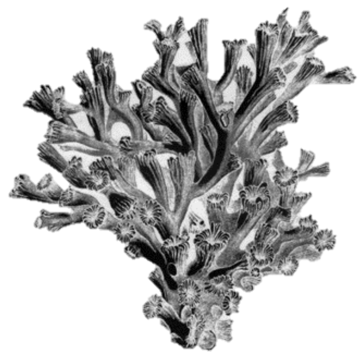
AMENDMENT 16
TO THE ATLANTIC MACKEREL, SQUID, AND BUTTERFISH FISHERY MANAGEMENT PLAN

Measures to Protect Deep Sea Corals from Impacts of Fishing Gear

Environmental Assessment, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis



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Prepared by the Mid-Atlantic Fishery Management Council
in cooperation with
the National Marine Fisheries Service (NMFS)

Council Address	NMFS Address
Mid-Atlantic Fishery Management Council	Greater Atlantic Regional Fisheries Office
800 North State Street, Suite 201	55 Great Republic Drive
Dover, DE 19901	Gloucester, MA 01930

1.0 EXECUTIVE SUMMARY

This document analyzes proposed management measures that would protect deep sea corals from the impacts of commercial fishing gear in the Mid-Atlantic Fishery Management Council region. This action is proposed as an amendment to the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan (FMP), however, the proposed measures would affect several other commercial fisheries operating in the mid-Atlantic region. The measures under consideration include: designation of "deep sea coral zones," restrictions on the use of bottom-tending commercial fishing gear within designated deep sea coral zones, provisions for vessel transit through deep sea coral zones, Vessel Monitoring System (VMS) requirements for the *Illex* squid fishery, and framework provisions to be added to the FMP for ease of potential future modifications to deep sea coral protection measures.

1.1 HISTORY AND PURPOSE OF THIS ACTION

Deep sea corals are fragile and slow-growing invertebrates that serve an important role in unique and diverse deep sea ecosystems. However, deep sea corals are known to be vulnerable to bottom-tending fishing gear, particularly bottom trawls. Given recent and historical observations of deep sea corals and suitable deep sea coral habitat in offshore mid-Atlantic environments, the Mid-Atlantic Fishery Management Council (MAFMC or Council) initiated this Amendment in 2012 to consider measures to protect deep sea corals from the impacts of fishing gear. After reviewing initial public scoping comments, the Council developed a range of alternatives and associated analyses. The Council adopted preferred alternatives at its June 2015 Council meeting, after considering comments received during public hearings and a written public comment period (comment summaries are available on the Council's website at www.mafmc.org).

The purpose of this amendment is *to identify and implement measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic region*. The Council recognizes the ecological and cultural value of deep sea corals and is exercising its authority under the discretionary provisions of the reauthorized Magnuson-Stevens Act (MSA) to recommend management measures to minimize fishery impacts to deep sea corals in the Mid-Atlantic Council region. At the same time, the importance and value of commercial fisheries that operate in or near areas of deep sea coral habitat is also recognized by the Council. As such, measures in this amendment are considered in light of their benefit to corals as well as the cost to commercial fisheries.

1.2 SCOPE OF THE ACTION

The MAFMC, the New England Fishery Management Council (NEFMC), and the South Atlantic Fishery Management Council (SAFMC) have signed a Memorandum of Understanding (MOU) identifying areas of consensus and common strategy related to conservation of corals and mitigation of the negative impacts of fishery interactions with corals.[1] As per the terms of the MOU, the Mid-Atlantic Council developed the alternatives in this document to be applicable only to areas within the MAFMC region boundary as defined in the current regulations (see Section 4.4). The NEFMC is currently developing deep sea coral protection measures within the NEFMC region under an Omnibus Deep Sea Corals Amendment.[2]

[1] The full Memorandum of Understanding is available at http://www.mafmc.org/actions/msb/am16.

[2] For more information, see http://www.nefmc.org/library/omnibus-deep-sea-coral-amendment.

The measures proposed in this amendment would impact commercial fisheries operating with bottom-tending fishing gear (i.e., bottom trawls, dredges, bottom longlines, sink gillnets, or pots/traps) in offshore environments near the continental shelf/slope break. Although gear restrictions are being developed within the MSB FMP, the proposed alternatives are not limited to the activities of the MSB fisheries. Management measures developed under the regulatory authority described in Section 4.2 and implemented via this amendment could be applied to any federally regulated fishing activity within the range of the MSB fisheries, including activity or gears that are not used in these fisheries. However, the Council has determined that the management measures in this amendment would **not apply** to American lobster trap fisheries (see Section 4.4).

The measures proposed in this amendment are not intended to regulate recreational gear types; however, the Council may consider recreational measures for deep sea coral protections in a future action, and the framework provision alternatives of this amendment may allow the Council to do so through a future framework action.

1.3 AMENDMENT ALTERNATIVES

The range of alternatives in this amendment includes options to designate "deep sea coral zones" in which the use of certain types of bottom-tending fishing gear would be restricted, options to add Framework provisions to the MSB FMP to increase the efficiency of future modifications to any coral protection measures, and an alternative to require VMS for federally-permitted *Illex* squid vessels.

Deep sea coral zones would consist of gear-restricted areas designed for the protection of known deep sea corals or likely deep sea coral habitat. This document describes and evaluates several different "broad" coral zone and "discrete" coral zone alternatives. The broad coral zone alternatives consist of large, deeper areas, the vast majority of which are beyond current locations of known fishing effort. Broad zones are intended to have more of a precautionary focus, primarily by limiting and preventing the expansion of commercial gear use into these deeper areas. Discrete coral zones would consist of smaller areas of known coral presence or highly likely coral habitat. These areas primarily consist of offshore canyons or slope areas along the continental shelf edge, many of which have known deep sea coral communities and all of which have highly likely deep sea coral habitat.

The specific discrete zone alternatives considered in this document, in addition to the no action alternative, include designation options for fifteen canyon or canyon-slope areas with known or highly likely coral presence, with five sub-options for different boundary designations proposed by different management or other stakeholder groups during amendment development. The Council-preferred alternative for discrete zones includes designation of all fifteen discrete areas, using boundaries developed at a Council-sponsored collaborative workshop of scientists, fishermen, managers, and other stakeholders. The first sets of discrete zone boundaries considered during amendment development were proposed by the Council's Deep Sea Corals Fishery Management Action Team (FMAT) based primarily on a NOAA habitat suitability model for deep sea corals, as well as historical deep sea coral records and high resolution bathymetry and slope data. Additional boundary options were submitted to the Council for consideration in 2013 (by a small group of commercial fishing industry advisory panel members) and 2015 (one set from the Garden State Seafood Association and another from by a coalition of environmental non-governmental organizations, or NGOs). To reconcile these various options, the Council held a Coral Zone Boundary Workshop in April 2015,[3] convening Council's Squid, Mackerel,

[3] More information and supporting documents available at: http://www.mafmc.org/workshop/2015/deep-sea-corals.

and Butterfish Advisory Panel, the Ecosystems and Ocean Planning Advisory Panel, members of the Deep Sea Corals FMAT, invited deep sea coral experts, additional fishing industry representatives, and other interested stakeholders. At the workshop, boundaries were developed through a collaborative process and negotiated in real time based on considerations for both coral protections and the operational needs of fisheries operating in the areas. The end result was a set of consensus boundaries developed by workshop participants as a compromise between various interest groups, with the goal of protecting corals while limiting impacts to the fishing industry.

Within discrete zones, the Council-preferred alternatives include a prohibition on all bottom-tending gear with an exemption for the red crab trap fishery. The Council considered two major action alternatives for gear restrictions: prohibit all bottom-tending fishing gear or prohibit only *mobile* bottom-tending gear. Under the alternative for prohibition on all bottom-tending gear, there are two sub-alternatives, which would exempt either or both the red crab trap fishery and/or the golden tilefish bottom longline fishery (these exemptions would not be necessary in the event that only mobile bottom-tending gear was prohibited). The Council's preferred alternative includes an exemption for the red crab fishery for a period of *at least* two years, but plans to revisit the exemption after that point. As described below in Section 4.0 and Section 5.0, these gear restriction alternatives would not apply to the American lobster trap fishery.

The broad coral zone designation alternatives considered in this document include four options with landward boundaries defined by approximated depth contours, including the 200, 300, 400, and 500-meter depth contours near the continental shelf break, and the Council-preferred broad zone, which uses a landward boundary based on a combination of an approximated 450 meter depth-contour and the preferred discrete zone landward boundaries. For all broad zone designation alternatives, the area would extend to the north and south until coinciding with approximated Mid-Atlantic Council region boundaries contained in the Code of Federal Regulations, and would also extend eastward to the edge of the U.S. EEZ. The Council-preferred broad zone (Alternative 1F) integrates the boundaries of the Council-preferred set of fifteen discrete zones, developed at the aforementioned collaborative workshop, and otherwise approximates the 450-meter depth contour, falling between the 400-meter and 500-meter depth contour.

The two sets of Council-preferred coral zones (broad and discrete) are overlapping: all Council-preferred discrete zones fall within the Council-preferred broad zone. However, the zones are proposed as distinct types of gear restricted areas to maintain the option of designating different sets of measures or restrictions within each zone type. The combined Council-preferred broad and discrete zones encompass an area of approximately 38,000 square miles.

In February 2016, the Council voted to name the proposed deep sea coral protection area in honor of the late Senator Frank Lautenberg, a five-term United States senator from New Jersey who was responsible for several important pieces of ocean conservation legislation. Senator Lautenberg authored several provisions included in the reauthorized MSA, including the discretionary provisions described in this document giving regional fishery management councils the authority to protect coral habitat areas from fishing gear. The Council proposes that the combined broad and discrete zones, if implemented, be officially known as the "Frank R. Lautenberg Deep Sea Coral Protection Area."

This document also contains transit provision alternatives. The Council-preferred alternatives for both broad and discrete zones would allow vessels to transit gear-restricted areas provided that their net is on the reel (for trawl vessels), or their gear is otherwise on deck (for other gear types). The Council also considered allowing transit under a specific VMS declaration, but did not select this as a preferred alternative.

Additional alternative sets in this amendment include options to modify the Framework provisions of the MSB FMP, as well as the option to require use of VMS for *Illex* squid vessels. The Council-preferred options include adding several framework provisions for coral measures to the FMP, as well as requiring that all federally-permitted *Illex* squid vessels use VMS. All alternatives considered in this action are summarized in Box ES-1 and described in more detail in Section 5.0 (which also contains a description of alternatives considered but rejected).

Box ES-1. Summary of Amendment Alternatives. Bold=Council preferred. *Italics* = sub-alternative.		
Alt. Set	**Alt.**	**Description**
1	1A	No action/*status quo*
	1B	Designate a broad zone with a landward boundary approximating the 200m depth contour, and extending to the edges of the MAFMC region boundary and the EEZ.
	1C	Designate a broad zone with a landward boundary approximating the 300m depth contour, and extending to the edges of the MAFMC region boundary and the EEZ.
	1D	Designate a broad zone with a landward boundary approximating the 400m depth contour, and extending to the edges of the MAFMC region boundary and the EEZ.
	1E	Designate a broad zone with a landward boundary approximating the 500m depth contour, and extending to the edges of the MAFMC region boundary and the EEZ.
	1F	**Designate a broad zone with a landward boundary approximating the 450m depth contour, with the approximating occurring between a hard landward boundary of 400m and a hard seaward boundary of 500m, and extending to the edges of the MAFMC region boundary and the EEZ.**
2	2A	No action/*status quo*
	2B	**Prohibit all bottom-tending gear within broad zones**
	2B-1	***Exempt red crab trap fishery from broad zone restrictions***
	2B-2	*Exempt golden tilefish bottom longline fishery from broad zone restrictions*
	2C	Prohibit all mobile bottom-tending gear within broad zones
	2D	Require VMS for vessels within broad coral zones
	2E	**Allow for transit through broad zones with gear stowage requirement**
	2F	Allow for transit through broad zones via change in VMS declaration
3	3A	No action/*status quo*
	3B	**Designate discrete coral zones**
	3B-1	*2013 Advisor-proposed Boundaries (3 discrete zones only)*
	3B-2	*Fishery Management Action Team Boundaries*
	3B-3	*Garden State Seafood Association Boundaries*
	3B-4	*NGO Coalition Boundaries*
	3B-5	***Workshop Boundaries***
4	4A	No action/*status quo*
	4B	**Prohibit all bottom-tending gear within discrete zones**
	4B-1	***Exempt red crab trap fishery from discrete zone restrictions***
	4B-2	*Exempt golden tilefish bottom longline fishery from discrete zone restrictions*
	4C	Prohibit all mobile bottom-tending gear within discrete zones
	4D	**Allow for transit through discrete zones with gear stowage requirement**
	4E	Allow for transit through discrete zones via change in VMS declaration
5	5A	No action/*status quo*
	5B	**Option to modify coral zone boundaries via framework action**
	5C	**Option to modify management measures through a framework action**
	5D	**Options to add additional discrete zones through a framework action**
	5E	**Option to implement special access program through framework action**
6	6A	No action/*status quo*
	6B	**Require VMS for federally-permitted *Illex* squid vessels**

1.4 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

The range of alternatives proposed in this document is associated with a range of potential impacts to several Valued Ecosystem Components (VECs), including 1) the physical environment and Essential Fish Habitat or EFH, 2) the managed resources, 3) deep sea corals, 4) human communities, and 5) protected resources. These impacts are described in Section 7.0 of this document, and summarized below and in Boxes ES-2 through ES-5.

1.4.1 Broad Zone Designations and Management Measures

The broad zone designation and gear restriction alternatives are precautionary in nature and are primarily intended to "freeze the footprint of fishing" to protect corals from future expansion of fishing effort into deeper waters. Generally, the more total area that is restricted and the more fishing activity that is restricted, the greater the predicted benefits are for deep sea corals, as well as for benthic habitat and EFH. However, as more areas are restricted and more fishing activities are restricted, social and economic impacts to those who fish in these areas is also expected to increase; however, the impacts would be lessened by expected shifts in commercial fishing effort toward areas just outside any implemented coral zones.

Because of the large degree of spatial overlap among all broad zone designation alternatives, the overall impacts for most VECs are expected to be somewhat similar. All of the broad zone designation options (other than the no action alternative) would result in a large precautionary protected area, the vast majority of which would consist of areas that do not currently experience fishing activity (or experience very little fishing activity). Differences in impacts among broad zone designation options can be assessed based on differences in the landward boundary, near the heads of the canyons and the shelf/slope break between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there would be no expected differences in impacts on any of the VECs between any of the broad zone designation alternatives, as all of the alternatives overlap in this area. In addition, little to no fishing activity currently takes place deeper than 500 meters. Therefore, the magnitude of impacts is expected to increase as designation alternatives extend into shallower water, both because more total area would be protected and because more fishing effort occurs in shallower areas of the broad zones, meaning that the proposed action will have more of an impact in these areas.

Impacts to Habitat and Deep Sea Corals

For habitat and deep sea corals, the expected impacts from broad zone designation and management measures are similar for these two VECs. However, the overall benefits to deep sea corals and habitats are expected to be greater than the benefits to EFH because corals are widely distributed in a variety of outer continental shelf and slope habitats, are highly vulnerable to fishing gear, and have very long recovery times, whereas EFH for most managed species is more restricted to shallower water. Two notable exceptions are tilefish and deep-sea red crabs. However, the amount of protection that the proposed action would provide to deep-sea corals and habitats is somewhat reduced by the fact that many corals exist in areas with some degree of natural protection from fishing gear, i.e., areas that are totally or partially inaccessible to fishing gear (especially bottom trawls) due to extreme depths and steep slopes that fishermen tend to avoid due to the potential for lost or damaged fishing gear. The broad zone coral protection alternatives proposed in this amendment would protect deep-sea corals and habitats from current fishing activity on the outer continental shelf and slope as well as prevent the future expansion of fishing effort into deeper water.

In combination with gear restrictions, all of the broad zone action alternatives (1B through 1F) are expected to result in direct positive impacts to habitat and deep sea corals. All of these alternatives would create areas that protect deep sea corals and their habitats and some amount of EFH from the adverse effects of current and future fishing activity. The No Action Alternative 1A would be expected to result in neutral impacts relative to the baseline conditions, under which ongoing gear interactions with habitat and deep sea corals are likely to be occurring, in particular near the shelf/slope break. The magnitude of the positive impacts is expected to vary based on which alternative is selected and differences in overlap with EFH and deep sea coral habitat, as well as the distribution of fishing effort across the total area under consideration for broad zone protection.

In summary, higher direct positive impacts to habitat and deep sea corals are expected from shallower boundary designations, particularly in the canyons, compared to those from deeper boundary designations, due to differences in total habitat and coral area protected and differential fishing effort occurring within each of the proposed areas. The relative impacts to EFH and deep sea corals from the various designation alternatives are expected to be most positive for Alternative 1B, followed by Alternative 1C and 1F (similar to each other, with positive impacts to a lesser extent than 1B), then 1D, then Alternative 1E. Lastly, Alternative 1A (*status quo*/no designation) would have no positive impacts (neutral impacts relative to *status quo*, with expected continued gear interactions under the baseline conditions).

Under gear restriction Alternatives 2B and 2C, direct positive impacts to habitat and deep sea corals would be expected relative to the *status quo* resulting from reduced interactions with bottom-tending gear. The expected magnitude of this impact varies based on which designation and exemption options are selected in conjunction. In general, Alternative 2B (prohibition on all bottom-tending gear) is expected to result in greater positive impacts relative to Alternative 2C (prohibition on mobile bottom-tending gear), and both action alternatives would have a greater positive impact compared to Alternative 2A (*status quo*/no gear restrictions). The differences in the magnitude of positive impacts between Alternative 2B and 2C may not be substantial given that it is currently believed that sediment and biological disturbance by mobile bottom-tending gear is typically greater than that of stationary bottom-tending gear.

For the exemption alternatives, any existing negative impacts to habitat or deep sea corals resulting specifically from the red crab fishery or tilefish fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for these fisheries, including the no action/*status quo* alternative for gear restrictions (Alternative 2A), the combination of Alternative 2B with the exemption alternative specific to each fishery (2B-1 for the red crab fishery and 2B-2 for the tilefish fishery), and Alternative 2C (prohibitions on only mobile bottom-tending gear). However, overall, long-term impacts to habitat and deep sea corals would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected under the combination of Alternative 2B and 2B-2 (exemption for tilefish), to a lesser extent under the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and to a slightly lesser extent from Alternative 2C, due to closing these areas to other gear types and freezing the current footprint of fishing.

If no gear restriction measures were implemented, but a designation alternative was, the designation alone of any broad zone would have no direct impacts, but could result in slight indirect positive impacts from increased awareness of deep sea coral ecosystems, increased research focus or funding, and/or additional monitoring.

Alternative 2D would require VMS for all federally permitted vessels fishing within broad coral zones (regardless of gear type or permit). If implemented in combination with gear restriction alternatives, requiring VMS within broad coral zones would be expected to improve enforcement of such measures and to aid in future analysis of any gear restricted areas and their potential impacts on habitat or deep sea corals. However, many vessels and fisheries operating in these areas are already required to use VMS as a condition for holding certain permits, so the actual impacts of this alternative would be limited in magnitude. Thus, Alternative 2D would be expected to have neutral to indirect slight positive impacts to habitat and deep sea corals relative to the *status quo*, depending on the degree to which monitoring is actually improved.

Alternatives 2E and 2F would allow for vessel transit either under the condition that gear be stowed (Alt. 2E) or that a VMS declaration for "transit" be submitted (Alt. 2F). Regardless of the broad zone designation alternative implemented, both of these transit alternatives would be expected to have neutral to slight indirect negative impacts to habitat and deep sea corals relative to the *status quo* and baseline environment conditions, since these provisions are not expected to change the rate of interactions with habitat but may make gear restrictions more difficult to enforce. Alternative 2E may have slightly more negative indirect impacts compared to Alternative 2F, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

Impacts to the Managed Resources

For the managed resources, direct impacts are unlikely. The measures proposed in this action are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). However, indirect positive impacts may be realized through increased habitat quality and possible refugia from fishing effort, particularly for species with strong habitat associations in the canyon environments (Boxes ES-2 and ES-3). Because the managed resources are generally highly mobile, widely distributed, and vary in their reproductive strategies, it is difficult to evaluate the extent to which gear-restricted areas may indirectly benefit the stocks as a whole. The expected magnitude of any positive impacts to managed resources from gear restrictions within a broad zone would be small for most species. Indirect positive impacts would be expected to be relatively greater for some species, particularly for red crab and golden tilefish which have specific habitat and distributional considerations in the areas considered.

Overall, any broad zone designation in combination with gear restrictions are likely to have neutral to indirect slight positive impacts to the managed resources. The magnitude of potential indirect positive impacts may vary slightly between designation and gear restriction alternatives. Alternatives 1B, 1C, and 1F are likely to have similar neutral to slight indirect positive impacts to the managed resource relative to the *status quo* Alternative 1A (if implemented in combination with gear restriction alternatives). Under Alternatives 1D and 1E, neutral to slight indirect positive impacts are expected, to a lesser magnitude than Alternatives 1B, 1C, and 1F.

For gear restriction alternatives, in general, Alternative 2B (prohibition on all bottom-tending gear) is expected to result in slightly greater indirect positive impacts to the managed resources relative to Alternative 2C (prohibition on mobile bottom-tending gear), due to additional reduction of fishing activity within the broad coral zones. Both action alternatives would have a greater positive impacts compared to Alternative 2A (*status quo*/no gear restrictions). Under the no action/*status quo* Alternative 2A, one would expect ongoing sustainable management of the managed resources under baseline conditions. Sub-alternatives under Alternative 2B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 2B-1) and the golden tilefish bottom longline fishery (Alt. 2B-2). In general, the combination of alternatives that provide a larger area of refuge and habitat protection in areas that overlap with fishing have a higher possibility of providing indirect positive impacts to the managed resources. Sub-alternative 2B-1 (exemption for red crab) restricts less effort within the proposed areas compared to sub-alternative 2B-2 (exemption for tilefish). Thus, in relative terms, among these alternatives, the indirect positive impacts would be highest under Alternative 2B alone, followed by the combination of 2B and 2B-2, then by the combination of 2B and 2B-1, then by the combination of 2B, 2B-1, and 2B-2, then by Alternative 2C, then Alternative 2A. The effects of the exemption for red crab would not be expected to vary with the designation alternative, since all red crab fishing effort takes place within the area of broad zone that overlaps among all designation alternatives. For tilefish, the exemption would have somewhat variable impacts under designation alternatives, as effort does not currently occur within the 400m or 500m broad zones and therefore tilefish effort would not be displaced under those designation alternatives.

For the VMS requirement within broad zones (Alternative 2D), no direct impacts would be expected on the managed resource. In combination with any broad zone designation, neutral to indirect slight positive impacts would be expected relative to the *status quo*, given an expected increased ability to monitor and enforce current and future management measures. Both Alternatives 2E (transit with gear stowage) and 2F (transit with VMS transit declaration), in combination with any broad zone designation alternative, would be expected to have neutral impacts to the managed resources, relative to the *status quo.* These measures will not impact stock status or affect implementation of other management measures.

Impacts to Human Communities

If implemented in combination with gear restriction alternatives (Alts. 2B or 2C), all of the action alternatives for broad zone designations would be expected to result in overall neutral to moderate negative economic impacts for fishing businesses, depending on the fishery and the ability to redistribute effort. Higher impacts are expected for the red crab fishery under Alternative 2B absent an exemption under Alternative 2B-1. Negative impacts may be direct, through the increased costs associated with avoiding closed areas, or indirect, in terms of opportunity costs and/or reductions in efficiency resulting from fishing in different areas that may not be preferred fishing grounds for a given target species. The magnitude of impacts is complicated to assess, given that the vast majority of the proposed broad coral zones are not currently experiencing fishing activity. In addition, the preferred alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity.

In general, the fisheries most likely to be impacted by the alternatives include trawl vessels targeting squid and whiting, and the red crab trap fishery. The areas where trawl vessels are most likely to be impacted include the shallower portions of the broad zones (near the shelf/slope break), where some fishing effort currently occurs. The mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons. Industry representatives have indicated that some of the boundary alternatives proposed for broad zones would cut off important areas for fishing and/or setting and deploying gear for trawl fisheries. These conversations led to an April 2015 Council workshop where the Council’s Ecosystems and Ocean Planning Advisory Panel and the Mackerel, Squid, Butterfish Advisory Panel, along with other industry participants and coral experts, negotiated and redrew boundary proposals for discrete coral zones. These boundaries were adopted in the Council's final action for both the discrete and the broad coral zones (i.e., both Alternatives 1F and 3B-5 follow these boundaries on the landward side). These boundaries were developed by consensus among these groups and were designed to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. This is expected to lessen the economic impacts of this Council-preferred broad zone.

The Council's preferred alternatives include an exemption for the red crab trap fishery (sub-Alternative 2B-1). Under Alternative 2B (prohibition on all bottom-tending gear) and absent an exemption under Alternative 2B-1, the economic impacts specific to the red crab fishery would be expected to be high negative, as a substantial portion of their fishing effort takes places within the broad zones (regardless of designation option). Thus, impacts specifically to the red crab fishery would range from neutral to high negative under various gear restriction and exemption alternative combinations.

For fisheries other than red crab, restrictions within the deeper portions of the various proposed broad zone options (below about 500m) are expected to have very little economic impacts as little or no effort currently occurs here and any restricted effort is expected to be easily displaced. Gear restrictions in these deeper areas are being proposed to cover these deeper areas as a precautionary measure against the future expansion of effort. The likelihood and extent of potential future fishing effort (if unrestricted) in these areas is difficult to predict, but would be expected to be relatively minor if it occurred at all, as high costs associated with developing new deep sea fisheries and operating far from shore would be expected to deter this type of expansion. Thus, the economic impacts to fishing communities associated with gear restrictions in the broad zones are much more limited than would appear by considering the size of the restricted area alone.

In combination across designations and gear alternatives, the overall magnitude of the direct and indirect impacts to fishing operations resulting from the implementation of broad coral zones with bottom fishing restrictions likely ranges from neutral to moderate negative, depending on the range of current operations and ease of redistributing effort for a given fishery. Because more current fishing activity takes place within the 200m and 300m broad zones (Alternatives 1B and 1C, respectively), these designations would be expected to result in slight to moderate direct and indirect negative impacts. Alternatives 1D and 1F, according to the analysis described in the sections above, can be expected to result in similar negative economic impacts, ranging from slight to moderate negative, though to a lesser extent than those resulting from Alternatives 1B and 1C. Because very little fishing activity occurs deeper than 500m, the impacts expected from Alternative E are expected to be neutral to slight negative.

The prohibition on all bottom-tending gear (Alt. 2B) would be expected to have greater negative economic impacts than a prohibition on mobile bottom-tending gear (Alt. 2C). Any fishing exemption alternatives implemented in combination with a restriction on all bottom-tending gear would likely result in neutral impacts to that specific fishery relative to the *status quo*; however, these exemptions would reduce the negative economic impacts associated with gear restricted areas for these fisheries and overall result in moderate positive economic impacts in combination with alternative 2B.

In addition to the gear specific restrictive measures within the proposed broad coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone. Under Alternative 2D (Council non-Preferred), vessels would be required to use an approved VMS unit as a condition for operating within the broad coral zone. In combination with gear restriction alternatives, this measure could enhance the enforceability of coral restrictive gear zones providing positive impacts to deep sea corals. Potential economic impacts of this measure are mixed with an uncertain net impact. However, most vessels operating in these areas are already required to use VMS as such overall low economic impacts are expected. However, for vessels that may not have a VMS system, the costs to initially equip the vessel are approximately $1,700-$3,300, plus operating costs for the unit of approximately $40-$100 per month.

Under Alternative 2E (Council Preferred), vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). In combination with gear restriction alternatives, this measures would be expected to generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas. Under Alternative 2F (Council non-Preferred), vessels would be allowed to transit through gear-restricted broad coral areas if they submit a VMS declaration specific to transit prior to crossing into designated deep sea coral zones. In combination with gear restriction alternatives (2B or 2C), this alternative could generate slight positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas. In addition, this alternative would enhance the enforceability of coral restrictive gear zones. However, the use of VMS has an associated cost that make the overall economic impacts of this alternative more uncertain, and likely to range from slight negative to slight positive.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect positive impacts from the designation of gear-restricted broad coral zones associated with the protection of deep sea corals. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

Impacts to Protected Resources

Impacts to protected resources for broad zone gear restricted areas are uncertain, and depend on a number of factors including current species distribution, patterns of effort shifts resulting from gear restricted areas, and whether the concentration of gear deployed changes in areas that experience high interaction rates. The changes proposed in this amendment are not expected to result in an increase in fishing effort overall, just shifts in the location of that effort.

It is expected that for the majority of the fisheries affected by this action, effort that would typically occur within the broad or discrete zones will shift to just outside the zone boundaries (i.e., just shallower than the zone boundaries). Large-scale shifts in effort, i.e., from the proposed broad or discrete zones to nearshore waters, are not expected. In general, the fisheries most likely to be impacted by the gear restriction alternatives, and therefore the fisheries that are most likely to experience shifts in fishing effort, include trawl vessels targeting squid and whiting. Because the red crab trap fishery would be exempt from gear restrictions under the Council's preferred alternative, red crab effort is not expected to shift and therefore interactions with this gear type would not be expected to change. The areas where trawl vessels are most likely to be impacted include the shallower portions of the broad zones (near the shelf/slope break), where some fishing effort currently occurs.

Fishery operations using gilllnet, scallop dredge, and bottom longline gear types are very limited in the proposed areas, as these gear types are generally used closer to shore and take few trips within the proposed areas. Thus, any effort shifts resulting from the proposed coral zones is likely to be insignificant for those vessels prosecuting their fishery with these gear types. As a result, increased concentration of gear associated with these vessels around the coral zones is unlikely.

Regardless of the area restricted for coral protections, the total number of vessels and amount of gear in the water are not expected to be substantially different from current conditions. Without more fine-scale fishing effort and protected resources interaction data, it is not possible to forecast precisely what entanglement or interaction risks would exist if the closures are implemented; however, we can assess the range of possible impacts to protected species that could result from shifts in effort and the risks associated with these possible impacts. Impacts for protected resources may range from negative to positive for broad zone designation and gear restriction alternatives (Box ES-2).

Box ES-2. Summary comparison of the range of impacts to the affected environment from broad coral zone designation and management measure Alternatives. Bold=Council preferred. *Italics = sub-alternative.*

Alternative	Physical Environment/ Habitat	Managed Resources	Deep Sea Corals	Human Communities	Protected Resources
Alt. 1A: No action/*Status Quo*	Neutral	Neutral	Neutral	Neutral	Neutral
Alt. 1B: Landward Boundary ~ 200 m Depth Contour	Neutral (alone); Moderate direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Neutral (alone); negative to positive (w/ gear restrictions)
Alternative 1C: Landward Boundary ~300 m Depth Contour	Neutral (alone); Moderate direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Neutral (alone); negative to positive (w/ gear restrictions)
Alternative 1D: Landward Boundary ~400 m Depth Contour	Neutral (alone); Slight direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Slight to moderate direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Neutral (alone); negative to positive (w/ gear restrictions)
Alternative 1E: Landward Boundary ~500 m Depth Contour	Neutral (alone); Slight direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Slight to moderate direct positive (w/ gear restrictions)	Neutral (alone); Neutral to slight direct & indirect negative (w/ gear restrictions)	Neutral (alone); negative to positive (w/ gear restrictions)
Alternative 1F: Landward Boundary approx. 450 m with discrete zones (Council preferred)	Neutral (alone); Moderate direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Neutral (alone); negative to positive (w/ gear restrictions)

Box ES-2. Summary comparison of the range of impacts to the affected environment from broad coral zone designation and management measure Alternatives. Bold=Council preferred. *Italics* = *sub-alternative.*					
Alternative	**Physical Environment/ Habitat**	**Managed Resources**	**Deep Sea Corals**	**Human Communities**	**Protected Resources**
Alternative 2A (No action/*Status Quo*)	Neutral	Neutral	Neutral	Neutral	Neutral
Alternative 2B: Prohibit All Bottom-tending Gear (Council preferred)	Slight to moderate direct positive (greater positive vs. 2C)	Neutral to slight indirect positive	Slight to high direct positive (depending on boundary)	Neutral to moderate negative (higher negative vs. 2C), depending on boundary	Uncertain; Negative to Positive
Sub-Alternative 2B-1: Exempt red crab fishery (Council preferred)	Overall positive in combination with 2B; but less positive than 2B alone	Neutral to slight indirect positive in combination with 2B; less positive than 2B alone.	Overall positive in combination with 2B; but less positive than 2B alone	Overall moderate positive in combination with 2B	Uncertain; Negative to Positive
Sub-Alternative 2B-2: Exempt golden tilefish fishery	Overall positive in combination with 2B; but less positive than 2B alone	Neutral to slight indirect positive in combination with 2B; less positive than 2B alone.	Overall positive in combination with 2B; but less positive than 2B alone	Overall moderate positive in combination with 2B	Uncertain; Negative to Positive
Alternative 2C: Prohibit Mobile Bottom-tending Gear	Slight to moderate direct positive (less positive vs. 2B)	Neutral to slight indirect positive	Slight to high direct positive (depending on boundary)	Neutral to moderate negative (lower negative vs. 2B), depending on boundary	Uncertain; Negative to Positive
Alternative 2D: Require VMS for Vessels in Broad Coral Zones	Neutral to indirect slight positive	Neutral to indirect slight positive	Indirect slight positive	Neutral to slight direct negative	Neutral to indirect slight positive
Alternative 2E: Allow transit with gear stowage requirement (Council preferred)	Neutral to indirect slight negative	Neutral	Indirect slight negative	Slight positive in combination with gear restrictions	Neutral
Alternative 2F: Allow transit via change in VMS declaration	Neutral to indirect slight negative	Neutral	Indirect slight negative	Slight negative to slight positive depending on costs	Neutral

1.4.2 Discrete Zone Designations and Management Measures

Alternatives for discrete zone designation (Alternative set 3) consist of a no action alternative (3A) and a discrete zone designation Alternative 3B with a series of sub-options for various boundaries. All of the discrete zone designation options (other than the no action alternative), if implemented in combination with gear restrictions, would protect large combined offshore areas. Similar to the broad zones, there are large portions of the discrete zone boundary options in each canyon that overlap, as well as portions of the canyons consisting of areas that do not currently experience fishing activity (or experience very little fishing activity). Thus, like the broad zones, the overall impacts across VECs from each of the discrete zone boundary options is expected to be somewhat similar, with the main differences in expected impacts resulting primarily from the varying boundaries at the landward edge of each discrete zone, near the heads of the canyons between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there is much less variation in the impacts of the discrete zone designation alternatives, as little to no fishing activity currently takes place deeper than 500 meters.

