill, A. B. 2005. Offshore renewable energy: ecological implications of generating electricity in the coastal zone: Ecology and offshore renewable energy. Journal of Applied Ecology **42**:605-615.

Gill, A., S. Degraer, A. Lipsky, N. Mavraki, E. Methratta, and R. Brabant. 2020. Setting the Context for Offshore Wind Development Effects on Fish and Fisheries. Oceanography 33(4), 118-127.Gobler, C. J., O. M. Doherty, T. K. Hattenrath-Lehmann, A. W. Griffith, Y. Kang, and R. W. Litaker. 2017. Ocean warming since 1982 has expanded the niche of toxic algal blooms in the North Atlantic and North Pacific oceans. Proceedings of the National Academy of Sciences **114**:4975-4980.

Grealis, E., Hynes, S., O'Donoghue, C., Vega, A., Van Osch, S. and Twomey, C., 2017. The economic impact of aquaculture expansion: An input-output approach. Marine Policy, 81, pp.29-36.

Greene, C. H., E. E. Head, P. Smith, P. C. Reid, and A. Conversi. 2013. Remote climate forcing of decadal-scale regime shifts in Northwest Atlantic shelf ecosystems. Limnology and Oceanography **58**:803-816.

Grieve, B. D., J. A. Hare, and V. S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the U.S. Northeast Continental Shelf. Scientific Reports **7**:6264.

Guirlet, E., K. Das, J.-P. Thomé, and M. Girondot. 2010. Maternal transfer of chlorinated contaminants in the leatherback turtles, *Dermochelys coriacea*, nesting in French Guiana. Chemosphere **79**:720-726.

Hall, C. M. 2001. Trends in ocean and coastal tourism: the end of the last frontier? Ocean Coast. Manag. **44**:601–618.

Harris, H. S., S. R. Benson, K. V. Gilardi, R. H. Poppenga, T. M. Work, P. H. Dutton, and J. A. K. Mazet. 2011. Comparative health assessment of western Pacific leatherback turtles (*Dermochelys coriacea*) foraging off the coast of California, 2005–2007. Journa of Wildlife Diseases **47**:321-337.

Häussermann, V., C. S. Gutstein, M. Beddington, D. Cassis, C. Olavarria, A. C. Dale, A. M. Valenzuela-Toro, M. J. Perez-Alvarez, H. H. Sepúlveda, K. M. McConnell, F. E. Horwitz, and G. Försterra. 2017. Largest baleen whale mass mortality during strong El Niño event is likely related to harmful toxic algal bloom. PeerJ **5**:e3123.

Hayes, S. A., S. Gardner, L. Garrison, A. Henry, and L. Leandro. 2018. North Atlantic Right Whales – Evaluating Their Recovery Challenges in 2018. NOAA Technical Memorandum NOAA-TM-NMFS-NE-247, NOAA, DOC.

Hazel, J., I. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green turtle *Chelonia mydas*. Endangered Species Research **3**:105-113.

Hill, A. N., C. Karniski, J. Robbins, T. Pitchford, S. Todd, and R. Asmutis-Silvia. 2017. Vessel collision injuries on live humpback whales, *Megaptera novaeangliae* , in the southern Gulf of Maine. Marine Mammal Science **33**:558-573.

Hinck, J. E., T. M. Bartish, B. S. Blazer, N. D. Denslow, T. S. Gross, M. S. Myers, and e. al. 2004. Biomonitoring of Environmental Status and Trends (BEST) Program: Environmental Contaminants and Their Effects on Fish in the Rio Grande Basin U.S. Geological Survey, Columbia Environmental Research Center, Columbia.

Hoagland, P., D. M. Anderson, Y. Kaoru, and A. W. White. 2002. The economic effects of harmful algal blooms in the United States: Estimates, assessment issues, and information needs. Estuaries **25**:819-837.

Hobbs, K. E., D. C. G. Muir, E. W. Born, R. Dietz, T. Haug, T. Metcalfe, C. Metcalfe, and N. Oien. 2003a. Levels and patterns of persistent organochlorines in minke whale (*Balaenoptera acutorostrata*) stocks from the North Atlantic and European Arctic. Environmental Pollution **121**:239-252.

Hobbs, K. E., D. C. G. Muir, E. W. Born, R. Dietz, T. Haug, T. Metcalfe, C. Metcalfe, and N. Øien. 2003b. Levels and patterns of persistent organochlorines in minke whale (*Balaenoptera acutorostrata*) stocks from the North Atlantic and European Arctic. Environmental Pollution: 14.

Hobbs, K. E., D. C. G. Muir, and E. Mitchell. 2001. Temporal and biogeographic comparisons of PCBs and persistent organochlorine pollutants in the blubber of ®n whales from eastern Canada in 1971±199. Environmental Pollution:12.

Irvine, L. G., M. Thums, C. E. Hanson, C. R. McMahon, and M. A. Hindell. 2017. Quantifying the energy stores of capital breeding humpback whales and income breeding sperm whales using historical whaling records.

Royal Society Open Science **4**:160290. Ishikawa, H., M. Goto, and T. Mogoe. 2013. Stranding Record in Japan: 1901-2012 (In Japanese). Report, Shimonoseki Academy of Marine Science, Japan.

Jacobsen, J. K., L. Massey, and F. Gulland. 2010. Fatal ingestion of floating net debris by two sperm whales (*Physeter macrocephalus*). Marine Pollution Bulletin:3.

Jacobson, E., B. Homer, B. Stacy, E. Greiner, N. Szabo, C. Chrisman, F. Origgi, S. Coberley, A. Foley, J. Landsberg, L. Flewelling, R. Ewing, R. Moretti, S. Schaf, C. Rose, D. Mader, G. Harman, C. Manire, N. Mettee, A. Mizisin, and G. Shelton. 2006. Neurological disease in wild loggerhead sea turtles *Caretta caretta*. Diseases of Aquatic Organisms **70**:139-154.

Jöhnk, K. D., Huisman, J., Sharples, J., Sommeijer, B., Visser, P. M., & Stroom, J. M. 2008. Summer heatwaves promote blooms of harmful cyanobacteria. Global Change Biology, **14 (3):** 495–512. https://doi.org/10.1111/j.1365-2486.2007.01510.x

Johnston, E. L., M. Mayer-Pinto, and T. P. Crowe. 2015. REVIEW: Chemical contaminant effects on marine ecosystem functioning. Journal of Applied Ecology **52**:140-149.

Kellar, N., T. Speakman, C. Smith, S. Lane, B. Balmer, M. Trego, K. Catelani, M. Robbins, C. Allen, R. Wells, E. Zolman, T. Rowles, and L. Schwacke. 2017. Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the Deepwater Horizon disaster (2010-2015). Endangered Species Research **33**:143-158.

Keller, J. M., J. R. Kucklick, M. A. Stamper, C. A. Harms, and P. D. McClellan-Green. 2004. Associations between Organochlorine Contaminant Concentrations and Clinical Health Parameters in Loggerhead Sea Turtles from North Carolina, USA. Environmental Health Perspectives **112**:1074-1079.

Keller, J. M., P. D. McClellan-Green, J. R. Kucklick, D. E. Keil, and M. M. Peden-Adams. 2006. Effects of Organochlorine Contaminants on Loggerhead Sea Turtle Immunity: Comparison of a Correlative Field Study and <i>In Vitro</i> Exposure Experiments. Environmental Health Perspectives **114**:70-76.

Kemper, C. M., D. Pemberton, M. Cawthorn, S. Heinrich, J. Mann, B. Würsig, P. Shaughnessy, and R. Gales. 2003. Aquaculture and marine mammals: co-existence or conflict? Pages 208-225 *in* N. Gales, M. Hindell, and R. Kirkwood, editors. Marine mammals: fisheries, tourism, and management issues. CSIRO Publishing.

Kingston, P. F. (2002). Long-term environmental impact of oil spills. Spill Science & Technology Bulletin, 7(1-2), 53-61.

Klanjscek, T., R. M. Nisbet, H. Caswell, and M. G. Neubert. 2007. A model for energetics and bioaccumulation in marine mammals with applications to the right whale. Ecological Applications **17**:2233-2250.

Kleisner, K. M., M. J. Fogarty, S. McGee, J. A. Hare, S. Moret, C. T. Perretti, and V. S. Saba. 2017. Marine species distribution shifts on the U.S. Northeast Continental Shelf under continued ocean warming. Progress in Oceanography **153**:24-36.

Kovacs, K. M., and C. Lydersen. 2008. Climate Change Impacts on Seals and Whales in the North Atlantic Arctic and Adjacent Shelf Seas. Science Progress **91**:117-150.

Kröger, K., J. P. A. Gardner, A. A. Rowden, and R. G. Wear. 2006. Long-term effects of a toxic algal bloom on subtidal soft-sediment macroinvertebrate communities in Wellington Harbour, New Zealand. Estuarine, Coastal and Shelf Science **67**:589-604.

Kühn, S., and J. A. van Franeker. 2020. Quantitative overview of marine debris ingested by marine megafauna. Marine Pollution Bulletin **151**:110858.

Kvitek, R., J. Goldberg, G. Smith, G. Doucette, and M. Silver. 2008. Domoic acid contamination within eight representative species from the benthic food web of Monterey Bay, California, USA. Marine Ecology Progress Series **367**:35-47.

Lai, W. W.-P., Y.-C. Lin, Y.-H. Wang, Y. L. Guo, and A. Y.-C. Lin. 2018. Occurrence of Emerging Contaminants in Aquaculture Waters: Cross-Contamination between Aquaculture Systems and Surrounding Waters. Water, Air, & Soil Pollution **229**:249.

Laist, D., A. Knowlton, and D. Pendleton. 2014. Effectiveness of mandatory vessel speed limits for protecting North Atlantic right whales. Endangered Species Research **23**:133-147.

Lam, V. W. Y., W. W. L. Cheung, G. Reygondeau, and U. R. Sumaila. 2016. Projected change in global fisheries revenues under climate change. Scientific Reports **6**:32607.

Lamb, M. Levin, J. A. Litz, W. E. McFee, N. J. Place, F. I. Townsend, R. S. Wells, and T. K. Rowles. 2012. Anaemia, hypothyroidism and immune suppression associated with polychlorinated biphenyl exposure in bottlenose dolphins (*Tursiops truncatus*). Proceedings of the Royal Society B: Biological Sciences **279**:48-57.

Lamont, M. M., R. R. Carthy, and I. Fujisaki. 2012. Declining Reproductive Parameters Highlight Conservation Needs of Loggerhead Turtles (*Caretta caretta*) in the Northern Gulf of Mexico. Chelonian Conservation and Biology **11**:190-196.

Lavender, A. L., S. M. Bartol, and I. K. Bartol. 2014. Ontogenetic investigation of underwater hearing capabilities in loggerhead sea turtles (*Caretta caretta*) using a dual testing approach. Journal of Experimental Biology **217**:2580-2589.

Law, K. L., S. Moret-Ferguson, N. A. Maximenko, G. Proskurowski, E. E. Peacock, J. Hafner, and C. M. Reddy. 2010. Plastic Accumulation in the North Atlantic Subtropical Gyre. Science **329**:1185-1188.

Le Bris, A., K. E. Mills, R. A. Wahle, Y. Chen, M. A. Alexander, A. J. Allyn, J. G. Schuetz, J. D. Scott, and A. J. Pershing. 2018. Climate vulnerability and resilience in the most valuable North American fishery. Proceedings of the National Academy of Sciences **115**:1831-1836.

Leandro, L. F., G. J. Teegarden, P. B. Roth, Z. Wang, and G. J. Doucette. 2010. The copepod *Calanus finmarchicus*: A potential vector for trophic transfer of the marine algal biotoxin, domoic acid. Journal of Experimental Marine Biology and Ecology **382**:88-95.

Lefebvre, K. A., S. Bargu, T. Kieckhefer, and M. W. Silver. 2002. From sanddabs to blue whales: the pervasiveness of domoic acid. Toxicon **40**:971-977.

Letcher, R. J., J. O. Bustnes, R. Dietz, B. M. Jenssen, E. H. Jørgensen, C. Sonne, J. Verreault, M. M. Vijayan, and G. W. Gabrielsen. 2010. Exposure and effects assessment of persistent organohalogen contaminants in arctic wildlife and fish. Science of The Total Environment **408**:2995-3043.

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K. L. Krijgsveld, M. Leopold, and M. Scheidat. 2011. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters **6**:035101.

Lipsky, A., S. Moura, A. Kenney, and R. Bellevance. 2016. Addressing Interactions between Fisheries and Offshore Wind Development: The Block Island Wind Farm.

Lloyd, B. 2003. Potential effects of mussel farming on New Zealand's marine mammals and seabirds : a discussion paper. New Zealand Department of Conservation, Wellington, New Zealand.

Love, M. S., D. M. Schroeder, W. Lenarz, A. MacCall, A. S. Bull, and L. Thorsteinson. 2006. Potential use of offshore marine structures in rebuilding an overfished rockfish species, bocaccio (*Sebastes paucispinis*). Fishery Bulletin **104**:383–390.

Lysiak, N. S. J., S. J. Trumble, A. R. Knowlton, and M. J. Moore. 2018. Characterizing the Duration and Severity of Fishing Gear Entanglement on a North Atlantic Right Whale (*Eubalaena glacialis*) Using Stable Isotopes, Steroid and Thyroid Hormones in Baleen. Frontiers in Marine Science **5**.

Mackenzie Jr, C.L. and Tarnowski, M., 2018. Large shifts in commercial landings of estuarine and bay bivalve mollusks in northeastern United States after 1980 with assessment of causes. Mar. Fish. Rev, 80, pp.1-28.

MacLeod, C. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endangered Species Research **7**:125-136.

Macreadie, P. I., A. M. Fowler, and D. J. Booth. 2011. Rigs-to-reefs: will the deep sea benefit from artificial habitat? . Front. Ecol. Environ. **9**:455–461.

Madsen, P., M. Wahlberg, J. Tougaard, K. Lucke, and P. Tyack. 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Marine Ecology Progress Series **309**:279-295.

Manire, C. A., E. T. Anderson, L. Byrd, and D. A. Fauquier. 2013. Dehydration as an effective treatment for brevetoxicosis in loggerhead sea turtles (*Caretta caretta*). Journal of Zoo and Wildlife Medicine **44**:447-452.

Martin, K. J., S. C. Alessi, J. C. Gaspard, A. D. Tucker, G. B. Bauer, and D. A. Mann. 2012. Underwater hearing in the loggerhead turtle (*Caretta caretta*): a comparison of behavioral and auditory evoked potential audiograms. Journal of Experimental Biology **215**:3001-3009.

Massachusetts Bay Program, M. 1991. Sources and loadings of pollutants to the Massachusetts Bays, Prepared by Menzie-Cura and Associates, Inc., Massachusetts Bays Program Report, Boston, MA.

Mazaris, A. D., A. S. Kallimanis, S. P. Sgardelis, and J. D. Pantis. 2008. Do long-term changes in sea surface temperature at the breeding areas affect the breeding dates and reproduction performance of Mediterranean loggerhead turtles? Implications for climate change. Journal of Experimental Marine Biology and Ecology **367**:219-226.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M.-N. Jenner, J. D. Penrose, R. I. T. Prince, J. Murdoch, and K. McCabe. 2000. Australian Petroleum Production Exploration Association.203.

McClain, C. R., Nunnally, C., & Benfield, M. C. (2019). Persistent and substantial impacts of the Deepwater Horizon oil spill on deep-sea megafauna. Royal Society open science, 6(8), 191164.