Impacts to Habitat and Deep Sea Corals

As described in Section 1.4.1 for the broad zones, the impacts to habitat and deep sea corals are expected to be similar across these two VECs, but positive impacts are likely to be higher for deep sea corals for the same reasons described above. In combination with gear restrictions, all of the discrete zone designation sub-alternatives under 3B (3B-1 through 3B-5) are expected to result in direct positive impacts to deep sea corals and habitats. All of these alternatives would also protect some amount of designated EFH for federally-managed fish species and protect deep sea coral habitat from current gear impacts prevent the expansion of current fishing effort into deeper waters. Alternative 3A, no designation of discrete zones, would be expected to result in neutral impacts relative to the baseline conditions, under which ongoing gear interactions with habitat and deep sea corals may be occurring, in particular near the shelf/slope break.

The magnitude of the positive impacts is expected to vary based on the designation sub-alternative selected, based on differences in overlap with EFH and coral habitat, as well as variation in the distribution of fishing effort across the total area under consideration for discrete zone protections. The expected magnitude of positive impacts from Alternatives 3B-2 (FMAT boundaries), 3B-4 (NGO coalition boundaries) and 3B-5 (Workshop boundaries) are largely very similar. In comparison, the boundaries under Alternative 3B-1 (Advisor 2013) for the Mey-Lindenkohl Slope, Baltimore Canyon, and Norfolk Canyon include comparable habitat protected for these specific canyons compared to Alternatives 3B-2, 3B-4, and 3B-5, but this alternative only includes designations for these three canyon areas, meaning that an overall much lower amount of protection for EFH and corals would be expected under this sub-alternative. For Alternative 3B-3, because on the whole these boundaries are much smaller for each proposed discrete zone, a fair amount of EFH and coral habitat encompassed by Alternatives 3B-2, 3B-4, and 3B-5 would be excluded by these boundaries.

In general, alternatives restricting the use of more gear types within the discrete zones, with fewer exemptions, are expected to result in greater positive impacts to habitat. Alternatives that improve the compliance with and enforcement of gear restriction measures are expected to result in indirect positive impacts. However, given that portions of the proposed discrete zones are currently unfished, and that natural protections are afforded to many unique habitat areas located at unfishable depths and slopes, the conservation value of the proposed measures is probably limited.

Under gear restriction Alternatives 4B and 4C, reduced interactions with bottom-tending gear would have direct positive impacts to deep-sea habitats, EFH, and deep sea corals. The expected magnitude of this impact varies based on which designation and exemption options are selected in conjunction. In general, Alternative 4B (prohibition on all bottom-tending gear) is expected to result in greater positive impacts to habitat relative to Alternative 4C (prohibition on mobile bottom-tending gear), and both action alternatives would have a greater positive impact on habitat compared to Alternative 4A (*status quo*/no gear restrictions). The differences in the magnitude of positive impacts between Alternative 4B and 4C may not be substantial given that the effects of mobile bottom-tending gear are typically greater than the effects of stationary bottom-tending gear.

Sub-alternatives under Alternative 4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-2). These exemptions would not be necessary under Alternative 4C (prohibition on mobile bottom tending gear). Any existing negative impacts to habitat and deep sea corals resulting specifically from the red crab fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). Similarly, any existing negative impacts to habitat and deep sea corals resulting specifically from the tilefish fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). However, overall, long-term impacts to habitat and corals would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected for either of these exemption alternatives if implemented in combination with Alternative 4B, since a prohibition on the use of all bottom-tending gears except red crab pots and/or tilefish longlines would still be effective in protecting deep-sea corals and habitats from the more damaging effects of current or future bottom trawling and dredging.

Overall, the impacts of these gear restriction and exemption alternatives are expected to range from slight to moderate positive impacts on habitat and EFH, and slight to high positive impacts on deep sea corals. In relative terms, the magnitude of these positive impacts is expected to be greatest from Alternative 4B alone (without an exemption sub-option), which would prohibit the most gear types with no exemptions. The next highest positive impacts would be expected from the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for golden tilefish). Alternative 4B with exemption for tilefish only is expected to have greater positive impacts than Alternative 4B in combination with an exemption for red crab, given that the spatial footprint of the tilefish fishery within the proposed areas is much smaller. The combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for red crab) would have the next highest positive impacts, followed by the combination of 4B, 4B-1, and 4B-2. Alternative 4C would have impacts similar in magnitude to the combination of Alternatives 4B, 4B-1, and 4B-2; however, Alternative 4C would theoretically restrict fewer fisheries and thus would have slightly lower positive impacts. Finally, no positive habitat impacts would be expected under the no action/*status quo* alternative for gear restrictions (Alt. 4A; neutral impacts relative to the baseline conditions with continued gear-habitat interactions expected under the baseline conditions).

Alternatives 4D and 4E would allow for vessel transit either under the condition that gear be stowed (Alt. 4D) or that a VMS declaration for “transit” be submitted (Alt. 4E). Regardless of the discrete zone designation sub-alternative implemented, both of these transit alternatives would be expected to have neutral to slight indirect negative impacts to habitat relative to the *status quo* and baseline environment conditions, since any provisions that allow for transit may make gear restrictions more difficult to enforce. Alternative 4D may have slightly more negative indirect impacts compared to Alternative 4E, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

Impacts to the Managed Resources

Impacts to the managed resources are similar to those described in Section 1.4.1 for broad coral zones. Direct impacts are unlikely, as the measures are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). However, indirect positive impacts may be realized through increased habitat quality and possible refugia from fishing effort, particularly for species with strong habitat associations in the canyon environments. The expected magnitude of any positive impacts to managed resources from gear restrictions within discrete zones would be small for most species. Indirect positive impacts would be expected to be relatively greater for some species, particularly for red crab and golden tilefish which have specific habitat and distributional considerations in the areas considered.

Overall, any discrete zone designation in combination with gear restrictions are likely to have neutral to indirect slight positive impacts to the managed resources. The magnitude of potential indirect positive impacts may vary slightly between designation and gear restriction alternatives. In relative terms, designation Alternatives 3B-2, 3B-4, and 3B-5 are likely to have the same magnitude of slight indirect positive impacts to the managed resource relative to the *status quo* Alternative 3A (if implemented in combination with gear restriction alternatives). The total area designated among these three alternatives is very similar, and although the boundaries vary slightly, this variation is unlikely to make an appreciable difference in the magnitude of impacts to the managed resources. Under Alternative 3B-3, neutral to slight indirect positive impacts are expected, to a lesser degree than Alternatives 3B-2, 3B-4, and 3B-5 given the much smaller area and less overlap with current fishing activity. Alternative 3B-1 would be expected to result in the least possible slight indirect positive impacts, given that only three canyons are proposed for designation under this alternative. No positive impacts (neutral impacts) are expected under the *status quo* designation Alternative 3A.

For gear restriction alternatives, in general, Alternative 4B (prohibition on all bottom-tending gear) is expected to result in slightly greater indirect positive impacts to the managed resources relative to Alternative 4C (prohibition on mobile bottom-tending gear), due to additional reduction of fishing activity within the discrete coral zones. Both action alternatives would have a greater positive impacts compared to Alternative 4A (*status quo*/no gear restrictions). Under the no action/*status quo* Alternative 4A, one would expect ongoing sustainable management of the managed resources under baseline conditions. Sub-alternatives under Alternative 4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-2). In general, the combination of alternatives that provide a larger area of refuge and habitat protection in areas that overlap with fishing have a higher possibility of providing indirect positive impacts to the managed resources. Sub-alternative 4B-1 (exemption for red crab) restricts less effort within the proposed areas compared to sub-alternative 4B-2 (exemption for tilefish). Thus, in relative terms, among these alternatives, the indirect positive impacts would be highest under Alternative 4B alone, followed by the combination of 4B and 4B-2, then by the combination of 4B and 4B-1, then by the combination of 4B-1, and 4B-2, then by Alternative 4C, then Alternative 4A.

Both transit Alternatives 4D (transit with gear stowage) and 4E (transit with VMS transit declaration), in combination with any discrete zone designation alternative, would be expected to have neutral impacts to the managed resources, relative to the *status quo*. These measures will not impact stock status or affect implementation of other management measures.

Impacts to Human Communities

If implemented in combination with gear restriction alternatives (Alts. 4B or 4C), all of the action alternatives for discrete zone designations would be expected to result in overall slight to moderate negative economic impacts for fishing businesses, depending on the fishery and the ability to redistribute effort. Higher impacts are expected for the red crab fishery under Alternative 4B absent an exemption under Alternative 4B-1. Negative impacts may be direct, through the increased costs associated with avoiding closed areas, or indirect, in terms of opportunity costs and/or reductions in efficiency resulting from fishing in different areas that may not be preferred fishing grounds for a given target species. The magnitude of impacts is complicated to assess, given the overlap in discrete coral zones and the fact that substantial portions are not currently experiencing fishing activity due to extreme depths or slopes. In addition, the preferred alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity.

In general, the fisheries most likely to be impacted by the alternatives include trawl vessels targeting squid and whiting, and the red crab trap fishery. The areas where trawl vessels are most likely to be impacted include the shallower portions of the discrete zones (near the shelf/slope break), where some fishing effort currently occurs. The mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons. As described above, the April 2015 Council workshop resulted in consensus discrete zone boundaries which were adopted in the Council's final action for both the discrete and the broad coral zones (i.e., both Alternatives 1F and 3B-5 follow these boundaries on the landward side). These boundaries were designed to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. This is expected to lessen the economic impacts of the Council-preferred discrete zones.

The Council's preferred alternatives include an exemption for the red crab trap fishery (sub-Alternative 4B-1). Under Alternative 4B (prohibition on all bottom-tending gear) and absent an exemption under Alternative 4B-1, the economic impacts specific to the red crab fishery would be expected to be high negative, as a substantial portion of their fishing effort takes places within the discrete zones (regardless of designation option). Thus, impacts specifically to the red crab fishery would range from neutral to high negative under various gear restriction and exemption alternative combinations.

For fisheries other than red crab, restrictions within the deeper portions of the various proposed discrete zone options (below about 500m) are expected to have very little economic impacts as little or no effort currently occurs here and any restricted effort is expected to be easily displaced. In combination across designations and gear alternatives, the overall magnitude of the direct and indirect impacts to fishing operations resulting from the implementation of discrete coral zones with bottom fishing restrictions likely ranges from slight to moderate negative, depending on the footprint of current operations and ease of redistributing effort for a given fishery. Alternative 3B-1 would be expected to have the lowest negative economic impacts, as this alternative only includes three canyons for designation. Alternative 3B-3 (GSSA boundaries) would have slightly more negative economic impacts, followed by the Council-preferred Alternative 3B-5. The FMAT and NGO Coalition boundaries (Alternatives 3B-2 and

3B-4 respectively), would have comparable impacts that would be higher than the other boundary proposal alternatives.

The prohibition on all bottom-tending gear (Alt. 4B) would be expected to have greater negative economic impacts than a prohibition on mobile bottom-tending gear. In particular, the red crab fishery would experience high negative impacts from Alternative 4B without a simultaneous adoption of sub-alternative 4B-1 (exemption for the red crab fishery), as a substantial portion of the effort for this fishery occurs within the discrete zones. The number of other fisheries and spatial extent of other bottom-tending passive gear types in these areas is limited. Any fishing exemption alternatives implemented to a restriction on all bottom-tending gear would likely result in neutral impacts to that specific fishery relative to the *status quo*; however, these exemptions would reduce the negative economic impacts associated with gear restricted areas for these fisheries and overall result in moderate positive economic impacts in combination with alternative 4B.

Under Alternative 4D (Council Preferred), vessels would be allowed to transit through gear-restricted discrete coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). In combination with gear restriction alternatives, this measures would be expected to generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restricted areas. Under Alternative 4E (Council non-Preferred), vessels would be allowed to transit through gear-restricted discrete coral areas if they submit a VMS declaration specific to transit prior to crossing into designated deep sea coral zones. In combination with gear restriction alternatives (4B or 4C), this alternative could generate slight positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restricted areas. In addition, this alternative would enhance the enforceability of coral restrictive gear zones. However, the use of VMS has an associated cost that make the overall economic impacts of this alternative more uncertain, and likely to range from slight negative to slight positive.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect positive impacts from the designation of gear-restricted discrete coral zones associated with the protection of deep sea corals. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

Impacts to Protected Resources

Impacts to protected resources for discrete zone gear restricted areas are similar to those described in Section 1.4.1 for broad zones. Impacts are uncertain, and depend on a number of factors including current species distribution, patterns of effort shifts resulting from gear restricted areas, and whether the concentration of gear deployed changes in areas that experience high interaction rates. The changes proposed in this amendment are not expected to result in an increase in fishing effort overall, just shifts in the location of that effort. It is expected that for the majority of the fisheries affected by this action, effort that would typically occur within the discrete or discrete zones will shift to just outside the zone boundaries (i.e., just shallower than the zone boundaries). Effort shifts are expected to be relatively concentrated near the shelf/slope break, shifting from areas just deeper than the proposed discrete zone boundaries to areas just shallower than the proposed discrete zone boundaries. Regardless of the area restricted for coral protections, the number of vessels and amount of gear in the water are not expected to be substantially different from current conditions. Without more fine-scale fishing effort and protected resources interaction data, it is not possible to forecast precisely what entanglement or interaction risks would exist if the closures are implemented; however, we can assess the range of possible impacts to protected species that could result from shifts in effort and the risks associated with these possible impacts. Impacts for protected resources may range from negative to positive for discrete zone designation and gear restriction alternatives.

Box ES-3. Summary comparison of the range of impacts to the affected environment from discrete coral zone designation and management measure Alternatives. Bold=Council preferred. *Italics = sub-alternative.*

Alternative	**Physical Environment/ Habitat**	**Managed Resources**	**Deep Sea Corals**	**Human Communities**	**Protected Resources**
3A (No discrete zone designation)	Neutral	Neutral	Neutral	Neutral	Neutral
3B-1 (Advisor 2013 boundaries)	Neutral (alone); Slight direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Slight to moderate direct positive (w/ gear restrictions)	Neutral (alone); Slight direct & indirect negative (w/ gear restrictions)	Uncertain; Negative to Positive (w/ gear restrictions)
3B-2 (FMAT boundaries)	Neutral (alone); Moderate positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Uncertain; Negative to Positive (w/ gear restrictions)
3B-3 (GSSA boundaries)	Neutral (alone); Slight direct positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Slight to moderate direct positive (w/ gear restrictions)	Neutral (alone); Slight direct & indirect negative (w/ gear restrictions)	Uncertain; Negative to Positive (w/ gear restrictions)
3B-4 (NGO coalition boundaries)	Neutral (alone); Moderate positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Uncertain; Negative to Positive (w/ gear restrictions)

Box ES-3. Summary comparison of the range of impacts to the affected environment from discrete coral zone designation and management measure Alternatives. Bold=Council preferred. *Italics = sub-alternative.*					
Alternative	**Physical Environment/ Habitat**	**Managed Resources**	**Deep Sea Corals**	**Human Communities**	**Protected Resources**
3B-5 (Council preferred boundaries)	Neutral (alone); Moderate positive (w/ gear restrictions)	Neutral (alone); neutral to slight indirect positive (w/ gear restrictions)	Indirect slight positive (alone); Moderate to high direct positive (w/ gear restrictions)	Neutral (alone); Slight to moderate direct & indirect negative (w/ gear restrictions)	Uncertain; Negative to Positive (w/ gear restrictions)
Alternative 4A (No action/*Status Quo*)	Neutral	Neutral	Neutral	Neutral	Neutral
Alternative 4B: Prohibit All Bottom-tending Gear (Council preferred)	Slight to moderate direct positive depending on designation	Neutral to slight indirect positive	Slight to high direct positive (depending on boundary)	Slight to moderate direct and indirect negative (depending on fishery and discrete zone designated)	Uncertain; Negative to Positive (w/ gear restrictions)
Sub-Alternative 4B-1: Exempt red crab fishery (Council preferred)	Overall positive in combination with 4B; but less positive than 4B alone	Neutral to slight indirect positive in combination with 4B; less positive than 4B alone.	Overall positive in combination with 4B; but less positive than 4B alone	Overall moderate positive in combination with 4B	Uncertain; Negative to Positive (w/ gear restrictions)
Sub-Alternative 4B-2: Exempt golden tilefish fishery	Overall positive in combination with 4B; but less positive than 4B alone	Neutral to slight indirect positive in combination with 4B; less positive than 4B alone.	Overall positive in combination with 4B; but less positive than 4B alone	Overall moderate positive in combination with 4B	Uncertain; Negative to Positive (w/ gear restrictions)
Alternative 4C: Prohibit Mobile Bottom-tending Gear	Slight to moderate direct positive depending on designation	Neutral to slight indirect positive	Slight to high direct positive (depending on boundary)	Slight to moderate direct and indirect negative (depending on fishery and discrete zone designated)	Uncertain; Negative to Positive (w/ gear restrictions)
Alternative 4D: Allow transit with gear stowage requirement (Council preferred)	Neutral to indirect slight negative	Neutral	Indirect slight negative	Slight positive in combination with gear restrictions	Neutral
Alternative 4E: Allow transit via change in VMS declaration	Neutral to indirect slight negative	Neutral	Indirect slight negative	Slight negative to slight positive depending on costs	Neutral

1.4.3 Framework Provision Alternatives

Framework provision alternatives are proposed in Alternative set 5. Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. This action proposes to modify the list of items in the FMP that could be modified through a framework, to allow for future consideration of deep sea coral measures through a framework action.

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. Thus, they are not expected to result in any direct impacts to any of the VECs, though indirect impacts are possible from some of the alternatives on some VECs if they allow for more efficient responses to immediate conservation concerns for deep sea corals or associated habitats. Specifically, framework provision action alternatives 5B through 5D would be expected to result in neutral to indirect slight positive impacts to habitat and deep sea corals, if framework actions allowed a quick and efficient response to an immediate conservation need. Action alternative 5E, an allowance for special access program development through a framework action, is expected to result in neutral impacts to deep sea corals and habitat. The no action Alternative 5A may result in indirect slight negative impacts to deep sea corals if it would cause future pressing conservation issues for corals to be delayed or deprioritized.

For managed resources and protected resources, the framework provision alternatives are not expected to impact these VECs either directly or indirectly.

For human communities, Alternatives 5B, 5C, and 5E could potentially have slight indirect positive impacts if they allowed for a quick and efficient response to an immediate social or economic need. Alternative 5D, the option to add a discrete coral zone, would not be expected to address such a need.

The impacts of any future coral measures considered under any of these framework provisions would be described in a future NEPA analysis.

Box ES-4. Summary comparison of the range of impacts to the affected environment from framework provision alternatives. Bold=Council preferred.					
Alternative	**Physical Environment/ Habitat**	**Managed Resources**	**Deep Sea Corals**	**Human Communities**	**Protected Resources**
Alt. 5A: No action/*status quo*	Neutral	Neutral	Neutral to indirect slight negative	Neutral to slight indirect negative	Neutral
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	Neutral to indirect slight positive	Neutral	Neutral to indirect slight positive	Neutral to slight indirect positive	Neutral
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	Neutral to indirect slight positive	Neutral	Neutral to indirect slight positive	Neutral to slight indirect positive	Neutral
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	Neutral to indirect slight positive	Neutral	Neutral to indirect slight positive	Neutral	Neutral
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	Neutral	Neutral	Neutral	Neutral to slight indirect positive	Neutral

1.4.4 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. *Illex* vessels are not currently required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). Alternative 6B could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. This alternative set focuses exclusively on the *Illex* fishery because most other fisheries that operate in these deep water, offshore environments considered in this action are already required to use VMS. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

Relative to the baseline environmental conditions, Alternative 6A would be expected to result in neutral impacts to most VECs; however, for deep sea corals, Alternative 6A could result in indirect slight negative impacts in combination with gear restricted area alternatives, as these gear restricted areas may be more difficult to enforce without adequate VMS coverage. Given the current VMS coverage among *Illex* permit holders, any slight negative impacts are expected to be very minor.

Alternative 6B would require use of VMS for all *Illex* squid moratorium vessels (regardless of whether fishing activity is occurring within or outside of any designated deep sea coral zones). Impacts to habitat, the managed resources, deep sea corals, and protected resources are expected to range from neutral to indirect slight positive, as any increased VMS coverage may improve future analysis of fishing effort, gear restricted area effectiveness, and other spatial management measures, potentially resulting in benefits to these VECs. Potential impacts to the human environment are likely to be neutral to slight negative, since most *Illex* moratorium vessels are already required to use VMS due to their participation in other fisheries. If there are *Illex* vessels that do not have a VMS system, the costs to equip the vessel are approximately $1,700-$3,300 plus operating costs for the unit of approximately $40-$100 per month.

Box ES-5. Summary comparison of the range of impacts to the affected environment from *Illex* VMS requirement alternatives. Bold=Council preferred.

Alternative	Physical Environment/ Habitat	Managed Resources	Deep Sea Corals	Human Communities	Protected Resources
Alt. 6A: No action/*status quo*	Neutral	Neutral	Neutral to indirect slight negative	Neutral	Neutral
Alt. 6B: Require VMS for federally permitted *Illex* vessels	Neutral to indirect slight positive	Neutral to indirect slight positive	Neutral to indirect slight positive	Neutral to slight negative	Neutral to indirect slight positive

1.4.5 Combined Impacts of Council Preferred Alternatives

The Council has identified a set of preferred alternatives for this action that includes:

- **Alternative 1F**: Designation of a broad coral zone with a landward boundary approximating the 450-meter depth contour, and also incorporating a set of discrete coral zone boundaries developed at a 2015 collaborative workshop (discrete zone boundaries of Council-preferred Alternative 3B-5). The remaining boundaries fall along the MAFMC-NEFMC boundary to the north, the U.S. EEZ to the east, and the SAFMC-MAFMC boundary to the south.
- **Alternative 2B**: Restriction on use of all bottom-tending fishing gear within the designated broad zone, with the exception of lobster gear (which is not covered by this action) and the red crab trap gear as per the exemption alternative below.
- **Alternative 2B-1**: An exemption to broad zone gear restrictions for the red crab trap fishery.
- **Alternative 2E**: Allowance for vessels using bottom-tending gear to transit through the designated gear-restricted broad coral zone, provided that the vessel's gear is on deck (the net is on the reel for trawl vessels, or gear is otherwise on deck for other gear types).
- **Alternative 3B-5**: Designation of a set of fifteen discrete coral zones in distinct canyon or canyon-slope areas with known deep sea coral presence. This boundary sub-alternative was developed at a Council-sponsored collaborative workshop in April 2015. *The preferred discrete zones are entirely contained within the preferred broad zone*, but separate designations are proposed to allow for the possibility of future separate management measures and strategies to be applied to each zone.
- **Alternative 4B**: Restriction on use of all bottom-tending fishing gear within the designated discrete zones, with the exception of lobster gear (which is not covered by this action) and the red crab trap gear as per the exemption alternative below.
- **Alternative 4B-1**: An exemption to discrete zone gear restrictions for the red crab trap fishery.
- **Alternative 4D**: Allowance for vessels using bottom-tending gear to transit through a designated gear-restricted discrete coral zone, provided that the vessel's gear is on deck (the net is on the reel for trawl vessels, or gear is otherwise on deck for other gear types).

- **Alternatives 5B**: Modify the FMP's Framework Provisions to allow coral zone boundaries to be modified in the future through a framework action.
- **Alternative 5C**: Modify the FMP's Framework Provisions to allow coral zone management measures to be modified in the future through a framework action.
- **Alternative 5D**: Modify the FMP's Framework Provisions to allow additional coral zones to be designated in the future through a framework action.
- **Alternative 5E**: Modify the FMP's Framework Provisions to allow special access programs for fisheries to be implemented in the future through a framework action.
- **Alternative 6B**: A requirement for all *Illex* squid federal permit holders to install and use VMS on board the vessel.

In combination, the preferred alternatives result in a large offshore area that is restricted to all bottom-tending gear, except for lobster and red crab gear. The combined alternatives result in what is effectively one large gear restricted area, as the preferred discrete zones entirely overlap the preferred broad zone, and at this time, identical management measures are proposed to be implemented within each type. In the future, the Council may wish to tailor management measures to specific coral zone types or specific canyons.

The combined broad and discrete coral zones proposed for bottom-tending gear restrictions would encompass a large protected area of approximately 99,000 km^2. The vast majority of this area, however, consists of deep water areas that do not currently experience fishing activity (or experience very little fishing activity). One of the primary aims of the gear restricted coral zones is to protect corals from future expansion of fishing effort into deeper waters. The impacts of the combined Council-preferred alternatives for each VEC are described briefly below. A detailed description of the impacts of all considered alternatives is found in Section 7.0.

Impacts to Habitat

The combination of Council preferred alternatives is expected to result in moderate direct positive overall impacts to EFH. The preferred alternatives would create designated gear restricted areas that overlap with some amount of EFH for several managed species, providing protection in these areas from the adverse effects of current and future fishing activity. The magnitude of positive impacts to EFH is expected to be small for most species, given that EFH for most managed species within the action area is restricted to shallower water. The exception is red crab, for which a substantial amount of EFH is contained within the combined preferred coral zones. The Council preferred alternatives for management measures includes an exception to bottom-tending gear restrictions for the red crab fishery, thus any negative impacts to habitat resulting directly from the red crab fishery are likely to continue. However, the overall impact to red crab and other EFH is still expected to be positive overall given the prohibition on other bottom tending gear. Some EFH would also be protected for golden tilefish under the preferred alternatives.

The preferred vessel transit alternatives (2E and 4D) are expected to have neutral to slight indirect negative impacts to the EFH relative to the *status quo*, as these measures may make gear restrictions in coral zones slightly more difficult to enforce. The preferred framework provision alternatives 5B through 5E are primarily administrative in nature and would not have direct impacts on habitat or EFH; however, they could result in slight indirect positive impacts to EFH if they allow for more efficient responses to immediate conservation concerns. The Council preferred VMS requirement for *Illex* squid permit holders (Alternative 6B) is expected to have neutral to slight indirect positive impacts on the managed resources, as any increased VMS coverage may improve future analysis of fishing effort and other spatial management measures, potentially resulting in benefits to habitat and EFH.

Thus, overall, moderate direct positive impacts to EFH are expected from the combination of preferred alternatives.

Impacts to the Managed Resources

Direct impacts to the managed resources from the combination of Council preferred alternatives are unlikely. The preferred alternatives in this action are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). However, indirect positive impacts from the preferred coral zone designation and gear restriction alternatives may be realized through increased habitat quality and possible refugia from fishing effort, particularly for species with strong habitat associations in the canyon environments. It is difficult to predict the magnitude of any indirect impacts to the managed resources; however, the expected magnitude would be small for most species given that most of the species considered are highly mobile, distributed more inshore, and/or do not have strong habitat associations with the deep water areas proposed for protection. The exceptions to this conclusion may be red crab and golden tilefish.

The preferred vessel transit alternatives (2E and 4D) are expected to have neutral impacts to the managed resources relative to the *status quo*, as these measures will not impact stock status or affect implementation of other management measures. The preferred framework provision alternatives 5B through 5E are administrative in nature and are not expected to impact the managed resources either directly or indirectly. The Council preferred VMS requirement for *Illex* squid permit holders (Alternative 6B) is expected to have neutral to slight indirect positive impacts on the managed resources, as any increased VMS coverage may improve future analysis of fishing effort and other spatial management measures, potentially resulting in benefits to the managed resources.

Overall, the preferred alternatives in combination are likely to have neutral to indirect slight positive impacts to the managed resources.

Impacts to Deep Sea Corals

The combination of Council preferred alternatives is expected to result in moderate to high direct positive impacts to deep sea corals, resulting from reductions in existing interactions with fishing gear, and prevention of future interactions. The overall magnitude of positive impacts is somewhat limited by the fact that many corals exist in areas with some degree of natural protection from fishing gear, i.e., areas that are totally or partially inaccessible to fishing gear (especially bottom trawls) due to extreme depths and steep slopes that fishermen tend to avoid due to the potential for lost or damaged fishing gear. However, the preferred alternatives proposed in this amendment would protect a substantial amount of deep sea corals from current fishing activity on the outer continental shelf and slope (where more effort currently occurs) as well as prevent the future expansion of fishing effort into deeper water. Indirect positive impacts are also possible due to increased awareness of Mid-Atlantic coral communities and possible increased efforts to fund monitoring of deep sea canyon and slope environments.

Within the preferred combined coral zones, the preferred gear restriction alternative is a restriction on all bottom-tending gear, which will result in greater protection for corals than a restriction on only mobile bottom-tending gear. Although any existing negative impacts to deep sea corals resulting specifically from the red crab fishery would likely continue to occur under the Council preferred exemption alternatives for this fishery (2B-1 and 4B-1), overall long-term positive impacts to deep sea corals would still be expected from the combination of Council preferred alternatives, due to closing these areas to other gear types and freezing the current footprint of fishing.

The preferred vessel transit alternatives (2E and 4D) may somewhat lessen the positive impacts to deep sea corals, since these provisions may make gear restriction measures more difficult to enforce. Preferred framework provision alternatives 5B through 5D would be expected to result in neutral to indirect slight positive impacts to deep sea corals, as they may allow for more efficient responses to immediate conservation concerns. The impacts of any future coral measures considered under any of these framework provisions would be described in a future NEPA analysis. The Council preferred VMS requirement for *Illex* squid permit holders (Alternative 6B) is expected to have neutral to slight indirect positive impacts on deep sea corals, in that it may make gear restrictions and other spatial management measures easier to enforce.

Overall, the preferred alternatives in combination are likely to have moderate to high direct positive impacts to deep sea corals.

Impacts to Human Communities

The combination of Council preferred alternatives is expected to result in overall slight to moderate negative economic impacts for fishing businesses, depending on the current footprint and operations of each fishery, and the ability to redistribute effort. Negative impacts may be direct, through the increased costs associated with avoiding closed areas, or indirect, in terms of opportunity costs and/or reductions in efficiency resulting from fishing in different areas that may not be preferred fishing grounds for a given target species.

The preferred alternatives would be expected to cause some redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity. In general, the fisheries most likely to be impacted by the preferred alternatives include trawl vessels targeting squid and whiting. The areas where trawl vessels are most likely to be impacted include the shallower portions of the broad/discrete coral zones (near the shelf/slope break), where some fishing effort currently occurs. The mobile gear fisheries in question tend to operate in very specific areas near the heads and bights of the canyons. The Council preferred boundaries for the discrete zones, which were also incorporated in to the preferred broad zone boundary, were developed at an April 2015 Council workshop as described in Section 1.4.2 above and in more detail in Section 5.0. These boundaries were designed by a group of fishermen, coral and habitat scientists, conservation interest groups, and managers to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. These preferred boundaries are thus expected to have some negative impacts to fishing communities by forcing some vessels to redistribute effort, but these impacts are not expected to be severe. The Council's preferred alternatives include an exemption for the red crab trap fishery (sub-Alternative 2B-1). Thus, impacts specifically to the red crab fishery from the Council preferred alternatives are expected neutral relative to the *status quo*.

The preferred vessel transit alternatives (2E and 4D) are expected to have slight positive impacts to human communities in combination with gear restriction measures, as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas. The preferred framework provision alternatives 5B, 5C, and 5E are primarily administrative in nature and are expected to result in neutral to slight indirect positive impacts to human communities, given that these measures may allow an efficient adjustment to management measures that could address social or economic concerns. Alternative 5D, the option to add a discrete coral zone, would not be expected to address such a need and would be expected to have neutral impacts relative to the *status quo*. The Council preferred VMS requirement for *Illex* squid permit holders (Alternative 6B) is expected to have neutral to slight negative impacts on human communities, as VMS installation and operation has associated costs. All current *Illex* permit holders appear to have VMS installed already as a condition of other permits held, however, a VMS declaration requirement for targeting *Illex* may impose additional small transmission costs.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect positive impacts from the designation of gear-restricted coral zones for the protection of deep sea corals. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

Overall, impacts to human communities from the combined preferred alternatives are expected to range from slight indirect positive to moderate direct and indirect negative, depending on the community and the degree to which the combination of preferred alternatives impacts the distribution of current fishing effort.

Impacts to Protected Resources

Overall impacts to protected resources resulting from the combination of Council preferred alternatives are uncertain, and depend on a number of factors including current species distribution, patterns of effort shifts resulting from gear restricted areas, and whether the concentration of gear deployed changes in areas that experience high interaction rates. The changes proposed in this amendment are not expected to result in an increase in fishing effort overall, just shifts in the location of that effort for some fisheries. A detailed description of possible impacts of effort shifts is included in Section 7.5.

The preferred vessel transit alternatives (2E and 4D) are expected to have neutral impacts to protected resources relative to the *status quo*. The framework provision alternatives 5B through 5E are administrative in nature not expected to impact protected resources either directly or indirectly. The Council preferred VMS requirement for *Illex* squid permit holders (Alternative 6B) is expected to have neutral to slight indirect positive impacts on protected resources, as any increased VMS coverage may improve future analysis of fishing effort and other spatial management measures, potentially resulting in benefits to protected resources.

Depending on the many factors described above and in Section 7.5, the overall impacts to protected resources form the combined Council preferred alternatives could range from negative to positive.

Summary

Box ES-6 summarizes the expected impacts of the combination of all Council preferred alternatives for each VEC, as described above.

Box ES-6. Summary of the expected impacts of combined Council preferred alternatives on each VEC.				
Physical Environment/ EFH	**Managed Resources**	**Deep Sea Corals**	**Human Communities**	**Protected Resources**
Moderate direct positive	Neutral to slight indirect positive	Moderate to high direct and indirect positive	Slight indirect positive to moderate direct and indirect negative	Uncertain impacts ranging from negative to positive

2.0 CONTENTS, TABLES, AND FIGURES

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3.0 LIST OF ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	
ABC	Acceptable Biological Catch
ACUMEN	Atlantic Canyons Undersea Mapping Expedition
ASMFC	Atlantic States Marine Fisheries Commission (Commission)
ASSRT	Atlantic Sturgeon Status Review Team
ATGTRS	Atlantic Trawl Gear Take Reduction Strategy
ATGTRT	Atlantic Trawl Gear Take Reduction Team
BOEM	Bureau of Ocean and Energy Management
BTG	Bottom-tending gear
CPUE	Catch per unit effort
CeTAP	Cetacean and Turtle Assessment Program
C.F.R.	Code of Federal Regulations
CONMAP	Continental Margin Mapping Program
CV	Coefficient of Variation
CPH	Confirmation of Permit History
CEA	Cumulative Effects Assessment
DPSWG	Data Poor Stock Working Group
DAS	Days at Sea
DSCRTP	Deep Sea Coral Research and Technology Program
DMNH	Delaware Museum of Natural History
DOC	Department of Commerce
DPS	Distinct Population Segment
DEIS	Draft Environmental Impact Statement
ESA	Endangered Species Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EFH	Essential Fish Habitat
EEZ	Exclusive Economic Zone
EO	Executive Order
EFP	Exempted Fishing Permit
ENSO	El Niño–Southern Oscillation
FR	Federal Register
FMAT	Fishery Management Action Team
FMP	Fishery Management Plan
F	Fishing mortality rate
FT	Full-time
GSSA	Garden State Seafood Association
GRA	Gear restricted area
GB	Georges Bank
GAR	Greater Atlantic Region
GARFO	Greater Atlantic Regional Fisheries Office (formerly Northeast Regional Office/NERO)
GRT	Gross registered tonnage
GOM	Gulf of Maine
HAPC	Habitat Areas of Particular Concern
HPTRP	Harbor Porpoise Take Reduction Plan
IFQ	Individual Fishing Quota
LOA	Letter of Acknowledgement
LAGC	Limited Access General Category

Acronyms and Abbreviations	
LOF	List of Fisheries
MBTG	Mobile bottom-tending gear
MSB	Mackerel, Squid, and Butterfish
MSA	Magnuson-Stevens Fishery Conservation and Management Act (as currently amended)
MMPA	Marine Mammal Protection Act
MSY	Maximum Sustainable Yield
MOU	Memorandum of Understanding
MT	Metric tons
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council (Council)
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOS	National Ocean Service
NOAA	National Oceanic and Atmospheric Administration
NM	Nautical mile
NOAA OER	NOAA Office of Exploration and Research
NGO	Non-governmental organization
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center
NGOM	Northern Gulf of Maine
NWA	Northwest Atlantic
OY	Optimum Yield
PDT	Plan Development Team (NEFMC)
PS	Producer surplus
PT	Part-time
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
ROV	Remotely Operated Vehicle
SMAST	School for Marine Sciences and Technology (UMass Dartmouth)
SAB	South Atlantic Bight
SNE	Southern New England
SSB	Spawning Stock Biomass
SSC	Scientific and Statistical Committee
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
TRP	Take Reduction Plan
TAL	Total Allowable Landings
TRAC	Transboundary Resource Assessment Committee
TDD	Turtle Deflector Dredge
TED	Turtle Excluder Device
USD	U.S. Dollars
USFWS	U.S. Fish and Wildlife Service
USSR	Union of Soviet Socialist Republics
US	United States
USGS	U.S. Geological Survey
VEC	Valued Ecosystem Component
VMS	Vessel Monitoring System
VTR	Vessel Trip Report
WHOI	Woods Hole Oceanographic Institution

4.0 BACKGROUND AND PURPOSE

Deep sea corals are unique, fragile, slow-growing marine organisms that are valued for their function as habitat for many fish and invertebrates, as well as for a variety of ecosystem and cultural services they provide. These corals occupy deep, largely unexplored offshore areas that include the continental shelf break and marine canyons in the Mid-Atlantic, and are considered to be very vulnerable to human activities such as fishing (e.g., Hourigan 2009). When commercial fishing gears, such as trawls or pots, contact the sea floor in areas where deep sea corals occur, they become a potential threat to coral ecosystems through scarring, crushing or complete removal of corals. Deep sea corals can live for hundreds or even thousands or years, and damaged or destroyed deep sea corals may take many years to become re-established, if they are able to do so at all (see section 6.2.2.3 for a description of fishery gear impacts to deep sea coral).

Deep sea coral communities are among the most biologically diverse biological communities in the deep sea, and may increase the resilience of deep water ecosystems to external shocks. Corals provide habitat for many species of fish and invertebrates including nursery grounds, protection, reproduction, and feeding. Additionally, deep sea corals may sequester atmospheric carbon dioxide, and can serve as long-term indicators of climate change by serving as a record for ocean temperature changes. Corals also offer opportunities for pharmaceutical, engineering, and medical research. Finally, deep sea corals have cultural value, including non-use benefits such as existence value (Foley et al. 2010). The general public has seen increasing opportunities in recent years to view and appreciate deep sea communities by engaging virtually in deep sea exploration streamed via the internet.

The Mid-Atlantic Fishery Management Council (Council) recognizes the value of deep sea corals and is exercising its authority under the reauthorized Magnuson-Stevens Act (MSA) to recommend management measures to minimize fishery impacts to deep sea corals in the Mid-Atlantic region. This amendment is a regulatory vehicle initiated by the Council to identify and develop fishery management measures that will limit the negative impacts of commercial fishing on deep sea corals. At the same time, the Council recognizes the importance and value of commercial fisheries that operate in or near areas of deep sea coral habitat. As such, measures proposed in this amendment are considered in light of their expected benefits to corals as well as their potential costs to commercial fisheries.

4.1 PURPOSE AND NEED FOR ACTION

The purpose of this action is to consider area-based management measures for deep sea corals. This action is needed to reduce potential impacts to corals from fishing activity, as allowed under the Council's discretionary authority. The Council developed this amendment with the stated goal of "identifying and implementing measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic region." The Council aimed to protect valued deep sea corals and their dependent ecosystem components while also considering the operational needs and long term sustainability of commercial fisheries.

Deep sea corals are fragile and slow-growing organisms that are highly vulnerable to various types of disturbance of the sea floor, including fishing activities. Corals are valued for their habitat, ecosystem, cultural, and other values, yet remain largely unprotected from human disturbance in the Mid-Atlantic. Research on commercial fishing gear impacts to deep sea corals indicates that fishing gear can damage or destroy corals in variety of ways. At the same time, the Council recognizes that important commercial fisheries operate in or near the areas under consideration for coral protection, many of which have highly specific spatial needs for efficient operation. This amendment contains alternatives that aim to protect corals to the extent practicable by restricting fishing in select areas where fishing effort and prime coral habitats overlap, as well as by restricting expansion of effort into less heavily fished areas where corals are known or are highly likely to be present.

4.2 REGULATORY AUTHORITY

The alternatives in this document are based on application of discretionary provisions related to deep sea corals contained in section 303(b) of the 2007 reauthorization of the MSA. These provisions give the Regional Fishery Management Councils the authority to designate zones where, and periods when, fishing may be restricted in order to protect deep sea corals. Section 303(b)(2) states that any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, may:

(A) designate zones where, and periods when, fishing shall be limited, or shall not be permitted, or shall be permitted only by specified types of fishing vessels or with specified types and quantities of fishing gear;

(B) designate such zones in areas where deep sea corals are identified under section 408 (this section describes the deep-sea coral research and technology program), to protect deep sea corals from physical damage from fishing gear or to prevent loss or damage to such fishing gear from interactions with deep sea corals, after considering long-term sustainable uses of fishery resources in such areas; and

(C) with respect to any closure of an area under this Act that prohibits all fishing, ensure that such closure—

- (i) is based on the best scientific information available;
- (ii) includes criteria to assess the conservation benefit of the closed area;
- (iii) establishes a timetable for review of the closed area's performance that is consistent with the purposes of the closed area; and
- (iv) is based on an assessment of the benefits and impacts of the closure, including its size, in relation to other management measures (either alone or in combination with such measures), including the benefits and impacts of limiting access to: users of the area, overall fishing activity, fishery science, and fishery and marine conservation;

The Council seeks to balance the exercise of this discretionary authority with the management objectives of the Mackerel, Squid, and Butterfish (MSB) FMP and the value of potentially affected commercial fisheries.

In May 2010, the Council received guidance from the NMFS Northeast Regional Office (now the Greater Atlantic Regional Office) regarding implementation of the discretionary provisions (Kurkul 2010). Important aspects of this guidance include:

- Coral areas must have a nexus to a fishery managed by the Council under a fishery management plan. Councils may include deep sea coral measures in any fishery management plan (FMP) with respect to any fishery. Councils must show that the deep-sea coral areas are located within the geographical range of the fishery as described in the FMP.
- Coral zones can include additional area beyond the locations of deep-sea corals if necessary to ensure the effectiveness of protection measures, which may include the following:
  - Restrictions on time/location of fishing within zones,
  - Limiting fishing to specific vessel types or vessels fishing with specific gear types/quantities of gear, and

    - Closure of zones to fishing.
- Measures can apply to any MSA regulated fishing activity, even if that activity or gear type is not managed by the FMP that includes the measures.
- Long-term sustainable use of fishery resources must be considered prior to designating deep-sea coral protection zones. This should include documenting fishery resources in deep sea coral areas and how those uses could impact deep sea corals. Councils should also consider how to balance protection of deep sea coral areas from any current or future impacts with sustainable uses of fishery resources in coral zones.
- Unlike the Essential Fish Habitat (EFH) authority, the discretionary authority does not carry a consultation requirement.
- According to the 2010 guidance, for coral management provisions to apply to fisheries managed under the Atlantic Coastal Cooperative Fisheries Management Act (ACA), either the ASMFC must take complementary action in their FMP, or there must be a Council FMP for the same resource. This guidance specifies that in the Greater Atlantic Region, the offshore component of the American lobster fishery would not be subject to coral protection measures enacted in an MSA FMP.

In 2014, the NMFS Office of Habitat Conservation issued additional guidance as an "informational memo" to the Councils (Sutter 2014). This guidance suggested that it may be possible to apply the discretionary provisions to fisheries managed under the ACA, such as the American lobster fishery. Specifically, the guidance states that "measures may apply to fishing that is managed under a different federal FMP or to state-regulated fishing that is authorized in the EEZ." The Council proposing such measures would likely need to work in close coordination with, and potentially take joint action with, the ASFMC. At the time this memo was received, the Mid-Atlantic Council had spent several years developing alternatives under the 2010 guidance regarding applicability of measures to the lobster fishery. As such, the Council determined that it would continue to develop measures that would not apply to the lobster fishery. In the future, the Council may choose to work with the ASMFC on a separate action to develop measures to protect deep sea corals from the impacts of fishing gear.

4.3 FMP HISTORY AND MANAGEMENT OBJECTIVES

Bottom trawls have been consistently identified as the gear type with the greatest potential to negatively affect deep sea corals. The proposed measures to protect deep sea corals therefore include gear restrictions affecting bottom trawl fisheries, especially those operating near areas identified as prime deep sea coral habitat. Among the Council's management plans, the FMP that directly governs major offshore trawl fisheries operating in areas of likely coral habitat in the Mid-Atlantic is the MSB FMP. As such, measures to protect deep sea corals are being considered through an amendment to this plan. Nevertheless, and as detailed below in section 4.4, alternatives developed in this amendment are not limited to the activities of the MSB fisheries, and may apply to other federally regulated fishing activities as well.

Management of the MSB fisheries began through the implementation of three separate FMPs (one each for mackerel, squid, and butterfish) in 1978. The plans were merged in 1983. Over time a wide variety of management issues have been addressed including stock rebuilding, habitat conservation, bycatch minimization, and limiting participation in the fisheries. The history of the plan and its amendments can be found at http://www.mafmc.org/fisheries/fmp/msb.

The management goals and objectives, as described in the current FMP are listed below.

1. Enhance the probability of successful (i.e., the historical average) recruitment to the fisheries.

2. Promote the growth of the U.S. commercial fishery, including the fishery for export.
3. Provide the greatest degree of freedom and flexibility to all harvesters of these resources consistent with the attainment of the other objectives of this FMP.
4. Provide marine recreational fishing opportunities, recognizing the contribution of recreational fishing to the national economy.
5. Increase understanding of the conditions of the stocks and fisheries.
6. Minimize harvesting conflicts among U.S. commercial, U.S. recreational, and foreign fishermen.

4.4 MANAGEMENT UNIT AND SCOPE OF ALTERNATIVES

The management unit (fish stock definition) for the MSB FMP is all Atlantic mackerel (*Scomber scombrus*), Longfin squid (*Doryteuthis (Amerigo) pealeii*),[4] Illex squid (*Illex illecebrosus*), and butterfish (*Peprilus triacanthus*) under U.S. jurisdiction in the northwest Atlantic, with a core fishery management area from Maine to North Carolina.

Although gear restrictions are being developed within the MSB FMP, the alternatives listed in this document aim to achieve protection of deep sea corals and are not limited to the activities of the MSB fisheries. Management measures developed under the regulatory authority described in Section 4.2 and implemented via this amendment could be applied to any federally regulated fishing activity within the range of the MSB fisheries, including activity or gears that are not used in these fisheries.

However, management measures under this amendment would **not apply** to American lobster trap fisheries. While the Council recognizes the potential damage to corals from lobster gear, the majority of the development of this amendment occurred under the guidance that NMFS has no authority to regulate the use of lobster pots to protect deep-sea corals in federal waters. In 2010, NMFS advised the New England and Mid-Atlantic Councils that they could not regulate the use of lobster gear independently of the Atlantic States Marine Fisheries Commission (ASMFC) in a deep-sea coral management action (Kurkul 2010). In 2014, new guidance distributed by NMFS Headquarters indicated that such regulations can be proposed by fishery management councils under certain circumstances (Sutter 2014). Any action by the Council to regulate the use of lobster pots in federal waters would require a consultation, and probably collaboration, with the ASMFC. Because the bulk of this amendment was developed under the old guidance, the Council did not specifically target the lobster industry for engagement in the process. Therefore, the Council has indicated that this amendment should not apply to lobster gear at this time; however; they may consider developing a framework action at some point in the future to revisit all fixed gear restrictions and exemptions.

The Mid-Atlantic Fishery Management Council, the New England Fishery Management Council (NEFMC), and the South Atlantic Fishery Management Council (SAFMC) have signed a Memorandum of Understanding (MOU) identifying areas of consensus and common strategy related to conservation of corals and mitigation of the negative impacts of fishery interactions with corals.[5] As per the terms of the MOU, the Mid-Atlantic Fishery Management Council has agreed to develop alternatives applicable only to areas within the Mid-Atlantic Council region boundary as defined in the current regulations (Figure 1).[6] The NEFMC has agreed to develop management measures applicable

[4] For longfin squid, there was a scientific name change from *Loligo pealeii* to *Doryteuthis (Amerigo) pealeii*. To avoid confusion, this document will utilize the common name “longfin squid” wherever possible, but this squid is often referred to as "*Loligo*" by interested parties.

[5] The full Memorandum of Understanding is available at http://www.mafmc.org/actions/msb/am16.

[6] Council boundaries are defined in the Code of Federal Regulations (C.F.R.), at 50 C.F.R. §§ 600.105(a) and (b), available at http://www.gpo.gov/fdsys/granule/CFR-2001-title50-vol3/CFR-2001-title50-vol3-sec600-105/content-detail.html.

within the boundaries of their Council region, and the SAFMC will continue to manage deep sea corals via its Coral, Coral Reef and Live/Hardbottom FMP.[7]

The NEFMC began developing deep sea coral alternatives several years ago as part of their Essential Fish Habitat Omnibus Amendment 2; however, the NEFMC has since split coral protection measures into a separate Omnibus Deep Sea Corals Amendment, which recently resumed development in late 2015.[8] To promote continuity and consistency in regional protection of deep sea corals, the alternatives contained in this document were developed with consideration of consistency in approach to deep sea coral protections initially considered by the NEFMC. As the NEFMC has resumed development of coral measures, the Plan Development Team (PDT) is drafting alternatives that are similar in approach to those selected by the MAFMC.

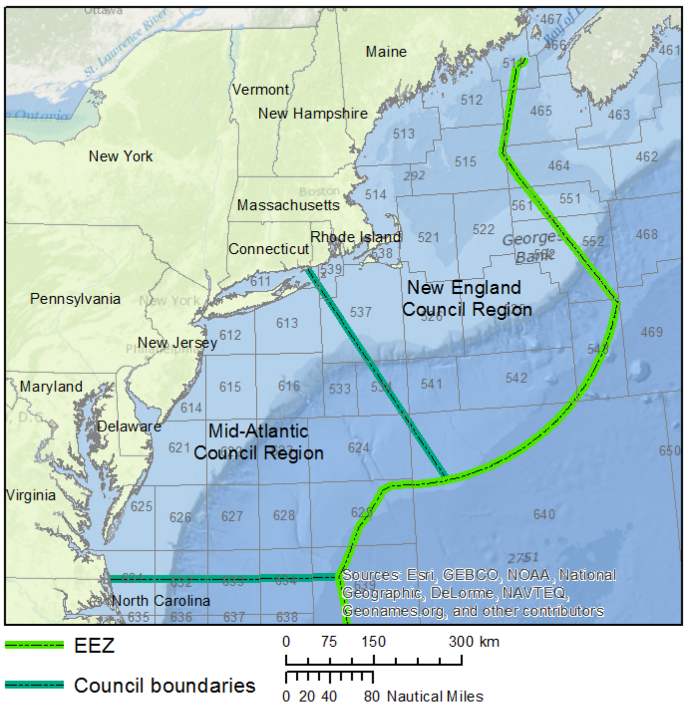

Figure 1: Mid-Atlantic and New England Council regions.

[7] See: http://www.safmc.net/Library/Coral

[8] For more information, see http://www.nefmc.org/library/omnibus-deep-sea-coral-amendment.

5.0 MANAGEMENT ALTERNATIVES

This amendment attempts to achieve the Council's desired deep sea coral protections while considering the social and economic value of potentially affected fisheries. In recognition of the diversity of potential solutions to these two goals, a range of alternative management measures ("alternatives") were developed for consideration in terms of their effectiveness and practicability. This approach also complies with the statutory requirements of the National Environmental Policy Act (NEPA) for a consideration of a "range of alternatives" in evaluating the environmental impacts of federal actions. The range of alternatives is presented below.

The majority of the alternatives were developed in order to apply the discretionary provisions of the MSA for designating "deep sea coral zones." Within potential designated deep sea coral zones, there are additional alternatives that propose restrictions on certain federally regulated fishing activities within them. Two types of deep sea coral zones are proposed, as described below.

Broad deep sea coral zones are intended to encompass large, mostly unfished and unexplored areas, where measures would limit and prevent expansion of commercial gear use where little or no fishing has historically occurred. The concept of these broad coral zones is in line with the "freeze the footprint" approach outlined in NOAA's Strategic Plan for Deep Sea Corals:

> "The expansion of fisheries using mobile bottom-tending gear beyond current areas has the potential to damage additional deep-sea coral and sponge habitats. Potentially, many undocumented and relatively pristine deep-sea coral and sponge ecosystems may exist in unmapped areas untouched, or relatively untouched, by mobile bottom-tending gear. This objective takes a precautionary approach to "freeze the footprint" of fishing that uses mobile bottom-tending gear in order to protect areas likely to support deep-sea coral or sponge ecosystems until research surveys demonstrate that proposed fishing will not cause serious or irreversible damage to such ecosystems in those areas. Special emphasis is placed on mobile bottom-tending gear (e.g., bottom trawling), as this gear is the most damaging to these habitats. This objective applies to areas where use of such gear is allowed or might be allowed in the future. If subsequent surveys identify portions of these areas that do not contain deep-sea corals or sponges, NOAA may recommend that suitable areas be opened for fishing using such gear" (NOAA Coral Reef Conservation Program 2010).

This concept is further illustrated in Figure 2, which is taken from the Strategic Plan.

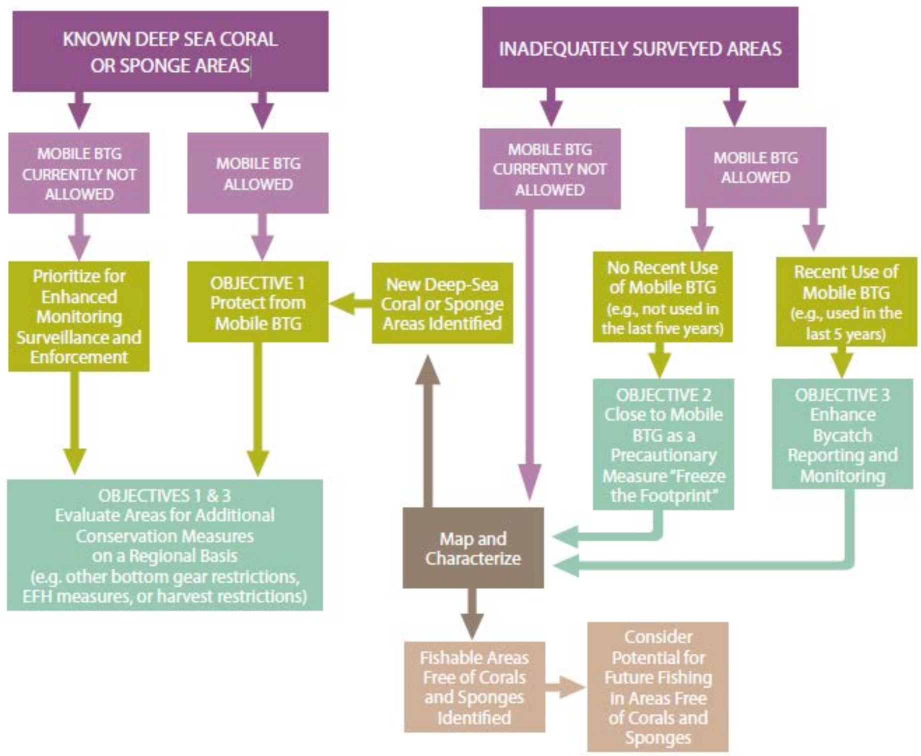

Figure 2: NOAA's precautionary approach to manage bottom-tending gear, especially mobile bottom-tending gear and other adverse impacts of fishing on deep-sea coral and sponge ecosystems, as described in NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems.

Discrete deep sea coral zones are proposed as smaller areas encompassing known coral presence locations or areas of highly likely coral habitat. These areas primarily consist of offshore submarine canyons or slope areas along the continental shelf edge, where corals are common. Fishing activity occurs nearby these areas, and to some extent within them. Therefore, restrictions applied to these areas would mainly reduce or eliminate current fishing activities rather than just prevent their expansion.

These two types of deep sea coral zones could be implemented simultaneously. The alternatives are structured so that different types of zones could have either different management measures or the same management measures applied within each type of zone. If both broad and discrete zones are implemented and management measures differ between the two types, the more restrictive management measures would apply in any areas of overlap.

Based on the framework described above, seven sets of alternatives are presented in this document:

1) Designation of broad deep sea coral zones (5.1),
2) Management measures within broad zones (5.2),
3) Designation of discrete deep sea coral zones (5.3),
4) Management measures within discrete zones (5.4),
5) Framework provisions for future refinements to deep sea coral zone measures (5.5),
6) Vessel Monitoring System (VMS) requirements (5.6), and
7) Alternatives considered but rejected from further analysis (5.7).

The measures proposed in this action are designed to prioritize protection of structure-forming corals, given their apparent enhanced habitat value relative to other types of corals. Structure-forming corals typically require hard substrate to attach. Given the relative rarity of hard substrate in the mid-Atlantic, the coral zone boundary alternatives proposed in this document are designed to capture areas of hard substrate in the canyons, and to prioritize observations of structure-forming corals for protection (although other coral types would also receive protection under the proposed measures). In addition, although the alternatives in this action are designed specifically around deep sea corals, there are several other unique deep sea habitat types that would benefit from implementation of gear-restricted coral areas, including deep sea sponges and unique ecological communities associated with methane seeps.

As described in the Executive Summary of this document, in February 2016, the Council voted to name the combined proposed deep sea coral protection areas in honor of the late Senator Frank Lautenberg, a five-term United States senator from New Jersey who was responsible for several important pieces of ocean conservation legislation. Senator Lautenberg authored several provisions included in the reauthorized MSA, including the discretionary provisions described in this document giving regional fishery management councils the authority to protect coral habitat areas from fishing gear. The Council proposes that the combined broad and discrete zones, if implemented, be officially known as the "Frank R. Lautenberg Deep Sea Coral Protection Area."

5.1 BROAD CORAL ZONE DESIGNATION ALTERNATIVES

Except for the no action alternative, all broad zone alternatives would begin with a landward boundary approximating a depth contour, and extend into deeper waters out to the edge of the Exclusive Economic Zone (EEZ) to the east and to the MAFMC region boundaries to the north and south. Because depth contours drawn directly from high resolution bathymetry data are very complex with many thousands of vertices, these contours would need to be approximated in order to draw boundary lines on a map that could be entered into navigation systems as a series of coordinates. The methodology used for simplifying and approximating depth contour lines is described in Appendix A.

Alternative 1A: No Action/*Status Quo*

Under this alternative, no action would be taken to designate a broad deep sea coral zone. This option is equivalent to the *status quo*. There are currently no regulations in the MAFMC management region designed specifically for the protection of deep sea corals. Several canyons have been closed to mobile bottom-tending gear for tilefish habitat protection. These tilefish Gear Restricted Areas (GRAs) include part of Norfolk Canyon in the Mid-Atlantic region (Figure 3).[9] As was noted in the analysis for those actions, deep sea corals do receive some protection from mobile bottom-tending gear via this GRA. There are also GRAs implemented under the Summer Flounder, Scup, and Black Sea Bass FMP, intended to protect juvenile scup from incidental capture in small mesh fisheries for longfin squid, black sea bass, and silver whiting (hake).[10] These GRAs cover some areas of known and likely deep sea coral habitat (Figure 3 and Figure 4). However, because the scup GRAs are seasonal closures affecting only certain fisheries, and because corals are sessile organisms, these GRAs do not provide substantial protection for deep sea corals.

[9] Regulations available at http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9f5bb83d0dd1bf6af01d7baf383b29c0&r=SUBPART&n=50y12.0.1.1.5.14.

[10] Regulations available at http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9f5bb83d0dd1bf6af01d7baf383b29c0&r=SUBPART&n=50y12.0.1.1.5.8#se50.12.648_1124.

Alternative 1B: Landward boundary approximating 200-meter depth contour

Under this alternative, a broad coral zone would be designated with the landward boundary approximating the 200 meter (109 fathom) depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and eastward to the edge of the EEZ (Figure 4).

Alternative 1C: Landward boundary approximating 300-meter depth contour

Under this alternative, a broad coral zone would be designated with the landward boundary approximating the 300 meter (164 fathom) depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and eastward to the edge of the EEZ (Figure 4).

Alternative 1D: Landward boundary approximating 400-meter depth contour

Under this alternative, a broad coral zone would be designated with the landward boundary approximating the 400 meter (219 fathom) depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and eastward to the edge of the EEZ (Figure 4).

Alternative 1E: Landward boundary approximating 500-meter depth contour

Under this alternative, a broad coral zone would be designated with the landward boundary approximating the 500 meter (273 fathom) depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and eastward to the edge of the EEZ (Figure 4).

Alternative 1F: Landward boundary simplified between 400 meter and 500-meter depth contour and prioritizing discrete zone boundaries *(Council preferred)*

Under this alternative, a broad coral zone would be designated with the landward boundary drawn between the 400 meter (219 fathom) contour as a hard landward boundary and the 500 meter (273 fathom) contour as a hard seaward boundary. The line created using this technique would focus on the center point (450 meters or 246 fathoms) between the hard landward and seaward boundaries, with a 50-meter depth tolerance in either direction as a guide used to draw this line as straight as possible without crossing the hard boundaries. In areas where there is conflict or overlap between this broad zone and any designated discrete zone boundaries, the discrete zone boundaries would be prioritized. From the landward boundary, the broad zone boundaries would extend along the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ as the eastward boundary (Figure 4).

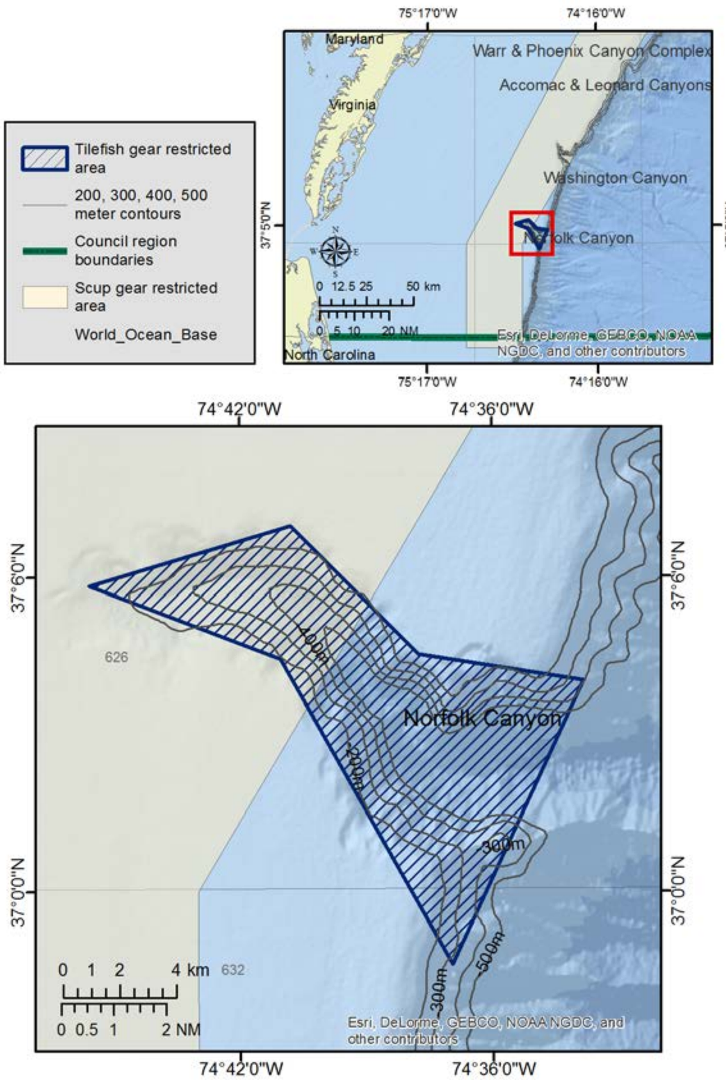

Figure 3: Current tilefish gear restricted area in Norfolk Canyon, with southern scup GRA also shown.