McMahon, C. R., and G. C. Hays. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. Global Change Biology **12**:1330-1338.

Metcalfe, C., B. Koenig, T. Metcalfe, G. Paterson, and R. Sears. 2004. Intra- and inter-species differences in persistent organic contaminants in the blubber of blue whales and humpback whales from the Gulf of St. Lawrence, Canada. Marine Environmental Research **57**:245-260.

Methratta, E., A. Hawkins, B. Hooker, A. Lipsky, and J. Hare. 2020. Offshore Wind Development in the Northeast US Shelf Large Marine Ecosystem: Ecological, Human, and Fishery Management Dimensions. Oceanography 33(4), 16-27.Meyer-Gutbrod, E., C. Greene, and K. Davies. 2018. Marine Species Range Shifts Necessitate Advanced Policy Planning: The Case of the North Atlantic Right Whale. Oceanography **31**.

Meyer-Gutbrod, E., C. Greene, P. Sullivan, and A. Pershing. 2015a. Climate-associated changes in prey availability drive reproductive dynamics of the North Atlantic right whale population. Marine Ecology Progress Series **535**:243-258.

Meyer-Gutbrod, E. L., and C. H. Greene. 2018. Uncertain recovery of the North Atlantic right whale in a changing ocean. Global Change Biology **24**:455-464.

Meyer-Gutbrod, E. L., C. H. Greene, P. J. Sullivan, and A. J. Pershing. 2015b. Climate-associated changes in prey availability drive reproductive dynamics of the North Atlantic right whale population. Marine Ecology Progress Series **535**:243-258.

Milewski, I. Impacts of Salmon Aquaculture on the Coastal Environment: A Review. Conservation Council of New Brunswick.

Miller, J. H., and G. R. Potty. 2017. Overview of Underwater Acoustic and Seismic Measurements of the Construction and Operation of the Block Island Wind Farm. Journal of the Acoustical Society of America **141**:3993-3993.

Milton, S., P. Lutz, and G. Shigenaka. 2003. Chapter 4 Oil Toxicity and Impacts on Sea Turtles. Pages 35-47 Oil and Sea Turtles: Biology, Planning, and Response. NOAA National Ocean Service.

Montagna, P. A., R. D. Kalke, and C. Ritter. 2002. Effect of restored freshwater inflow on macrofauna and meiofauna in upper Rincon Bayou, Texas, U. S. A. Estuaries **25**:1436–1447.

Montie, E. W., R. J. Letcher, C. M. Reddy, M. J. Moore, B. Rubinstein, and M. E. Hahn. 2010. Brominated flame retardants and organochlorine contaminants in winter flounder, harp and hooded seals, and North Atlantic right whales from the Northwest Atlantic Ocean. Marine Pollution Bulletin **60**:1160-1169.

Moore, S. E., R. R. Reeves, B. L. Southall, T. J. Ragen, R. S. Suydam, and C. W. Clark. 2012. A New Framework for Assessing the Effects of Anthropogenic Sound on Marine Mammals in a Rapidly Changing Arctic. BioScience **62**:289-295.

Mori, C., B. Morsey, M. Levin, T. S. Gorton, and S. De Guise. 2008. Effects of Organochlorines, Individually and in Mixtures, on B-Cell Proliferation in Marine Mammals and Mice. Journal of Toxicology and Environmental Health, Part A **71**:266-275.

Mrosovsky, N. 1980. Temperature dependence of sexual differentiation in sea turtles: implications for conservation practices. Biological Conservation **18**:271-280.

Mrosovsky, N., G. D. Ryan, and M. C. James. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin **58**:287-289.

National Research Council (NRC). 2000. Marine Mammals and Low-Frequency Sound: Progress Since 1994. Washington, DC: National Academies Press.

National Research Council. 2003. Ocean Noise and Marine Mammals. Washington, DC: National Academies Press.

National Research Council. 2005. Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects. Washington, DC: National Academies Press.

NEFSC (Northeast Fisheries Science Center). 2017. 62nd Northeast Regional Stock Assessment Workshop (62nd SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 17-03; 822 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/.

Negri, R. M., N. G. Montoya, J. I. Carreto, R. Akselman, and D. Inza. 2004. *Pseudo-nitzschia australis, Mytilus edulis, Engraulis anchoita*, and Domoic Acid in the Argentine Sea.4.

Nelms, S. E., J. Barnett, A. Brownlow, N. J. Davison, R. Deaville, T. S. Galloway, P. K. Lindeque, D. Santillo, and B. J. Godley. 2019. Microplastics in marine mammals stranded around the British coast: ubiquitous but transitory? Scientific Reports **9**:1075.

Nelms, S. E., T. S. Galloway, B. J. Godley, D. S. Jarvis, and P. K. Lindeque. 2018. Investigating microplastic trophic transfer in marine top predators. Environmental Pollution **238**:999-1007.

Nelms, S. E., W. E. D. Piniak, C. R. Weir, and B. J. Godley. 2016. Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation **193**:49-65.

NMFS, and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision., National Marine Fisheries Service, Silver Spring, MD.

Northeast Data Portal, 2021. www.northeastoceandata.org. Accessed May 12, 2021.

Nowacek, D. P., L. Thorne, D. Johnston, and P. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mamm. Rev. **37**:81–115.

Nowacek, D.P., C. W. Clark, D. Mann, P. JO. Miller, H. C. Rosenbaum, J. S. Golden, M. Jasny, J. Kraska, and B. L. Southall. 2015. Marine seismic surveys and ocean noise: time for coordinated and prudent planning. Front. Ecol. Environ. 13(7), 378–386.

Olsgard, F. 1993. Do toxic algal blooms affect subtidal soft-bottom communities? :18.

Parks, S. E., M. Johnson, D. Nowacek, and P. L. Tyack. 2011. Individual right whales call louder in increased environmental noise. Biol Lett **7**:33-35.

Oremus, K.L., 2019. Climate variability reduces employment in New England fisheries. Proceedings of the National Academy of Sciences, 116(52), pp.26444-26449.

Patino-Martinez, J., A. Marco, L. Quiñones, and L. A. Hawkes. 2014. The potential future influence of sea level rise on leatherback turtle nests. Journal of Experimental Marine Biology and Ecology **461**:116-123.

Pearce, I. B. 1990. Contaminants in Living Resources of Stellwagen Bank - Resources at Risk. Presented at Stellwagen Bank Conference, University of Massachusetts, Boston Campus, April 26-27, 1990.

Peck, M., and J. K. Pinnegar. 2019. Climate change impacts, vulnerabilities and adaptations: North Atlantic and Atlantic Arctic marine fisheries. Page 87 Impacts of climate change on fisheries and aquaculture.

Percy, J. A. 1977. Responses of arctic marine benthic crustaceans to sediments contaminated with crude oil. Environmental Pollution **13**:1-10.

Pershing, A., and K. Stamieszkin. 2020. The North Atlantic Ecosystem from Plankton to Whales. Annual Review of Marine Science **12**:4.1-4.21.

Perrault, J. R., K. D. Bauman, T. M. Greenan, P. C. Blum, M. S. Henry, and C. J. Walsh. 2016. Maternal transfer and sublethal immune system effects of brevetoxin exposure in nesting loggerhead sea turtles (*Caretta caretta*) from western Florida. Aquatic Toxicology **180**:131-140.

Petersen, J. K., C. Saurel, P. Nielsen, and K. Timmermann. 2016. The use of shellfish for eutrophication control. Aquaculture International **24**:857-878.

Peterson, C. H., Rice, S. D., Short, J. W., Esler, D., Bodkin, J. L., Ballachey, B. E., & Irons, D. B. (2003). Long-term ecosystem response to the Exxon Valdez oil spill. Science, 302(5653), 2082-2086.

Petruny-Parker, M., A. Malek, M. Long, D. Spencer, F. Mattera, E. Hasbrouck, J. Scotti, K. Gerbino, J. Wilson. 2015. Identifying Information Needs and Approaches for Assessing Potential Impacts of Offshore Wind Farm Development on Fisheries Resources in the Northeast Region. US Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2015-037. 79 pp.

Pham, C. K., Y. Rodríguez, A. Dauphin, R. Carriço, J. P. G. L. Frias, F. Vandeperre, V. Otero, M. R. Santos, H. R. Martins, A. B. Bolten, and K. A. Bjorndal. 2017. Plastic ingestion in oceanic-stage loggerhead sea turtles (*Caretta caretta*) off the North Atlantic subtropical gyre. Marine Pollution Bulletin **121**:222-229.

Pike, D. A. 2013a. Climate influences the global distribution of sea turtle nesting: Sea turtle nesting distributions. Global Ecology and Biogeography **22**:555-566.

Pike, D. A. 2013b. Forecasting range expansion into ecological traps: climate-mediated shifts in sea turtle nesting beaches and human development. Global Change Biology **19**:3082-3092.

Pike, D. A., E. A. Roznik, and I. Bell. 2015. Nest inundation from sea-level rise threatens sea turtle population viability. Royal Society Open Science **2**:150127.

Piniak, W. E. D. 2012. *Acoustic Ecology of Sea Turtles: Implications for Conservation*. Ph.D., Duke University.

Pinzone, M. 2015. POPs in free-ranging pilot whales, sperm whales and fin whales from the Mediterranean Sea_ Influence of biological and ecological factors. Environmental Research:12.

Plourde, S., C. Lehoux, C. L. Johnson, G. Perrin, and V. Lesage. 2019. North Atlantic right whale (*Eubalaena glacialis*) and its food: (I) a spatial climatology of *Calanus* biomass and potential foraging habitats in Canadian waters. **00**:19.

Pomeroy, R., Dey, M.M. and Plesha, N., 2014. The social and economic impacts of semi-intensive aquaculture on biodiversity. Aquaculture Economics & Management, 18(3), pp.303-324.

Popper, A., A Hawkins, R. Fay, D. Mann, S. Bartol, and T. Carlson, et al. 2014. Sound exposure guidelines for fishes and sea turtles: a technical report prepared by ANSI-accredited standards committee S3/SC1 and registered with ANSI. *ASA S3/SC1* 4.

Price, C. S., J. A. Morris, Jr., E. P. Keane, D. M. Morin, C. Vaccaro, and D. W. Bean. 2017. Protected species and marine aquaculture interactions.

Primavera, J.H., 2006. Overcoming the impacts of aquaculture on the coastal zone. Ocean & Coastal Management, 49(9-10), pp.531-545.

Pulster, E. L., Gracia, A., Armenteros, M., Toro-Farmer, G., Snyder, S. M., Carr, B. E., ... & Murawski, S. A. (2020). A first comprehensive Baseline of Hydrocarbon pollution in Gulf of Mexico fishes. Scientific reports, 10(1), 1-14.)

Record, N. R., W. M. Balch, and K. Stamieszkin. 2019a. Century-scale changes in phytoplankton phenology in the Gulf of Maine. PeerJ **7**:e6735.

Record, N. R., J. Runge, D. Pendleton, W. Balch, K. Davies, A. Pershing, C. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S. Kraus, R. Kenney, C. Hudak, C. Mayo, C. Chen, J. Salisbury, and C. Thompson. 2019b. Rapid Climate-Driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. Oceanography **32**.

Reece, J., D. Passeri, L. Ehrhart, S. Hagen, A. Hays, C. Long, R. Noss, M. Bilskie, C. Sanchez, M. Schwoerer, B. Von Holle, J. Weishampel, and S. Wolf. 2013. Sea level rise, land use, and climate change influence the distribution of loggerhead turtle nests at the largest USA rookery (Melbourne Beach, Florida). Marine Ecology Progress Series **493**:259-274.

Richardson, W. J., CGreene Jr., C Malme, and D. Thomson. 1995. Marine Mammals and Noise. San Diego, CA: Academic Press.

Riefolo, L., C. Lanfredi, A. Azzellino, G. R. Tomasicchio, D. A. Felice, V. Penchev, and D. Vicinanza. 2016. Offshore Wind Turbines: An Overview of the Effects on the Marine Environment. Page 9. International Society of Offshore and Polar Engineers.

Robinson, R. A., H. Q. P. Crick, J. A. Learmonth, I. M. D. Maclean, C. D. Thomas, F. Bairlein, M. C. Forchhammer, C. M. Francis, J. A. Gill, B. J. Godley, J. Harwood, G. C. Hays, B. Huntley, A. M. Hutson, G. J. Pierce, M. M. Rehfisch, D. W. Sims, B. M. Santos, T. H. Sparks, D. A. Stroud, and M. E. Visser. 2009. Travelling through a warming world: climate change and migratory species. Endangered Species Research 7:87-99.

Rochman, C. M., E. Hoh, T. Kurobe, and S. J. Teh. 2013. Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. Sci Rep **3**:3263.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proc Biol Sci **279**:2363-2368.

Romano, T., M. Keogh, C. Kelly, P. Feng, L. Berk, and C. Schlundt. 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure. Can. J. Fish. Aquat. Sci. **61**:1124–1134.

Romero, M. L., and L. K. Butler. 2007. Endocrinology of Stress.8.

Ross, P., R. De Swart, R. Addison, H. Van Loveren, J. Vos, and A. Osterhaus. 1996. Contaminant-induced immunotoxicity in harbour seals: Wildlife at risk? Toxicology **112**:157-169.

Ryan, C., B. McHugh, B. Boyle, E. McGovern, M. Bérubé, P. Lopez-Suárez, C. Elfes, D. Boyd, G. Ylitalo, G. Van Blaricom, P. Clapham, J. Robbins, P. Palsbøll, I. O'Connor, and S. Berrow. 2013. Levels of persistent organic pollutants in eastern North Atlantic humpback whales. Endangered Species Research **22**:213-223.

Saba, V. S., S. M. Griffies, W. G. Anderson, M. Winton, M. A. Alexander, T. L. Delworth, J. A. Hare, M. J. Harrison, A. Rosati, G. A. Vecchi, and R. Zhang. 2016. Enhanced warming of the Northwest Atlantic Ocean under climate change. Journal of Geophysical Research: Oceans **121**:118-132.

Sadove, S. S., and S. J. Morreale. 1990. Marine mammal and sea turtle encounters with marine debris in the New York Bight and the Northeast Atlantic. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-154, NOAA, DOC.

Sallenger, A. H., K. S. Doran, and P. A. Howd. 2012. Hotspot of accelerated sea-level rise on the Atlantic coast of North America. Nature Climate Change **2**:884-888.

Savage, K. 2017. Alaska and British Columbia large whale unusual mortality event summary report. NOAA. Schwacke, L. H., E. S. Zolman, B. C. Balmer, S. De Guise, R. C. George, J. Hoguet, A. A. Hohn, J. R. Kucklick, S.

Sharp, S., W. McLellan, D. Rotstein, A. Costidis, S. Barco, K. Durham, T. Pitchford, K. Jackson, P. Daoust, T. Wimmer, E. Couture, L. Bourque, T. Frasier, B. Frasier, D. Fauquier, T. Rowles, P. Hamilton, H. Pettis, and M. Moore. 2019. Gross and histopathologic diagnoses from North Atlantic right whale *Eubalaena glacialis* mortalities between 2003 and 2018. Diseases of Aquatic Organisms **135**:1-31.

Shimada, T., C. Limpus, R. Jones, and M. Hamann. 2017. Aligning habitat use with management zoning to reduce vessel strike of sea turtles. Ocean & Coastal Management **142**:163-172.

Shumway, S.E., 1990. A review of the effects of algal blooms on shellfish and aquaculture. Journal of the world aquaculture society, 21(2), pp.65-104.

Simenstad, C. A., and K. L. Fresh. 1995. Influence of Intertidal Aquaculture on Benthic Communities in Pacific Northwest Estuaries: Scales of Disturbance. Estuaries **18**:43.