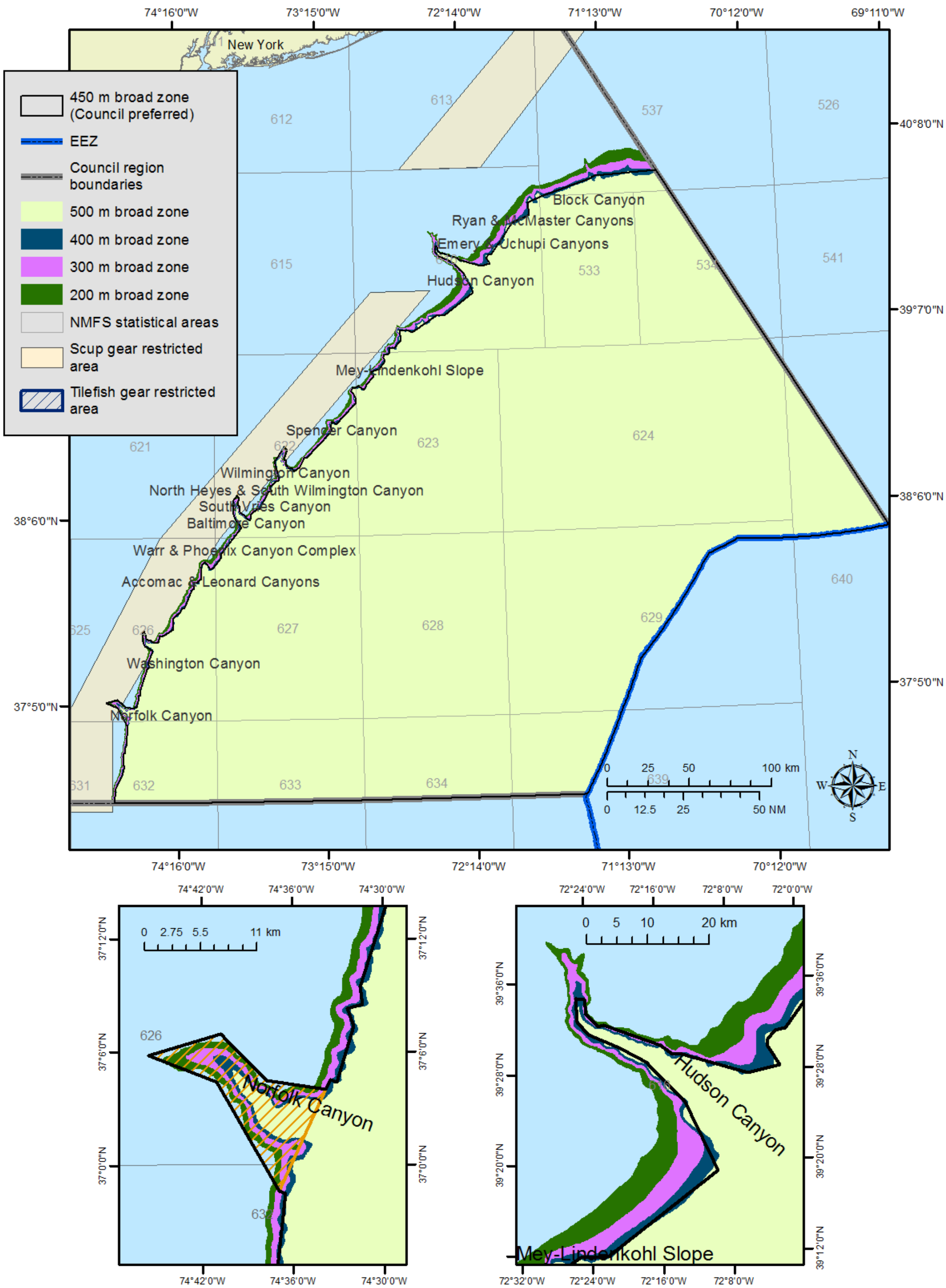

Figure 4: Broad coral zone alternatives.

5.2 MANAGEMENT MEASURES WITHIN BROAD CORAL ZONES

Alternative 2A: No Action/*Status Quo*

Under this alternative, no action would be taken to implement management measures in any designated broad deep sea coral zones. This is equivalent to the *status quo*. As noted under Alternative 1A, there are currently no regulations in the MAFMC management region designed specifically for the protection of deep sea corals.

Alternative 2B: Prohibit all bottom-tending gear *(Council preferred)*

Under this alternative, vessels would be prohibited from using any bottom-tending gear within designated broad coral zones. "Bottom-tending gear" includes any mobile bottom-tending gear (as defined in Alternative 2C below), as well as any stationary or passive gear types that contact the bottom, including bottom longlines, pots and traps, and sink or anchored gill nets.

As indicated in section 4.4, alternatives contained in this document would not apply to the American lobster trap fishery. While the Council recognizes the potential damage to corals from lobster gear, the majority of the development of this amendment occurred under the 2010 guidance for use of the MSA discretionary provisions for deep sea corals, which stated that NMFS could not apply these provisions to the development of regulations for the lobster fishery. Based on revised guidance issued in 2014, the Council may consider a future action to implement measures to protect deep sea corals from the impacts of lobster gear. Such an action would require the close coordination and potential joint action with the Atlantic States Marine Fisheries Commission.

Sub-alternative 2B-1: *Exempt red crab fishery from broad zone restrictions (Council preferred)*

If implemented in conjunction with Alternative 2B, sub-alternative 2B-1 would exempt the red crab fishery from restrictions on all bottom-tending gear. This exemption would apply indefinitely, or until superseded by a future action. The red crab fishery currently consists of only three vessels, which harvest crabs using traps. These vessels focus effort along the center of a narrow range of depth (targeting 350 fathoms or 640 meters; see Section 6.3.7 for a description of the fishery). Thus, any prohibition on all bottom-tending gear within the proposed broad zones, absent an exemption, would impact all fishing activity for red crab within the Mid-Atlantic Council region.

Sub-alternative 2B-2: *Exempt golden tilefish fishery from broad zone restrictions*

If implemented in conjunction with Alternative 2B, sub-alternative 2B-2 would exempt the golden tilefish fishery from restrictions on all bottom-tending gear. Golden tilefish are primarily harvested using bottom longlines. Sub-alternative 2B-2 would allow the golden tilefish bottom longline fishery to continue operation within a designated broad zone, but prevent current or future use of stationary or passive bottom-tending gear targeting other species (with the exception of red crab trap gear if implemented in combination with sub-alternative 2B-1 above).

Alternative 2C: Prohibit all mobile bottom-tending gear

Under this alternative, vessels would be prohibited from using any mobile bottom-tending gear within designated broad coral zones. Mobile bottom-tending gear (as defined at 50 C.F.R. §648.200 with respect to the Northeast multispecies and tilefish fisheries) means gear in contact with the ocean bottom, and towed from a vessel, which is moved through the water during fishing in order to capture fish, and includes otter trawls, beam trawls, hydraulic dredges, non-hydraulic dredges, and seines (with the exception of a purse seine). This option does not include fixed or stationary gear types, or gear types that are otherwise not towed from a vessel (such as pots, traps, longlines, handlines, and gillnets), nor does it include gear types that do not contact the seafloor (such as purse seines or mid-water trawls).

Alternative 2D: Require VMS for vessels within broad coral zones

Under this alternative, vessels would be required to use an approved VMS unit as a condition for operating within any broad coral zones. This alternative was designed such that it could be implemented alone or in combination with any of the gear restriction alternatives above. Currently, VMS is required for vessels issued various types of permits for: Northeast multispecies, monkfish, scallop, herring, surfclam, ocean quahog, mackerel, and longfin squid/butterfish.[11]

Alternative 2E: Allow for transit with gear stowage requirements *(Council preferred)*

Under this alternative, vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). The Council had previously considered this alternative with language allowing for transit through gear-restricted discrete areas provided that the gear be "not available for immediate use," as defined in §648.2 of the federal regulations and applied for several other restricted areas and fisheries.[12] The Council determined that the existing transit language at §648.2 would be too burdensome for commercial vessels under the spatial measures proposed in this amendment, given that very small portions of coral areas would need to be transitted. For example, the proposed gear-restricted portion of Hudson Canyon is very narrow and would place a large burden on vessels to haul in gear for very short transit times. Thus, the Council's preferred alternative for transit would require only that the vessel's net be on the reel (for trawl vessels) or gear be on board (for other gear types).

Alternative 2F: Allow for transit via change in VMS declaration

Under this alternative, vessels would be allowed to transit through gear-restricted broad coral areas if they submit a VMS declaration specific to transit prior to crossing into designated deep sea coral zones. This alternative would require NMFS to create a "transit" VMS declaration. This alternative was designed to be selected in combination with gear restriction alternatives (2B or 2C). If no gear restrictions were implemented, special allowances for transit through coral zones would not be necessary. If no gear restrictions were implemented but a VMS requirement was still desired, Alternative 2D (require VMS for vessels within broad coral zones) would be the more appropriate alternative.

[11] Current regulations for vessels required to use VMS are detailed at: http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9f5bb83d0dd1bf6af01d7baf383b29c0&r=SUBPART&n=50y12.0.1.1.5.1#se50.12.648_110.

[12] See http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9f5bb83d0dd1bf6af01d7baf383b29c0&mc=true&n=pt50.12.648&r=PART&ty=HTML#se50.12.648_12.

5.3 DISCRETE CORAL ZONE DESIGNATION ALTERNATIVES

Alternative 3A: No Action/*Status Quo*

Under this alternative, no action would be taken to designate discrete deep sea coral zones. This option is equivalent to the *status quo*. As described under Alternatives 1A and 2A, there are currently no regulations in the Mid-Atlantic region specifically designed to protect deep sea corals.

Alternative 3B: Designation of Discrete Coral Zones

Under this alternative, specific submarine canyons and slope areas would be designated as discrete coral zones based on observed coral presence or highly likely coral presence indicated by modeled suitable habitat. Proposed discrete zones are listed in Table 1 and are shown in Figure 5.

Table 1: Discrete zones proposed under Alternative 3B.

Proposed Discrete Zone Canyon or Complex	
1	Block Canyon
2	Ryan and McMaster Canyons
3	Emery and Uchupi Canyons
4	Jones and Babylon Canyons
5	Hudson Canyon
6	Mey-Lindenkohl Slope (encompassing several canyons, including Mey, Hendrickon, Toms, South Toms, Berkley, Carteret, and Lindenkohl Canyons, and the slope area between them)
7	Spencer Canyon
8	Wilmington Canyon
9	North Heyes and South Wilmington Canyons
10	South Vries Canyon
11	Baltimore Canyon
12	Warr and Phoenix Canyon Complex
13	Accomac and Leonard Canyons
14	Washington Canyon
15	Norfolk Canyon

Multiple boundary options were proposed for each discrete zone by various stakeholder groups during the alternatives development and public comment process. These boundary options are described as sub-alternatives 3B-1 through 3B-5, presented in chronological order based on when they were developed or last refined. The geographic coordinates of discrete zone alternatives are listed in Appendix C.

Sub-alternative 3B-1: *Advisor-proposed boundaries for three discrete zones*

Under this sub-alternative, discrete zone boundaries are proposed for Norfolk Canyon, Baltimore Canyon, and the Mey-Lindenkohl Slope, as developed by a member of the Council's MSB Advisory Panel (AP) following an April 2013 Deep Sea Corals Alternatives workshop (Figure 5).

Sub-alternative 3B-2: *FMAT boundaries*

The discrete zone boundaries under this alternative were developed in 2014 by the Council's Deep Sea Corals Fishery Management Action Team (FMAT). These boundaries were developed primarily using the combination of a NOAA habitat suitability model for deep sea corals (Kinlan et al. 2013) and high resolution bathymetry data to identify areas of very high seafloor slope (>30 degrees). Recent research has indicated that the coral habitat suitability model has been very successful in predicting coral habitat, and additionally has confirmed that areas of slope greater than 30 degrees almost always contain hardbottom habitat and deep sea corals. Areas of high and very high habitat suitability and areas of high slope were buffered by approximately 0.4 nautical miles to account for spatial uncertainties associated with the current resolution of the habitat model. Specific locations of historical and recent coral observations were also considered when developing boundaries, especially where recent data was available for observations that have not yet been incorporated into the habitat model. Specific criteria for FMAT development of these boundaries are described in Appendix C. The boundaries for this sub-alternative are shown in Figure 5.

Sub-alternative 3B-3: *Garden State Seafood Association boundaries*

These boundaries were developed and submitted to the Council during the amendment's public comment period in February 2015 by a group of fishing industry stakeholders, through Garden State Seafood Association (GSSA). GSSA developed these boundaries during a series of meetings with active fishermen, where they sought input on important fishing grounds in and around the proposed coral zones. These boundaries are thus focused on preserving fishing access for key commercial fisheries in these areas, while protecting corals in areas that are less critical to the fishing industry (Figure 5).

Sub-alternative 3B-4: *NGO Coalition boundaries*

These boundaries, shown in Figure 5, were developed and submitted to the Council by a coalition of NGO representatives and Ecosystems and Ocean Planning Advisory Panel members, in advance of the Council's April 2015 Deep Sea Corals Workshop. The approach to developing this proposal involved comparing the FMAT boundaries (sub-alternative 3B-2) and the GSSA boundaries (sub-alternative 3B-3) and developing a compromise for each discrete zone based on key coral areas and observed fishing effort as described in the public hearing document. The methodology focused on reducing the buffer around predicted coral areas where fishing effort is more concentrated.

Sub-alternative 3B-5: *Corals Workshop boundaries (Council preferred)*

These boundaries, shown in Figure 5, were developed collaboratively by participants at the Council's April 29-30, 2015 Deep Sea Corals Workshop in Linthicum, MD. Participants included the Council's Squid, Mackerel, and Butterfish Advisory Panel, the Ecosystems and Ocean Planning Advisory Panel, members of the Deep Sea Corals FMAT, invited deep sea coral experts, additional fishing industry representatives, and other interested stakeholders. Workshop details and a summary report are available on the Council's website at http://www.mafmc.org/workshop/2015/deep-sea-corals. Note that the workshop boundary for Norfolk Canyon was designed to follow the landward boundary of the existing tilefish GRA, within which mobile bottom-tending gear is prohibited to protect designated tilefish Habitat Area of Particular Concern (HAPC; see Section 6.2.6).

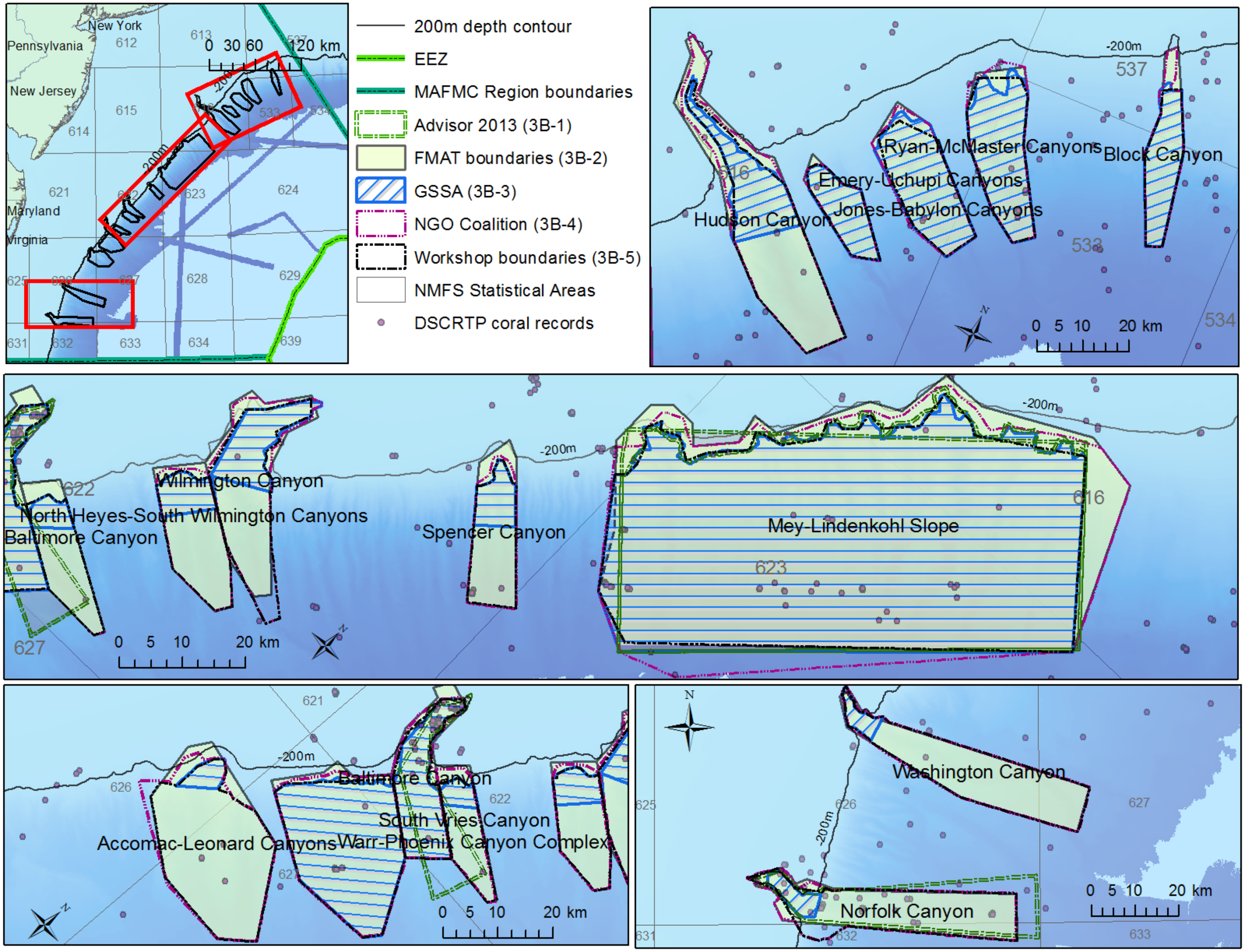

Figure 5: Discrete coral zone alternatives.

5.4 MANAGEMENT MEASURES WITHIN DISCRETE CORAL ZONES

Alternative 4A: No Action/*Status Quo*

Under this alternative, no action would be taken to implement management measures in any potential discrete deep sea coral zones. This is equivalent to the *status quo*. As noted under Alternatives 1A, 2A, and 3A, there are currently no regulations in the MAFMC management region designed specifically for the protection of deep sea corals.

Alternative 4B: Prohibit all bottom-tending gear *(Council preferred)*

Under this alternative, vessels would be prohibited from using any bottom-tending gear within designated discrete coral zones. "Bottom-tending gear" includes any mobile bottom-tending gear (as defined in Alternative 4C below), as well as any stationary or passive gear types that contact the bottom, including bottom longlines, pots and traps, and sink or anchored gill nets. As indicated in section 4.4, alternatives contained in this document would not apply at this time to fisheries managed solely by the Atlantic States Marine Fisheries Commission, such as American lobster.

Sub-alternative 4B-1: *Exempt red crab fishery from discrete zone restrictions (Council preferred)*

If implemented in conjunction with Alternative 4B, sub-alternative 4B-1 would exempt the red crab fishery from restrictions on all bottom-tending gear in discrete zones, for a period of at least two years following implementation of the amendment, after which time the exemption may be superseded by a framework action. The red crab fishery currently consists of only three active vessels, which harvest crabs using traps. These vessels focus effort along the center of a narrow range of depth (targeting 350 fathoms, or 640 meters; see Section 6.3.7 for a description of the fishery). This depth contour runs through all 15 proposed discrete zones. An exemption was proposed given that the operational needs of this fishery may make skipping over multiple closed areas prohibitively burdensome for these vessels.

Sub-alternative 4B-2: *Exempt golden tilefish fishery from discrete zone restrictions*

If implemented in conjunction with Alternative 4B, sub-alternative 4B-2 would exempt the golden tilefish fishery from restrictions on all bottom-tending gear in discrete zones. Golden tilefish are primarily harvested using bottom longlines. Selecting sub-alternative 4B-2 would allow the golden tilefish bottom longline fishery to continue operation within designated discrete zones.

Alternative 4C: Prohibit mobile bottom-tending gear

Under this alternative, vessels would be prohibited from using any mobile bottom-tending gear within designated discrete coral zones. This prohibition could include any or all of the discrete coral zones listed in Table 1. Mobile bottom-tending gear (as defined at 50 C.F.R. §648.200 with respect to the Northeast multispecies and tilefish fisheries) means gear in contact with the ocean bottom, and towed from a vessel, which is moved through the water during fishing in order to capture fish, and includes otter trawls, beam trawls, hydraulic dredges, non-hydraulic dredges, and seines (with the exception of a purse seine).

Alternative 4D: Allow for transit with gear stowage requirements *(Council preferred)*

Under this alternative, vessels would be allowed to transit through gear-restricted discrete areas, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types).

Alternative 4E: Allow for transit via change in VMS declaration

Under this alternative, vessels would be allowed to transit through gear-restricted discrete areas if they submit a VMS declaration specific to transit prior to crossing into designated discrete coral zones. This alternative would require NMFS to create a "transit" VMS declaration.

5.5 FRAMEWORK PROVISIONS TO ALLOW FUTURE MODIFICATIONS TO MANAGEMENT MEASURES

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. The MSB FMP contains a list of actions that are able to be taken via framework action. The following alternatives would modify that list to allow framework actions related to the proposed deep sea coral measures in this amendment. In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. The purpose of modifying the list of "frameworkable items" in the FMP is to demonstrate that the concepts included on the list has previously been considered in an amendment (i.e., they are not novel). The impacts of any future proposed action or change would be analyzed through a separate process, which would include public comment opportunities and documentation of compliance with all applicable laws (NEPA, MSA, MMPA, etc.).

Recently completed research surveys have observed deep sea corals in several submarine canyons within the Mid-Atlantic Council management area. Additional research is planned or ongoing and many data products will not be available within the planned timeline for this amendment. Modifying the framework provisions of the FMP would allow the Council to modify deep sea coral zones or management measures in response to new information or issues arising after implementation of the amendment.

In June 2015, the Council's motion identifying preferred alternatives for this alternative set specified that these framework adjustments "must be in keeping with the purpose of the amendment, to identify and implement measures that reduce to the extent practicable impacts of fishing gear on deep sea corals in the mid-Atlantic region." This indicates that the Council intends for any future framework actions falling under the preferred alternatives below to be consistent with this stated amendment goal.

Alternative 5A: No Action

Under this alternative, no changes would be made to the framework provisions of the MSB FMP. Any future modifications to the deep sea coral zones or associated management measures would likely have to be accomplished through an amendment to the FMP.

Alternative 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*

This alternative would give the Council the option to modify the boundaries of broad or discrete deep sea coral zones through a framework action.

Alternative 5C: Option to modify management measures within zones via framework action *(Council preferred)*

This alternative would give the Council the option to modify fishing restrictions, exemptions, monitoring requirements, and other management measures within deep sea coral zones through a framework action, including measures directed at gear and species not currently addressed in the FMP, with the purpose of such measures being to further the FMP's goal of protecting deep sea corals from physical damage from fishing gear or to prevent loss or damage to such fishing gear from interactions with deep sea corals. This would also include the ability to add a prohibition on anchoring (as discussed by the Council at their February 2015 meeting).

Alternative 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*

This alternative would allow the Council to add discrete coral zones through a framework action.

Alternative 5E: Option to implement special access program via framework action *(Council preferred)*

This alternative would give the Council the option to design and implement a special access program for commercial fishery operations in deep sea coral zones through a framework action.

5.6 VESSEL MONITORING ALTERNATIVES

Alternative 6A: No Action

Under this alternative, no changes would be made to the VMS requirements for *Illex* squid moratorium vessels. *Illex* vessels are not required to use VMS as a condition of the *Illex* permit, however, most *Illex* vessels do so to comply with requirements for other permits they hold (e.g., longfin squid or mackerel). As of June 2016, there were only three *Illex* permits that didn't also have a longfin or mackerel permit requiring VMS. Of those three, all of them had a scallop permit requiring VMS.

Alternative 6B: Vessel Monitoring Systems (VMS) requirement for *Illex* squid moratorium vessels *(Council preferred)*

This option would require use of VMS for all *Illex* squid moratorium vessels (regardless of whether fishing activity is occurring within or outside of any designated deep sea coral zones). As indicated above, as of June 2016, all *Illex* permitted vessels currently have VMS onboard to fulfill requirements for other permits.

5.7 ALTERNATIVES CONSIDERED BUT REJECTED

The following section contains options that were previously included in the range of alternatives, but have been removed from further consideration at this time.

1. Require Council review and approval for fishing within broad zones

- ***Sub-alternative:*** Implement special access program (for existing fisheries)
- ***Sub-alternative:*** Implement exploratory fishing access program (for potential new fisheries)
- ***Sub-alternative:*** Implement research/experimental access program (for scientific research)

This alternative set was considered but rejected primarily due to existing exemption and access programs that would serve essentially the same purpose. Specifically, Exempted Fishing Permits (EFPs) issued through the Greater Atlantic Regional Fisheries Office (GARFO) would cover many of the intended activities described under the sub-alternatives above. An EFP is a permit that authorizes a fishing vessel to conduct fishing activities that would be otherwise prohibited under the regulations at 50 C.F.R. part 648 or part 697. Generally, EFPs are issued for activities in support of fisheries-related research, including seafood product development and/or market research, compensation fishing, and the collection of fish for public display. Exploratory fishing as described in the sub-alternative above would be covered by the existing EFP program.

For a special access program, if the Council wishes to permit special access for any fishing activities, it is possible that such a system could be designed. However, the Council would need to give specific direction as to how such a system would operate, including who would be eligible, the types of fishing and species to be harvested. A special access program could additionally be considered at a later date via a framework action, provided that Alternative 5E, the option to implement a special access program via framework action, is implemented.

For scientific research, a statutory exemption is provided within the MSA, meaning scientific research activities are exempt from any and all MSA regulations. A Letter of Acknowledgement (LOA) can be obtained from the Regional Office that acknowledges certain activities as scientific research conducted from a scientific research vessel. A LOA is not required for scientific research, but serves as a convenience to the researcher and to law enforcement entities. To be considered a scientific research vessel, a vessel must be conducting scientific research activity under the direction of a foreign government agency, a U.S. government agency, a U.S. state or territorial agency, university or other accredited educational institution, international treaty organization, or scientific institution.

More information about EFPs, LOAs, and other exempted activity summarized above is available at: http://www.greateratlantic.fisheries.noaa.gov/aps/permits/forms/efploaeeaapossessionloaguidance.pdf.

2. Require observers on vessels fishing in broad coral zones

This alternative was considered but removed from the range of alternatives due to ongoing efforts to resolve issues related to observer coverage funding and industry cost-sharing. Specifically, an Omnibus Industry-Funded Monitoring Amendment is currently under development by the Mid-Atlantic and New England Fishery Management Councils, the content of which is directly related to these types of proposed requirements. The Omnibus amendment was initiated following NMFS's partial disapproval of both Amendment 5 to the Atlantic Herring FMP and Amendment 14 to the MSB FMP, which contained recommendations for 100 percent observer coverage for certain vessels and provisions for cost-sharing with industry participants. There is no current legal mechanism that allows NMFS and the fishing industry to share observer costs, and budget uncertainties have prevented NMFS from being able to commit to funding for increased observer coverage for particular fisheries.[13] Without a clear and viable funding source for this requirement, this alternative is not practical at this time. Once the Omnibus Industry-Funded Monitoring Amendment is completed, the Council may choose to address observer coverage requirements or targets within broad coral zones through a future framework action (provided that Alternative 5C to modify management measures within coral zones via Framework is implemented).

3. Require gear monitoring electronics on board to fish within broad or discrete zones (equipment monitoring gear distance from seafloor)

This alternative was proposed at the August 2013 Council meeting, and would require vessels operating in broad or discrete zones to have gear monitoring electronics on board that are able to read the distance from the seafloor at which the vessel's gear is operating. This alternative was ultimately removed from the range under consideration due to the need for further development, including clarification on how such a requirement would work and the specific purpose it would serve. Specifically, whether this alternative would serve as a tool for enforcement purposes, or simply as a tool for the vessel operator's knowledge (i.e., to facilitate avoiding bottom contact). More information is needed on how these systems would operate in the context of the proposed measures in this amendment, and the potential benefits to requiring them on board, including any potential intersection with enforcement.

This alternative was proposed in response to concerns regarding vessel movement in and around zones when fishing gear is not fully deployed. The FMAT and Council recognized the need for more information and development of measures to address these issues. Specifically, consideration of vessel needs for deployment and haulback of gear (which for squid trawl vessels often extends significantly behind the vessel) was warranted. Squid trawlers target specific high productivity areas in and around the heads of the canyons, near the continental shelf-slope break. Upon implementation of any discrete coral zones, future fishing activity near these zones would likely occur very near the boundaries of such zones. This would pose a potential problem for vessels positioning for gear deployment or haulback, or drifting into closed areas during these processes. The Council requested feedback and suggestions specific to this issue from the public and the Council's advisors during the public hearing process. Additionally, the Council requested comments on potential allowances and associated restrictions for transit through any potential coral zones (for example, transit allowances for vessels with stowed gear, etc.).

4. Exempt *Illex* and longfin squid fisheries from broad zone restrictions AND

5. Exempt *Illex* and longfin squid fisheries from discrete zone restrictions

Alternatives exempting the *Illex* and longfin squid fisheries from both broad and discrete zone were removed from consideration. The FMAT recommended that these alternatives be removed given that if the Council wished to avoid negative economic impacts to the squid fisheries, there exists a sufficient range of options within the document to do so, including the "no action" option under each alternative set as well as the option to designate the deepest depth-based broad

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[13] For more information, see the Omnibus Industry-Funded Monitoring Amendment documents available at: http://www.mafmc.org/actions/observer-funding-omnibus.

zone (500m). For analysis purposes under the National Environmental Policy Act (NEPA), when the above exemption alternatives are included in any set of alternatives taken in combination, the result is essentially a *status quo* situation in terms of impacts to the affected environment. Thus, these exemption alternatives would appear to be contrary to the "purpose and need" of the amendment if they would result in a lack of meaningful action in combination with other alternatives.

6. Depth-contour based boundaries for discrete coral zones

Under this alternative, the landward boundary designations of the discrete coral zones would follow one of the following depth contours: 200 m, 300 m, 400 m, or 500 m. The boundary would follow the contour until the point at which the depth contour boundary intersects with the original boundaries of the sides of the canyon, and follow the original boundaries on the seaward side. The FMAT recommended that these options be moved to "considered but rejected" for several reasons. The discrete zones are intended to encompass areas of coral presence and highly likely coral habitat, and therefore the revised discrete zone boundaries were drawn based on the best available scientific information about coral presence and suitable habitat. In the course of re-drawing the boundaries, the FMAT attempted to align any landward boundaries with one of the proposed depth contours. The FMAT found that the vast majority of proposed depth-contour based boundaries did not meet or approximate the criteria for drawing the boundaries based on coral presence and habitat suitability (see Appendix A). Given the differences across canyon and slope areas, there was additionally no consistent depth contour across proposed areas which would approximate areas of high coral habitat suitability. Finally, including these depth-contour based boundaries would result in many different sets of boundaries for each area that would not be meaningfully different from each other, nor would the depth-based boundaries be meaningfully different from the other alternatives under consideration. Therefore, these depth contour based alternatives for discrete zones were not further analyzed.

6.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The affected environment consists of those resources expected to experience environmental impacts if the actions under consideration in this amendment are implemented. The affected environment consists of several Valued Ecosystem Components (VECs), including components of the environment that could be affected by the management measures being considered in this amendment. These include:

- The physical environment, including Essential Fish Habitat (EFH);
- The managed resources (the managed species under this FMP, as well as other species managed by either the Mid-Atlantic or New England Fishery Management Council that may be affected by the management measures considered in this action);
- Deep sea corals (the resource this action is designed to protect);
- The human (socioeconomic) environment, including commercial fisheries likely to be impacted by this action); and
- Protected resources, including species and habitats protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA).

These environmental components are described in the sections below. Because of the spatial nature of the alternatives proposed in this action, the description of the affected environment is focused on the habitats, species, and fisheries that occur in deep offshore waters, near and beyond the continental shelf break. The coral zone management measures in this action are proposed only in offshore areas, mainly beyond 200 meters depth, with a small amount of area proposed for protection between 100 and 200 meters. Although some shifts in fishing effort are expected to result from the proposed action, these shifts are expected to be limited to areas in relatively close proximity to the proposed coral areas. In other words, because the fisheries affected by the proposed gear restricted areas are generally deep water fisheries operating in strategic areas near the continental shelf/slope break, fishing effort currently occurring in the proposed gear restricted areas is expected to be displaced to areas just outside the gear restricted areas (see Section 7.0). The proposed measures are thus not expected to impact nearshore fisheries, species, or habitats; for this reason, the description of the affected environment considers only offshore fisheries, species, and habitats potentially impacted by the proposed measures.

6.1 PHYSICAL ENVIRONMENT AND ESSENTIAL FISH HABITAT

6.1.1 Physical Environment

The following description of the physical environment is adapted from the NOAA Technical Memo “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” (Stevenson et al. 2004, available at: http://www.nefsc.noaa.gov/publications/tm/tm181/), and Levin and Gooday (2003).

The action area includes the Northeast U.S. Shelf Ecosystem, which has been described as including the area from the Gulf of Maine south to Cape Hatteras, extending from the coast seaward to the edge of the continental shelf, including the slope waters offshore to the Gulf Stream. The continental slope includes the area east of the shelf, out to a depth of 2000 m. Beyond the continental slope is a large, deeper area of the northwestern Atlantic Ocean that extends from the edge of the shelf out to the outer boundary of the U.S. Exclusive Economic Zone (EEZ). Four distinct sub-regions comprise the NOAA Fisheries Greater Atlantic Region: the Gulf of Maine, Georges Bank, the Mid-Atlantic Bight (MAB), and the continental slope. The Fishery Management Unit for the four species managed by the Atlantic Mackerel, Squid, and Butterfish FMP extends from Maine to the southern end of Florida, with a core area between Portland, Maine and Cape Hatteras, North Carolina (Figure 6). However, the physical environment that would be affected by this action is confined to the outer continental shelf and slope, primarily between Block and Norfolk canyons, and the deep-sea environment in and around the proposed coral areas shown in Figure 4. The physical environment described in the following pages is slightly broader in scope, extending northeast of Block Canyon to include similar outer shelf, slope, and deep-sea environments within the Greater Atlantic region on the southern flank of Georges Bank.

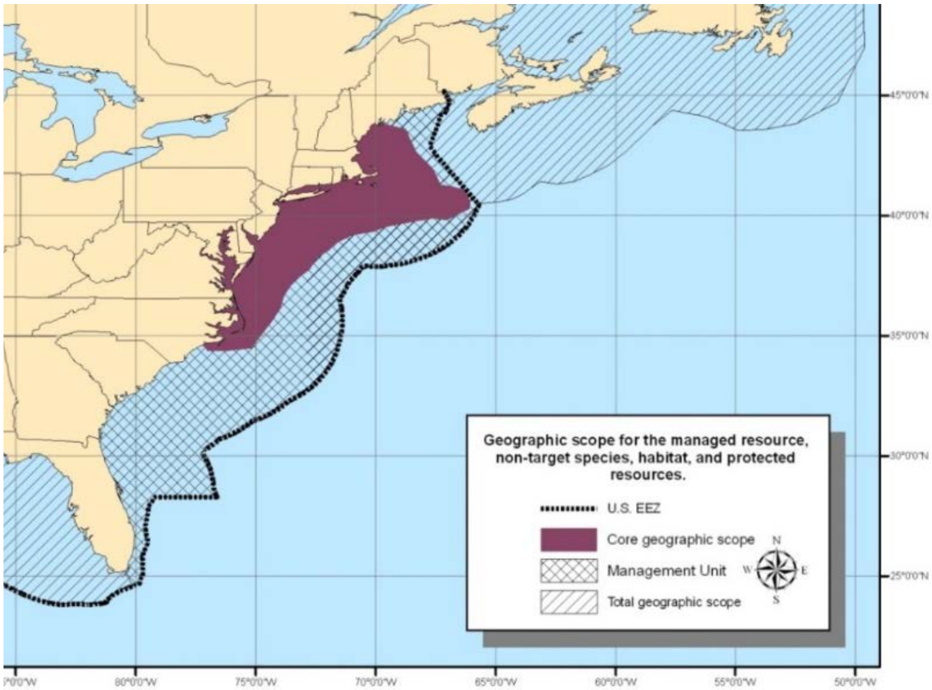

Figure 6: Geographic scope of the Atlantic mackerel, squid, and butterfish fisheries.

The continental slope extends from the continental shelf break, at depths between 60-200 m, eastward to a depth of 2000 m. The width of the slope varies from 10-50 km, with an average gradient of 3-6°; however, local gradients can be nearly vertical. The base of the slope is defined by a marked decrease in seafloor gradient where the continental rise begins. The morphology of the present continental slope appears largely to be a result of sedimentary processes that occurred during the Pleistocene, including, 1) slope upbuilding and progradation by deltaic sedimentation principally during sea-level low stands; 2) canyon cutting by sediment mass movements during and following sea-level low stands; and 3) sediment slumping.

The slope is cut by at least 70 large canyons between Georges Bank and Cape Hatteras and numerous smaller canyons and gullies, many of which may feed into the larger canyon systems. In New England, within the U.S. EEZ, there are also four seamounts (Bear, Mytilus, Retriever, and Balanus) which are part of the larger New England Seamount Chain, which extends eastward into the Atlantic Ocean. There are no known major seamounts within the Mid-Atlantic Council region’s federal waters.

Sediments generally become progressively finer with increasing depth and distance from land, although in some areas submarine canyons channel coarser sediments onto the continental slope and rise. A “mud line” occurs on the slope at a depth of 250-300 m, below which fine silt and clay-size particles predominate. Localized coarse sediments and rock outcrops are found in and near canyon walls, and occasional boulders occur on the slope because of glacial rafting. Sand pockets may also be formed because of downslope movements. Gravity induced downslope movement is the dominant sedimentary process on the slope, and includes slumps, slides, debris flows, and turbidity currents, in order from thick cohesive movement to relatively nonviscous flow. Slumps may involve localized, short, down-slope movements by blocks of sediment. However, turbidity currents can transport sediments thousands of kilometers.

A benthic sediment map from the Continental Margin Mapping Program (CONMAP) series, relative to Council preferred coral zones, is shown in Figure 7. This sediment map is a compilation of grain-size data produced by the U.S. Geological Survey (USGS) and includes both published and unpublished studies. Sediment was classified using the 1929 Wentworth grain-size scale and the 1954 Shepard scheme of sediment classification. Certain grain-size categories are combined because of the paucity of some sediment textures. True boundaries between sediment types are highly irregular or gradational. This is due to textural variability not characterized at this scale, and because the accuracy of the navigational systems used during the earlier studies is limited. Sediment classification reflects the dominant surficial sediment type for that area and does not infer that other sediment types are not present. Blank parts of the maps indicate areas where data are insufficient to infer sediment type. This data layer is supplied primarily as a gross overview and to show general textural trends.

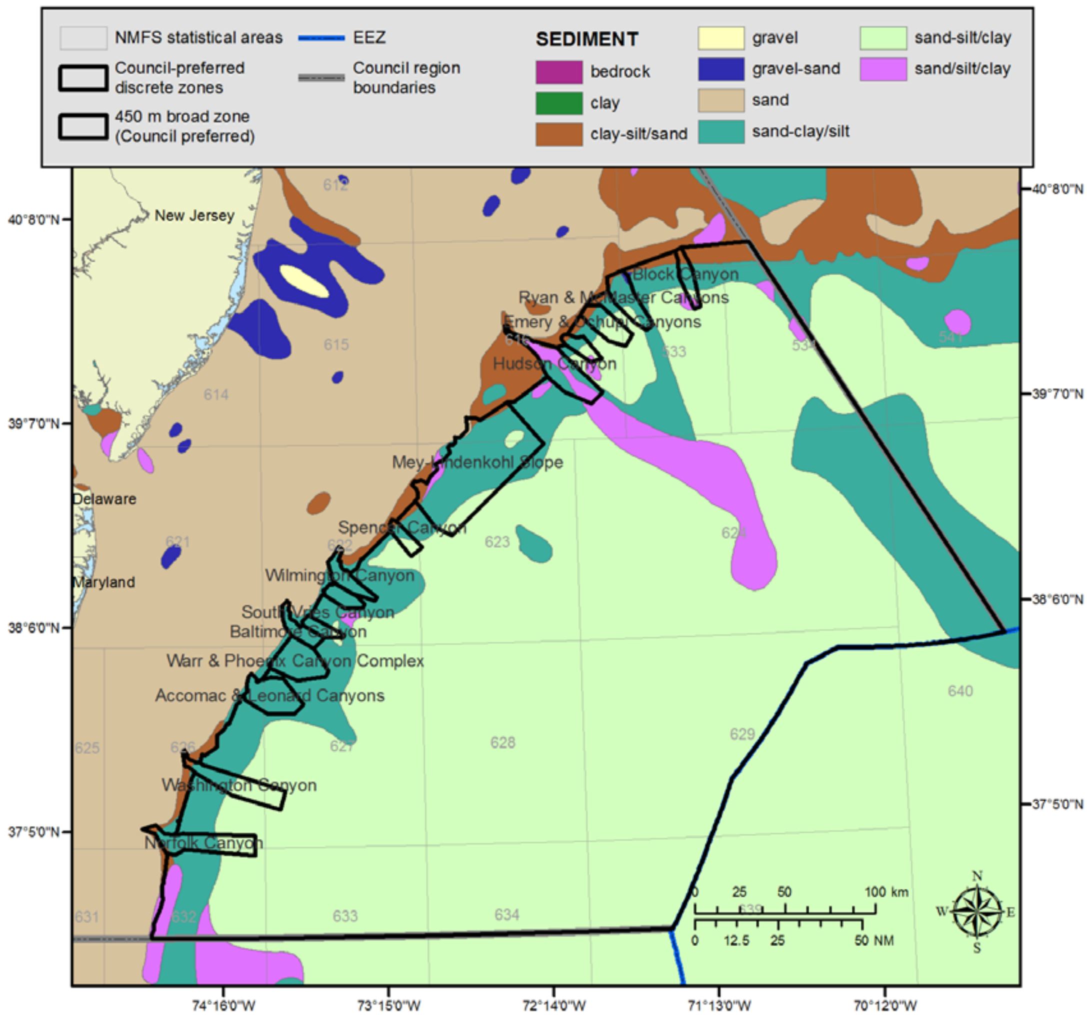

Figure 7: Atlantic Seafloor Sediment (CONMAP), relative to Council preferred coral zones.[14]

[14] Metadata available at: https://coast.noaa.gov/arcgis/rest/services/MarineCadastre/PhysicalOceanographicAndMarineHabitat/MapServer/11.

Submarine canyons are not spaced evenly along the slope, but tend to decrease in areas of increasing slope gradient. Canyons are typically “v” shaped in cross section and often have steep walls and outcroppings of bedrock and clay. The canyons are continuous from the canyon heads to the base of the continental slope. Some canyons end at the base of the slope, but others continue as channels onto the continental rise. Larger and more deeply incised canyons are generally significantly older than smaller ones, and there is evidence that some older canyons have experienced several episodes of filling and re-excavation. Many, if not all, submarine canyons may first form by mass-wasting processes on the continental slope, although there is evidence that some canyons were formed because of fluvial drainage (e.g., Hudson Canyon). Canyons can alter the physical processes in the surrounding slope waters. Fluctuations in the velocities of the surface and internal tides can be large near the heads of the canyons, leading to enhanced mixing and sediment transport.

As discussed in Obelcz et al. (2014), submarine canyons can be differentiated into two main categories: shelf-sourced and slope-sourced canyons. Shelf-sourced canyons can extend several kilometers into the shelf break. Slope-sourced canyons tend to be closely-spaced, have heads located deeper than the shelf edge, and primarily capture sediment released during local slope failures. During the Pleistocene, when sea level was much lower, rivers delivered significant volumes of sediment to the outer shelf, much of which was transported directly into shelf-sourced canyons and funneled offshore into deep sea fans. The primary geomorphological features of the five major shelf-sourced canyons in the Mid-Atlantic (Norfolk, Washington, Baltimore, Wilmington, and Hudson Canyons), as presented in more detail in Obelcz et al. (2014) and Rona et al. (2015), are described below. Despite broad scale morphological similarities between these canyons, they each display distinct differences in their finer scale morphology, orientation, steepness, and geology. Within individual canyons, marked differences are also observed on a finer scale (e.g., by depth, proximity to slope, eastern vs. western or northern vs. southern walls). The rest of the canyons being considered in this action are on the continental slope, although some of them cut into the shelf to some extent. Block Canyon is a small, narrow canyon that, judging from its geomorphology, is also a shelf-sourced canyon. All the canyons being considered in this action for discrete coral protection zones are shown in detail in Section 7.3.4.

Hudson Canyon

Hudson Canyon is the largest shelf-sourced canyon on the US Atlantic coast and one of the largest in the world, extending for over 400 km from the outer shelf down to the upper continental rise at about 3500 m depth. The Hudson River channel extends seaward into New York Bay, where it links with the Hudson Shelf Valley. This valley extends southeast as a shallow trough 5-40 meters below the surrounding shelf surface, with a width of approximately 4-16 km. Shortly seaward of where the Hudson Shelf Valley ends, the canyon begins, cutting through the continental shelf and slope for 50 km as a gorge with a floor ranging from 120 to 2000 meters depth, and a maximum relief of about 1200 m. Rim to rim widths range from 5-10 km. The head of Hudson Canyon contains two bifurcating branches in the initial 10 km section of the canyon (around 100 to 300 meters depth). Many ridges and gullies intersect the canyon walls perpendicularly from the canyon axis. Canyon morphology changes with increasing depth, along with a distinct asymmetry between the eastern and western walls of the canyon (Rona et al. 2015). Sediment distribution data indicates the presence of coarse-grained sediment at the canyon rims and walls, mostly along the eastern side, while a cover of fine sediment accumulates on the western flank of the canyon. The head of Hudson Canyon is recognized as a commercial and recreational fishing “hot spot,” according to fishing industry reports as well as fishery independent and fishery dependent survey information (Rona et al. 2015).. In addition to high primary productivity in the area, this canyon’s status as a fisheries hotspot may also be due to its physical features that provide structured habitat spaces. A detailed description of the topography, sediments, habitat types, and biodiversity in the head of Hudson Canyon is provided in Pierdomenico et al. (2015).

Wilmington Canyon

Wilmington Canyon, located about 130 km south of Delaware Bay, extends approximately 19 km landward of the shelf edge, and is the second largest of the five shelf-sourced canyons in the Mid-Atlantic Council region. There is some evidence that Wilmington and Baltimore Canyon originated from the same fluvial system, based on their proximity, similar sizes, and stratigraphic features. Wilmington Canyon is possibly linked to more than one drainage system, including the former Great Egg and/or Delaware Rivers, and possibly the Hudson. The bidirectional orientation and large size of this canyon is possibly explained by connections to multiple drainages. The main shape of Wilmington Canyon includes a large, ~45° eastward bend about halfway along its length within the shelf. Toward the head of the canyon, cross sections are primarily U-shaped, while south of the axial bend, the canyon is primarily V-shaped. The northern wall of this canyon is locally steeper and contains a greater number of tributary canyons compared to the southern wall. Seaward of the axial bend, both walls are cut by steep tributary canyons. Where these tributary canyons meet the main canyon axis, many 20-150m high bathymetric escarpments, or “hanging valleys” are found. These are present in several other shelf-sourced canyons, but most common in Wilmington Canyon. These hanging valleys indicate differential rates of erosion between the primary canyon axis and tributary canyons, most likely due to higher rates of erosion by sediment passing through the primary canyon during periods when sea level was much lower than it is today (Obelcz et al. 2014).

Baltimore Canyon

Baltimore Canyon is located ~30m to the south of Wilmington Canyon, and is smaller in all dimensions, and relatively more U-shaped or flat bottomed. The head of Baltimore Canyons contains a series of bathymetric steps and terraces just below the canyon rim in depths of 110-130 m below sea level that can be traced laterally for several kilometers. The main axis of Baltimore Canyon contains several wide meanders, beginning from about 5 km into the canyon. The steepness and roughness of the northern vs. southern walls is relatively symmetric over the length of the canyon; however, both walls increase in roughness starting about 8 km down the canyon (Obelcz et al. 2014).

Washington Canyon

Washington Canyon, located about 130 km east of Chesapeake Bay, is the smallest of the shelf-sourced canyons described here. The axis of the canyon changes orientation approximately 10 km from the canyon head, then runs perpendicular to the shelf edge for the remaining 6 km to the shelf edge. Washington Canyon has a steeper axial gradient compared to Norfolk, Wilmington, and Baltimore Canyons. The northern wall, between the thalweg and the 500-meter depth contour, is steeper and contains greater evidence for mass wasting than the southern wall.

Generally, hanging valleys are not observed at the confluences between tributary canyons and the main canyon axis (Obelcz et al. 2014).

Norfolk Canyon

Norfolk Canyon, located south of Wilmington Canyon, has a sigmoidal shape with a broad axial bend seaward of its head. Just seaward of this bend, the canyon walls are intersected by many tributary canyons and gullies. Throughout the canyon, the northern wall is steeper and rougher than the southern wall. Norfolk Canyon also contains a broad terrace on the north wall near the shelf edge, below the canyon rim. A distinct difference in sediment mineralogy on the shelf suggests that both Norfolk and Washington Canyon (the two southernmost canyons described here) had different sources of sediment than the other, more northern shelf-sourced canyons (Baltimore, Wilmington, and Hudson) (Obelcz et al. 2014).

Biological Communities

Benthic organisms that inhabit the continental slope are strongly zoned by depth and/or water temperature, although these patterns are modified by the presence of topography, including canyons, channels, and current zonations (Hecker 1990). Moreover, at depths of less than 800 m, the fauna is extremely variable and the relationships between faunal distribution and substrate, depth, and geography are less obvious (Wiebe et al. 1987). Fauna occupying hard surface sediments are not as dense as in comparable shallow water habitats (Wiebe et al. 1987), but there is an increase in species diversity from the shelf to the intermediate depths of the slope. Diversity then declines again in the deeper waters of the continental rise and plain. Hecker (1990) identified four megafaunal zones on the slope of Georges Bank and southern New England (Table 2).

Table 2: Faunal zones of the continental slope of Georges Bank and Southern New England. Source: Hecker 1990.

Zone	Approx. Depth (m)	Gradient	Current	Fauna
Upper Slope	300 - 700	Low	Strong	Dense filter feeders; Scleratinians (*Dasmosmilia lymani, Flabellum alabastrum*), quill worm (*Hyalinoecia*)
Upper Middle Slope	500 - 1300	High	Moderate	Sparse scavengers; red crab (*Geryon quinqueidens*), long-nosed eel (*Synaphobranchus*), common grenadier (*Nezumia*). Alcyonarians (*Acanella arbuscula, Eunephthya florida*) in areas of hard substrate
Lower Middle Slope/Transition	1200 - 1700	High	Moderate	Sparse suspension feeders; cerianthids, sea pens (*Distichoptilum gracile*)
Lower Slope	> 1600	Low	Strong	Dense suspension and deposit feeders; ophiurid (*Ophiomusium lymani*), cerianthids, sea pens

Another study in the Mid-Atlantic Bight was carried out by Hecker et al. (1983) on the continental margin (100 m to 2300 m) east of New Jersey. Five major zones were observed, with faunal breaks at 400 m, 750 m, 1450 m and 1600 m. The megafauna between 200 and 400 m comprised mainly crabs (Cancer spp., *Munida iris*), sea pens (*Stylatula elegans*), and anemones (*Cerianthus borealis*). Between 400 m and 750 m dominants were the red crab (*Geryon quinquedens*), the anemone *Bolocera tuediae*, quill worms (*Hyalinoecia artifex*), rattails

(*Nezumia spp.*) and hake (*Urophycis chesteri*). Between 700 m and 1400 m the eel *Synaphobranchus spp.* became dominant. From 1400 m to 2300 m *Ophiomusium lymani* and *Echinus affinis*, cerianthid anemones and the sea pen *Distichoptilum gracile* were dominant. Megafaunal abundances were highest in the shallower (<600 m) and deeper (>1400 m) parts of the margin. Species richness was higher in areas with boulders, outcrops and cliffs than in primarily muddy areas (Hecker et al. 1983).

One group of organisms of interest because of the additional structure they can provide for habitat and their potential long life span are the gorgonian and alcyonacean deep sea corals. These corals can be bush or treelike in shape; species found in this form attach to hard substrates such as rock outcrops or gravel. These species can range in size from a few millimeters to several meters, and the trunk diameter of large specimens can exceed 10 cm. A detailed description of the types, distributions, and importance of deep-sea corals in the region can be found in Section 6.3.

As opposed to most slope environments, canyons may develop a lush epifauna. Hecker et al. (1983) found faunal differences between the canyons and slope environments. Hecker and Blechschmidt (1979) suggested that faunal differences were due at least in part to increased environmental heterogeneity in the canyons, including greater substrate variability and nutrient enrichment. Hecker et al. (1983) found highly patchy faunal assemblages in the canyons, and also found additional faunal groups located in the canyons, particularly on hard substrates, that do not appear to occur in other slope environments. Canyons are also thought to serve as nursery areas for a number of species (see Section 6.3.3; Cooper et al. 1987; Hecker 2001). Shallow water (<230 meters) canyon habitats and common benthic fauna on Georges Bank in Table 3 were reported by Cooper et al. (1987).

Table 3: Habitat types for the canyons of Georges Bank, including characteristic fauna in depths less than 230 meters. Source: Cooper et al. 1987.

Habitat Type	Geologic Description	Canyon Locations	Most Commonly Observed Fauna
I	Sand or semiconsolidated silt substrate (claylike consistency) with less than 5% overlay of gravel. Relatively featureless except for conical sediment mounds.	Walls and axis	Cerianthid, pandalid shrimp, white colonial anemone, Jonah crab, starfishes, portunid crab, greeneye, brittle stars, mosaic worm, red hake, fourspot flounder, shellless hermit crab, silver hake, gulf stream flounder
II	Sand or semiconsolidated silt substrate (claylike consistency) with more than 5% overlay of gravel. Relatively featureless.	Walls	Cerianthids, galatheid crab, squirrel hake, white colonial anemone, Jonah crab, silver hake, sea stars, ocean pout, brittle stars, shellless hermit crab, greeneye
III	Sand or semiconsolidated silt (claylike consistency) overlain by siltstone outcrops and talus up to boulder size. Featured bottom with erosion by animals and scouring.	Walls	White colonial anemone, pandalid shrimp, cleaner shrimp, rock anemone, white hake, sea stars, ocean pout, conger eel, brittle stars, Jonah crab, lobster, blackbelly rosefish, galatheid crab, mosaic worm, tilefish
IV	Consolidated silt substrate, heavily burrowed/excavated. Slope generally more than 5º and less than 50º. Termed “pueblo village” habitat.	Walls	Sea stars, blackbelly rosefish, Jonah crab, lobster, white hake, cusk, ocean pout, cleaner shrimp, conger eel, tilefish, galatheid crab, shellless hermit crab
V	Sand dune substrate.	Axis	Sea stars, white hake, Jonah crab, goosefish

Table 4 lists species of fish observed during 34 dives in four different bottom habitat types over a depth range of 234-1001 meters with a remotely-operated underwater vehicle (ROV) in Baltimore and Norfolk canyons in 2012 and 2013. The habitat types were classified as: SS= Sand/mud bottom; SSB=steeply sloping mostly sand/mud bottom; GRR=gravel, rocks, rubble fields; WRR=canyon walls, rocks, and ridges. At least 84 unique fish taxa in 52 families were identified from ROV transects across all habitats in the two canyons. Of all the fishes observed during 144 hours of bottom observations, relatively few (Table 4) dominated each of the four habitats. Cutthroat eels were, by far, the most commonly observed group of fishes, especially in the SSB and WRR habitats. In addition to cutthroat eels, blackbelly rosefishes, shortbeard codlings, spotted barracudinas, longfin hakes, and grenadiers were common in all four habitats, although codlings and rosefishes were better represented in the more rugged habitats. In a multivariate comparison between habitat types, fishes associated with sand (the least complex habitat) were significantly different from all other habitats (Ross et al. 2015). Myctophids, grenadiers, longfin hake, greeneyes, and witch flounder were more common in sandy habitats than in the other three habitats.

Ross and his colleagues also reported a strong influence of depth on fish assemblage structure in these two canyons. The taxa observed at depths shallower than 1400 meters were different than those in deeper water, with a gradual faunal transition between about 800 and 1200 meters. A third group of fishes had wide depth ranges overlapping the two extreme groups. In addition to the ROV observations, Ross et al. (2015) also collected fishes in 40 otter trawl tows over a depth range of 103-1712 meters, mostly along the edges and outside of the two canyons where soft, towable bottom could be found. Trawling added 34 benthic species and seven families not identified during ROV dives.

Table 4: Common taxa of fishes (>1%) observed during 34 ROV dives in Baltimore and Norfolk canyons expressed as percentage of total number observed in four bottom habitat types (see text). Source: Ross et al. (2015).

Taxa	Common name	SS	SSB	GRR	WRR
Synaphobranchus spp.	Cutthroat eels	22.65	48.06	20.01	43.50
Chlorophthalmus agassizi	Shortnose greeneye	2.92			
Arctozenus risso	Spotted barracudina	1.81	3.80	3.16	3.82
Ceratoscopelus maderensis	Horned lanternfish			2.78	
Myctophidae	Lantern fishes	9.58			
Coryphaenoides rupestris	Rock grenadier				
Nezumia bairdii	Common grenadier	6.72	3.89	1.67	
Nezumia sp.	Grenadier	6.75	3.32	2.11	1.19
Laemonema barbatula	Shortbeard codling	1.77	5.12	15.35	13.34
Brosme brosme	Cusk			1.13	2.35
Phycis chesteri	Longfin hake	10.03	6.31	4.35	1.94
Merluccis albidus	White hake	1.96			
Ophidiiformes	Cusk-eels		1.09		
Benthocometes robustus	Robust cusk eel				1.37
Dicrolene intronigra	Species of cusk eel	1.30	2.28		
Lophius americanus	Monkfish	1.42		2.93	
Hoplostehus mediterraneus	Silver roughy				2.96
Hoplostethus spp.	Roughy			1.65	5.23
Helicolenus dactyolopterus	Blackbelly rosefish	3.77	9.63	24.87	11.01
Epigonidae	Deepwater cardinalfishes	1.44			
Lycenchelys verrillii	Wolf eel	2.58	1.47		
Glyptocephalus cynoglossus	Witch flounder	14.05	4.84		
Symphurus sp.	Tonguefish			11.73	5.65

6.1.2 Essential Fish Habitat

Pursuant to the Magnuson-Stevens Act Essential Fish Habitat (EFH) Provisions (50 CFR Part 600.815 (a)(1)), an FMP must describe EFH by life history stage for each of the managed species in the plan. This information was updated in Amendment 11 to the MSB FMP in 2011. EFH for the four species managed under this FMP is described using fundamental information on habitat requirements by life history stage that is summarized in a series of EFH source documents produced by NMFS and available at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. The updated EFH designations (text and maps) are available at http://www.habitat.noaa.gov/protection/efh/efhmapper/.

EFH for northern shortfin squid is found on the outer continental shelf and slope to a maximum depth of 400 meters and for Atlantic mackerel to depths between 300 and 400 meters. All four MSB species, however, are pelagic. Squid migrate up in the water column at night and down in the daytime in response to the daily vertical migrations of their prey. Characteristics of EFH for life stages of other federally-managed species on the outer continental shelf and slope in the Mid-Atlantic that could be affected by the management measures included in this amendment are described in Table 5. An additional species not included in this table is monkfish: current EFH descriptions for this species specify a maximum depth of 200 meters, but they have been caught in bottom trawls at depths of 500 meters on the continental slope in the Mid-Atlantic and have been reported at 600 meters in Norfolk Canyon (Steimle et al. 1999b).

Table 5: Depth ranges and habitat types currently described as EFH for managed species and life stages* on the Mid-Atlantic outer continental shelf and slope (>200 meters) with year of designation.

Species	Life Stage	Depth (m)	Habitat	Date
Acadian redfish	Juveniles	25-400	Silt, mud, or hard bottom	1998
	Adults	50-350		
Atlantic butterfish	Juveniles	10-280	Pelagic	2011
	Adults			
Atlantic mackerel	Juveniles	0-320	Pelagic	2011
	Adults	0-380		
Deep-sea red crab	Juveniles	700-1800	Silt and clay substrates	2002
	Adults	200-1300		
Golden tilefish	Juveniles/ adults	100-300	Burrows in semi-consolidated clay substrate	2009
Ocean quahogs	Juveniles/ adults	8-245	In substrate to depth of 3 feet	1998
Northern shortfin squid	Juveniles/ adults	40-400	Pelagic	2011
Offshore hake	Juveniles	170-350	Bottom habitats	2000
	Adults	150-380		
Rosette skate	Juveniles/ adults	33-530, mostly 74-274	Sand and mud	2003
Silver hake	Juveniles	20-270	Bottom habitats over all substrate types	1998
	Adults	30-325		
Witch flounder	Juveniles	50-450 to 1500	Bottom habitats with fine-grained substrate	1998
	Adults	25-300		
White hake	Juveniles	5-225	Pelagic waters and bottom substrates of mud or fine-grained sand	1998
	Adults	5-325		

* = excludes egg and larval stages

6.2 MANAGED RESOURCES

This section describes the managed resources that would potentially be affected by measures proposed in this action. In addition to the Atlantic mackerel, butterfish, longfin squid, and *Illex* squid fisheries managed under this FMP, this action may impact several additional fisheries managed by either or both the MAFMC and the NEFMC.

Potentially affected fisheries, considered as combinations of target species and gear types, were identified by using Vessel Trip Report (VTR) and dealer data from 2000-2013. First, VTR data was used to identify major species-gear combinations reporting fishing activity in or near the proposed coral areas, using the single latitude and longitude point reported on each submitted VTR. There is some uncertainty associated with the reported fishing locations on VTR records, given that only a single latitude/longitude point is reported for each trip. However, examining many records over a long time period can reliably show which fisheries tend to operate in or near the proposed coral zones.

For the second part of this analysis, revenue generated from trips taken within the proposed coral areas was estimated for major species-gear combinations, by linking each trip's VTR record to revenues reported through seafood dealer reports (see Section 7.0 for more details). These revenue estimates were compared to total coastwide revenues over the same time period in order to identify fisheries that would potentially be impacted by this action. Based on data from 2000-2013, the major identified species-gear combinations to be considered include:

1. Bottom otter trawl – Squid (*Illex* and longfin)
2. Bottom otter trawl – Silver hake (whiting)[15]
3. Bottom otter trawl – Summer flounder, scup, and black sea bass[16]
4. Pots/Traps – Deep sea red crab
5. Bottom longline – Golden tilefish
6. Dredge – Sea scallops

This analysis also identified American lobster trap fishing effort as occurring in these areas; however, because this action would not apply to lobster fisheries (see Section 4.4), this gear-species combination was excluded from further analysis. Each of the identified target species is described below in terms of biological characteristics, stock status, and a brief management overview. Social and economic characteristics of each fishery, as well as additional management descriptions, are described in Section 6.4.

6.2.1 Atlantic Mackerel

Atlantic mackerel (*Scomber scombrus*) is a schooling, semi-pelagic/semi-demersal species (may be found near the bottom or higher in the water column), distributed between Newfoundland, Canada and North Carolina. Two distinct groups of Atlantic mackerel have been identified, including a northern contingent and a southern contingent. The two contingents overwinter primarily along the continental shelf between the MAB and Nova Scotia, although it has been suggested that overwintering occurs as far north as Newfoundland. With the advent of warming shelf water in the spring, the two contingents begin migration, with the northern contingent moving along the coast of Newfoundland and historically into the Gulf of St. Lawrence for spawning from the end of May to mid-August. The southern contingent spawns in the mid-Atlantic and Gulf of Maine from mid-April to June, then moves north to the Gulf of Maine and Nova Scotia. In late fall, migration turns south and fish return to the over-wintering grounds (Didden 2015a). Biochemical studies (Mackay 1967) have not established that genetic differences exist between the two groups and precise estimates of the relative contributions of the two groups cannot be made (ICNAF 1975). Atlantic mackerel in the northwest Atlantic are assessed as a unit stock and are considered one stock for fishery management purposes.

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[15] Analysis conducted for this document identified silver hake (*Merluccius bilinearisl*) as a primary species caught in or near the proposed coral zones. Silver hake is managed by the NEFMC under the small-mesh multispecies FMP, which also includes red hake (*Urophycis chuss*) and offshore hake (*Merluccius albidus*). There are two stocks of silver hake (northern and southern), two stocks of red hake (northern and southern), and one stock of offshore hake, which primarily co-occurs with the southern stock of silver hake. There is little to no separation between silver and offshore hake in the fishery or the market. Catches of silver and offshore hake are generally known and sold as "whiting," while the fishery that harvests any of these species is known as the "whiting fishery." The southern silver hake catch limit is adjusted to account for the average catches of offshore hake, which are often mixed with silver hake or have often been misreported as landings of silver hake. As such, information about both silver hake and offshore hake is provided in the description of the affected environment.

[16] Summer flounder, scup, and black sea bass are considered together given that the commercial harvest of these three species occurs predominately in a mid-Atlantic mixed trawl fishery. These species are managed by the MAFMC under a single FMP.

All Atlantic mackerel are sexually mature by age 3, while about 50% of the age 2 fish are mature. Average size at maturity is about 10.5-11" fork length (Grosslein and Azarovitz 1982).

Atlantic mackerel are opportunistic feeders that can ingest prey either by individual selection of organisms or by passive filter feeding (Pepin et al. 1988). Juveniles eat mostly small crustaceans such as copepods, amphipods, mysid shrimp and decapod larvae, and also feed on small pelagic molluscs (*Spiratella* and *Clione*) when available. Adult diets are similar, but also include a wider assortment of organisms and larger prey items, including euphausiid, pandalid and crangonid shrimp, chaetognaths, larvaceans, pelagic polychaetes and the larvae of many marine species (Berrien 1982).

Atlantic mackerel is an important prey species and is known to be preyed upon by many pelagic and demersal fish species, as well as by marine mammals and seabirds (Didden 2015a). The most recent stock assessment estimated mackerel mortality for a subset of key finfish predators, but estimates for marine mammals and seabirds are not available (TRAC 2010). Additional life history information is detailed in the EFH document for the species (Studholme et al. 1999).

The mackerel stock was most recently assessed via a Transboundary Resource Assessment Committee in 2010 (TRAC 2010), which analyzed data through 2008. Given the uncertainty in the assessment results, the TRAC agreed that short term projections and characterization of stock status relative to estimated reference points would not be an appropriate basis for management advice. Since the 2010 TRAC also identified substantial technical issues with the preceding assessment, the status of mackerel is currently classified as "unknown" with respect to stock status (overfished and overfishing status). Recent results from the Northeast Fisheries Science Center (NEFSC) Spring Trawl survey are highly variable, according to the “NEFSC Biological Update” that is created as part of the annual quota setting process (NEFSC 2015a).

The fisheries for Atlantic mackerel in the Greater Atlantic Region operate primarily in the Mid-Atlantic region from Massachusetts to North Carolina, using predominantly single and paired mid-water trawl, bottom trawl, purse seine, and to a lesser extent, gillnet gear. More information on the biology and management of Atlantic mackerel, including recent management documents, can be found at: http://www.greateratlantic.fisheries.noaa.gov/sustainable/species/msb/index.html. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.3.1.