Simmonds, M. P. 2012. Cetaceans and Marine Debris: The Great Unknown. Journal of Marine Biology **2012**:1-8. Simmonds, M. P., and V. C. Brown. 2010. Is there a conflict between cetacean conservation and marine renewable-energy developments? Wildlife Research **37**:688.

Sivle, L., P. Wensveen, P. Kvadsheim, F. Lam, F. Visser, C. Curé, C. Harris, P. Tyack, and P. Miller. 2016. Naval sonar disrupts foraging in humpback whales. Marine Ecology Progress Series **562**:211-220.

Skalski, J. R., W. H. Pearson, and C. I. Malme. 1992. Effects of Sounds from a Geophysical Survey Device on Catch-per-Unit-Effort in a Hook-and-Line Fishery for Rockfish (<i>Sebastes</i> spp.). Canadian Journal of Fisheries and Aquatic Sciences **49**:1357-1365.

Slabbekoorn, H., N, Bouton, I. van Opzeeland, A. Coers, C. ten Cate, and A. Popper. 2010. A noisy spring: the impact of globally rising underwater sound levels on fish. Trends Ecol. Evol. (Amst). **25**:419–427.

Smith, L. C., M. Smith, and P. Ashcroft. 2011. Analysis of environmental and economic damages from British Petroleum's Deepwater Horizon oil spill. Albany Law Rev. **74**:563–585.

Sousa, A., F. Alves, A. Dinis, J. Bentz, M. J. Cruz, and J. P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecological Indicators **98**:9-18.

Spitz, J., A. W. Trites, V. Becquet, A. Brind'Amour, Y. Cherel, R. Galois, and V. Ridoux. 2012. Cost of Living Dictates what Whales, Dolphins and Porpoises Eat: The Importance of Prey Quality on Predator Foraging Strategies. PLoS One **7**:e50096.

Stacy, N., C. Field, L. Staggs, R. MacLean, B. Stacy, J. Keene, D. Cacela, C. Pelton, C. Cray, M. Kelley, S. Holmes, and C. Innis. 2017. Clinicopathological findings in sea turtles assessed during the Deepwater Horizon oil spill response. Endangered Species Research **33**:25-37.

Stamper, M. A., C. W. Spicer, D. L. Neiffer, K. S. Mathews, and G. J. Fleming. 2009. Morbidity in a Juvenile Green Sea Turtle (*Chelonia mydas*) Due to Ocean-Borne Plastic. Journal of Zoo and Wildlife Medicine **40**:196-198.

Stone, K. M., S. M. Leiter, R. D. Kenney, B. C. Wikgren, J. L. Thompson, J. K. D. Taylor, and S. D. Kraus. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. Journal of Coastal Conservation **21**:527-543.

Stramma, L., E. D. Prince, S. Schmidtko, J. Luo, J. P. Hoolihan, M. Visbeck, D. W. R. Wallace, P. Brandt, and A. Körtzinger. 2012. Expansion of oxygen minimum zones may reduce available habitat for tropical pelagic fishes. Nature Climate Change **2**:33-37.

Suchanek, T. H. 1993. Oil Impacts on Marine Invertebrate Populations and Communities. American Zoologist **33**:510-523.

Sunday, J. M., K. E. Fabricius, K. J. Kroeker, K. M. Anderson, N. E. Brown, J. P. Barry, S. D. Connell, S. Dupont B. Gaylord, J. M. Hall-Spencer, T. Klinger, M. Milazzo, P. L. Munday, B. D. Russell, E. Sanford, V. Thiyagarajan, M. L. H. Vaughan, S. Widdicombe, and C. D. G. Harley. 2017. Ocean acidification can mediate biodiversity shifts by changing biogenic habitat. Nature Climate Change **7**:81-85.

Tabuchi, M., N. Veldhoen, N. Dangerfield, S. Jeffries, C. C. Helbing, and P. S. Ross. 2006. PCB-Related Alteration of Thyroid Hormones and Thyroid Hormone ReceptorGene Expression in Free-Ranging Harbor Seals (*Phoca vitulina*). Environmental Health Perspectives **114**:1024-1031.

Teal, J. M., K. Burns, and J. Farrington. 1978. Analyses of Aromatic Hydrocarbons in Intertidal Sediments Resulting from Two Spills of No. 2 Fuel Oil in Buzzards Bay, Massachusetts. Journal of the Fisheries Research Board of Canada **35**:510-520.

ten Brink, T.S. and Dalton, T., 2018. Perceptions of Commercial and Recreational Fishers on the Potential Ecological Impacts of the Block Island Wind Farm (US). Frontiers in Marine Science, 5, p.439.

Themelis, D., L. Harris, and T. Hayman. 2016. Preliminary analysis of human-induced injury and mortality to cetaceans in Atlantic Canada.

Thomsen, F., A. B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson. 2016. MaRVEN – Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy.

Thomsen, F., K. Lüdemann, R. Kafemann, and W. Piper. 2006. Effects of offshore wind farm noise on marine mammals and fish, biola, Hamburg, Germany on behalf of COWRIE Ltd. https://tethys.pnnl.gov/sites/default/files/publications/Effects_of_offshore_wind_farm_noise_on_marine-mammals_and_fish-1-.pdf

Thomson, J. A., M. R. Heithaus, D. A. Burkholder, J. J. Vaudo, A. J. Wirsing, and L. M. Dill. 2012. Site specialists, diet generalists? Isotopic variation, site fidelity, and foraging by loggerhead turtles in Shark Bay, Western Australia. Marine Ecology Progress Series **453**:213-226.

Thronson, A., and A. Quigg. 2008. Fifty-Five Years of Fish Kills in Coastal Texas. Estuaries and Coasts **31**:802-813.

Tilbrook, A. J., A. I. Turner, and I. J. Clarke. 2000. Effects of stress on reproduction in non-rodent mammals: the role of glucocorticoids and sex differences. Reviews of Reproduction **5**:9.

Tougaard, J., and O. D. Henriksen. 2009. Underwater Noise from Three Types of Offshore Wind Turbines: Estimation of Impact Zones for Harbor Porpoises and Harbor Seals. Journal of the Acoustical Society of America **125**:3766-3773.

Turner, J., G. Doucette, C. Powell, D. Kulis, B. Keafer, and D. Anderson. 2000. Accumulation of red tide toxins in larger size fractions of zooplankton assemblages from Massachusetts Bay, USA. Marine Ecology Progress Series **203**:95-107.

Turner, J. T., G. J. Doucette, B. A. Keafer, and D. M. Anderson. 2005. Trophic accumulation of PSP toxins in zooplankton during *Alexandrium fundyense* blooms in Casco Bay, Gulf of Maine, April–June 1998. II. Deep Sea Research Part II: Topical Studies in Oceanography **52**:2784-2800.

United States Coast Guard (UCSG). 2020. The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf. 199 pp.

United States Department of the Navy. 2018. Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement Volume 1. Naval Facilities Engineering Command Atlantic, Norfolk, VA. 1020 pp.

van de Merve, J., M. Hodge, J. Whittier, K. Ibrahim, and S. Lee. 2010. Persistent organic pollutants in the green sea turtle *Chelonia mydas*: nesting population variation, maternal transfer, and effects on development. Marine Ecology Progress Series **403**:269-278.

Van Der Hoop, J. M., M. J. Moore, S. G. Barco, T. V. N. Cole, P.-Y. Daoust, A. G. Henry, D. F. McAlpine, W. A. McLellan, T. Wimmer, and A. R. Solow. 2013. Assessment of Management to Mitigate Anthropogenic Effects on Large Whales: Mitigation of Human-Whale Interactions. Conservation Biology **27**:121-133.

van der Hoop, J. M., A. E. Nousek-McGregor, D. P. Nowacek, S. E. Parks, P. Tyack, and P. T. Madsen. 2019. Foraging rates of ram-filtering North Atlantic right whales. Functional Ecology **33**:1290-1306.

van der Hoop, J. M., A. S. M. Vanderlaan, T. V. N. Cole, A. G. Henry, L. Hall, B. Mase-Guthrie, T. Wimmer, and M. J. Moore. 2015. Vessel Strikes to Large Whales Before and After the 2008 Ship Strike Rule: Ship Strike Rule effectiveness. Conservation Letters **8**:24-32.

Vandenberg, L. N., T. Colborn, T. B. Hayes, J. J. Heindel, D. R. Jacobs, D.-H. Lee, T. Shioda, A. M. Soto, F. S. vom Saal, W. V. Welshons, R. T. Zoeller, and J. P. Myers. 2012. Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. Endocrine Reviews **33**:378-455.

Vanderlaan, A. S. M., and C. T. Taggart. 2009. Efficacy of a Voluntary Area to Be Avoided to Reduce Risk of Lethal Vessel Strikes to Endangered Whales. Conservation Biology **23**:1467-1474.

Víkingsson, G. A., B. Þ. Elvarsson, D. Ólafsdóttir, J. Sigurjónsson, V. Chosson, and A. Galan. 2014. Recent changes in the diet composition of common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters. A consequence of climate change? Marine Biology Research **10**:138-152.

Wallace, B., S. Kilham, F. Paladino, and Spotila, Jr. 2006. Energy budget calculations indicate resource limitation in Eastern Pacific leatherback turtles. Marine Ecology Progress Series **318**:263-270.

Walsh, C. J., S. R. Leggett, B. J. Carter, and C. Colle. 2010. Effects of brevetoxin exposure on the immune system of loggerhead sea turtles. Aquatic Toxicology **97**:293-303.

Wang, H., F. Wu, W. Meng, J. C. White, P. A. Holden, and B. Xing. 2013. Engineered Nanoparticles May Induce Genotoxicity. Environmental Science & Technology **47**:13212-13214.

Weilgart, L. 2018. THE IMPACT OF OCEAN NOISE POLLUTION ON FISH AND INVERTEBRATES.36. Weisbrod, A. V., D. Shea, M. J. Moore, and J. J. Stegeman. 2000. Organochlorine exposure and bioaccumulation in the endangered Northwest Atlantic right whale (*Eubalaena glacialis*) population. Environmental Toxicology and Chemistry **19**:654-666.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn, and J. C. Sweeney. 2005. Integrating life-history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Science of The Total Environment **349**:106-119.

Wilber, M. G., S. Young, and L. Wilson. 2012. Impact of Aquaculture on Commercial Fisheries: Fishermen's Local Ecological Knowledge. Human Ecology **40**:29-40.

Wilber, D.H., Carey, D.A. and Griffin, M., 2018. Flatfish habitat use near North America's first offshore wind farm. Journal of Sea Research, 139, pp.24-32.

Wilcox, C., N. J. Mallos, G. H. Leonard, A. Rodriguez, and B. D. Hardesty. 2016. Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. Marine Policy **65**:107-114.

Wilhelmsson, D., Malm, T. and Öhman, M.C., 2006. The influence of offshore windpower on demersal fish. ICES Journal of Marine Science, 63(5), pp.775-784.

Williams, R., E. Ashe, and P. D. O'Hara. 2011. Marine mammals and debris in coastal waters of British Columbia, Canada. Marine Pollution Bulletin **62**:1303-1316.

Williams, R., G. A. Vikingsson, A. Gislason, C. Lockyer, L. New, L. Thomas, and P. S. Hammond. 2013. Evidence for density-dependent changes in body condition and pregnancy rate of North Atlantic fin whales over four decades of varying environmental conditions. ICES Journal of Marine Science **70**:1273-1280.

Wilson, C., A. V. Sastre, M. Hoffmeyer, V. J. Rowntree, S. E. Fire, N. H. Santinelli, S. D. Ovejero, V. D'Agostino, C. F. Marón, G. J. Doucette, M. H. Broadwater, Z. Wang, N. Montoya, J. Seger, F. R. Adler, M. Sironi, and M. M. Uhart. 2016. Southern right whale (*Eubalaena australis*) calf mortality at Península Valdés, Argentina: Are harmful algal blooms to blame? Marine Mammal Science **32**:423-451.Wise, C. F., J. T. F. Wise, S. S. Wise, W. D. Thompson, J. P. Wise, and J. P. Wise. 2014. Chemical dispersants used in the Gulf of Mexico oil crisis are cytotoxic and genotoxic to sperm whale skin cells. Aquatic Toxicology **152**:335-340.

Wise Jr, J. P., Wise, J. T., Wise, C. F., Wise, S. S., Gianios Jr, C., Xie, H., ... & Wise Sr, J. P. (2014). Concentrations of the genotoxic metals, chromium and nickel, in whales, tar balls, oil slicks, and released oil from the gulf of Mexico in the immediate aftermath of the deepwater horizon oil crisis: is genotoxic metal exposure part of the deepwater horizon legacy?. Environmental science & technology, 48(5), 2997-3006.

Wise, C. F., S. S. Wise, W. D. Thompson, C. Perkins, and J. P. Wise. 2015. Chromium Is Elevated in Fin Whale (*Balaenoptera physalus*) Skin Tissue and Is Genotoxic to Fin Whale Skin Cells. Biological Trace Element Research **166**:108-117.

Work, P. A., A. L. Sapp, D. W. Scott, and M. G. Dodd. 2010. Influence of small vessel operation and propulsion system on loggerhead sea turtle injuries. Journal of Experimental Marine Biology and Ecology **393**:168- 175.

Wright, A. J., N. Soto, A. Baldwin, M. Bateson, C. Beale, and C. Clark. 2007. Do Marine mammals experience stress related to anthropogenic noise? Int. J. Comp. Psychol. **20**:274–316.

Yntema, C. L., and N. Mrosovsky. 1980. Sexual Differentiation in Hatchling Loggerheads (Caretta caretta) Incubated at Different Controlled Temperatures. Herpetologica **36**:5.

Young, O. Y. 2015. Marine animal entanglements in mussel aquaculture gear. Masters. University of Akureyri, Akureyri, Iceland.

CHAPTER 9 REGULATORY IMPACT REVIEW & FINAL 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 FRFA 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 mortality and serious injury of Atlantic large whales due to entanglement in commercial fishing gear (see Chapter 2 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 provisions include 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 mortality and serious injury 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 5) 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 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 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 buoy 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 buoy line risk reduction. At the 2009 ALWTRT meeting, the Team agreed on a schedule to develop a management approach to reduce the risk of mortality and serious injury due to buoy lines. As a result of this schedule, NMFS committed to publishing a final rule to address buoy 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 buoy 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, 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 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 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 2021. 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 buoy lines. 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 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. 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 anticipated issuing a new final Biological Opinion concluding the consultation that was initiated in 2017 for the federal American lobster fishery and other federal fisheries.

Pursuant to section 7 of the Endangered Species Act (ESA), NOAA's National Marine Fisheries Service (NMFS) issued a Biological Opinion (Opinion) on May 27, 2021, that considered the effects of the NMFS' authorization of ten fishery management plans (FMP), NMFS' North Atlantic Right Whale Conservation Framework, and the New England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2, on ESA-listed species and designated critical habitat. The ten FMPs considered in the Opinion include the: (1) American lobster; (2) Atlantic bluefish; (3) Atlantic deep-sea red crab; (4) mackerel/squid/butterfish; (5) monkfish; (6) Northeast multispecies; (7) Northeast skate complex; (8) spiny dogfish; (9) summer flounder/scup/black sea bass; and (10) Jonah crab FMPs. The American lobster and Jonah crab FMPs are permitted and operated through implementing regulations compatible with the interstate fishery management plans (ISFMP) issued under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (ACA), the other eight FMPs are issued under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA).