6.2.2 Atlantic butterfish

Atlantic butterfish (*Peprilus triacanthus*) is a semi-pelagic/semi-demersal schooling fish species primarily distributed between Nova Scotia, Canada and Florida, and most abundant from the Gulf of Maine to Cape Hatteras (Didden 2015b). Butterfish is a fast growing species that forms loose schools by size. They winter near the edge of the continental shelf in the MAB and migrate inshore in the spring into southern New England and Gulf of Maine waters. During the summer, butterfish occur over the entire mid-Atlantic shelf from sheltered bays and estuaries out to about 200m depth. In late fall, butterfish move southward and offshore in response to falling water temperatures (MAFMC 2015b).

Butterfish are short-lived and grow rapidly; while they seldom attain an age greater than 3 years, they can occasionally live up to 6 years. Butterfish mature at age 1, spawn during the summer months (June-August), and begin schooling at about 60 mm in size (Collete and Klein-MacPhee, 2002). Juvenile butterfish range from 16 mm to about 120 mm. During their first year, they grow to 76-127 mm, or about half their adult size. Adult butterfish range from about 120 mm to 305mm with an average length of 150-230 mm. Approximately half of 120 mm fish are mature for butterfish collected on the northeast shelf, which corresponds to an age of about 1 year (MAFMC 2015b).

Butterfish exhibit a planktivorous diet, feeding mainly on zooplankton, ctenophores, chaetognaths, euphausiids and other organisms. Butterfish are preyed upon by a large number of medium-sized predatory fishes such as bluefish, weakfish, and spiny dogfish, large pelagic fish including swordfish, marine mammals including pilot whales and common dolphins, seabirds such as greater shearwaters and northern gannets, and invertebrates such as squid (Cross et al. 1999). Recent assessments have explored consumption of butterfish by a subset of key finfish predators but estimates for marine mammals, birds, and invertebrates are not available (Didden 2015b). Additional life history information is detailed in the EFH document for the species (Cross et al. 1999).

Butterfish was previously considered overfished, until the most recent benchmark stock assessment in March 2014 concluded that the stock is above target stock size and experiencing low fishing mortality; thus, the stock is not overfished and overfishing is not occurring (NEFSC 2014a).

The fisheries for Atlantic butterfish in the Greater Atlantic Region operate primarily in the Mid-Atlantic region from Massachusetts to North Carolina, using predominantly single and paired mid-water trawl, bottom trawl, and purse seine. Butterfish itself has historically been primarily a bycaught/discarded species. However, a small directed fishery for butterfish exists, and other fish species caught in this directed fishery include: red hake, silver hake, spiny dogfish, scup, unclassified skate, fourspot flounder, longfin squid, Atlantic mackerel, and little skate. More information on the biology and management of Atlantic butterfish, including recent management documents, can be found at: http://www.greateratlantic.fisheries.noaa.gov/sustainable/species/msb/index.html. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.2.

6.2.3 Longfin squid

Longfin squid (*Doryteuthis (Amerigo) pealeii*), formerly named *Loligo* squid, is a semi-pelagic/semi-demersal schooling cephalopod species primarily distributed in continental shelf waters located between Newfoundland and the Gulf of Venezuela (Didden 2015c). In the northwest Atlantic Ocean, longfin squid are most abundant in the waters between Georges Bank and Cape Hatteras, NC where the species is commercially exploited. A recent genetics study indicates that the population inhabiting the waters between Cape Cod Bay, MA and Cape Hatteras, NC is a single stock (Shaw et al. 2010). The species migrates long distances during its short lifespan. North of Cape Hatteras, longfin squid migrate offshore during late autumn to overwinter in warmer waters along the shelf edge and slope, and then return inshore during the spring where they remain until late autumn (Jacobson 2005).

Recruitment occurs throughout the year with seasonal peaks in overlapping “microcohorts” which have rapid and different growth rates. As a result, seasonally stable biomass estimates may mask substantial population turnover. Recruitment is largely driven by environmental factors. For most squid species, temperature plays a large role in migrations and distribution, growth, and spawning. Individuals hatched in warmer waters during the summer grow more rapidly than those hatched in winter and males grow faster and attain larger sizes than females (NEFSC 2011).

Longfin serves as a key prey species for a variety of marine mammals, diving birds, and finfish species. Natural mortality is very high; especially for spawners. Additional life history information is detailed in the EFH document for the species (Jacobson 2005).

The life history characteristics of short-lived squid present unique challenges to stock assessments and most of the traditional approaches that have been used for finfish species have not been successfully applied to squid stocks (Boyle and Rodhouse 2005). Longfin squid was last assessed in 2010 (NEFSC 2011). The assessment indicated that the longfin squid stock was not overfished in 2009, but overfishing status cannot be determined because no overfishing threshold was recommended (though the assessment did describe the stock as "lightly exploited"). The assessment essentially found that the longfin squid stock appears to have successfully supported the range of observed catches (9,600-26,100 mt) during 1976-2009, as well as relatively high levels of finfish predation during 1977-1984 and 1999-2009. Assessment documents are available at: http://www.nefsc.noaa.gov/saw/reports.html. Recent results from the NEFSC Trawl surveys are highly variable, and are graphed in the "NEFSC Biological Update" that is created as part of the annual quota setting process (NEFSC 2015b).

The fisheries for longfin squid in the Greater Atlantic Region operate primarily in the Mid-Atlantic region from Massachusetts to North Carolina, using predominantly single and paired mid-water trawl, bottom trawl, and purse seine. More information on the biology and management of longfin squid, including recent management documents, can be found at: http://www.greateratlantic.fisheries.noaa.gov/sustainable/species/msb/index.html. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.3.

6.2.4 Illex squid

Illex squid (*Illex illecebrosus*) is a semi-pelagic/semi-demersal schooling cephalopod species distributed between Newfoundland and the Florida Straits. The age and growth of *Illex* has been well studied relative to other squid species. Based on a statolith age analysis, *Illex* squid residing in U.S. waters have a maximum lifespan of about 215 days (about 7 months, Hendrickson 2004).

Illex is a terminal spawner with a protracted spawning season. The only confirmed spawning area is located in the MAB where the winter cohort spawns during late May (Hendrickson 2004). Spawning may also occur offshore in the Gulf Stream/Slope Water frontal zone.

Illex feed primarily on fish, cephalopods (i.e., squid) and crustaceans. Fish prey include the early life history stages of Atlantic cod, Arctic cod and redfish, sand lance, mackerel, Atlantic herring, haddock and scalping. *Illex* also feed on adult capelin, smelt and mummichogs. Cannibalism is significant, and *Illex* also feed on longfin squid. When *Illex* are offshore in the spring, they primarily consume euphausiids, whereas they consume mostly fish and squid when they are inshore in the summer and fall. *Illex* also consume less crustaceans and more fish as they grow larger. *Illex* are an important prey species and are known to be preyed upon by many pelagic and demersal fish species, as well as by marine mammals, seabirds, and longfin squid (Didden 2015d). Additional life history information is detailed in the EFH document for the species (Cargnelli et al. 1999b).

The stock status of *Illex* is unknown with respect to being overfished or experiencing overfishing. The stock was most recently assessed in 2006, with data through 2004, at SARC 42 (NEFSC 2006). It was not possible to evaluate current stock status because there were no reliable current estimates of stock biomass or fishing mortality rate. In addition, no projections were made in SAW 42. The previous assessment, SAW 37, also could not evaluate current stock status because there were no reliable estimates of absolute stock biomass or fishing mortality to compare with existing reference points. However, based on a number of qualitative analyses, it was determined that overfishing was not likely to have occurred during 1999-2002 (Didden 2015d). Recent results from the NEFSC Trawl surveys are highly variable, and are graphed in the "NEFSC Biological Update" that is created as part of the annual quota setting process (NEFSC 2015b).

The fisheries for *Illex* squid in the Greater Atlantic Region operate primarily in the Mid-Atlantic region from Massachusetts to North Carolina, using predominantly single and paired mid-water trawl, bottom trawl, and purse seine. More information on the biology and management of *Illex* squid, including recent management documents, can be found at: http://www.greateratlantic.fisheries.noaa.gov/sustainable/species/msb/index.html. Additional management information and social and economic descriptions of the fishery can be found in Section 6.4.4.

6.2.5 Summer Flounder, Scup, and Black Sea Bass

These species are considered together here given that the commercial harvest of these three species occurs predominately in a mid-Atlantic mixed trawl fishery. Summer flounder, scup, and black sea bass have been managed under a single FMP since 1996 when black sea bass and scup were incorporated into the summer flounder FMP. Because of their presence in, and movement between, state waters (0-3 miles) and federal waters (3-200 miles), the Council manages summer flounder, scup, and black sea bass cooperatively with the Atlantic States Marine Fisheries Commission (ASMFC). The two management entities work in conjunction with NMFS as the federal implementation and enforcement entity.

The management unit for summer flounder (*Paralichthys dentatus*) consists of the U.S. waters in the western Atlantic Ocean from the southern border of North Carolina northward to the U.S.-Canadian border. The management unit for both scup (*Stenotomus chrysops*) and black sea bass (*Centropristis striata*) is U.S. waters in the western Atlantic Ocean from Cape Hatteras, North Carolina northward to the U.S.-Canadian border. All three species migrate annually from inshore waters in the warmer months to offshore waters in the colder months. The exact timing of this migration varies with latitude.

Information on life history and stock status is summarized for all three species below. Reports on stock status, including annual assessment and reference point update reports, Stock Assessment Workshop (SAW) reports, Stock Assessment Review Committee (SARC) reports, are available online at the Northeast Fisheries Science Center (NEFSC) website: http://www.nefsc.noaa.gov/. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.5.

Summer Flounder

Summer flounder (*Paralichthys dentatus*) is a demersal flatfish found in waters from Canada to South Carolina (possibly to Florida), primarily south of Cape Cod. Summer flounder spawn during the fall and winter over the open ocean areas of the continental shelf. From October to May, larvae and postlarvae migrate inshore, entering coastal and estuarine nursery areas. Juveniles are distributed inshore and in many estuaries throughout the range of the species during spring, summer, and fall. Adult summer flounder exhibit strong seasonal inshore-offshore movements, normally inhabiting shallow coastal and estuarine waters during the warmer months of the year and remaining offshore during the colder months. In spring, summer flounder are distributed in warmer waters on the southern shelf and shelf break to depths of approximately 500 ft (152 m). In the fall, they are primarily on inner shelf at depths of less than 200 ft (61 m).

Summer flounder habitat includes pelagic waters, demersal waters, saltmarsh creeks, seagrass beds, mudflats, and open bay areas from the Gulf of Maine through North Carolina. Summer flounder are opportunistic feeders; their prey includes a variety of fish and crustaceans. While the natural predators of adult summer flounder are not fully documented, larger predators (e.g., large sharks, rays, and monkfish) probably include summer flounder in their diets (Packer et al. 1999).

Male and female growth rates vary substantially, with males growing more slowly. Males rarely live longer than 10 years, whereas females may live for up to 20 years and attain weights of about 25 lb (Bolz et al. 1999). In the 2013 benchmark stock assessment for summer flounder, the median length at maturity was estimated as 26.0 cm (10.2 inches) for male summer flounder, 29.2 cm (11.5 inches) for female summer flounder, and 26.8 cm (10.5 inches) for the sexes combined. The median age of maturity for summer flounder was determined to be 1.1 years for males, 1.4 years for females, and 1.2 years for both sexes combined (NEFSC 2013). Additional life history information is detailed in the EFH document for the species (Packer et al. 1999), available at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/.

Summer flounder was under a rebuilding plan from 1993 through the fall of 2011. The most recent summer flounder benchmark stock assessment took place in 2013 as part of 57th SAW (NEFSC 2013). This assessment indicated that the summer flounder stock was not overfished and overfishing was not occurring in 2012. In June 2015, the NEFSC updated this assessment with commercial and recreational fishery data and research survey indices of abundance through 2014. This assessment update indicated that the stock was not overfished, but that overfishing was occurring in 2014, compared to the Spawning Stock Biomass (SSB) and fishing mortality (F) biological reference points from the 2013 benchmark assessment. SSB in 2014 was estimated to be about 88.90 million pounds, about 65% of the SSB_{MSY} proxy (proxy for spawning stock biomass at maximum sustainable yield, i.e., $SSB_{35\%}$) of 137.55 million pounds and about 29% higher than the overfished threshold of 68.78 million pounds (i.e., ½ $SSB_{35\%}$). F in 2014 was estimated to be 0.359, about 16% higher than the F_{MSY} proxy (i.e., $F_{35\%}$) of 0.309. This change in the status of the summer flounder stock may be partly due to lower than expected recruitment. The assessment update showed that five of the last seven year classes were initially over-estimated by 22% to 49% in the stock assessment. The assessment update showed that recruitment (i.e., the number of age 0 fish) was below average from 2010 through 2013. The assessment update also showed past under-estimations of F and over-estimation of SSB (NEFSC 2015d). There is also evidence of illegal harvest in recent years in the form of unreported, underreported, or misreported landings, which may have contributed the stock status issues highlighted in the recent assessment update.

Scup

Scup (*Stenotomus chrysops*) are a schooling, demersal (i.e., bottom-dwelling) species found in a variety of habitats in the Mid-Atlantic. Scup are distributed primarily between Cape Cod and Cape Hatteras. EFH for scup includes demersal waters, areas with sandy or muddy bottoms, mussel beds, and sea grass beds from the Gulf of Maine through Cape Hatteras, North Carolina. Scup undertake extensive seasonal migrations between coastal and offshore waters. Scup are found in estuaries and coastal waters during the spring and summer, and in the fall and winter they move offshore and to the south, to overwinter in outer continental shelf waters south of New Jersey to North Carolina at depths of 250-610 feet (76-186 m). In spring, they migrate north and inshore to New Jersey, New York, and southern New England where they remain until fall. Scup spawn once annually over weedy or sandy areas, mostly off of southern New England. Spawning takes place from May through August, peaking in June and July (Steimle et al. 1999a).

About 50% of scup are sexually mature at two years of age (at about 17 cm total length). Nearly all scup older than three years of age are sexually mature. Scup reach a maximum age of at least 14 years. They may live as long as 20 years; however few scup older than age 7 are caught in the mid-Atlantic (NEFSC 2015e).

Adult scup are benthic feeders. They consume a variety of prey, including small crustaceans (including zooplankton), polychaetes, mollusks, small squid, vegetable detritus, insect larvae, hydroids, sand dollars, and small fish. The NEFSC food habits database lists several predators of scup, including several shark species, skates, silver hake, bluefish, summer flounder, black sea bass, weakfish, lizardfish, king mackerel, and goosefish. Additional life history information is detailed in the EFH document for the species (Steimle et al. 1999a), available at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/.

Scup was under a formal rebuilding plan from 2005 through 2009. NMFS declared the scup stock rebuilt in 2009 based on the findings of a benchmark stock assessment for scup in 2008 (DPSWG 2009). The most recent benchmark stock assessment for scup took place in 2015 as part of the 60th SAW. This assessment found that the scup stock was not overfished and overfishing was not occurring in 2014 relative to the new biomass reference points. SSB was estimated to be 403 million pounds in 2014, about 210% of the SSB_{MSY} proxy (i.e., $SSB_{40\%}$) of 192 million pounds. F in 2014 was estimated to be 0.127, about 57% of the F_{MSY} proxy (i.e., $F_{40\%}$) of 0.220 (NEFSC 2015e).

Black Sea Bass

Black sea bass (*Centropristis striata*) are distributed from the Gulf of Maine through the Gulf of Mexico. Adults and juveniles are mostly found on the continental shelf, but young of the year (i.e., fish less than one year old) can be found in estuaries. Adults prefer to be near structures such as rocky reefs, coral patches, cobble and rock fields, mussel beds, and shipwrecks. Adults in the Mid-Atlantic show strong site fidelity during the summer but migrate to offshore wintering areas south of New Jersey when water temperatures decrease in the fall. Adults in the South Atlantic and Gulf of Mexico do not migrate during the winter (Drohan et al. 2007).

Black sea bass are protogynous hermaphrodites, meaning that they are born female but later transition to males, usually around 2-5 years of age. Male black sea bass are either of the dominant or subordinate type. Dominant males are larger than subordinate males and develop a bright blue nuccal hump during the spawning season. About half of black sea bass are sexually mature by 2 or 3 years of age and about 20 cm in length. Most black sea bass greater than 19 cm are either in a transitional stage between female and male or have fully transitioned to the male stage. Studies have shown that fishing pressure can decrease the age of transition from female to male. Black sea bass reach a maximum size of about 60 cm and a maximum age of about 12 years (Drohan et al. 2007; DPSWG 2009).

Black sea bass in the mid-Atlantic spawn in nearshore continental shelf areas at depths of 20-50 m. Spawning usually takes place between April and October. During the summer, adult black sea bass share complex coastal habitats with tautog, hakes, conger eel, sea robins and other migratory fish species. EFH for black sea bass consists of pelagic waters, structured habitat, rough bottom, shellfish, sand, and shell, from the Gulf of Maine through Cape Hatteras, North Carolina. Juvenile and adult black sea bass mostly feed on crustaceans, small fish, and squid. The NEFSC food habits database lists spiny dogfish, Atlantic angel shark, skates, spotted hake, summer flounder, windowpane, and goosefish as predators of black sea bass. Additional life history information is detailed in the EFH document for the species (Drohan et al. 2007), available at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/.

The protogynous life history and structure-orienting behavior of black sea bass pose challenges for analytical assessments of this species. Most stock assessments of mid-Atlantic species rely heavily on data collected during the NEFSC's biannual bottom trawl survey. This survey does not sample areas with physical structure that are used extensively by black sea bass for habitat.

The northern stock of black sea bass (i.e., black sea bass north of Cape Hatteras, North Carolina) was under a rebuilding plan from 2000 until 2009. Black sea bass were declared rebuilt based on the findings of the Data Poor Stocks Working Group, which performed a benchmark stock assessment for black sea bass in 2008 (DPSWG 2009). This remains the most recent benchmark stock assessment for black sea bass that has passed peer review and been accepted for use in management. This assessment was last updated in 2012. This update indicated that the stock was not overfished and overfishing was not occurring in 2011 relative to the biological reference points from the last benchmark stock assessment. F was estimated to be 0.21 in 2011, about 48% of the F_{MSY} reference point of 0.44. SSB was estimated to be 24.6 million pounds in 2011, slightly above SSB_{MSY} reference point of 24.0 million pounds (NEFSC 2012).

A 2015 data update indicates that commercial and recreational landings of black sea bass have been relatively stable over the past several years. Fisheries-independent survey data indicate that a very large year class entered the population in 2011. That cohort continues to be the most dominant year class in the population (NEFSC 2015c).

6.2.6 Golden Tilefish

Golden tilefish (*Lopholatilus chamaeleonticeps*) are found along the outer continental shelf and slope from Nova Scotia, Canada to Surinam on the northern coast of South America, in depths of 250 to 1500 feet (76-457 m). In the southern New England/mid-Atlantic area, tilefish generally occur at depths of 250 to 1200 feet (76-366 m). Two stocks have been identified: one in the mid-Atlantic/southern New England and the other in the Gulf of Mexico and the south of Cape

Hatteras (MAFMC 2016). The management unit is all golden tilefish under U.S. jurisdiction in the Atlantic Ocean north of the Virginia/North Carolina border.

Tilefish are relatively slow growing and long-lived, with a maximum observed age of 46 years and a maximum length of 110 cm for females and 39 years and 112 cm for males. Tilefish of both sexes are mature at ages between 5 and 7 years (NEFSC 2014a).

Tilefish are generally found in and around submarine canyons where they occupy burrows in the sedimentary substrate (NEFSC 2014a). Their habitat is a relatively restricted band, approximately 80-540 m deep and 8-17°C, known as the "warm belt" on the outer continental shelf and upper slope of the northwest Atlantic coast. Within this band, tilefish are more abundant near the 15°C isotherm which occurs between 100-240 m (Steimle et al. 1999b).

There are indications that at least some of the population is relatively non-migratory. Tilefish are shelter-seeking and adults have been observed and photographed using rocks, boulders, and the scour depressions beneath them, exposed rocky ledges, and horizontal and vertical burrows in semi-lithified clay outcrops on the upper slopes, flanks, and shoulders of submarine canyons (Steimle et al. 1999b). Able et al. (1982) suggested that sediment type might control the distribution and abundance of the species, and the longline fishery for tilefish in the Hudson Canyon area is primarily restricted to areas with Pleistocene clay substrate (Turner 1986).

Freeman and Turner (1977) suggest that tilefish are not restricted to a specific burrow, but may move within a local area. They noted that larger fish are less abundant at depths greater than 238 m, which is also true of the population south of Cape Hatteras (Low et al. 1983). The mean size of tilefish was greatest at intermediate depths (approximately 200-240 m) for both the northern and southern stocks (Low et al. 1983).

Amendment 1 to the Tilefish FMP (MAFMC 2009) re-examined and revised EFH designations for tilefish, narrowing the temperature and depth ranges previously designated. The revised juvenile and adult EFH designations also include detailed descriptions of sediment types required for burrowing and other benthic habitat features that provide shelter for tilefish (see Section 6.1.2 and Table 5). Although the revised designations emphasize temperature and substrate type (clay) over depth as being indicative of EFH, depth was used for the purposes of mapping the EFH designations. Depth is fixed and not seasonally variable, therefore the depth ranges that define the area where the preferred bottom temperatures conditions typically prevail (100 to 300 meters, or 328 ft to 984 ft) were used to create maps of benthic EFH for juvenile and adult tilefish on the outer continental shelf and slope from the U.S./Canadian boundary to the Virginia/North Carolina boundary. The EFH Source Document, which includes details on stock characteristics and ecological relationships, is available from: http://www.nefsc.noaa.gov/nefsc/habitat/efh/.

Amendment 1 also designated Habitat Areas of Particular Concern (HAPCs) for juvenile and adult tilefish in portions of Norfolk, Veatch, Lydonia, and Oceanographer canyons on the outer continental shelf and slope that are known to have clay outcrop/pueblo habitats,[17] a habitat type

[17] The complex of burrows in clay outcrops along the slopes and walls of submarine canyons, and elsewhere on the outer continental shelf, have been called "pueblo habitat", because of their similarity to human structures in the southwestern United States.

that is particularly sensitive to fishing impacts. Within these designated HAPCs, Amendment 1 prohibited the use of bottom-tending mobile gear, creating four tilefish GRAs.[18]

The examination of stomach and intestinal contents by various investigators reveal that tilefish feed on a great variety of food items. Prey items identified in tilefish stomachs include several species of crabs, mollusks, annelid worms, polychaetes, sea cucumbers, anemones, tunicates, shrimp, sea urchins, and several species of fishes. Freeman and Turner (1977) reported that crustaceans were the principal food items of tilefish, regardless of size, with the squat lobster (*Munida*) and spider crabs (*Euprognatha*) being by far the most important crustaceans.

Able et al. (1982) concluded that a primary function of tilefish burrows was predator avoidance. The NEFSC database only notes goosefish as a predator. While tilefish are sometimes preyed upon by spiny dogfish and conger eels, by far the most important predator of tilefish is other tilefish (Freeman and Turner 1977). It is also probable that large bottom-dwelling sharks of the genus *Carcharhinus*, especially the dusky and sandbar, prey upon free swimming tilefish.

Golden tilefish was under a stock rebuilding strategy beginning in 2001 until it was declared rebuilt in 2014, when the stock underwent its most recent benchmark stock assessment. This assessment was peer reviewed and approved for use by management at the 58th SAW (NEFSC 2014a). The tilefish resource was not overfished and overfishing was not occurring in 2012. SSB was estimated be 11.53 million lb (5,229 mt) in 2012, about 101% of the biomass target SSB_{MSY} proxy = $SSB_{25\%}$ = 11.36 million lb (5,153 mt). The fishing mortality rate was estimated to be 0.275 in 2012, below the fishing mortality threshold F_{MSY} proxy = $F_{25\%}$ = 0.370.

The FMP for this species became effective in 2001, and included management and administrative measures to ensure effective management of the golden tilefish resource. Tilefish are primarily caught by bottom longline gear (directed fishery) and otter trawl gear (incidental fishery). The FMP implemented a limited entry program and a tiered commercial quota allocation of the overall allowable landings. Amendment 1 to the Golden Tilefish FMP created an IFQ (Individual Fishing Quota) program, effective in 2009. The commercial golden tilefish fisheries (IFQ and incidental) are managed using catch and landings limits, commercial quotas, trip limits, gear regulations, permit requirements, and other provisions as prescribed by the FMP.

Reports on stock status, including SAW and SARC reports and assessment update reports are available online at the Northeast Fisheries Science Center (NEFSC) website: http://www.nefsc.noaa.gov/. The Golden Tilefish FMP, including subsequent Amendments and Frameworks, are available on the Council website at: http://www.mafmc.org/fisheries/fmp/tilefish. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.6.

6.2.7 Deep-Sea Red Crab

The Atlantic deep-sea red crab (*Chaceon quinquedens*) is a slow-growing crustacean, with an estimated life span of fifteen years or more. The red crab is patchily distributed along the

[18] Of these four GRAs, only Norfolk Canyon is within the Mid-Atlantic Council region and therefore within the action area for this Deep Sea Corals Amendment. The Council preferred broad and discrete coral zone alternatives were drawn to follow the majority of the landward boundary of the Norfolk Canyon Tilefish GRA. For exact coordinates of all Tilefish GRAs, see tilefish regulations at: http://www.nero.noaa.gov/regs/fr.html.

continental shelf edge and slope of the western Atlantic, primarily at depths of 400-1800 m between Emerald Bank, Nova Scotia and the Gulf of Mexico, as well as parts of the Gulf of Maine. Juvenile red crab live in deeper waters than adult red crab, and for the majority of the year, males are generally distributed in deeper waters than females (NEFMC 2011).

There is limited information about red crab spawning locations and times. Erdman et al. (1991) suggested that the egg brooding period may be about nine months, at least for the Gulf of Mexico population, and larvae are hatched in the early spring there. There is no evidence of any restricted seasonality in spawning activity in any geographic region of the population, although a mid-winter peak is suggested as larval releases are reported to extend from January to June (Wigley et al. 1975; Haefner 1977; Lux et al. 1982; Erdman et al. 1991).

Based on laboratory observations, larvae probably consume zooplankton. Juveniles and adults are opportunistic feeders. Post-larval, benthic red crabs eat a wide variety of infaunal and epifaunal benthic invertebrates (e.g., bivalves) that they find in the silty sediment or pick off the seabed surface. Smaller red crabs eat sponges, hydroids, mollusks (gastropods and scaphopods), small polychaetes and crustaceans, and possibly tunicates. Larger crabs eat similar small benthic fauna and larger prey, such as demersal and mid-water fish (*Nezumia* and myctophids), squid, and the relatively large, epibenthic, quill worm (*Hyalinoecia artifex*). They can also scavenge deadfalls (e.g., trawl discards) of fish and squid, as they are readily caught in traps with these as bait and eat them when held in aquaria.

Deep-sea red crab is considered a data poor stock since they inhabit deep water, are rarely caught in the trawl survey, and there is little information about their life history. Only male red crabs are landed in the trap fishery, which is managed by the NEFMC via the Atlantic Deep-Sea Red Crab FMP, implemented in 2002. The species is managed as a single stock, though red crabs in the Gulf of Maine are not included in reference point, biomass, or management calculations.

Deep sea red crab was most recently assessed at the Data Poor Stock Working Group in 2008. The assessment found that as of 2008, the stock status was unknown. Additional information regarding stock status can be found in the assessment report (DPSWG 2009), available at: http://www.nefsc.noaa.gov/saw/datapoor/.

Since implementation of the FMP, the biological and economic information about the red crab resource and fishery has been updated in a 2004 SAFE Report, a 2006 Stock Assessment Workshop, and through the January 2009 DPSWG and Review Panel Report. These reports provide additional data to supplement the first red crab assessment completed over 30 years ago (Wigley et al. 1975).

The directed, limited access red crab fishery is a male-only fishery, currently managed under a "hard" quota (i.e., the fishery is closed when the quota is reached), gear restrictions, and limits on processing crabs at sea. Although there is an open access permit category, the small possession limit of 500 pounds per trip has kept this sector of the fishery very small. The directed red crab fishery is limited to using parlor-less crab pots, and is considered to have little, if any, incidental catch of other species. Landings of red crab varied somewhat before the implementation of the FMP, but have stabilized (NEFMC 2016).

The management unit for red crab includes all U.S. waters of the Atlantic Ocean from 35° 15.3' N. lat. (the latitude of Cape Hatteras Light, North Carolina) northward to the U.S./Canada border. The fishery operates in this range, setting conical mesh traps along the 350 fathom (640 m) depth contour. This depth is targeted to allow for male-only harvest, as red crabs segregate by sex and depth, and take of female crabs is prohibited.

According to EFH source document, adult red crabs appear to be primarily associated with soft sediments, specifically "smooth or dimpled, unconsolidated and consolidated silt-clay sediments." (Steimle et al. 2001). However, some reports indicate that red crab catch occurs both on hard and soft bottom. Haefner and Musick (1974) and Gray (1970) reported that red crab appear to have a preference for inter-canyon habitat, finding lower catch rates within canyons than on the slope adjacent to the canyon. However, Valentine (1980) found that red crabs were more common in Oceanographer Canyon compared to the southern edge of Georges Bank. Auster et al. (1991) found a more random distribution around the 700 meter depth contour, without apparent aggregations.

More information on the red crab resource, including the FMP, amendments, and specifications documents are available at: http://www.nefmc.org/management-plans/red-crab. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.7.

6.2.8 Silver Hake (Whiting)

The small-mesh multispecies fishery consists of three species: Silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and offshore hake (*Merluccius albidus*). There are two stocks of silver hake (northern and southern), two stocks of red hake (northern and southern), and one stock of offshore hake, which primarily co-occurs with the southern stock of silver hake. Catches of silver and offshore hake are known as "whiting," while the fishery that harvests any of these species is known as the "whiting fishery." As previously noted, analysis conducted for this document identified silver hake (*Merluccius bilinearis*) as a primary species caught within the proposed coral zones. However, there is little to no separation between silver and offshore hake in the fishery or the market. Catches of silver and offshore hake are generally known and sold as "whiting," while the fishery that harvests any of these species is known as the "whiting fishery." The southern silver hake ABC is adjusted by 4 percent to account for the average catches of offshore hake, which are often mixed with silver hake or have often been misreported as landings of silver hake. As such, information about both silver hake and offshore hake is provided in the description of the affected environment.

Silver and offshore hake are slender, fast swimming gadids that are often found in dense schools associated with specific hydrographic conditions, prey concentrations, and spawning requirements. Analyses of bottom trawl catches in U.S waters show that adult silver hake are found throughout the survey area (Cape Hatteras, North Carolina to Cape Sable, Nova Scotia) in winter and spring, but are concentrated in deep basins in the Gulf of Maine and along the continental slope from Nova Scotia to Cape Hatteras. Silver hake generally occur at depths less than 200 m but can be found in depths up to 900 m. In the NEFSC trawl survey, larger and older fish are found further north and in deeper waters, and smaller younger fish are found in relatively shallow waters. Depth appears to be a more important determinant of silver hake distribution than temperature (Morse et al. 1999).

During spring and summer, silver hake move into nearshore waters in the Gulf of Maine, to the northern edge of Georges Bank, and northward in the Middle Atlantic Bight. By autumn, they return again to the deeper basins in the Gulf and along the continental slope. Major spawning areas are coastal Gulf of Maine, southern Georges Bank, and waters south of Rhode Island. Silver hake are relatively fast growing, reach sexual maturity at 2-3 years of age (20-30 cm), and live a maximum of 15 years, although in recent years few fish older than 6 years are caught.

In terms of substrate associations, in the NEFSC trawl survey, catch rates increase from fine sand to silt to clay; and are generally higher in all these than on coarser substrates (Methratta and Link 2006). Silver hake have been observed at high densities in mud habitats bordering deep boulder reefs, resting on boulder surfaces, and foraging over deep boulder reefs in the southwestern Gulf of Maine (Auster and Lindholm 2005). This species makes greater use of the water column (for feeding, at night) than other two hakes and avoids gravel, rocky habitats, preferring fine sediments and deeper water (>70 m for adults).

The diet of silver hake consists primarily of fish, crustaceans, and squids, depending on the size, age, and sex of the silver hake. Young fish (< 20 cm) eat mainly crustaceans, such as euphausiids and shrimps. As silver hake grow they consume a larger proportion of fish and individuals > 35 cm feed almost exclusively on fish, including smaller hake and other schooling fishes such as young herring, mackerel, menhaden, alewives, sand lance, or silversides, as well as crustaceans and squids (Morse et al. 1999).

Offshore hake (*Merluccius albidus*) are found along the shelf/slope break. Their distribution in the Northeast US extends from the southeastern flank of Georges Bank to Cape Hatteras. At night, juveniles and adults are found in the water column. During the day, both life stages are found in mud, mud/sand, and sand habitats. As their common name implies, offshore hake have the deepest distribution of any of the four hake species managed by NEFMC. There is little information available on the reproductive biology of offshore hake. Spawning appears to occur over a protracted period or even continually throughout the year from the Scotian Shelf through the Mid-Atlantic Bight. Offshore hake feed on pelagic invertebrates, e.g. euphausiids and other shrimps, and pelagic fish, including conspecifics.

Silver hake, red hake, and offshore hake were last assessed at the 51st SAW in November-December 2010 (NEFSC 2011). Northern and southern silver hake are assessed separately. While a formal analytical assessment was attempted, the model was deemed insufficient for use in providing management advice, due in part to questions about survey catchability across ages and years. Based on reference points updated during the assessment, the silver hake stocks are not overfished and overfishing is not occurring. The biomass reference point is based on catch per tow in the trawl survey, and the fishing mortality reference point is based on an exploitation index, i.e. fishery catch divided by the survey catch per tow biomass index.

The results of the most recent silver hake stock assessment update can be found in the SAFE Report for Fishing Year 2013 (NEFMC 2013b). Results of the assessment update show that both stocks of silver hake are not overfished and overfishing is not occurring. The three year average fall biomass index in the north and south are both above the overfished management threshold. The exploitation index measured as the ratio of catch to survey has remained consistently low since the previous benchmark assessment and well below the management overfishing definition thresholds.

For offshore hake, it was determined that there is insufficient evidence to make a status determination for the stock, and current reference points were rejected. The primary issues in determining reference points are that the surveys cover an unknown and variable portion of the stock, and that commercial catch data are insufficient to understand trends.

Reports on stock status, including SAW and SARC reports and assessment update reports are available online at the Northeast Fisheries Science Center (NEFSC) website: http://www.nefsc.noaa.gov/. The EFH Source Document, which includes details on stock characteristics and ecological relationships, is available at the following website: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.8.

6.2.9 Atlantic Sea Scallops

The Atlantic sea scallop (*Placopetcen magellanicus*) is a bivalve mollusk that is distributed along the continental shelf, typically on sand and gravel bottoms from the Gulf of St. Lawrence to North Carolina. The species generally inhabit waters less than 20°C and depths that range from 30-110 m on Georges Bank, 20-80 m in the Mid-Atlantic, and less than 40 m in the near-shore waters of the Gulf of Maine.

Egg and larval stages are pelagic until the larvae settle to the seabed. Spat survival is enhanced on sedentary branching plants or animals, and on hard surfaces. Juveniles and adults occur on sand, gravel, and areas of mixed sand and gravel substrates. They are also associated with shell debris. Once settled, scallops are generally sessile, although they do exhibit local movements, e.g. for predator avoidance. Larval sea scallops are pelagic filter feeders; juveniles and adults are benthic suspension feeders.

Although all sea scallops in the U.S. EEZ are managed as a single stock, assessments focus on two main parts of the stock and fishery that contain the largest concentrations of sea scallops: Georges Bank and the Mid-Atlantic, which are combined to evaluate the status of the whole stock.

The scallop assessment is a very data rich assessment. The overall biomass and recruitment information are based on results from several surveys including: the NEFSC federal survey; a School for Marine Science and Technology (SMAST) video survey; Virginia Institute of Marine Science (VIMS) paired tow dredge survey; and towed camera survey conducted by Arnie's Fishery. These data sources are combined in the assessment of the resource and in models used to set fishery allocations.

A benchmark assessment for sea scallops was last conducted in 2014 (SARC59, NEFSC 2014b). SARC 59 included a formal stock status update through 2013, and updated reference points including Fmsy=0.32 and B=132,000 mt. In 2013, the stock was not overfished and overfishing was not occurring.

In general, Mid-Atlantic scallop biomass is declining. This is primarily from the depletion of the large biomass in the Elephant Trunk and several years of poor recruitment (2009-2011). However, stronger Mid-Atlantic recruitment has been observed in 2012 and 2013. Once these scallops grow larger, biomass in the Mid-Atlantic is expected to increase.

Most limited access effort is from vessels using scallop dredges, including small dredges. The number of vessels using scallop trawl gear has decreased continuously and has been at 11 full-time trawl vessels since 2006. In comparison, there has been an increase in the number of full-time and part-time small dredge vessels after 2002. About 80% of the scallop pounds are landed by full-time dredge and about 13% landed by full-time small dredge vessels since fishing year 2007.

Reports on stock status, including SAW and SARC reports and assessment update reports are available online at the Northeast Fisheries Science Center (NEFSC) website: http://www.nefsc.noaa.gov/. The EFH Source Document, which includes details on stock characteristics and ecological relationships, is available at the following website: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. Additional management information, catch trends, and social and economic descriptions of the fishery can be found in Section 6.4.9.

6.3 DEEP SEA CORALS

Deep sea corals, also referred to as cold-water corals, are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deep or cold oceanic waters. Most occur below 50 meters depth, but some species are known to occur in shallower waters (NOAA 2010). Deep sea corals are unlike shallow water corals often found in tropical ecosystems in that they do not possess the symbiotic photosynthetic algae known as zooxanthellae, which produce food for corals found in shallow waters. Deep sea corals are sessile invertebrates that exist mainly in areas where photosynthesis cannot occur due to lack of light, and so instead they must obtain food from their environment. Corals prey on zooplankton, and rely on currents to deliver a supply of food as well as to disperse larvae and remove waste products. Deep sea corals are often extremely long-lived and slow growing animals, making them particularly vulnerable to physical disturbance. Coral aggregations grow slowly, at rates of approximately 4-25 mm per year, resulting in very slow recovery from any disturbance. Some of the oldest deep sea coral reefs in the world are believed to be thousands of years old (Foley et al. 2010).

Given suitable water, current, and substrate conditions, many types of deep sea corals can form complex reef-like structures or other types of three-dimensional complex habitats. These structures may occur as individual small colonies less than a meter in diameter or they may form aggregations that can create vast reef complexes tens of kilometers across and tens of meters in height over time. These “structure-forming” deep sea corals tend to have complex branching morphology and the ability to grow to sufficient size to provide substrate or refuge for associated fishes and invertebrates. There is increasing evidence that many areas of deep coral and sponge habitats function as ecologically important habitats for fish and invertebrates. Structure-forming corals include many different types of corals, thus representing a functional group of conservation interest, rather than a single taxonomic group (Lumsden et al. 2007).

6.3.1 Types of Deep Sea Corals in the Greater Atlantic Region

Deep sea corals found in the Greater Atlantic region are found within the Class Anthozoa, with major types including stony corals (Order Scleractinia), sea pens (Order Pennatulacea), true soft corals and gorgonians (Orders Alcyonacea),[19] and black corals (Order Antipatharia). Types of deep sea corals observed to date in the Greater Atlantic range from small, solitary corals to larger colonies including complex structure-forming corals. These corals also vary in their vulnerability to bottom disturbance, reproductive strategies, growth rates, and ecological associations (Lumsden et al. 2007). Table 6 describes the major types and orders of deep sea corals found in the Mid-Atlantic Council region, including representative species and notable characteristics. More information about coral growth rates and reproduction can be found in Section 6.3.4, which reviews deep sea coral vulnerability to fishing gear.

As previously noted, the measures proposed within this action are designed to prioritize protection of structure forming corals, given their apparent enhanced habitat value relative to other types of corals. Structure-forming corals typically require hard substrate to attach. Given the relative rarity of hard substrate in the mid-Atlantic, the coral zone boundary alternatives proposed in this document are designed to capture areas of hard substrate in the canyons, and to prioritize observations of structure-forming corals for protection.

In addition, although the alternatives in this action are designed specifically around deep sea corals, there are several other unique deep sea habitat types that would benefit from implementation of gear-restricted coral areas, including deep sea sponges and unique ecological communities associated with methane seeps. NOAA's Strategic Plan for Deep-Sea Corals and Sponge Ecosystems (NOAA 2010) provides background information regarding sponges. Skarke et al. 2014 provides additional information on cold methane seeps, including a summary of a large number of recently identified seeps along the U.S. Atlantic margin in and around many of the canyons proposed for protection in this amendment.

[19] Although previously separate Orders (Alconyacea and Gorgonacea), many taxonomists now group gorgonians with true soft corals under the Order Alcyonacea.

Table 6: Subclasses and orders of deep sea corals known to occur in the NMFS Greater Atlantic Region. Sources: Lumsden et al. 2007 and Hourigan et al. 2015.

Class	Subclass	Order	Common Names	Representative species	Notable characteristics
Anthozoa	Hexacorallia	Scleractinia	Stony corals	*Desmophyllum dianthus, Flabellum spp., Lophelia pertusa, Astrangia poculata*	In the Greater Atlantic region, most are solitary, with a few colonial species. A few species can be found in shallow water. A few branching species form deep-water biogenic reef frameworks known as bioherms, coral banks, or lithoherms.
		Antipatharia	Black corals	*Leiopathes sp., Cirrhipathes sp.*	Occur mostly in tropical regions, but some species known to occur in the Greater Atlantic region. Several species observed from New England Seamount chain and submarine canyons as well. Many branching forms.
	Octocorallia	Alconyacea	Alconyaceans (true soft corals) and Gorgonians (sea fans, sea whips)[20]	*Alcyonium spp., Paragoria arborea, Acanthogoria armata, Paramuricea spp., Primnoa resedaeformis*	Limited presence on continental shelf in mid-Atlantic; mostly found on slope. Some reach relatively large sizes. May be two distinct species assemblages found above and below ~500 m depth. Most true soft corals are not major structure-forming species. Gorgonians have many branching forms with several major structure-forming species.
		Pennatulacea	Sea pens	*Pennatula aculeata, Stylatula elegans*	Unlike most other deep sea corals, prefer muddy sediments, anchored by buried peduncle. May be less vulnerable to fishing gear. Numerous records of *Pennatula sp.* on outer continental shelf as far south as the Carolinas. *S. elegans* is abundant on Mid-Atlantic coast outer shelf. Contribution as habitat and to biodiversity is not well understood. Recent discoveries in Canada (Baillon et al. 2012) and Maine (NEFSC, unpublished data) indicate some species of sea pen may provide nursery habitat to larval fish (e.g., redfish, *Sebastes* spp.)

[20] Although previously separate Orders (Alconyacea and Gorgonacea), taxonomists now group gorgonians with true soft corals under the Order Alcyonacea.

6.3.2 Deep Sea Coral Distribution and Abundance in the Greater Atlantic Region

Deep sea corals can be found both on the continental shelf and slope in the Greater Atlantic Region. In general, slope-inhabiting benthic organisms, including deep sea corals, tend to be strongly zoned by depth and/or water temperature, although these patterns are modified by the presence of topography, including canyons, channels, and current zonations. The fauna occupying hard surface sediments tends to be less dense compared to comparable shallow water habitats, but there is an increase in species diversity from the shelf to the intermediate depths of the slope. Diversity then declines again in the deeper waters of the continental rise (Stevenson et al. 2004).

6.3.2.1 Deep Sea Coral Research and Technology Program Database

Records of deep sea corals in U.S. waters are maintained in a database by NOAA's Deep Sea Coral Research and Technology Program (DSCRTP). The DSCRTP was established under the reauthorized Magnuson-Stevens Act, and is required to collect information about existing research on deep sea corals, to map known locations of deep sea corals, to conduct new research on deep sea corals, and to provide this information to regional fishery management councils. [21]

The deep sea coral database has gone through several iterations, and is intended to serve as a central data source for historical records from samples archived in museums, research institutions, and reported in scientific literature, as well as observations from incidental catch records and research surveys. The database compiles existing biological observations on deep sea corals and sponges and their locations, and also serves to aggregate new spatial data records from DSCRTP-funded research. **The records contained in this database are presence-only**, meaning that it does not include areas that were surveyed but did not contain corals. When reviewing database records, it is important to keep in mind that many areas have not been adequately surveyed for the presence of deep sea corals, so a lack of records in the database should not be interpreted as a lack of corals in the physical environment. In general, there is very little absence or abundance information available for deep sea corals in the mid-Atlantic, although limited absence data for some areas may become available as data is processed from recent research.

Section 7.0 contains an analysis of deep sea coral observations from the DSCRTP database relative to specific proposed coral areas. In summary, as of June 2013, the DSCRTP database contained 870 records of deep sea coral presence within the MAFMC management region. Of these, 635 records (73%) were included within the combined proposed broad coral zones. Within the proposed discrete zones, the areas of highest historical coral observations are contained within Baltimore Canyon, Norfolk Canyon, and the Mey-Linedenkohl Slope. The coral records within the total area of the proposed coral zones are composed of sea pens (40%), soft corals/gorgonians (34%), and hard/stony corals (26%). Outside of the proposed zones, there are 232 total records, the majority of which are stony corals or sea pens. This analysis does not yet include observations from more recent surveys (2012-2014; see Section 6.3.2.2 below), and it is worth reiterating that many areas in the mid-Atlantic have not been explored for the presence of corals, and a lack of historical records does not necessarily indicate a lack of deep sea corals.

[21] See http://coralreef.noaa.gov/deepseacorals/noaasrole/research_technology/ for more information about the DSCRTP. The DSCRTP online coral database has recently been made available online at: https://deepseacoraldata.noaa.gov.

6.3.2.2 Recent Research Surveys (2012-2014)

Several recent research surveys, conducted between 2012 and 2014, have resulted in new observations of deep sea corals in the Mid-Atlantic that have not yet been incorporated into the DSCRTP database. Because much of the data from these surveys are still being processed and reported, the level of detail in the available new information varies by survey. Some surveys have only preliminary data available at this time, and some have reported general locations of coral observations as opposed to exact point locations. Detailed reports of coral diversity and abundance are not yet available for all recent surveys, though qualitative information is available. Recent survey coral observations and other data have been incorporated into this document to the extent that they are available, and were added to the amendment materials for consideration by the Council and the public as they became available during the amendment development process.

Table 7 and Figure 8 summarize the recent surveys and the canyon and slope areas explored, and additional information about each survey is provided below. Deep sea corals were observed on all of the expeditions, in all of the surveyed canyons and slope areas identified below, though not necessarily on all dives or transects. Additional information on the findings from these surveys relative to proposed MAFMC coral zones can be found in Section 7.0.

Table 7: Summary of recent (2012-2014) research surveys in the MAFMC region.

Expedition Identifier	Name	Dates	Survey Type	Vessel	Proposed Discrete Areas Surveyed
BOEM	Atlantic Deepwater Canyons Expedition	Aug.-Sept. 2012	ROV	Nancy Foster	Baltimore Canyon, Norfolk Canyon
HB1204	Deep Sea Coral Survey	July 2012	Towed Camera	Henry Bigelow	Mey-Lindenkohl Slope *(Middle Toms Canyon, Toms-Hendrickson inter-canyon Area, Toms Canyon, edge of Hendrickson Canyon)*
HB1302	Deep Sea Coral Survey	June 2013	Towed Camera	Henry Bigelow	Ryan Canyon
EX1304	Okeanos Explorer Northeast Canyons Expedition	Jul.-Aug. 2013	ROV	Okeanos Explorer	Block Canyon and surrounding areas
HB1404	Deep Sea Coral Survey	Aug. 2014	Towed Camera	Henry Bigelow	Mey-Lindenkohl Slope *(Lindenkohl Canyon, Toms Canyon, Carteret Canyon),* Washington Canyon, Accomac Canyon, Leonard Canyon, Wilmington Canyon, Spencer Canyon
EX1404	Okeanos Explorer Our Deepwater Backyard Expedition	Sept.-Oct. 2014	ROV	Okeanos Explorer	Mey-Lindenkohl Slope *(Lindenkohl Canyon, Hendrickson Canyon),* Washington Canyon, Norfolk Canyon, Phoenix Canyon, McMaster Canyon, Ryan Canyon

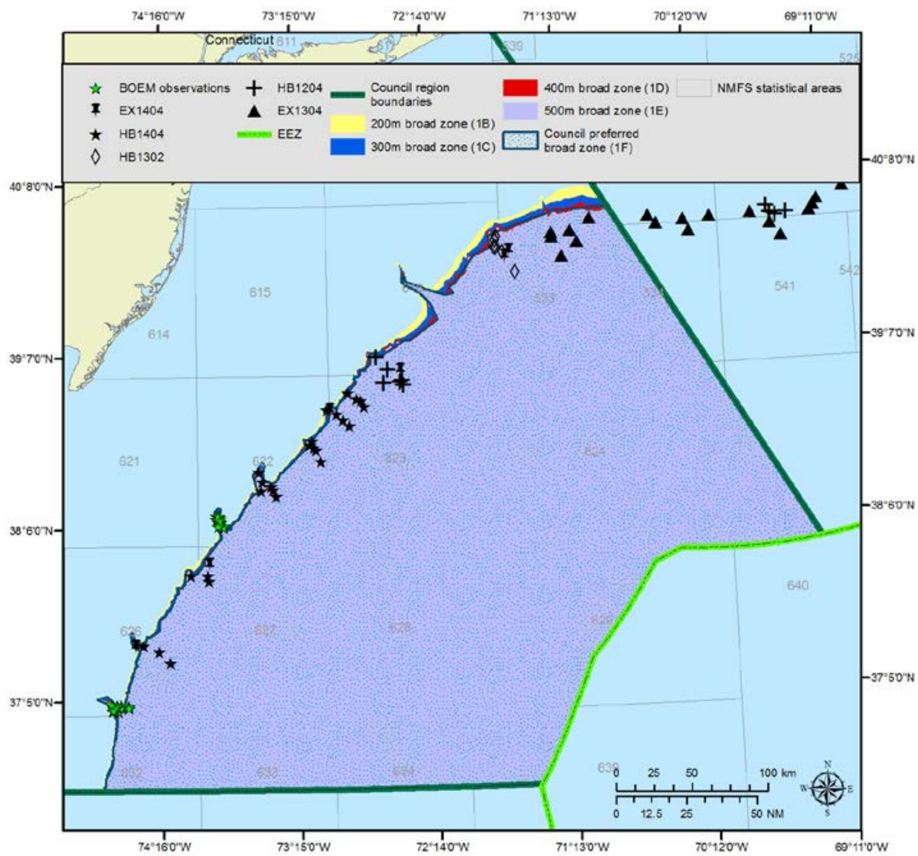


Figure 8: Map of recent (2012-2014) research surveys in the MAFMC region.

2012 BOEM Survey

In 2012, research cruises funded by the Bureau of Ocean Energy Management (BOEM) explored Mid-Atlantic deep sea hard bottom habitats, focusing on canyon habitats and coral communities. This survey included many dives in Baltimore Canyon using a remotely operated vehicle (ROV), and several dives in Norfolk Canyon. Deep sea corals were locally abundant in both Baltimore and Norfolk Canyons, and the surveys resulted in the first observations of the species *Lophelia pertusa* in the Mid-Atlantic (Figure 9). *L. pertusa* is a structure-forming coral commonly found off the coast of the southeastern U.S., and occasionally observed in New England, but has not previously been observed in the Mid-Atlantic. In September 2012, *L. pertusa* was observed in live colonies on steep walls in both Baltimore and Norfolk Canyons, at depths between 381 and 434 m. Several other coral types were observed in both Baltimore and Norfolk Canyons, including dense areas of *Paragorgia*, *Anthothela*, *Primnoa*, and *Acanthogorgia* communities (Figure 9). Sightings of lost fishing gear were also recorded in the two canyons, including traps, fishing lines, and nets (Brooke and Ross 2014). Baltimore and Norfolk Canyons are currently included in the range of possible deep sea coral discrete zones under Alternative 3B, and additionally covered by broad zone alternatives in alternative set 1.

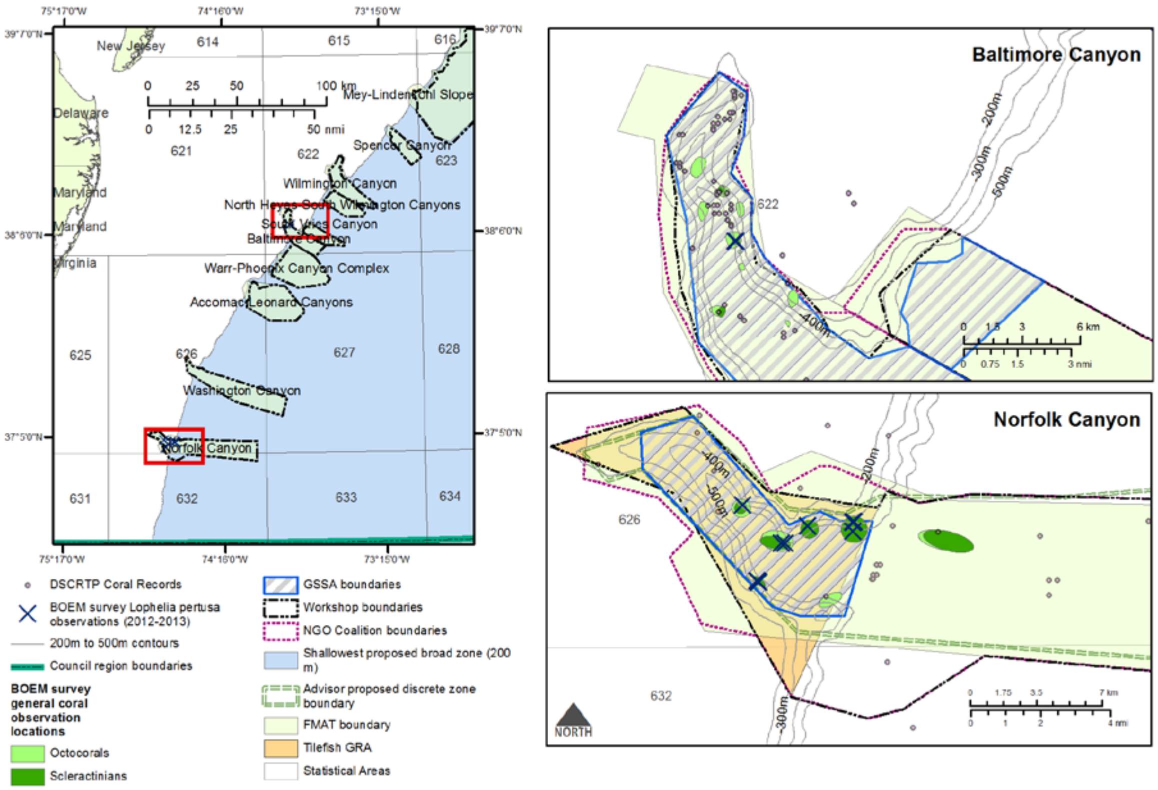


Figure 9: Observations of *Lophelia pertusa* from BOEM cruises in Baltimore and Norfolk Canyons, 2012 and 2013. Source: Brooke and Ross 2014.

2012 ACUMEN Survey

In the summer of 2012, the Atlantic Canyons Undersea Mapping Expeditions (ACUMEN) surveys concluded with a deep-sea coral survey funded by NOAA and the DSCRTP from aboard the NOAA ship *Henry Bigelow*.[22] Areas sampled in the Mid-Atlantic included Middle Toms Canyon, the edge of Hendrickson Canyon, the slope area between Toms and Hendrickson Canyons, and Toms Canyon. Using a towed camera system, high-resolution images were taken to collect data on deep-sea coral diversity, abundance, and distribution, as well as ground-truth locations of predicted deep-sea coral habitat (based on habitat suitability model outputs), historical records, and multibeam bathymetry collected by NOAA ships *Okeanos Explorer* and *Ferdinand Hassler*. Deep-sea corals were observed in many locations within the Toms Canyon complex, which is currently included in the range of proposed deep sea coral zones (the Mey-Lindenkohl slope area) under Alternative 3B. Corals were observed during every tow with fewest coral observations at the head of Toms Canyon and the most coral observations made in Middle Toms Canyon (see Section 7.0 for additional details). The majority of corals were gorgonians and alcyonaceans, with fewer observations of stony corals and sea pens. Differences among individual canyons likely reflect differences in depth and substrate type in the area where tows were conducted. These factors are hypothesized to influence coral abundance and distribution.

[22] http://oceanexplorer.noaa.gov/okeanos/explorations/acumen12/bigelow/welcome.html.

2013 Deep Sea Coral Research and Technology Program Survey

In the summer of 2013, scientists from NOAA, Woods Hole Oceanographic Institution (WHOI), and the Delaware Museum of Natural History (DMNH) conducted another deep-sea coral survey cruise aboard NOAA ship *Henry Bigelow*. This cruise, a follow-on to the successful ACUMEN initiative, utilized the same towed camera system and methodologies as the previous cruise. Only one Mid-Atlantic canyon, Ryan Canyon, was surveyed during this cruise. Based on data collected from approximately 9,000 bottom images, very few corals were observed along the shallowest surveyed portions of the canyon; however, corals were much more abundant in deeper portions of the canyon (see Section 7.0 for additional details). Similar to results from the 2012 expedition, in the areas surveyed, the majority of corals observed were gorgonians and alcyonaceans and differences in coral distribution within Ryan Canyon likely reflect differences in depth and substrate type.

2013-2014 Northeast Canyons and Seamounts Okeanos Explorer Expeditions

In the summer of 2013, the NOAA vessel *Okeanos Explorer* explored northeast submarine canyons using an ROV. In the Mid-Atlantic, this included work in and around Block Canyon, where deep sea corals were observed in July of 2013. This ROV dive began at approximately 1,870 meters depth and transitioned upslope, where numerous coral colonies were observed on the faces and tops of large hard features. Cup (stony) corals were also observed on the underside of ledges. The dominant species was *Acanella sp*., a type of bamboo coral that commonly occurs on both soft and hard substrates.[23]

Another *Okeanos Explorer* expedition was conducted in September and October of 2014.[24] This expedition included ROV dives in Lindenkohl and Hendrickson Canyons (within the Mey-Lindenkohl Slope proposed discrete zone), as well as in Washington, Norfolk, Phoenix, McMaster, and Ryan Canyons. In Washington Canyon, scientists observed colonies of deep sea corals including *Anthothela* and both white and pink bubblegum corals (*Paragorgia arborea*). In Norfolk Canyon, several colonies of gorgonians/alcyonaceans (including *Acanthagorgia*, *Anthothela*, and bubble gum corals), were observed in addition to many species of fish and invertebrates, including monkfish, red crab, and several schools of squid. In Phoenix Canyon, the dive began at about 1,135 meters depth, and many large rocks and outcrops encrusted with corals were observed, as well as several species of squid, skate, and flounder. High densities of cup corals under ledges were also observed. In Hendrickson Canyon, the ROV began at about 1,670 meters and observed abundant cup corals during this dive, generally located under frequent overhangs and outcrops. Also noted were gorgonians/alcyonaceans, black corals, stony corals, sea pens, and several species of fish. In McMaster canyon, octocorals were observed in high density, as well as groups of cup corals. Similar to Hendrickson Canyon, large groups of corals were observed living under overhangs and outcrops along the steep canyon walls. In Ryan Canyon, human debris was observed, in addition to shrimp, fish, eels, hake, dogfish, some cup corals, and coral rubble. Diversity of corals along the transect in Ryan Canyon was low (see Section 7.0 for additional details relative to proposed coral zones). Photos, videos, logs, and maps from these dives are publicly available at:
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1404/welcome.html.

[23] http://oceanexplorer.noaa.gov/okeanos/explorations/ex1304/dailyupdates/dailyupdates.html
[24] http://oceanexplorer.noaa.gov/okeanos/explorations/ex1404/welcome.html.

2014 Towed Camera Survey

A research survey aboard the *Henry Bigelow* using towed cameras took place in August 2014. Researchers surveyed portions of Lindenkohl, Toms, and Carteret Canyons (within the Mey-Lindenkohl Slope proposed discrete zone), as well as areas in Washington Canyon, Accomac and Leonard Canyons, Wilmington Canyon, and Spencer Canyon. Deep sea corals were observed in a number of analyzed images in all of these canyons (see Section 7.0 for additional details). These camera surveys were also used to further ground truth NOAA's coral habitat suitability model. Scientists noted that the abundance, distribution, and diversity of deep sea corals varied between and within canyons, exhibiting different trends correlating with different geological characteristics.

6.3.2.3 Northeast Fisheries Science Center Surveys and Observer Data

The NEFSC's fishery independent surveys have also been assessed for deep sea coral bycatch. Neither the NEFSC's trawl survey nor their scallop survey "catch" deep-sea corals in any meaningful quantities, nor is any catch of corals recorded in any meaningfully quantitative way. For example, prior to the year 2000, bycatch quantity in the Atlantic sea scallop surveys were estimated by cursory visual inspection or "eyeballing" only. Since that time, the survey has gathered more quantitative bycatch information. The bycatch data, referred to as "trash," is divided up into 3 categories: substrate, shell, and other invertebrates, but the log sheets still only record percent composition and total volume (bushels), and methods and accuracy of this quantification may vary. The NEFSC trawl surveys also have a "trash" component, with trash being defined as any substrate or non-coded invertebrate species. The trash is loosely described and roughly quantified to the whole liter.

An NEFSC epibenthic megafaunal survey with towed camera and video, trawls, and multibeam sonar mapping was conducted in the head region of Hudson Canyon (shelf and canyon, 100 – 500 m depth) irregularly between 2001 and 2012. Output from that cruise series included presence, absence, and density data for deep sea corals and sponges, as the survey accounted for all species encountered (i.e., no "junk"). However, visual and trawl coverage were limited and the extent of deep sea corals and sponge habitats had to be inferred from physical and geological factors (Pierdomenico et al. 2015). Corals encountered were exclusively the splitting cup coral, *Dasmosmilia lymani*, and white sea pen, *Stylatula elegans*, and all individual records are in the DSCRTP database.

The general lack of deep-sea coral in these surveys may be due to the surveys fishing too shallow to encounter the larger deep-sea coral species (e.g., nearly all the scallop surveys fish <100 m and all are <140 m) and the possibility that some of these larger corals (e.g., *Paragorgia spp.*, *Primnoa spp.*) may have been "fished out" in the relevant areas earlier in the 19th and 20th centuries. Nevertheless, the NEFSC is planning to improve their quantification of invertebrate bycatch in their groundfish and scallop surveys, including the identification and enumeration of any deep-sea corals encountered (D. Packer, personal communication, Feb. 2014).

Similarly, records of deep sea coral bycatch in the Northeast Fisheries Observer Program (NEFOP) data have historically been sparse and inconsistently recorded, although there has been an attempt to improve this in recent years. In the spring of 2013, NEFOP implemented database and protocol changes related to the documentation of deep sea coral interactions. The NEFOP Program Manual and NEFOP database now include more specific categories of coral, including:

soft coral, hard coral, sea pens, and sponges (as opposed to several inconsistent, more generic categories applied in prior years; D. Packer, pers. comm., Feb. 2014). A deep sea coral training module was developed based on a completed identification guide (Packer and Drohan 2013, unpublished), and has been successfully incorporated into all current observer certification programs offered at the NEFOP Training Center (including the At-Sea Monitor certification, Industry Funded Scallop Observer certification, and the NEFOP certification). This program includes basic coral identification skills, sampling protocols, and how corals interface with the NEFOP Species Verification Program. In addition to initial general identification, observers are now instructed on proper photographic logging of any deep sea coral bycatch. These photos are to be uploaded for species identification or confirmation by NOAA coral experts. All observer-issued reference materials are now uploaded with the most current Coral ID guide and sampling protocols. Additionally, all NEFOP editing staff have also been trained on the NEFOP Coral Program (D. Packer, pers. comm., Feb. 2014).

NEFOP records of deep-sea coral bycatch were obtained for the years 1994 to 2014. The data contains limited records with limited taxonomic information: there were 65 confirmed coral entries in the database collected from 1994-2014. Most of these records were identified as stony corals, with the remaining records composed primarily of sea pens (Table 8). Historically, observers did not record numbers or density; instead, corals tended to be discarded and the total weight simply estimated. Gear types in these recorded observations included otter trawls, scallop dredges, lobster pots and sink gill nets, at beginning haul depths ranging from 5.5 to 464 meters (3 to 254 fathoms). Estimated or actual weights for the deep-sea coral in a given haul ranged from 0.1 to 100 kg.

Table 8: NEFOP records of deep sea interactions in the Greater Atlantic Region, by coral type and gear type, 1994-2014. NK= not known.

Coral Type and Gear Type	Number of observations	Total weight (kg)
CORAL, SOFT, NK	**2**	**0.7**
TRAWL,OTTER,BOTTOM,FISH	2	0.7
CORAL, STONY, NK	**46**	**562.9**
DREDGE, SCALLOP,SEA	3	10.6
GILL NET, DRIFT-SINK, FISH	1	0.1
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	26	315.2
TRAWL,OTTER,BOTTOM,FISH	16	237
SEA PEN, NK	**17**	**7.8**
GILL NET, DRIFT-SINK, FISH	6	1.8
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	5	1.7
POT/TRAP, LOBSTER OFFSH NK	2	0.6
TRAWL,OTTER,BOTTOM,FISH	4	3.7
Grand Total	**65**	**571.4**

Within the Mid-Atlantic Council region, only 11 records of deep sea corals have been reported in the observer data since 1994. Of these, six of were recorded as interactions with gill nets in state waters in the Chesapeake Bay area. Of the remaining five records in federal waters, none occur within any of the currently proposed deep sea coral zones (Figure 10).