The 2021 Opinion determined that the proposed action may adversely affect, but is not likely to jeopardize, the continued existence of North Atlantic right, fin, sei, or sperm whales; the Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead, leatherback, Kemp's ridley, or North Atlantic DPS of green sea turtles; any of the five DPSs of Atlantic sturgeon; Gulf of Maine DPS Atlantic salmon; or giant manta rays. The Opinion also concluded that the proposed action is not likely to adversely affect designated critical habitat for North Atlantic right whales, the Northwest Atlantic Ocean DPS of loggerhead sea turtles, U.S. DPS of smalltooth sawfish, Johnson's seagrass, or elkhorn and staghorn corals. An Incidental Take Statement (ITS) was issued in the Opinion. The ITS includes reasonable and prudent measures and their implementing terms and conditions, which NMFS determined are necessary or appropriate to minimize impacts of the incidental take in the fisheries assessed in this Opinion.

In addition to consulting on the fishery management plans that authorize the fisheries managed under the ALWTRP, consultation on the Plan was reinitiated on May 3, 2021. The consultation considered the potential impacts of measures in the proposed rule and analyzed in the DEIS on ESA-listed species. As detailed in Chapter 5, the preferred alternative in the FEIS achieves more risk reduction than the proposed rule. Consultation on the ALWTRP and proposed amendment concluded on May 25, 2021, finding that the Plan operates as a mechanism to reduce fisheries related impacts on Atlantic large whales. It does not authorize any fishery. The effects of federal fisheries regulated under the Plan are fully considered under section 7 consultations conducted for the fishery management plans as described above, and incidental take attributed to federal fisheries is authorized under those consultations. Based on all of the above information, the gear regulations implemented by the Plan for U.S. fixed gear fisheries will have wholly beneficial effects to ESA-listed species or their critical habitat. As a result, it was determined that the Plan is not likely to adversely affect ESA-listed species or designated critical habitat under NMFS jurisdiction.

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, humpback whales were also listed as endangered. While no longer a strategic stock, they are caught in Category I and II 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 population model estimates a population size of 368 in 2019 (Pace 2021). Pettis et al. (2021) gives an estimate of 356 as of 2020 removing known mortalities since the latest population estimate used in the report (366). Since 2019 there have been 10 additional documented serious injuries and mortalities. 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 0.8 (Pace et al. 2017, Hayes et al. 2020, Pettis et al. 2021, Pace 2021).

- **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 population size is 1,396 and the minimum population size is 1,380 at the end of 2017, and has established a PBR level of 22 whales per year (Hayes et al. 2020).

- **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 7,418 at the end of 2017, a minimum population size of 6,029, and PBR of 12 (Hayes et al. 2020)

- **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 24,202 at the end of 2017, with a minimum population estimate of 18,902 and PBR of 189 (Hayes et al. 2020).

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.

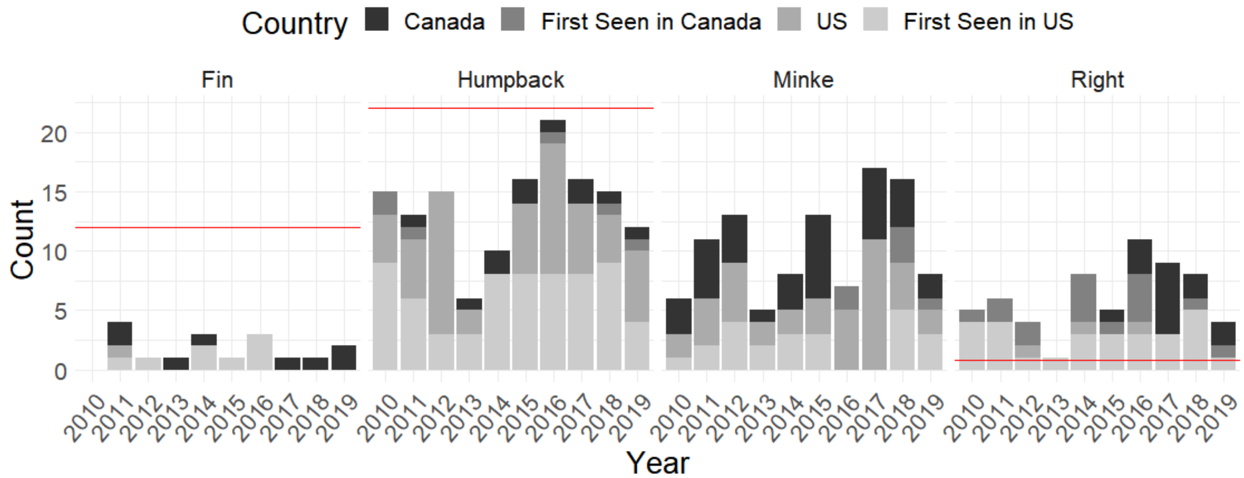


Figure 9.1: Entanglements that resulted in serious injury or mortality, according to the country of origin or country where the incident was first sighted. Incidents with prorated injuries and where serious injury was averted by disentanglement response are included as serious injuries and mortalities. The red line represents the current potential biological removal for the stock (PBR for minke whales is 189 and not pictured due to scale).

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 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 buoy 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 2019, the most recent year that data is available for all species. Humpback whales account for the greatest number of serious injury and mortalities from entanglements (135), followed by minke whales (104), right whales (61), and fin whales (17).

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 mortality and serious injury 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 1 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 1 percent or less of a stock's PBR (NOAA 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 Region lobster and Jonah crab trap/pot fisheries given these represent the vast majority of buoy 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 1) 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 lobster and Jonah crab trap/pot fisheries in the Northeast Region. The minimum trawl length specified varies by alternative (see below). Additional provisions set a maximum number of buoy 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 lobster trap/pot vessels from fishing in designated areas during designated periods (see below).

- **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 lobster trap/pot vessels subject to the Plan. All lobster trap/pot vessels in the Northeast Region will be required to have state specific markings on their buoy line. The proposed gear marking scheme expands the use of three 12-inch marks per buoy line in currently exempt waters of New Hampshire and Maine. It further requires an additional 3-foot mark representing the state of origin near the buoy and an additional color representative of all northeast trap/pot fisheries. Alternative 3 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 lobster and Jonah crab 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.

Table 9.1: A summary of the regulatory elements of the risk reduction alternatives analyzed in the FEIS, arranging the requirements by lobster management area and geographic region (where appropriate). The dark gray highlighted text represents regulations that will be implemented by a state or through ongoing or upcoming fishery management practices. OC = Outer Cape

Component	Area	Alternative 2	Alternative 3
Restricted Areas	All existing and new 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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.	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 will include conditions to protect right whales such as area restrictions, vessel speed, monitoring, and reporting requirements. All restricted areas listed here would require an exemption. Federal waters in the Outer Cape LMA would remain closed to all lobster fishing consistent with the ASMFC lobster FMP.
	LMA 1 Restricted Area, Offshore ME LMA 1/3 border, zones C/D/E	Oct – Jan	Oct – Feb
	South Island Restricted Area	Feb – April: Area from Non-preferred A in DEIS.	Feb – May: L-shaped area closed to buoy lines.
	Massachusetts Restricted Area	Credit for Feb-Apr, state water in MRA have a soft opening until May 15th, until no more than three whales remain as confirmed by surveys	Federal extensions of restricted area throughout MRA and LMA 1/OC state waters unless surveys confirm that right whales have left the area.
	Massachusetts Restricted Area North	Feb-Apr: Expand MRA north in MA state waters to NH border	Feb-Apr: Expand MRA north in MA state waters to NH border
	Georges Basin Restricted Area	-	Closed to buoy lines May through August.
Line Reduction	ME exemption line – 3 nm (5.6 km), Zones A, B, F, G	3 traps/trawl	-
	ME exempt area – 3 nm (5.6 km), Zones C, D, E	Status quo (2 traps/trawl)	-
	ME 3 (5.6 km) – 6 nm*, Zone A West**	8 traps/trawl per two buoy lines or 4 traps/trawl per one buoy line	Line allocations capped at 50 percent of average monthly lines in federal waters
	ME 3 (5.6 km) – 6 nm*, Zone B	5 traps/trawl per one buoy line	
	ME 3 (5.6 km) – 6 nm*, Zones C, D, E, F, G	10 traps/trawl per two buoy lines or 5 traps/trawl per one buoy line	Same as above
	ME 3 (5.6 km) – 12 nm (22.2 km), Zone A East**	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
	ME 6* – 12 nm (22.2 km), Zone A West**	15 traps/trawl per two buoy lines or 8 traps/trawl per one buoy line	Same as above
Buoy Line	ME 6* – 12 nm (22.2 km),	10 traps/trawl per two buoy lines or 5 traps/trawl per	Same as above

Component	Area	Alternative 2	Alternative 3
Reduction Continued	Zone B, D, E, F	one buoy line (status quo in D, E, & F)	
	ME 6* – 12 nm (22.2 km), Zone C, G	20 traps/trawl per two buoy lines or 10 traps/trawl per one buoy line	Same as above
	MA LMA 1, 6* – 12 nm (22.2 km)	15 traps/trawl	Same as above
	LMA 1 & OC 3 – 12 nm (5.6 – 22.2 km)	15 traps/trawl	Same as above
	LMA 1 over 12 nm (22.2 km)	25 traps/trawl	Same as above
	LMA 3, north of 50 fathom line on the south end of Georges Bank	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)
	LMA 3, south of 50 fathom line on the south end of Georges Bank	Year-round: 35 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
	LMA 3, Georges Basin Restricted Area	Year-round: 50 traps/trawl, increase maximum trawl length from 1.5 nm (2.78km) to 1.75 nm (3.24 km)	Same as above
Other Line Reduction	LMA 2	Existing 18% reduction in the number of buoy lines	-
	LMA 3	Existing and anticipated 12% reduction in buoy lines	-
Buoy Weak Link	Northeast Region	For all buoy lines incorporating weak line or weak insertions, remove weak link requirement at surface system	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
Weak Line	ME Exempt State Waters	1 weak insertion 50% down the line	Full weak rope in the top 75% of both buoy lines
	ME exemption line – 3 nm (5.6 km)	1 weak insertion 50% down the line	Same as above
	MA State Waters	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	NH State Waters	1 weak insertion 50% down the line	Same as above
	RI State Waters	Weak inserts every 60 ft (18.3 m) in top 75% of line or full weak line	Same as above
	ME Zone A West**, B, C, D, E; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above
	ME Zone A East**, F, and G; federal waters 3 – 12 nm (5.6 – 22.2 km)	1 weak insertion 33% down the line	Same as above
	MA and NH LMA 1 , OC; federal waters 3 – 12 nm (5.6 – 22.2 km)	2 weak insertions, at 25% and 50% down line	Same as above
	LMA 1 & OC over 12 nm	1 weak insertion 33% down the line	Same as above

Component	Area	Alternative 2	Alternative 3
	(22.2 km)		
	LMA 2	Weak inserts every 60 ft (18.3 m) or full weak line in top 75% of line	Same as above
	LMA 3	One buoy line weak year round to 75%	May - August: one weak line to 75% and 20% on other end. Sep – Apr: two weak “toppers” down to 20%

*Note that the 6 nautical mile line refers to an approximation, described in 50 CFR 229.32 (a)(2)(ii) and a similar approximation of the 50 fathom lines would be included in the final rule implementing the Preferred Alternative at 50 CFR 229.32 (a)(2)(iv).
**Maine Zone A East is the portion of Zone A that is east of 67°18.00' W and Maine Zone A is west of this longitude.

Table 9.2: 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
Cape Cod Bay	2	May, until only 3 whales remain	644
Outer Cape State Waters	2	May, until only 3 whales remain	260
Large South Island Restricted Area	2	February - April	5,468
Massachusetts Restricted Area North	2 & 3	Feb – Apr, soft opening into May	497
Offshore Maine	3	October - February	967
Georges Basin Core Area	3	May - August	557
Massachusetts Restricted Area	3	May, possible early open	3,069
L-shaped South Island Restricted Area	3	February - May	3,506

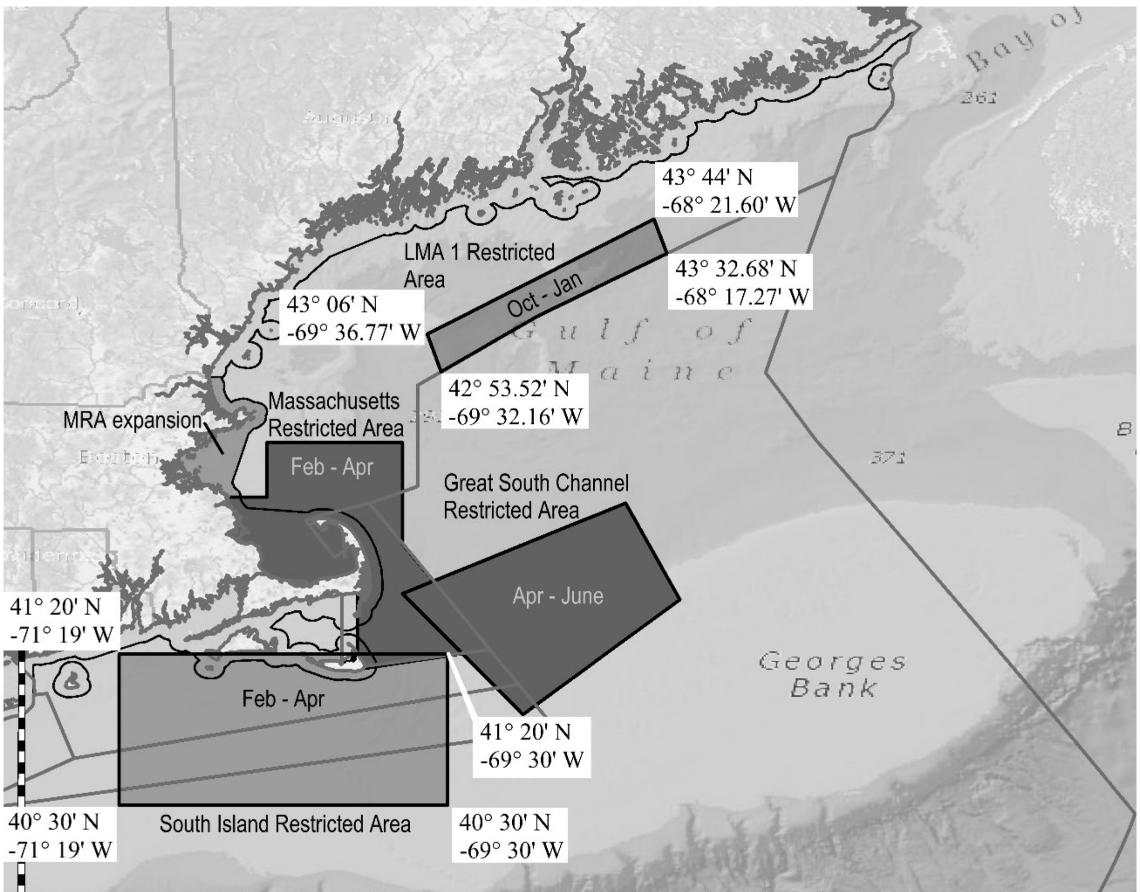


Figure 9.2: The lobster and Jonah crab trap/pot buoy line restricted areas proposed in Alternative 2 (Preferred) shaded in light gray. LMAs are delineated by the grey lines. The new South Island Restricted Area is proposed as closed to trap/pot buoy lines from February through April and the LMA 1 Restricted area is proposed from October through January. An expansion of the MRA into Massachusetts state waters to the New Hampshire border and extended in state waters in LMA 1 and the Outer Cape through at least May 15th, with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape LMA.

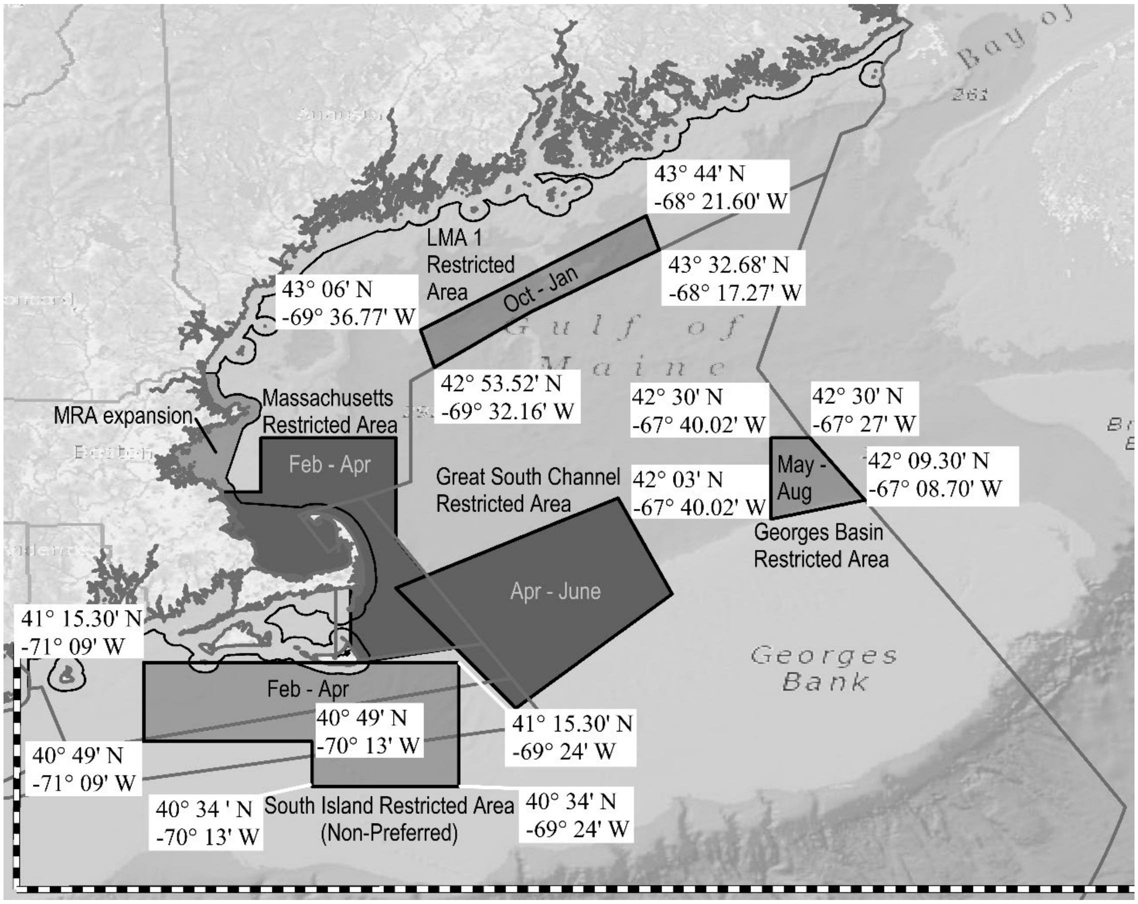


Figure 9.3: The restricted area options proposed in Alternative 3 (Non-preferred) shaded in light gray. The L-shaped South Island Restricted Area from February through April. The LMA 1 Restricted Area is proposed from October through February. The Georges Basin Restricted Area is proposed from May through August. An expansion of the MRA into Massachusetts state waters to the New Hampshire border and extended through at least May 15th, with a potential opening if whales are no longer present, is also included. In dark gray are existing seasonal restricted areas that would become areas with restrictions to fishing with buoy lines, with the exception of the Outer Cape LMA.

9.6 Regulatory Impact Review

9.6.1 *Baseline for Comparison*

The baseline for the economic analysis is the Alternative 1, which requires no action, and the baseline year is 2017.

9.6.2 *Time Horizon*

The rule is expected to be published in Oct 2021, and last for six years based on the average time for a round of rulemaking in the past. Therefore, the stream of costs and benefits would start in year 2021, and end in year 2026.

9.6.3 *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.

9.6.4 *Economic Analysis of Alternatives*

9.6.4.1 Benefits of Large Whale Protection

Since the suspension of commercial whaling in the United States, 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.

9.6.4.1.1 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.

Another study by Cisneros-Montemayor et al. (2010) suggests that global whale watching industry would generate over $2.5 billion (2009) in yearly revenue and about 19,000 jobs around the world. The U.S. and Canadian whale watching industry could create 3,657 jobs yearly from six marine mammal species within their Exclusive Economic Zones.

Ralph et. al.(2019) from International Monetary Fund point out whales have a multiplier effect of increasing phytoplankton production wherever they go, and these microscopic creatures not only contribute at least 50 percent of all oxygen to our atmosphere, they do so by capturing about 37 billion metric tons of CO^2, an estimated 40 percent of all CO^2 produced. Therefore, enhancing protection of whales from human-made dangers would deliver multiple benefits to the human beings as well as the planet. Their conservative estimates put the value of the average great whale, based on its various activities, at more than $2 million, and easily over $1 trillion for the current stock of great whales.

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 percent 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 percent in direct sales to whale watch operators and an increase of 17 percent 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.

9.6.4.1.2 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 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.

9.6.4.2 Costs of Large Whale Protection

9.6.4.2.1 Cost Savings on Disentanglement Effort

In addition to federal and state protective measures, disentanglement efforts have been extensively applied to large whale conservation after sightings of entangled whales. Despite life-threatening risks for disentangling team members, it is also extremely time consuming and costly to conduct consistent monitoring and disentanglement. According to the Center of Coastal Studies based in Provincetown, Massachusetts, the largest disentanglement team in the Northeast, the annual cost for the team is about $400,000. There are about ten similar teams including both federal, state, and local organizations within the Atlantic Large Whale Disentanglement Network in the United States, and more efforts from the Canadian counterparts. Fewer encountering of whales and the fishing gear could potentially save these high costs.

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 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).

9.6.4.2.2 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 buoy line employed by the Northeast Region lobster and Jonah crab 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 9.6 summarizes the estimated change in co-occurrence under each action alternative relative to the no action alternative (Alternative 1). Alternative 2 (Preferred), which includes trawl length requirements, weak rope or weak inserts, and restricted areas, is estimated to yield a reduction in co-occurrence of approximately 65 percent (54 percent without the MRA credit). Alternative 3 proposes a 50-percent line cap reduction in federal waters, seasonal trawl length requirements, more extensive weak rope, and restricted areas, yielding a 60 percent reduction in co-occurrence. Though Alternative 3 reaches a high reduction score, the compliance costs of large restricted areas and line reduction measures are higher compared to Alternative 2.

Table 9.6: Annual Change in Co-Occurrence between right whales and buoy lines in the Northeast Region

Alternative	Percent Reduction in Co-Occurrence
Alternative 1 (No Action)	0
Alternative 2 (with MRA credit)	65
Alternative 2 (without MRA credit)	54
Alternative 3	60

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 document 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 2020 dollars where annualized costs reflect initial and replacement costs over time. The calculation of annualized costs is based on a discount rate of 7 percent, consistent with current OMB guidelines. We also use a discount rate of 3 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.

9.6.4.2.3 Compliance Cost Estimation Methods

As discussed above, Alternatives 2 (Preferred) and 3 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.

9.6.4.2.3.1 Trawling Requirements

A major component of Alternative 2 is a minimum trawl length requirement – i.e., prohibiting trawls of less than a specified number of traps or pots – for lobster and Jonah crab trap/pot fisheries in the Northeast Region. 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.

9.6.4.2.3.2 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 lb (771 kg) strength.

Alternative 2 requires areas except for LMA 3 to insert weak points into the original ropes to make them weak. LMA 3 gears are required to have 75 percent of one buoy line to be fully engineered weak rope. In Alternative 3, all areas but LMA 3 are required to have both buoy lines to be 75 percent weak, and LMA 3 to have one buoy line 75 percent weak during May to August and the other buoy line 20 percent weak year round.

The cost of weak rope consists of material and labor cost. The South Shore sleeve is the most widely available weak insert available for purchase. 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.

9.6.4.2.3.3 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 percent 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.

9.6.4.2.3.4 Gear Marking Requirements

The proposed action would implement additional gear marking requirements compared to no action. Under Alternative 2 (Preferred), NMFS would mirror the Maine state regulations for all non-exempted waters, and would implement analogous marking for the other New England states. In state waters, the gear marking requirement would include one state-specific 3-foot (91cm) colored mark within 2 fathoms (3.7 m) of the buoy and at least two additional 1-foot (30 cm) marks in the top and bottom half of the gear. In federal waters, in addition to the top 3-foot (91 cm) mark, an additional green 1-foot (30 cm) mark would be required in the top 2 fathoms (3.7 m) of line, and at least three 1-foot (30 cm) marks would be required in the top, middle, and bottom of the buoy line below the surface system. Within 6 inches of each 1-foot state-colored mark, another 1-foot green mark would also be required to distinguish lines in federal waters from state waters. This Alternative would continue to allow multiple methods for marking line below the surface system (paint, tape, rope twine inserts, etc), with highly visible paint required for the 3-foot mark in the surface system. Under Alternative 3 (Non-preferred) the 3-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.

ID tape ropes are not available at this time. Suppliers that have produced it in small batches 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 conventional rope, which costs \$0.11 per foot for 3/8-inch (0.95 cm) diameter rope and \$0.26 per foot for 3/4-inch (1.9 cm) diameter rope. Table 6.20 describes the gear marking cost for Alternative 2 and 3.

9.6.4.2.4 Compliance Costs

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 1 the economic burden attributable to the ALWTRP would be unaffected. Thus, Alternative 1 would impose no additional costs on the regulated community.

The present value and annualized value of cost changes in Alternative 2 and Alternative 3 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 2, trawling up measures were estimated to cost between \$2.5 million and \$8.3 million per year. Under Alternative 3, a 50-percent buoy line reduction would cost \$5.5 million to \$14.4 million per year.

Weak rope requirements cost \$0.5 million per year in Alternative 2, but cost around \$2.2 million per year in Alternative 3 because fully engineered weak ropes are required for most buoy lines. Alternative 2 gear marking measures would cost \$5.8 million to \$7.8 million per year, while ID taped rope required in Alternative 3 cost $18.2 million per year. The compliance costs of the Alternative 2 restricted areas range from $1.6 million to $2.5 million. Restricted areas in Alternative 3 cost $3.7 million to $5.1 million per year for fishermen due to the large coverage and extended time period.

The total annualized cost of all proposed measures for Alternative 2 including gear marking, weak rope, restricted area, and gear conversion costs range from $10.5 million to $19.1 million, much lower than the Alternative 3, which range from $29.6 million to $40 million.

9.6.4.2.4.1 Transfers

There are no benefits or costs transferred to other fisheries as a result of this rule.

9.6.4.2.4.2 Uncertainties

A few assumption are made for this analysis. The first one is the effective time for the new rules would be six years. This assumption could affect the distribution of compliance costs as well as total value and annualized value.

Another key assumption 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.

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.

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.

9.6.4.2.4.3Results

As taken from the Executive Order, the purpose of Executive Order 12866 is to enhance planning and coordination with respect to new and existing regulations. This E.O. requires the Office of Management and Budget (OMB) to review regulatory programs that are considered to be "significant." E.O. 12866 requires a review of proposed regulations to determine whether or not the expected effects would be significant, where a significant action is any regulatory action that may:

- Have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, priorities of the President, of the principles set forth in the Executive Order.

In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, include 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.

As described in this section, from an economic perspective, the proposed action does not have an effect on the economy of $100 million, however it does adversely affect fishermen and fishing businesses, and their ports and can be considered to raise novel legal or policy issues arising out of MMPA mandates. As such, the Proposed Action is considered significant as defined by EO 12866 and has undergone OMB review. NMFS has considered the cost information presented above and believes that Alternative 2 (Preferred) offers the best option for achieving compliance with MMPA and ESA requirements. In addition, Alternative 2 (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 extending the South Island Restricted Area into May. Based on these considerations, NMFS has identified Alternative 2 (Preferred) as its proposed approach to achieving the goals of the ALWTRP.

Table 9.7: Summary of Annualized Value and Present Value of Compliance Costs by Alternatives (2020 U.S. dollars, in millions)

	Discount Rate	Gear Marking Lower	Gear Marking Upper	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 Total		27.8	37.1	2.2	12.1	39.8	7.8	12.0	0.0	0.0	50.0	91.1
Alt 2 AV	3%	5.1	6.8	0.4	2.2	7.3	1.4	2.2	0.0	0.0	9.2	16.8
Alt 2 AV	7%	5.8	7.8	0.5	2.5	8.3	1.6	2.5	0.0	0.0	10.5	19.1
Alt 3 Total		86.8	0.0	10.6	3.1	7.4	17.8	24.5	23.0	61.3	141.3	190.5
Alt 3 AV	3%	16.0	0.0	2.0	0.6	1.4	3.3	4.5	4.2	11.3	26.1	35.2
Alt 3 AV	7%	18.2	0.0	2.2	0.6	1.5	3.7	5.1	4.8	12.9	29.6	40.0

Notes:
1. Total values are in 2020 dollars, representing net present value of year 1 to year 6, in 2020 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 Final Regulatory Flexibility Analysis

The purpose of the Regulatory Flexibility Act (RFA) is to reduce the impacts of burdensome regulations and recordkeeping requirements on small businesses. To achieve this goal, the RFA requires federal agencies to describe and analyze the effects of proposed regulations, and possible alternatives, on small entities. Ultimately, the goal of the RFA analysis is to understand to what extent the action induces significant economic impacts on small entities. To this end, this document contains a Final Regulatory Flexibility Analysis (FRFA) prepared under §604 of the RFA, which includes an assessment of the effects that the proposed action and other alternatives are expected to have on small entities.

9.7.1 *Basis For and Purpose of the Rule*

9.7.1.1 Description of Projected Reporting, Recordkeeping, and other Compliance Requirements of the Rule

Requirements of the Action, including an estimate of the classes of small entities, will be subject to the requirement and the type of professional skills necessary for the required reporting and record keeping requirements.

This Final Rule contains a collection-of-information requirement subject to review and approval by OMB under the Paperwork Reduction Act (PRA), specifically the marking of fishing gear. This rule changes the existing requirements for the collection of information 0648-0364 by modifying gear marking for all buoy lines with the exemption of those fishing in Maine exempted waters in the Northeast Region Trap/Pot Management Area. As described in this preamble, mark colors will be changed for vessels identifying principal ports from Maine through Rhode Island to state-specific marks. Under the new marking scheme, a large 3-foot (91 cm) mark would be required within the top 2 fathoms (3.7 m) of the buoy in state and federal waters. Within state waters, at least two additional 12-inch (30.5 cm) marks would be required in the top and bottom of the main buoy line. In federal waters, at least three 12-inch (30.5 cm) marks would be required at the top, middle, and bottom of the main buoy line. In federal waters, an additional 12-inch (30.5 cm) green mark is required within 6 inches (15.3 cm) of each state specific mark (at least four in total, including the large mark in the surface system and at least three marks in the main buoy line). Each color mark must be permanently affixed on or along the line, and each color mark must be clearly visible when the gear is hauled or removed from the water. Paint and tape will be required for the surface system marks, and the commonly used colored ties and twine can be used within the main buoy lines. The changes from current gear marking include: The state color, the addition of a surface system mark, one less mark required in the main buoy line in state waters, and four additional marks required to distinguish federal waters. While Maine fishermen in non-exempt state waters have already marked their gear under Maine regulations, we include the costs of that effort in our calculation in response to comments that noted that the Maine regulations were implemented in anticipation of this rule. Additionally, we had previously assumed that about 20 percent of the gear marks were reapplied each year, but new information suggests they are applied annually. Using these assumptions, the public reporting burden for the Northeast Region lobster and Jonah crab gear marking requirements are estimated to affect 3,970 vessels that need to remark an average of 389 marks each year. Each mark takes approximately 6.7 to 8.6 minutes to apply, depending on the size of the mark and method used. Applying the annual hourly wage rate for fishermen of $26.5 results in a total estimated annual wage burden cost of $4.5 to 5.9 million dollars. Approximately 3,086 of the total entities, as described in Section 9.7.3, are considered small entities that would be impacted during this rulemaking. This Final Rule includes conservation equivalencies that aim to minimize the impact of the measures on small entities.

We invite the general public and other federal agencies to comment on proposed and continuing information collections, which helps us assess the impact of our information collection requirements and minimize the public's reporting burden. Written comments and recommendations for this information collection should be submitted at the following website www.reginfo.gov/public/do/PRAMain. Find this particular information collection by using the search function and entering either the title of the collection or the OMB Control Number 0648-0364.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

9.7.1.2 Federal Rules Which May Duplicate, Overlap, or Conflict with the Rule

No duplicative, overlapping, or conflicting federal rules have been identified.

9.7.2 *Changes from Initial Regulatory Flexibility Analysis*

9.7.2.1 Significant Issues Raised by the Public in Response to the IRFA and Summary of the assessment of the agency of such issue

The Final Rule analyzed within this FRFA benefitted from substantial input from the public. NMFS' scoping and public outreach efforts are fully described in Section 1.5 of the FEIS prepared for this rulemaking. In addition to NMFS' efforts, gear configuration changes within the rule are largely informed by the Maine Department of Marine Resources and Massachusetts Department of Marine Fisheries proposals, as well as the Rhode Island Department of Environmental Management. These states also conducted substantial outreach with fishermen through local management councils and fishery associations.

After publication of the proposed rule and Draft Environmental Impact Statement, we received over 1,100 unique submissions and many submissions generated by non-governmental organization campaigns including some submissions with multiple signatures representing over 200,000 people. Many commenters including general public, fishermen, fishing industry representatives and state and federal regulators and legislators expressed concern that this rule would cause them extreme economic hardship, with some stating that this rule would put them out of business. Many commenters expressed concerns about the effects of this rule on the economic health of their communities, the supply chain, and on the state of Maine. Some of these commenters suggested that subsidies to fishermen should be provided to assist fishermen impacted by this rulemaking. Appendix 1.1 of the FEIS lists these comments under Section 2 Economics and all received comments are represented in Appendix 3 of the FEIS.

Given the vast amount of industry input into the development of weak insertions, which would not require fishermen to replace buoy lines, and trawling up measures, many gear modifications implemented in the Final Rule were to control costs. However, the economic analysis in Chapter 6 indicates the cost of this rulemaking is up to $19.2 million for the first year, which is 3 percent of the landings value of the lobster fishery in 2019.

NOAA reprogrammed some funds to support fishermen in complying with gear modification changes, but at this time funds have not been appropriated by Congress or further reprogrammed to reimburse fishermen. In December 2019, $1.6 million in federal funds were reprogrammed from National Environmental Satellite, Data, and Information Service Procurement, Acquisition and Construction funds to support recovery actions for the right whale in the lobster/Jonah crab fishery. The funds were made available to fishermen through our partnership with the Atlantic States Marine Fisheries Commission (Commission). The funds were obligated to the Commission to collaborate with Maine, New Hampshire, Massachusetts, and Rhode Island to assist the lobster/Jonah crab fishery in adapting to and comply with the measures in this Final Rule and help to defray costs to support affected fishermen broadly.

9.7.2.2 Changes Made in the Rrule as a Result of Comments

Major changes in the proposed rule include conservation equivalencies in Maine LMA 1 waters, LMA 2 waters and LMA 3 waters to mitigate the potential economic costs caused by the regulation.

Where risk reduction benefits were sufficient, conservation equivalencies requested through public comments on the DEIS and proposed rule to mitigate operational and safety concerts were accepted and are included in this final rule. These include conservation equivalencies in Maine LMA 1 waters, LMA 2 and LMA 3. To enable the Maine LMA 1 conservation equivalencies, this rule also modifies regulations implementing the Atlantic Coastal Fisheries Cooperative Management Act at 50 CFR 697.21(b)2), increasing the maximum number of traps on a trawl with a single buoy lines from three to ten in some Maine Zones. This would allow vessel operators to trawl up to a 20-trap trawl or to use two ten trap trawls with one buoy line. Additional changes made to accommodate conservation equivalency measures offered by the Maine Department of Marine Resources and supported by commenters from the Maine fishing industry, including modifications to the number of traps on a trawl or the number of weak insertions based on Maine fishery zones and distance from shore out to 12 nm (22.2 km). This rule also implements conservation equivalency recommendations submitted by Rhode Island and supported by Rhode Island fishermen, modifying the LMA 2 measures with more expansive weak insert requirements throughout the LMA rather than trawling up requirements that challenged the capacity of some Rhode Island vessels. Additionally, this rule implements some of the conservation equivalency recommendations submitted by the Atlantic Offshore Lobstermen's Association as public comments on the DEIS and Proposed Rule for LMA 3. F This rule implements three management areas in LMA 3 with three different trawling up requirements, requiring more traps/trawl in the Georges Basin area where there is more risk to right whales. This increase in number of traps per trawl off of Georges Basin was offset by a lower number of traps required with in the Northeast Regions south of the 50 fathom depth contour on the south end of Georges Bank.

All these conservation equivalencies were created with input from fishermen from these areas, informed by their knowledge of measures that would best fit their economic, operational or safety needs. For LMA 2 vessels, the weak rope alternative implemented has less impact on catch and landings and therefore could have a lower economic impact compared to the LMA 2 measures analyzed in the IRFA..

This rule also modifies existing seasonal restricted areas that were closed to lobster and Jonah crab trap/pot fishing to allow ropeless fishing with exempted fishing permits (EFP). Under a revised restricted area definition, trap/pot fishermen could fish with trap/pot gear using "ropeless" methods, although an EFP would be required to exempt fishermen from surface marking requirements under other laws. 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 adopters.

9.7.3 *Summary of the Action*

Table 9.1 lists the details of the Final Rule applied to lobster and Jonah crab fisheries in the Northeast Region. The Final Rule would increase the number of traps per trawl based on area fished and miles fished from shore in the Northeast Region. Trawling up regulations in all coastal regions would be managed based on distance from shore, primarily outside of exempt or state waters. In the Final Rule, existing restricted areas would be modified to be closed to fishing with persistent buoy lines. Massachusetts Restricted Area would be expanded into Massachusetts state waters north to the New Hampshire border from February through April in both state regulations and the Final Rule. Additionally, all state waters within the Massachusetts Restricted Area would be closed by Massachusetts until May 15th unless surveys demonstrate that whales have left the area. Two new seasonal restricted areas would be created that would allow fishing without the use of persistent buoy lines: one in LMA 1 from October through January and one south of Cape Cod from February through April. Fishing without the use of persistent buoy lines would be allowed during these seasons, outside of Cape Cod Bay and the Outer Cape Cod Lobster Management 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 lb (771.1 kg). The Final Rule also includes more robust gear marking requirements that differentiate buoy lines by state, includes unique marks for federal waters, and expands into areas previously exempt from gear marking.

9.7.4 *Description and Estimate of the Number of Small Entities to which the Rule Applies*

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 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 Small Business Act 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[24] vessel database created by the 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 2017 to 2019 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[25] in LMA 1, LMA 2, LMA 3, 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 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 (2017-2019) 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 2019, 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 developed by the Industrial Economics (see Appendix 5.1 of FEIS for documentation), we identify 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 1,547 distinct entities identified as directly regulated entities in this action, those that held lobster permits in LMA 1, 2, 3, or OCC, or some combination. So all together, 3,460 entities are regulated under this action. Table 9.8 displays the details of regulated entities holding federal permits. Of all 1,547 entities, only two of them are large. Within the

[24] We use terms affiliation, fishing business and entity interchangeably in this section.

[25] During the time period of our analysis (2017-2019), 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.

1,545 small entities, 262 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 1,283 small entities with fishing revenue, 110 entities had no lobster landings. Therefore, 3,086 small entities would be considered as impacted small entities during this rulemaking. The average gross annual revenue for small entities with lobster landings was $287,000 in 2019, and 91.5 percent of that is from lobsters. For small entities without lobster landings, their annual gross revenue was $135,000. The average revenue for all small entities was about $252,000. The revenue of large entities are not reported here for data confidentiality reasons.

Table 9.8: The number of regulated entities with federal permitted vessels and their lobster landing value percentage of annual gross revenue in 2019 (in 2020 U.S. $)

	Large Entity	Lob% Large	Average Revenue Large	Small Entity	Lob% Small	Average Revenue Small	Total Entitie s
Fishing with Lobster Landing	2	83.9%	N/A	1,173	91.5%	$287,000	1,175
Fishing Without Lobster Landing	0	0	N/A	110	0	$135,000	110
No revenue	0	0	N/A	262	0	0	262
Total Entities	2		N/A	1,545		$252,000	1,547

Notes: 1. The determination of large or small entity is based on three-year average affiliation revenue from 2017 to 2019. Lobster landing percentage is calculated using only 2019 data.
2. Gross annual average revenue for large entities are not reported here due to confidentiality concern
Source: Social Science Branch vessel affiliation data, 2017-2019

9.7.5 *Description and Estimate of Economic Impacts on Small Entities*

To calculate the average profitability of small entities and large entities, we need to deduct the operational costs and fixed costs from the annual gross revenue for each vessel (2017-2019), 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 (Zou, Thunberg and Ardini, 2021). 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[26], vessels between 35 and 45 (10.7 and 13.7 meters) feet have a net profit[27] of $47,404; large vessels between 45 and 55 feet (13.7 and 16.8 meters) have an average profit of 73,063; and vessels above 55 feet (16.8 meters) have a profit of $34,463. The average profit for small entities is about $53,000, compared to their mean total revenue of $287,000, a profitability of 18%. Due the small number of large entities, profit and revenue for these entities cannot be reported for confidentiality concerns. This also means that the economic impacts on large entities would not be reportable and for this reason the analysis herein is focuses only on economic impacts of the Final Rule on small entities

Measures implemented in the Final Rule are intended to reduce the probability of mortality and serious injury of large whales include weak ropes or weak insertions, minimum trawl length

[26] All values are in 2020 US dollars.
[27] 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.

requirements, and seasonal restricted areas. Changes to gear marking requirements are also proposed to increase the chance of threat identification. These measures generate a series of compliance cost for small entities. Additional impacts on profits are estimated due to reduced revenue caused by catch reduction. In this section, we first identify the gear configuration change compliance costs year by year. Then we list the potential lost revenue from catch reduction and fuel cost changes, and finally we estimate the total profitability change for affected small entities.

Using the economic analysis methods identified above, Table 3 displays the gear configuration change 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. Weak rope only generates costs in Year 1. Trawling up would have cost savings of $3.6 million on surface systems, also only in Year 1. It will be shown as a negative number in Table 3. Results indicate that fishermen would have to pay $3.3 to $4.8 million in the first year to comply with the gear configuration change in the Final Rule, and $4.6 to $6.2 million per year in the subsequent 5 years. In total 6 years, the gear compliance costs could be between $26.5 and $35.7 million. Table 4 shows the potential lost revenue from catch reduction and fuel consumption change caused by trawling up and restricted area measures. The total 6-year costs would be from $23.5 to $55.4 million. In total, the Final Rule would cost small entities about $50 to $91.1 million in 6 years (Table 5). If applied to roughly 3,086 affected small entities, the first year costs would range between $3,200 and $6,200 per vessel, but would be lower in Years 2-6. The Year 1 costs would result in an estimated reduction in profit for small entities ranging from 6 percent to 12 percent.

Table 9.9. Yearly compliance costs from gear configuration change (in 2020 U.S. $, millions)

	Gear Marking Lower	Gear Marking Upper	Weak Rope	Trawling up	Total Lower	Total Upper
Year 1	4.6	6.2	2.2	-3.6	3.3	4.8
Year 2	4.6	6.2	0.0	0.0	4.6	6.2
Year 3	4.6	6.2	0.0	0.0	4.6	6.2
Year 4	4.6	6.2	0.0	0.0	4.6	6.2
Year 5	4.6	6.2	0.0	0.0	4.6	6.2
Year 6	4.6	6.2	0.0	0.0	4.6	6.2
Total	27.8	37.1	2.2	-3.6	26.5	35.7

Note: 1. The lower and upper bound for gear marking costs is due to different assumptions for marking methods in federal waters. The lower bound assumes that fishermen use duct tapes and conduct marking at shore, while the upper bound assumes that fishermen use twines at sea during transiting, which requires higher material costs and more time.
2. Negative number for trawling up means there is a cost saving from this measure.

Table 9.10. Yearly costs from catch reduction and fuel consumption changes (in 2020 U.S. $, millions)

	Trawling up Lower	Trawling up Upper	Restricted Area Lower	Restricted Area Upper	Total Lower	Total Upper
Year 1	5.2	12.4	1.3	2.0	6.5	14.4
Year 2	4.2	11.2	1.3	2.0	5.5	13.2
Year 3	3.1	8.7	1.3	2.0	4.5	10.7
Year 4	2.1	6.2	1.3	2.0	3.4	8.2

	Trawling up Lower	Trawling up Upper	Restricted Area Lower	Restricted Area Upper	Total Lower	Total Upper
Year 5	1.0	3.7	1.3	2.0	2.4	5.7
Year 6	0.0	1.2	1.3	2.0	1.3	3.2
Total	15.7	43.4	7.8	12.0	23.5	55.4

Note: 1. The lower and upper bound costs for trawling up come from an assumption that vessels adding less than three traps would have a 0 to 5 percent catch reduction, and vessels adding three or more traps would have a 5 to 10 percent catch reduction.
2. The lower and upper bound costs for restricted areas come from an assumption that relocating vessels would have a 5 to 10 percent catch reduction.

Table 9.11: Yearly total cost and profitability change (In 2020 U.S. $, millions)

	Total Costs Lower	Total Costs Upper	Profitability Change Lower	Profitability Change Upper
Year 1	9.8	19.2	6%	12%
Year 2	10.1	19.3	7%	13%
Year 3	9.1	16.9	6%	11%
Year 4	8.0	14.4	5%	9%
Year 5	7.0	11.9	5%	8%
Year 6	5.9	9.4	4%	6%
Total	50.0	91.1		

9.7.6 *Uncertainties in the economic 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.

For purpose of analysis the duration of the Final Rule was assumed to be six years based on the average time between ALWTRP rules in the past. With an anticipated implementation starting in 2021 the expected costs to regulated small entities would accrue through 2026. If the Final Rule remains unchanged the annual costs similar to that estimated for year 6 would be expected to continue.

Some caveats in economic analysis include:

1. In the analysis of gear conversion costs, there are a few assumptions: (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.

2. For the catch impact of restricted areas, VTR data have been used extensively in the calculation of catch per trap and trip percentage during the restricted period. We are aware 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.

3. In the analysis of the revenue losses associated with suspending fishing, we assume 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 closure 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.

9.8 References

Chami, R., Cosimano, T., Fullenkamp, C., & Oztosun, S. (2019) Nature's solution to climate change. Finance and Development Magazine. 34– 38.

Giraud, Kelly, Branka Turkin, John Loomis, and Joseph Cooper, Economic Benefit of the Protection Program for the Steller Sea Lion, Marine Policy 26(6):452-458, 2002.

Hageman, R., Valuing Marine Mammal Populations: Benefit Valuations in a Multi-Species Ecosystem, Administrative Report LJ-85-22, Southwest Fisheries Center, National Marine Fisheries Service, La Jolla, CA, 1985.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2019. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. NOAA Technical Memorandum NMFS-NE-258, NEFSC, NMFS, NOAA, DOC, Woods Hole, MA.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. Page 479. Northeast Fisheries Science Center, Woods Hole, MA.

Henry, A. G., M. Garron, D. Morin, A. Reid, W. Ledwell, and T. V. Cole. 2020. Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2013-2017. Page 59. Northeast Fisheries Science Center Reference Document, U.S. Department of Commerce.

Hoyt, E., Whale Watching 2000: Worldwide Tourism Numbers, Expenditures, and Expanding Socioeconomic Benefits : a Special Report from the International Fund for Animal Welfare, Internation Fund for Animal Welfare, Yarmouth Port, MA, 2000.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21:635-645.

Knowlton, A., P. Hamilton, M. Marx, H. Pettis, and S. Kraus. 2012. Monitoring North Atlantic right whale Eubalaena glacialis entanglement rates: a 30 yr retrospective. Marine Ecology Progress Series 466:293-302.

Lew DK,2015, Willingness to pay for threatened and endangered marine species: a review of the literature and prospects for policy use. Front. Mar. Sci. 2:96. doi: 10.3389/fmars.2015.00096

Loomis, J. and D. Larson, "Total Economic Values of Increasing Gray Whale Populations: Results from a Contingent Valuation Survey of Visitors and Households," Marine Resource Economics, Vol. 9, pp. 275-286, 1994.

NMFS 2014. Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the American Lobster Fishery.

NOAA , 2008. Stellwagen Bank National Marine Sanctuary Draft Management Plan / Draft Environmental Assessment, National Marine Sanctuary Program, Silver Spring, MD

O'Connor, S., Campbell, R., Cortez, H., & Knowles, T., 2009, Whale Watching Worldwide: tourism numbers, expenditures and expanding economic benefits, a special report from the International Fund for Animal Welfare, Yarmouth MA, USA, prepared by Economists at Large. Office of Management and Budget (OMB). 2003.Circular A-4 of Executive Order12866. 68 FR 58366.

Pace, R. M., 3rd, P. J. Corkeron, and S. D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecology and Evolution 7:8730-8741.

Pace, RM. 2021. Revisions and further evaluations of the right whale abundance model: improvements for hypothesis testing. NOAA Tech. Memo. NMFS-NE 269.

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Rumage, W.T., 1990. The economic value of whale watching at Stellwagen Bank, in The Resources and Uses of Stellwagen Bank. Part II, Proceedings of the Stellwagen Bank Conference, April 26-27, 1990, University of Massachusetts at Boston.

Samples, K. C., and Hollyer, J. R., 1990. Contingent valuation of wildlife resources in the presence of substitutes and complements, Economic Valuation of Natural Resources.Issues, Theory, and Applications, Chapter 11, eds R. Johnson and G. Johnson (Boulder, CO: Westview Press), 177–192.

Samples, Karl C., John A. Dixon, and Marcia M. Gowen, 1986. Information Disclosure and Endangered Species Valuation, Land Economics, 62:3:306-312.

Wallmo, K., and Lew, D. K. 2012. Public values for recovering and downlisting threatened and endangered marine species. Conserv. Biol. 26, 830–839. doi: 10.1111/j.1523-1739.2012.01899.x

Zou C, Thunberg E, Ardini G. 2021. Economic profile for American lobster (Homarus Americanus) fleets in the Northeastern United States. U.S. Dept Commer, Northeast Fish Sci Cent Ref Doc. 21-03; 24 p.

CHAPTER 10 APPLICABLE LAWS

10.1 Magnuson-Stevens Fishery Conservation and Management Act Including Essential Fish Habitat

The Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act require the National Marine Fisheries Service (NMFS) 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. NMFS policy regarding the preparation of National Environmental Policy Act (NEPA) documents recommends incorporating EFH assessments into environmental impact statements; therefore, this Final Environmental Impact Statement (FEIS) 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 (ALWTRP or 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 current action and other alternatives. An EFH consultation concluded on May 26, 2021 concluded that adverse impacts to EFH have been minimized to the extent practicable and no further EFH Conservation recommendations pursuant to 50 CFR §600.925(a) were provided.

10.2 National Environmental Policy Act

The analysis in this document was prepared in full compliance with the requirements of the 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 EIS is being prepared using the 1978 Council on Environmental Quality (CEQ) NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. This review began on August 2, 2019 (Notice of Intent published on this date) and the agency has decided to proceed under the 1978 regulations. This FEIS contains all the components required by NEPA, CEQ Regulations for Implementing NEPA, and National Oceanic and Atmospheric Administration (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 current 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 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. 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 through 8
- A list of preparers - Chapter 11
- 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, NMFS 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 sent 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 FEIS can be found in Appendix 1.1 and Volume 3.

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 FEIS, 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 FEIS 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, 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 mortality and serious injury 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 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 lobster and Jonah crab 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 Marine Mammal Protection Act (MMPA). Modifications to the Plan are necessary at this time. Chapter 3 describes how, considering the best available information, risk reduction measures in Alternatives 2 and 3 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 NMFS Greater Atlantic Regional Fisheries Office ALWTRP web page. Announcements of document availability will be made in the *Federal Register* and to the interested parties' mailing list. Copies were distributed to:

U.S. EPA, Region 1
1 Congress St., 11th Floor
Boston, MA 02203-0001

District Commander
First U.S. Coast Guard District
408 Atlantic Avenue Boston, MA 02210-2209

U.S. EPA, Region 2
290 Broadway,
25th Floor
New York, NY 10007

Director, Office of Marine Conservation
Department of State
2201 "C" Street, NW
Washington, DC 20520

U.S. EPA, Region 3
1650 Arch Street
Philadelphia, PA 19106

Executive Director
Marine Mammal Commission
4340 East-West Highway
Bethesda, MD 20814

U.S. EPA, Region 4
61 Forsyth Street
Atlanta, GA 30303

Director, Office of Environmental Policy and Compliance
U.S. Department of Interior
Main Interior Building (MS 2462)
1849 "C" Street, NW
Washington, DC 2052

10.2.4 *Opportunity for Public Comment*

The current Amendment to the Plan was developed between 2019 and 2021. Several opportunities for public input were provided during this time. Public scoping took place in August of 2019. A 60-day public comment period began for the Proposed Rule on December 31, 2020, and ended on March 1, 2021 (85 FR 86878, December 31, 2020). In January 2021, we held four public information sessions and in February 2021, we held four public hearings, all virtual due to the global COVID-19 pandemic. Although the purpose of the January meetings was to provide information and answer questions, we accepted oral comments on the proposed rule and the Draft EIS at all eight meetings. A summary of the written and oral comments received during the public scoping and public comment period can be found in Appendix 1.1 and Volume 3. The public meetings held are as follows:

Public Scoping

1. Thursday, August 8, 2019—Narragansett, RI, 6 p.m. to 9 p.m. URI Graduate School of Oceanography, Corless Auditorium, 215 South Ferry Road, Narragansett, RI 02882
2. Monday, August 12, 2019—Machias, ME, 6 p.m. to 9 p.m. University of Maine at Machias, Performing Arts Center, 116 O'Brien Avenue, Machias, ME 04654
3. Tuesday, August 13, 2019—Ellsworth, ME, 6 p.m. to 9 p.m. Ellsworth High School Performing Arts Center, 24 Lejok Street, Ellsworth, ME 04605
4. Wednesday, August 14, 2019—Waldoboro, ME, 6 p.m. to 9 p.m. Medomak Valley High School, 320 Manktown Road, Waldoboro, Maine 04572
5. Thursday, August 15, 2019—Portland, ME, 6 p.m. to 9 p.m. South Portland High School, 637 Highland Ave., South Portland ME, 04106
6. Monday, August 19, 2019—Portsmouth, NH, 6 p.m. to 9 p.m. Urban Forestry Center, 45 Elwyn Road, Portsmouth, NH 03801
7. Tuesday, August 20, 2019—Gloucester, MA, 6 p.m. to 9 p.m. NMFS Greater Atlantic Region, 55 Great Republic Drive, Gloucester, MA 01930
8. Wednesday, August 21, 2019—Bourne, MA, 6 p.m. to 9 p.m. Upper Cape Cod Regional Technical School, 220 Sandwich Rd., Bourne, MA 02352

DEIS and Proposed Rule Information Sessions

1. Rhode Island, Southern Massachusetts and Lobster Management Area (LMA) 3, Tuesday, January 12, 2021, 6:30-8:30 pm
2. Massachusetts (Outer Cape and LMA 1) and New Hampshire (LMA 1), Wednesday, January 13, 2021, 6:30-8:30 pm
3. Southern Maine, Tuesday, January 19, 2021, 6:30-8:30 pm
4. Northern Maine, Wednesday, January 20, 2021, 6:30-8:30 pm

DEIS and Proposed Rule Public Hearings

1. Rhode Island, Southern Massachusetts and LMA 3, Tuesday, February 16, 2021, 6:30-8:30 pm
2. Massachusetts (Outer Cape and LMA1) and New Hampshire (LMA 1), Wednesday, February 17, 2021, 6:30-8:30 pm
3. Southern Maine, Tuesday, February 23, 2021, 6:30-8:30 pm

4. Northern Maine, Wednesday, February 24, 2021, 6:30-8:30 pm

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 regulated under the 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 current 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 NMFS Biological Opinion (Opinion). The most recent relevant Opinion on fisheries regulated under the ALWTRP 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[28] 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 trap/pot 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 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

[28] 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.

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 trap/pot 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.

- On October 17, 2017, an ESA 7(a)(2)/7(d) memo issued by NMFS stated a 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. 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 anticipated issuing a new final Biological Opinion concluding the consultation that was initiated in 2017 for the federal American lobster fishery and other federal fisheries.

  Pursuant to section 7 of the Endangered Species Act (ESA), NOAA's National Marine Fisheries Service (NMFS) issued a Biological Opinion (Opinion) on May 27, 2021, that considered the effects of the NMFS' authorization of ten fishery management plans (FMP), NMFS' North Atlantic Right Whale Conservation Framework, and the New

England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2, on ESA-listed species and designated critical habitat. The ten FMPs considered in the Opinion include the: (1) American lobster; (2) Atlantic bluefish; (3) Atlantic deep-sea red crab; (4) mackerel/squid/butterfish; (5) monkfish; (6) Northeast multispecies; (7) Northeast skate complex; (8) spiny dogfish; (9) summer flounder/scup/black sea bass; and (10) Jonah crab FMPs. The American lobster and Jonah crab FMPs are permitted and operated through implementing regulations compatible with the interstate fishery management plans (ISFMP) issued under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (ACA), the other eight FMPs are issued under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA).

The 2021 Opinion determined that the actions under those management plans may adversely affect, but are not likely to jeopardize, the continued existence of North Atlantic right, fin, sei, or sperm whales; the Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead, leatherback, Kemp's ridley, or North Atlantic DPS of green sea turtles; any of the five DPSs of Atlantic sturgeon; Gulf of Maine DPS Atlantic salmon; or giant manta rays. The Opinion also concluded that the proposed action is not likely to adversely affect designated critical habitat for North Atlantic right whales, the Northwest Atlantic Ocean DPS of loggerhead sea turtles, U.S. DPS of smalltooth sawfish, Johnson's seagrass, or elkhorn and staghorn corals. An Incidental Take Statement (ITS) was issued in the Opinion. The ITS includes reasonable and prudent measures and their implementing terms and conditions, which NMFS determined are necessary or appropriate to minimize impacts of the incidental take in the fisheries assessed in this Opinion.

- A formal consultation was conducted on the Atlantic Large Whale Take Reduction Plan in 1997. Six subsequent informal consultations were completed in 2004, 2008, 2014, and 2015 associated with modifications to the Plan. Consultation on the Plan was reinitiated on May 3, 2021 including the potential impacts of the alternatives in the DEIS and proposed rule on ESA-listed species. As detailed in Chapter 5, the preferred alternative analysed in the FEIS that would be implemented by the final rule achieves at least as much risk reduction to right whales and other listed species as estimated in the DEIS. Consultation concluded on May 25, 2021, finding that the Plan operates as a mechanism to reduce fisheries related impacts on Atlantic large whales. It does not authorize any fishery. The effects of federal fisheries regulated under the Plan are fully considered under section 7 consultations conducted for the fishery management plans and incidental take attributed to federal fisheries is authorized under those consultations. Based on all of the above information, the gear regulations implemented by the Plan for U.S. fixed gear fisheries will have wholly beneficial effects to ESA-listed species or their critical habitat. As a result, it was determined that the Plan is not likely to adversely affect ESA-listed species or designated critical habitat under NMFS jurisdiction and no further consultation is necessary.

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 (NMFS) and Interior (U.S. FWS) and the MMPA is the authority under which much of the current rulemaking is being undertaken. The MMPA prohibits the "take" of marine mammals, with certain exceptions, in waters under U.S. jurisdiction and by U.S. citizens on the high seas. The MMPA requires consultation within NMFS if impacts on marine mammals are unavoidable. 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 Plan management areas are discussed in section 4.1 of the FEIS. The species of marine mammals not listed under the ESA that occur in the Plan management areas are discussed in section 4.1.2 except minke whales and North Atlantic humpback whales, which are discussed in section 4.1.1. NMFS has reviewed the impacts of this action on marine mammals and concluded that the management actions proposed are consistent with the provisions of the MMPA. 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 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. In 2020, NMFS provided a copy of the draft environmental assessment and a consistency determination to the state coastal management agency in every state with a federally-approved coastal management program whose coastal uses or resources are affected by these Jonah crab management measures. Each state has 60 days in which to agree or disagree with the determination regarding consistency with that state's approved coastal management program. If a state fails to respond within 60 days, the state's agreement will be presumed. NMFS has determined that this action is consistent to the maximum extent practicable with the approved coastal management programs of the U.S. Atlantic coastal states affected by the action. On January 18, 2021, this determination was submitted for review by the responsible state agencies under section 307 of the CZMA. New Hampshire and Rhode Island agreed with NMFS' determination. Maine and Massachusetts did not respond; therefore, consistency is inferred.

10.6 Administrative Procedure Act

This action was developed in compliance with the requirements of the Administrative Procedures Act (APA), and these requirements will continue to be followed when the final regulation is published. Section 553 of the APA establishes procedural requirements applicable to informal rulemaking by federal agencies. The purpose of these requirements is to ensure public access to the federal rulemaking process, and to give the public adequate notice and opportunity for comment. NMFS is not requesting any abridgement of the rulemaking process for this action.

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 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 the current 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 NEPA and the Regulatory Flexibility Act (RFA) for the preparation of a final environmental impact statement/regulatory impact review. NMFS complied with all relevant statutory and regulatory requirements as well as NMFS 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, NMFS strives to draft and present new 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 FEIS 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 and the Northeast Fisheries Science Center 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 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 purpose of the Paperwork Reduction Act is to control and, to the extent possible, minimize the paperwork burden for individuals, small businesses, nonprofit institutions, and other persons resulting from the collection of information by or for the Federal Government. The authority to manage information and recordkeeping requirements is vested with the Director of the Office of Management and Budget. This authority encompasses establishment of guidelines and policies, approval of information collection requests, and reduction of paperwork burdens and duplications. The gear marking requirements in this action constitute a collection-of-information requirement subject to the Paperwork Reduction Act. Comments on the burden estimates in the proposed rule and modifications to the collection requirements resulted in a modified burden estimate that has been provided to OMB. The general public and other Federal agencies are invited to comment on proposed and continuing information collections to help us assess the impact of our information collection requirements and minimize the public's reporting burden. Written comments and recommendations for this information collection should be submitted at the following website www.reginfo.gov/public/do/PRAMain. Find this particular information collection by using the search function and entering either the title of the collection or the OMB Control Number 0648-0364.

10.9 Executive Order 13132 - Federalism

Executive Order (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 Plan is provided by the take reduction team process. The implementation of any of the alternatives considered could 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:

The purpose of Executive Order 12866 is to enhance planning and coordination with respect to new and existing regulations. This E.O. requires the Office of Management and Budget (OMB) to review regulatory programs that are considered to be "significant." E.O. 12866 requires a review of proposed regulations to determine whether or not the expected effects would be significant, where a significant action is any regulatory action that may:

- Have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, priorities of the President, of the principles set forth in the Executive Order.

In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, include 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.

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. Because this rule has an adverse economic effect on a substantial number of fishermen and may raise novel legal or policy issues arising from the legal mandates of the MMPA, it is considered significant under EO 12866 and has undergone OMB review.

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 a Final Regulatory Flexibility Analysis (FRFA) that describes the impact of the rule on small entities. The FRFA 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 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 document. However, demographic data on participants in the lobster and crab fisheries affected by measures analyzed in this FEIS 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 percent higher than its state average (Maine). Washington and Cumberland Counties are the only counties with a minority rate more than 1 percent 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 FEIS.

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 Lobster and Jonah Crab 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)[29]
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%

[29] 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 current 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.

CHAPTER 11 LIST OF PREPARERS AND CONTRIBUTORS

<u>Preparers</u>

Michael J. Asaro
Economist
National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC), Social Sciences Branch

Peter Burns
Fishery Policy Analyst
NMFS, Greater Atlantic Regional Fisheries Office (GARFO), Sustainable Fisheries Division

Tim Cardiasmenos
National Environmental Policy Act (NEPA) Coordinator
NMFS, GARFO

Robert Black
Industrial Economics, Inc.

Diane Borggaard
Right Whale Recovery Coordinator
NMFS, GARFO, Protected Resources Division

Daniel Caless
Statistician
NMFS, GARFO, Analysis and Program Support Division

Colleen Coogan
Marine Mammal and Sea Turtle Branch Chief
NMFS, GARFO, Protected Resources Division

Neal Etre
Principal
Industrial Economics, Inc.

Marianne Ferguson
NEPA Policy Analyst
NMFS, GARFO

Jennifer Goebel
NMFS, GARFO

Sean Hayes
Chief, Protected Species Branch
NMFS, NEFSC

Allison Henry
Research Fishery Biologist
NMFS, NEFSC, Research Evaluation and Assessment Branch

Alessandra Huamani
Quantitative Modeler
Integrated Statistics, Inc.

Jerome Hermsen
Statistician Biologist
NMFS, GARFO, Analysis and Program Support Division

Ellen Keane
Bycatch Reduction and Outreach Biologist
NMFS, GARFO, Protected Resources Division

Alicia Miller
Quantitative Modeler
Ocean Associates

Meredith Moise
Environmental Specialist
Integrated Statistics, Inc.

David Morin
Large Whale Disentanglement Coordinator
NMFS, GARFO, Protected Resources Division

Brian Morrison
Principal
Industrial Economics, Inc.

Allison Murphy
Fishery Policy Analyst
NMFS, GARFO, Sustainable Fisheries Division

Danielle Palmer
Protected Resources Liaison
NMFS, GARFO, Protected Resources Division

Jessica Powell
Marine Mammal Fishery Interactions Biologist
NMFS, Southeast Regional Office (SERO), Protected Resources Division

André Price
Quantitative Modeler
Integrated Statistics, Inc.

Burton Shank
Research Fishery Biologist
NMFS, NEFSC, Research Evaluation and Assessment Branch

Kara Shervanick
Marine Mammal Biologist
Earth Resources Technology, Inc.

Alicia Schuler
Marine Resources Management Specialist
NMFS, GARFO, Protected Resources Division

Ainsley Smith
Regional Marine Mammal Stranding Coordinator
NMFS, GARFO, Protected Resources Division

Kate Swails
Communications and Internal Affairs
NMFS, GARFO

Jaclyn Taylor
Biologist
NMFS, Office of Protected Resources

Marisa Trego
Policy Analyst, Northeast Marine Mammal TRT Coordinator
NMFS, GARFO, Protected Resources Division

Carrie Upite
Fishery Biologist
NFMS, GARFO, Protected Resources Division

Chao Zou
Economist
Integrated Statistics, Inc.

Barb Zoodsma
Right Whale Conservation Coordinator
NMFS, SERO, Protected Resources Division

<u>Contributors</u>

John Almeida
Attorney Advisor
National Oceanic and Atmospheric Administration (NOAA) Office of General Counsel,
Northeast Section

Tim Cole
Research Fishery Biologist
NMFS, NEFSC, Research Evaluation and Assessment Branch

Danielle Cholewiak
Research Ecologist
NMFS, NEFSC, Research Evaluation and Assessment Branch

John Higgins
Fishing Industry Liaison
NMFS, GARFO, Protected Resources Division

Kristy Long
Fishery Biologist
NMFS, Office of Protected Resources

Daniel Marrone
Fishery Biologist
NMFS, GARFO, Protected Resources Division

Eric Matzen
NMFS, NEFSC, Protected Species Branch

Henry Milliken
Supervisory Research Fishery Biologist
NMFS, NEFSC, Research Evaluation and Assessment Branch

David Stevenson, Ph.D.
Marine Habitat Resource Specialist
NMFS, GARFO, Habitat Conservation Division

Staff members of NMFS GARFO and NEFSC were also consulted in preparing this Final Environmental Impact Statement (FEIS). Neal Etre, Brian Morrison, and Bob Black of IEc Inc. conducted co-occurrence analyses for the DEIS and were consulted on line model and model vessel considerations for this FEIS. No other persons or agencies were consulted.

CHAPTER 12 DISTRIBUTION LIST

As part of the review process under National Environmental Policy Act (NEPA), information for accessing the Final Environmental Impact Statement (FEIS) was distributed to the following persons or agencies:

Terry Alexander, ALWTRT
Thomas Nies, Executive Director;
John Quinn, Chairman
New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950
67 Grover Lane Harpswell, ME 04079

Regina Asmutis Silva, ALWTRT
Colleen Weiler, Alternate
Whale and Dolphin Conservation USA
7 Nelson St
Plymouth, MA 02360

David Borden, ALWTRT
Grant Moore, Alternate
Heidi Heininger
American Offshore Lobstermen's Association
23 Nelson St.
Dover, NH 03820

Dwight Carver ALWTRT
Ben Martens, Alternate
PO Box 131
Beals, ME 04611

Beth Casoni ALWTRT
Mike Lane, Alternate
MA Lobstermen's Association
8 Otis Place
Scituate, MA 02066-1323

Edward Chiofolo, ALWTRT
16 Blair Lane
Brookhaven, NY 11719

Alex Costidis, ALWTRT
Susan Barco, Alternate
Virginia Aquarium & Marine Science Center
717 General Booth Boulevard
Virginia Beach, VA, 23451

Kiley Dancy, ALWTRT
Chris Moore, Executive Director
Mike Luisi, Chair
Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201
Dover, DE 19901

Jane Davenport, ALWTRT
Defenders of Wildlife
1130 17th Street N.W.
Washington D.C. 20036

DHS/USCG/Seventh District (ole)
909 SE 1st Ave.
Miami, FL 33131-3050

Greg DiDomenico, ALWTRT
Warren Appel, Alternate
Garden State Seafood Asso.
Kevin Wark, Alternate
13103 Misty Glen Lane
Fairfax, VA 22033

Cindy Driscoll, ALWTRT
Amanda Weschler, Alternate
MD Dept. of Natural Resources
904 South Morris Street
Oxford, MD 21654

Clay George, ALWTRT
Georgia Department of Natural Resources
1 Conservation Way
Brunswick, GA 31523

Colleen Giannini ALWTRT
CT Department of Environmental Protection
PO Box 719, 333 Ferry Rd.
Old Lyme, CT 06371

Robert Glenn ALWTRT
MA Division of Marine Fisheries
1213 Purchase St
New Bedford, MA 02740

Michael Greco ALWTRT
DE Division of Fish & Wildlife
P.O. Box 330
Little Creek, DE 19961

Sonny Gwin, ALWTRT
10448 Azalea Rd
Berlin, MD 21811

John Haviland, ALWTRT
Lori Caron, Alternate
South Shore Lobstermen's Association
PO Box 543
Green Harbor, MA 02041

Dennis Heinemann, ALWTRT
Dee Allen, Alternate
Marine Mammal Commission
4340 East-West Highway, Room 700
Bethesda, MD 20814

Robert Kenney, ALWTRT
Tim Werner, Alternate
NARWC, and URI, Graduate School of Oceanography
Box 41, Bay Campus South Ferry Road
Narragansett, RI 02882

Toni Kerns, ALWTRT; Rep Robert Beal, Executive Director; Patrick Keliher, Chair
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite
200 A-N Arlington, VA 22201

Raymond King, ALWTRT
1444 Ferris St.
Atlantic Beach, FL 32233

Amy Knowlton, ALWTRT
Heather Pettis, Alternate
Kraus Marine Mammal Conservation Program
Anderson Cabot Center for Ocean Life
New England Aquarium
Central Wharf
Boston, MA 02110

Scott Landry, ALWTRT
Jooke Robbins, Alternate
David Mattila, Temporary Alternate
Provincetown Center for Coastal Studies
5 Holway Avenue
Provincetown, MA 02657

Charlie Locke, ALWTRT
P.O. Box 761 Wanchese, NC 27981

Rick Marks, ALWTRT
2300 Clarendon Blvd., Suite 1010
Arlington, VA, 22201

Robert Martore, ALWTRT
South Carolina. Dept. of Natural Resources
217 Ft. Johnson Rd.
Charleston, SC 29412

Greg Mataronas, ALWTRT
Peter Brodeur, Alternate
Rhode Island Lobstermen's Association
265 Long Highway
Little Compton, RI, 02837

Charles "Stormy" Mayo, ALWTRT
Provincetown Center for Coastal Studies
5 Holway Avenue
Provincetown, MA 02657

Patrice McCarron, ALWTRT
Maine Lobstermen’s Association
PO Box 215
Kennebunk, ME 04043

Bill McLellan, ALWTRT
University of North Carolina - Wilmington
601 South College Road
Wilmington, NC 28403

Richard Merrick, ALWTRT
134 King St.
Falmouth, MA 02540

Kristen Monsell, ALWTRT
Sarah Uhlemann, Alternate
Center for Biological Diversity
1212 Broadway, Ste. 800
Oakland, CA 94612

Attn: Katie Moore, LCDR
Kathryn Cyr,LTJG
Michael Thompson
DHS/USCG/Fifth District (Aole)
431 Crawford St.
Portsmouth, VA 23704

Fentress "Red" Munden, ALWTRT
NC Division of Marine Fisheries
PO BOX 1165
Morehead City, NC 28557

Nick Muto, ALWTRT
270 Jonathan’s Way
Brewster, MA 02631

Steve Nippert, ALWTRT
38 Witham St.
Gloucester, MA 01930

Bob Nudd Jr., ALWTRT
NH Lobstermen's Association
531 Exeter Road
Hampton, NH 03842

Scott Olszewski, ALWTRT
RI Div of Fish & Wildlife
3 Fort Wetherhill Rd.
Jamestown, RI 02835

Cheri Patterson, ALWTRT
Renee Zobel, Alternate
NH Fish and Game Dept.
225 Main St.
Durham, NH 03824

Charlie Phillips, ALWTRT
John Carmichael, Executive Director
Jessica McCawley, Chair
South Atlantic Fishery Management Council
PO Box 12753
Charleston, SC 29422

Tom Pitchford, ALWTRT
Florida Fish and Wildlife Conservation
Commission,
Fish and Wildlife Research Institute
370 Zoo Parkway
Jacksonville, FL 32218

Kristan Porter, ALWTRT
ME Lobstermen's Association Director
PO Box 233
Cutler, ME 04626

Chad Power, ALWTRT
NJ Division of Fish, Game, and Wildlife
Bureau of Marine Fisheries
PO Box 418
Port Republic, NJ 08241

Nicholas Record, ALWTRT
Bigelow Laboratory for Ocean Sciences
60 Bigelow Dr.
East Boothbay, ME 04544

Billy Reid, ALWTRT
4950 Cypress Point Circle, Apt. 203
Virginia Beach, VA 23455

Meghan Rickard, ALWTRT
Kim McKown, Alternate
NYS Dept. of Environmental Conservation
205 N. Belle Mead Rd., Suite 1
East Setauket, NY 11733

Michael Sargent, ALWTRT
Brian Pearce, Alternate
55 Bay View Dr
Steuben, ME 04680

Arthur "Sooky" Sawyer, ALWTRT
368 Concord St
Gloucester, MA 01930

Brian Sharp, ALWTRT
C.T. Harry, Alternate
International Fund for Animal Welfare
290 Summer St
Yarmouthport, MA 02675

Somers Smott, ALWTRT
Patrick Geer, Alternate
VA Marine Resources Commission
Building 96, 380 Fenwick Road
Ft. Monroe, VA 23651

Erin Summers, ALWTRT
Megan Ware, Alternate
Maine Dept of Marine Resources
21 State House Station
Augusta, ME 04333

Todd Sutton, ALWTRT
38 Fenner Ave
Newport, RI 02840

Wes Townsend, ALWTRT
30343 Vines Creek RD
Dagsboro, DE 19939

Stephen Train
ASMFC Lobster Board Chair
33 Vernon Rd.
Long Island, ME 04050

U.S. Environmental Protection Agency
(EPA) Office of Federal Activities; EIS
Filing Section
Ariel Rios Building (South Oval Lobby),
Room 7220
1200 Pennsylvania Avenue, NW
Washington, DC 20004

U.S. EPA, New England Headquarters
5 Post Office Square - Suite 100
Boston, MA 02109-3912

U.S. EPA Region 2
Main Regional Office
290 Broadway
New York, NY 10007-1866

U.S. EPA Region 3
1650 Arch Street
Philadelphia, PA 19103-2029

U.S. EPA Region 4
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-3104

Mason Weinrich, ALWTRT
Gloucester, MA 01930

David Wiley, ALWTRT
Stellwagen Bank NMS
175 Edward Foster Road
Scituate, MA 02066

John Williams, ALWTRT
PO Box 392
Stonington, ME 04681

Sharon Young, ALWTRT
Erica Fuller (CLF), Alternate
The Humane Society of the U.S
3 Lucia Lane
Sagamore Beach, MA 02562

CHAPTER 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 (ESA).

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 (ALWTRP or 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 ESA, 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 (MMPA), 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 (MSA) 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 MSA.

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 mortality and serious injury 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 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 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 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.

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 pounds (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 pounds.

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