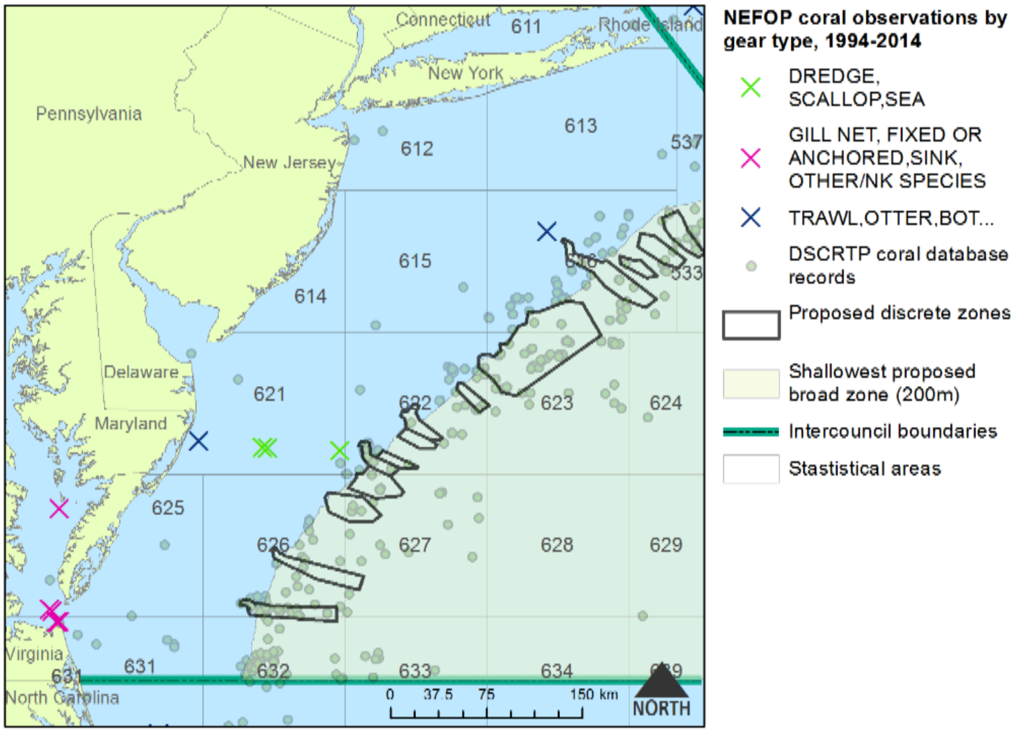


Figure 10: NEFOP records of deep sea corals in the Mid-Atlantic, 1994-2014.

When reviewing observer data for deep sea coral interactions, it is important to keep in mind that the percentage of commercial fishing trips actually covered by observers or the observer program varies depending on the fishery (gear type, fishing area, target species, etc.). Additionally, because the observer program observes thousands of trips every year in dozens of different fisheries, with each fishery having its own regulations for mesh size and configuration, a reported absence of deep-sea coral at a location may simply be a function of the catchability of the gear used. This is also a problem with the NEFSC surveys; fishing gear is not designed to "catch" deep-sea corals. Some level of gear impacts may be occurring that do not result in corals or coral fragments being retained or entangled in the gear, able to be viewed by an observer or scientists on the NEFSC trawl surveys. Due to these caveats, as well as the general lack of NEFOP coral records in the Mid-Atlantic Council region, this data source was not considered to be informative for inclusion in the analysis of impacts to corals described in Section 7.0.

6.3.2.4 Deep Sea Coral Habitat Suitability Model

A main limitation of point data for deep sea coral observations is that this data is mostly presence-only, and many areas have not been surveyed for the presence of deep sea corals. Surveying deep offshore habitats using ROVs or towed cameras is expensive and often logistically difficult. However, existing coral observation data, together with associated environmental data, are useful for developing models that can predict deep sea coral habitat based on known coral locations. A habitat suitability model has been created for deep sea corals in the Greater Atlantic Region, developed in partnership between NOAA's National Centers for Coastal Ocean Science (NCCOS) and the NEFSC (Kinlan et al. 2013). This predictive habitat model was developed by relating two types of data: 1) known deep sea coral presence locations from the DSCRTP database, and 2) environmental and geological predictor variables. A variety of environmental variables were incorporated, including slope, depth, depth change, rugosity, salinity, oxygen, substrate, temperature, turbidity, and others.

In July 2012, the NOAA ship *Bigelow* visited three "hotspots" predicted by the model, and surveyed the sites using WHOI's TowCam. Data collected during this cruise was used to refine model predictions. The model was qualitatively validated: all camera tow sites that were observed to be hotspots of coral abundance and diversity were also predicted hotspots of habitat suitability based on the regional model. The model was further validated during the August 2014 towed camera surveys previously described. Each attempt has indicated that this habitat suitability model performs well in predicting areas of likely deep sea coral habitat, as well as predicting areas where corals are unlikely to be found.

In the Greater Atlantic Region, several different taxonomic groups of deep sea corals were modeled. Some of these model outputs are better predictors of coral presence than others, due to different sample sizes of coral records of each type in the DSCRTP database. The model output for Gorgonian and Alcyonacean corals is expected to be the model with the best predictive ability for structure-forming deep sea corals, as it is based on a sizeable number of data points from known structure-forming species. Therefore, the model outputs for Gorgonian and Alcyonacean corals were used in Section 7.0 of this analysis to evaluate the habitat suitability of each proposed broad and discrete coral zone. Model outputs for the Mid-Atlantic Council region are displayed in Figure 11 and reflect the predicted likelihood of deep sea coral habitat for a given area. In this map, the predicted likelihood of coral habitat suitability is displayed in “thresholded logistic” maps, meaning the likelihood values are displayed by the following likelihood categories: very low, low, medium, high, and very high.[25]

It should be noted that the exact location of deep coral hotspots on the seafloor often depends on fine-scale seabed features (e.g., ridges or ledges of exposed hard substrate) that are smoothed over in this regional-scale model. The current resolution of the model is grid cells of approximately 370 m^2 (although there are plans to improve the model by increasing resolution to 25 m^2 within the next several years, as well as incorporate more recent coral observations). Habitat suitability maps based on this model should be viewed as representing only the general locations of predicted suitable coral habitat (within approximately 350-750 meters, or

[25] The thresholded logistic outputs were generated by the model developers through a cross-validation "tuning" process in which logistic predictions were confronted with coral presence data that had been left out of model fitting (test data). At each cross-validation iteration, these test data were used to find the optimal threshold to discriminate between presence points and background. The optimal threshold depends on the relative cost of false positive (FP) errors vs. false negative (FN) errors. For example, if false positives are deemed 10 times more costly than false negatives (a 10:1 FP:FN cost ratio), then the optimal threshold will be larger (more conservative), and result in a smaller area of only very high likelihood suitable habitat being identified. If false positives and false negatives are given equal weight, a much broader and less conservative area of suitable habitat will be identified. Likelihood classes were defined by FP:FN cost ratios as follows: Low (<1:1), Medium-Low (1:1 to 2:1), Medium (2:1 to 5:1), High (5:1 to 10:1), and Very High (>10:1). Only the most conservative (High and Very High habitat suitability likelihood) were used in the analysis described in Section 7.0. The reason for using the thresholded logistic outputs is that MaxEnt logistic values cannot be directly compared from one model to another. The cross-validation "tuning" process results in likelihood classes that can be directly compared across all modeled coral groups. This allowed the merging of three separate models: Alcyonacea, Gorgonian Alcyonacea, and Non-gorgonian Alcyonacea using comparable model outputs.

approximately two model grid cells). In addition, model predictions are of coral presence, and high likelihood of presence will not necessarily correlate with high abundance.

More information on the habitat suitability model is available in the supporting documentation for Kinlan et al. 2013, available at: http://coastalscience.noaa.gov/projects/detail?key=35.

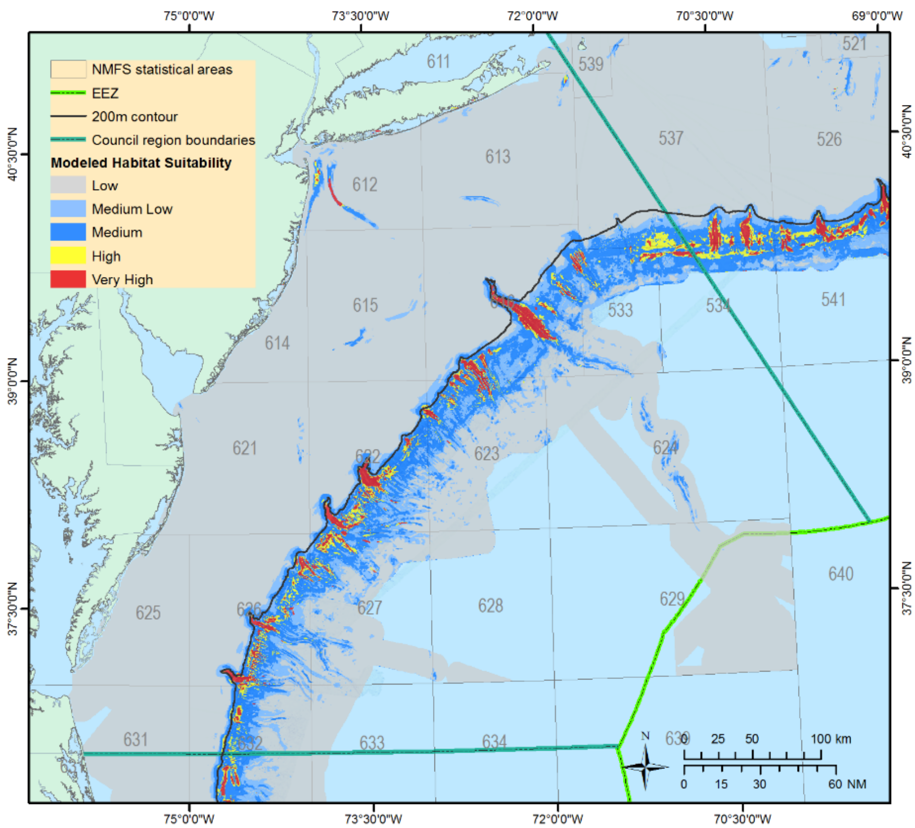


Figure 11: Modeled deep sea coral habitat suitability for the Mid-Atlantic Council region. Data from Kinlan et al. 2013.

6.3.3 Importance of Deep Sea Corals

Deep sea coral ecosystems are among the most biodiverse ecosystems in the deep sea, exhibiting high diversity of deep sea coral species as well as high diversity of associated fish and invertebrate species (Foley et al. 2010). Deep sea corals have also been shown to harbor a high diversity of microbial species, even among the same species of coral separated over a short distance (Gray et al. 2011).

Deep sea coral aggregations have been noted to have higher associated concentrations of fish than surrounding areas, and are believed to serve as nursery grounds and provide habitat for many species of fish and invertebrates at various life stages, including commercially important fish species (Costello et al. 2005; Auster 2007; Foley et al. 2010). There is recent evidence that deep sea corals play an important role in the early life history of some fish and shark species, providing nursery grounds and habitat for protection, reproduction, and feeding (Costello et al. 2015; Armstrong et al. 2014). Numerous types of fish have been noted to co-occur with three-dimensional deep sea coral habitat, including, for example, redfish (*Sebastes sp.*), rabbit fish

(*Chimaera monstrosa*), cusk (*Brosme brosme*), cod (*Gadhus morhua*), morid cods (*Laemonema sp.*), slimeheads (e.g., *Hoplostethus sp.*), American anglerfish (*Lophius americanus*), cusk eels (e.g., *Benthocometes robustus*), cutthroat eels (e.g., *Dysommina rugosa*), and various deep water sharks (see Costello et al. 2005; Auster 2007; Henry et al. 2013; Ross et al. 2015). It is hypothesized that fish associating with corals and other three-dimension habitat types may be seeking cover from predators, and/or sites for enhanced capture of prey (Costello et al. 2005; Auster 2007). Recent discoveries in Canada (Baillon et al. 2012) and Maine (NEFSC, unpublished data) indicate some species of sea pen may provide nursery habitat to larval fish (e.g., redfish, *Sebastes sp*.). Many invertebrate species have also been observed associated with deep sea corals, such as brittle stars, sea stars, and feathery crinoids which live directly on coral colonies, and smaller animals that may burrow into the skeletons (Foley et al. 2010). As previously noted, the measures proposed within this action are designed to prioritize protection of structure-forming corals, and their generally hard substrate habitats, given their apparent enhanced habitat value relative to other types of corals.

Deep sea corals also support other key ecosystem processes. In light of the contribution of anthropogenic carbon dioxide (CO_2) to global climate change, the deep sea may provide ecosystem services in the form of CO_2 sequestration, thus removing CO_2 from the atmosphere (Foley et al. 2010), though this idea has become more controversial recently (Armstrong et al. 2014). Microorganisms associated with corals may provide other ecosystem functions in addition to cycling carbon, such as fixing nitrogen, chelating iron, producing protective antibiotics, and other beneficial activities (Gray et al. 2011). Deep sea coral ecosystems have also offered opportunities for pharmaceutical and engineering research. Some species have been used in clinical trials for cancer research or bone grafting (Foley et al. 2010).

Deep sea corals also have cultural value, including non-use benefits such as existence value (Foley et al. 2010). The general public has seen increasing opportunities in recent years to view and appreciate deep sea ecosystems by engaging virtually in deep sea exploration streamed via the internet.

6.3.4 Vulnerability to Fishing Gear Impacts

Deep sea corals face a number of threats from human activities; however, the greatest threat to deep sea coral habitat is believed to be deep sea bottom fishing, in particular bottom trawling. A number of studies and reviews, summarized below, have assessed the impacts of commercial fishing on deep sea corals and coral reefs, addressing a range of gear types as well as study locations. Much of the information below was previously compiled by the NEFMC's Habitat Plan Development Team (PDT) during their initial development of coral protection alternatives between approximately 2010 and 2012. The PDT’s literature review has been supplemented with additional information from more recent studies.

6.3.4.1 Gear Interaction Studies

Research on gear impacts to deep sea corals specifically within the Mid-Atlantic Council region is extremely limited; thus, studies reviewed here include a range of different study locations worldwide. While the study sites cover a variety of locations, the impacts of commercial fishing on the local corals and seafloor are virtually identical throughout the literature. The conclusions drawn by these studies are that commercial fishing gear can damage or destroy deep-sea corals and associated fauna. Trawling, specifically, is very detrimental to coral and the seafloor. Several studies have concluded that deep water corals are especially fragile and the greatest disturbance and destruction occurs at depths targeted by commercial fishing (Heifetz et al. 2009, Hall-Spencer et al. 2002). Disturbances to deep sea corals range from scarring left by fishing gear to complete destruction of coral and stripping of the seafloor to underlying rock or sediment. The substrates of areas heavily fished with bottom-tending gear have been observed stripped to bare rock or reduced to coral rubble and sand, whereas unfished and lightly fished areas typically do not see such degradation (Grehan et al. 2005).

Most of the relevant research has involved study sites that were observed using some form of photographic or continuous video transects. Several studies mapped the area using sidescan sonar (Wheeler et al. 2005, Fosså et al. 2002) or multibeam sonar in conjunction with a deep camera system (Althaus et al. 2009, Grehan et al. 2005). This technique allows for determination of damage caused by dragging gear over the seafloor. The logs of fishing trips, reports from fishermen, and other literature on fishing activities at each of the areas, have also been utilized by several studies in different regions (Althaus et al. 2009, Koslow et al. 2001, Heifetz et al. 2009, Fosså et al. 2002, Cryer et al. 2002). Anecdotal reports acted as a guide to further research areas, as well as providing information about to the history of fishing and practices in the area (Fosså et al. 2002).

Potential gear impacts to corals depend on many factors, such as the configuration and weight of the gear, towing speed, sediment type, the strength of tides and currents, and the frequency of disturbance (Jones 1992; Clark et al. 2015). It should be noted that in many studies reviewed, there was frequently a lack of adequate descriptions of the gear used, so generalizations should be made with caution. A few studies were successful at providing gear descriptions, but the dimensions of gear size can vary and a universal description and size should not be assumed for all fishing effort with each gear type. Nevertheless, general conclusions were similar among various studies using different configurations of gear.

Passive or static gear types, such as pots, traps, or longlines, have been demonstrated to impact localized area of corals, though they have not been observed to be as destructive as trawl gear. Several studies have described passive gear interactions with benthic habitat, commonly in the form of observed entanglements of coral with fishing gear (Fosså et al. 2002, Ross et al. 2015). Despite these gear types having a smaller footprint compared to a trawl, in certain conditions these gear types may drag across the seafloor, potentially entangling corals or stirring up sediments (Clark et al. 2015). Longline impacts on corals and sponges have been observed where corals have been broken by longline weights or by the mainline cutting through them during fishing or hauling. However, mobile gear types are considered to have higher impacts to corals, as mortality is markedly increased due to corals being crushed, buried and wounded by gear as it is dragged over the bottom (Fosså et al. 2002).

Heifetz et al. (2009) and Stone (2006) conducted studies in the northern Pacific Ocean around the Aleutian Islands. Stone found that longline gear was observed on 76% of transects, but was found to only result in 5% of the total observed disturbed area. Trawling, on the other hand, was only seen at 28% of the transects, but disturbed 32.7% of the observed seafloor, indicating a relatively greater impact of trawls. Overall, 22 of the 25 transects showed disturbance to the seafloor (approximately 39% disturbance; Stone 2006). This was supported by the second study in this region (Heifetz et al. 2009) with evidence of trawling, indicated by uniform parallel striations in the seafloor, seen on several dives. Damage caused by traps was not statistically significant between the fished and unfished areas at this site. Both studies observed that the most damage done to corals and the seafloor occurred at depths where commercial fishing intensity was the highest (100-200m), with higher population densities occurring at 200-300m.

Studies conducted in the Northeast Atlantic Ocean have resulted in similar conclusions to those conducted in the Aleutian Islands. Fosså et al. (2002) found that damage to *Lophelia pertusa* reefs off of Norway was most severe at shallower depths where commercial fishing primarily took place. The various study sites presented a range of disturbance due to fishing. While the deeper water corals were intact and living at one site, almost all corals were crushed or dead at another. A third demonstrated multiple stages of coral degradation, from living to dead and crushed, as well as the base aggregate the reefs often form and grow on being crushed and spread out. The percent of damage to the area was correlated with the number of reports by the fishermen of fishing activity, bycatch, and corals in the area; ranging from 5-52% damaged. The continental shelf, at approximately 200-400m (below the highest levels of fishing), had the highest abundance of corals. These corals were intact and developed, whereas the shallower sites contained crushed coral and coral rubble, where damages were estimated at 30-50%.

Hall-Spencer et al. (2002), in a study focused on the West Ireland continental shelf break, found scars from trawl doors (indicated by parallel marks or furrows on the sea floor) that were up to 4km long, as well as coral rubble on trawled areas. Locations lacking observable trawl scars contain living, unbroken, *L. pertusa*. Similar findings were observed at a site off the northern coast of Ireland (Wheeler et al. 2005). Trawl marks were located on side scan sonar records, and video showed parallel marks left by trawl doors, as well as the net and ground line gear, on the seafloor. The amount of dead coral and coral rubble increased at sites that were obviously trawled.

Althaus et al. (2009) and Koslow et al. (2001) conducted studies on seamounts in Tasmania. Areas that had never been trawled, or were lightly fished (determined via trip logs), were dominated by the stony coral *Solenosmilia variabilis*, making up 89-99% of coral cover in never trawled areas (Althaus et al. 2009) as well as seamounts peaking below 1400m (Koslow et al. 2001). These studies found that active trawling at sites removed most, or all, of the coral and associated substrate, leaving bare rock in heavily trawled areas, and coral rubble and sand at the lower limits of fishing activity (Koslow et al. 2001). This was supported by photographic transects by Althaus et al. (2009) showing coral in less than 2% of trawled areas. "Trawling ceased" areas, where trawling had effectively stopped 5-10 years earlier, showed coral in approximately 21% of the transects. This study also found a higher abundance of the faster growing hydroids colonizing cleared areas, smaller corals and octocorals, as well as noting whip-like chrysogorgiid corals which were flexible and could presumably bend and pass under the trawls.

While several studies reported that much of the coral on fishing grounds was damaged or destroyed, there were areas that avoided contact. The surviving coral in fished areas was often located on undesirable fishing terrain, or at depths not targeted by fishermen. Corals growing on steep slopes have a natural protection from commercial fishing gear, as a slope greater than about 20 degrees cannot be trawled. Areas of higher three-dimensional complexity were also relatively untouched, as these were avoided by the fishermen for fear of damage and loss of their gear. The effect of seafloor topography on fishing and the resulting impact on corals was observed in a study site west of Ireland (Grehan et al. 2005). While evidence of active trawling was seen, indicated by trawl scars in mud and non-coral habitat, there was no fishing-related damage to corals on mounds having slopes greater than 20 degrees. Here, the terrain is too steep to trawl and the corals were naturally protected from the gear and relatively undamaged. Hall-Spencer et al. (2002) also noted that fishermen avoided uneven ground due to the loss of time and money from resulting gear upkeep of tangled and damaged gear. Areas of large coral bycatch were avoided in the future, as known trouble areas for the fishermen. Because of this only 5 of the 229 trawls in the study contained large amounts of coral bycatch. Thus, the areas where corals were present and undamaged tended to have a higher topographic complexity of the seafloor.

6.3.4.2 Coral Vulnerability and Recovery Potential

Most types of deep sea corals tend to be very sensitive to physical disturbance given that they are sessile, fragile, and extend above the seafloor in a manner that makes interactions with fishing gear more likely. The combination of high vulnerability to mechanical disturbance and low recoverability of deep sea corals makes these ecosystems an important target for conservation (Clark et al. 2015). Slow growth rates and reproductive processes that are so easily disrupted result in lengthy recovery period of disturbed areas. Because deep water reefs attract fauna and promote areas of high diversity in otherwise low diversity areas (see Section 6.3.3), fishermen have reported that as the damage to reefs increases, areas that were once fertile fishing grounds have seen fewer successful fishing trips (Fosså et al. 2002).

Increased mortality is the clearest effect from mechanical impacts of bottom-tending gear, in the form of crushing or burial. Wounds in the tissue and possible microbial infection could also influence the health of corals (Fosså et al. 2002). Bottom trawling and dredging can also impact corals via the suspension of sediments, which can smother corals and may suppress growth and recovery of colonies. However some types of scleractinian corals appear to be able to shed sediment and may be able to better cope with sediment resuspension (Fosså et al. 2002; Clark et al. 2015). Sediment layer disturbance can also alter the physical or chemical composition of the sediment, particularly in the more stable waters of the deep sea (Clark et al. 2015), potentially impacting suitable habitat for corals.

It is difficult to evaluate the impact that localized patches of destroyed coral can have on larger reef systems. There is likely a point below which corals would not be able to maintain populations (Fosså et al. 2002). Although sensitivity to disturbance may be similar between deep and shallow-waters corals, the rates of recovery appear to be much slower in the deep sea compared to shallower systems, especially at extreme depths (Jones 1992; Clark et al. 2015). Because little is known about the recovery of benthic deep sea fauna, inferences about recovery must be made by considering longevity and growth rates of the affected fauna. Although there are species- or location-specific differences in these factors, it is clear that coral species typically impacted by fishing gear grow very slowly and have very high longevity. These traits can translate into recovery on the scale of years, centuries, or millennia (Clark et al. 2015).

The approximate growth rates of deep sea corals have been calculated in several studies on different species of corals. Observations of Oculina reefs off the east coast of Florida at 6m and at 80m indicated that the corals found at the deepwater (80m) site grew relatively more quickly (16.1 mm/yr) than the same corals at the 6m site (11.3 mm/yr). When transplanted from 6m to 80m the coral polyps lost their zooxanthellae and fed off the food supply provided by the colder deep currents containing more nutrients (Reed 2002).

In a study conducted off of Atlantic Canada, Risk et al. (2002) examined the growth rates for *Primnoa resedaeformis*. The corals were found at approximately 200-600m and were dated to 2600-2920 years old ± 50-60 years using Carbon 14 dating techniques. Using the dated age and size of the colony (~0.5-0.75m in height) the average radial growth at the base of the coral was found to be 0.44 mm/yr and tip extension growth rates were around 1.5-2.5 mm/yr (Risk et al. 2002), slower than the estimated rate found for Oculina reefs. Another study working with *P. resedaeformis,* as well as *Paragorgia arborea*, found that the height of colonies ranged from 5-180cm for *P. arborea* (averaging 57cm) and 5-80cm for *P. resedaeformis* (averaging 29.5cm). The maximum age of samples collected was 61 years (found by counting annual growth rings under a dissecting microscope and x-ray examination). It estimated that the rate of growth for the first 30 years was around 1.8-2.2 cm/yr. After the coral began to age (>30 years), growth slowed to 0.3-0.7 cm/yr. This shows that initially the coral grows at a speed concurrent with the first study, and then dramatically slows to only a few millimeters a year, suggested by the second study (Mortensen and Buhl-Mortensen 2005). With a growth rate of, at most, a centimeter or two year, the complete destruction and clearing of the seafloor of corals can result in very long recovery time for both the coral, and associated fauna.

Deep sea coral reproduction is a subject that has not been the topic of research until recently. While the physiology of reproduction in corals has been studied, little is known about the process of timing involved and the survival of resulting offspring. Studies have, however, shown that many of the deep sea corals have separate sexes (Brooke and Stone 2007; Roberts et al. 2006; Waller et al. 2002; Waller et al. 2005). Brooke and Stone (2007) collected samples of corals (*Stylaster, Errinopora, Distichopora, Cyclohelia, and Crypthelia*) around the Aleutian Islands and discovered that the collection held a mix of females containing mature eggs, developing embryos, and planulae, males producing spermatozoa, and organisms with no reproductive material. As was pointed out the gametes within the collection were not synchronized which indicates that reproduction is either continuous, or prolonged during a certain season of the year (Brook and Stone 2007).

Waller et al. (2002) also found *Fungiacyathus marenzelleri* (collected from the Northeast Atlantic at 2200m) to be gonochoric, with a sex ratio of near 1:1. The mean diameter of oocytes did not vary significantly from month to month and all levels of sperm development were noted. The coral was thus considered quasi-continuous reproducers. An interesting finding of the study was that while *F. marenzelleri* has separate sexes, it can also undergo asexual reproduction and budding was present during the study. However, this was limited to no more than one bud found on any individual and no more than two individuals were found to bud at the same time (Waller et al. 2002), not nearly the kind of reproductive rate to sustain a population in highly disturbed areas.

Fecundity and reproductive traits for three other corals collected in the Northeast Atlantic were also determined in a study by Waller et al. (2005). *Caryophyllia ambrosia* (collected from 1100-1300m), *C. cornuformis* (from 435-2000m), and *C. seguenzae* (from 960-1900m) were all found to be cyclical hermaphroditic. The corals possessed both sexes but only one sex was dominant at a time, corals transitioning between sexes were seen in the study and labeled as “intermediates”. The fecundity of the corals was calculated at 200-2750 oocytes per polyp for *C. ambrosia*, 52-940 oocytes per polyp for *C. seguenzae* and no data due to insufficient samples of *C. cornuformis*. As with the other studies there was no significant difference in the average number of oocytes per month and continuous reproduction is assumed for both *C. ambrosia* and *C. cornuformis* (Waller et al. 2005).

The effects of mechanical disturbance and trauma to the soft coral *Gersemia rubiformis* (collected from the Bay of Fundy) was examined in a lab setting by Henry et al. (2003). In the study, eight colonies of soft coral, four control and four experimental, were set up in separate aquariums to determine damage and recovery rate of the organisms. The experimental colonies were rolled over and crushed every two weeks to simulate bottom contact trawling, with observations recording four days and then one week after disturbance. It was found that crushing the corals caused retraction of the entire colony. Damaged tissue was repaired and healed between 18 and 21 days. The effect the crushing had on coral reproduction was surprising to the researchers.

Thirteen days after the initial disturbance daughter colonies were seen forming at the base of the corals, and by the end of the experiment 100% of the corals had daughter colonies at one point during the study. The mortality rate of the juveniles was 100%, however, and no colonies survived past the polyp stage. Upon testing it was determined that these colonies were sexually derived, and since they had been separated for the experiment it is assumed that the corals were brooding when collected, as they were not visibly fertile prior to the experiment. It should be noted that the control group did not have any daughter colonies during the experiment, and only after (when they were experimentally also crushed) did daughter colonies appear. It is thought that the reason for this was the expulsion of premature planulae (resulting in their ultimate death) due to stress placed on the coral and the need to allocate resources to repair damaged tissue. While adult *G. rubiformis* was able to withstand the mechanical rolling and crushing, the increased mortality of offspring due to ejecting premature planulae may have increased long term effects as the corals are repeatedly disturbed and not able to produce surviving offspring (Henry et al. 2003).

While the physiology of these corals has been recently studied, more research is needed to determine the ability of corals to recolonize disturbed areas. Brooke and Stone (2007) concluded that a lightly impacted area would be able to recover via colony growth alone. However, heavily impacted areas, where the seafloor has been scoured and stripped of cover would require coral larvae to be dispersed via currents and settle the area again, which could be a slow, timely process.

6.4 HUMAN COMMUNITIES AND ECONOMIC ENVIRONMENT

This section describes the socio-economic importance of the MSB fisheries, as well as the importance of several other fisheries that may be impacted by measures proposed in this action (see Sections 6.2 and 7.0 for more information on how these fisheries were identified). Information was compiled from various FMPs and associated specifications documents to describe the human and economic environments of each fishery. Data presented for each fishery and the year of most recent data available vary based on the information source. The fisheries described below include the managed fisheries (MSB), as well as the summer flounder/scup/black sea bass, golden tilefish, red crab, silver hake (whiting), and scallop fisheries. These are the fisheries that the analysis described in Section 7.0 suggested may be impacted by this action. (While a very small percentage of the scallop-dredge revenues may be impacted, this fishery is included given the high value of the scallop fishery.)

6.4.1 Atlantic Mackerel

In the commercial Atlantic mackerel fishery, trawls, gillnet, longline, handline, rod and reel, purse seine, pot/trap, dredges, and dip nets are authorized for commercial use, with most landings originating from midwater otter trawls, paired midwater otter trawls, and bottom trawls. Gillnet gear accounts for a very small amount of the landings. The harvest is widely distributed between Maine and North Carolina. Concentrations of catch occur on the continental shelf southeast of Long Island, NY and east of the Delmarva Peninsula. The bulk of commercial landings occur between January and April, when stocks are in shallower water.

The mackerel fishery is managed using output controls (i.e., controlling harvest). The directed mackerel fishery can be closed when landings are projected to reach 95 percent of the total domestic harvest. The mackerel incidental catch fishery can be closed when landings are projected to reach 100 percent of the total domestic harvest.

U.S. commercial landings of mackerel increased steadily from roughly 3,000 metric tons (mt) in the early 1980s to greater than 31,000 mt by 1990. From 1992-2000, landings declined to relatively low levels before increasing in the early 2000s. The most recent years have seen a significant drop-off in harvest. U.S. commercial landings have been below the commercial quotas each year since quotas were established in 1994 (Figure 12).

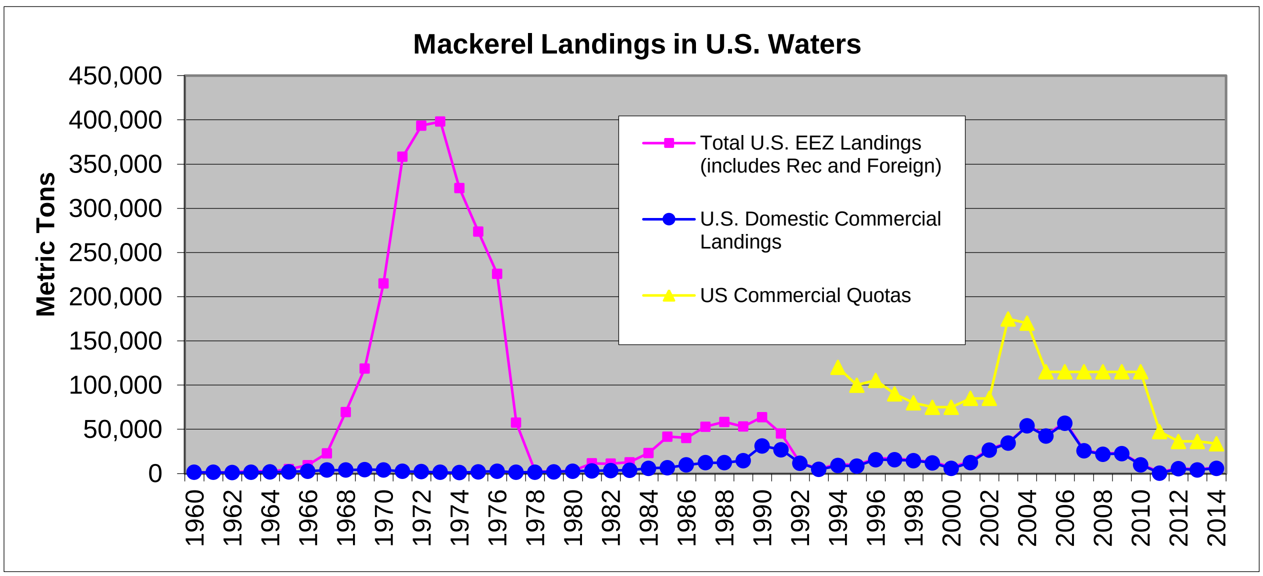


Figure 12: Historical Atl. Mackerel Landings in the U.S. EEZ.

Nominal ex-vessel price has generally varied between about $200-$700 per mt ($0.09-$0.32/lb), but when inflation is taken into account, erosion is observed in the ex-vessel per-pound value of mackerel from 1982-2010. The 2011 and 2012 prices increased substantially (near $700/mt), which is likely at least partially related to the low levels of mackerel landed. 2014 landings totaled 5,490 mt and generated $2.9 million in ex-vessel revenues, or about $491/mt ($0.22/lb). Total ex-vessel value tracks both price and the quantity of fish landed (see Didden 2015a).

The mackerel fishery became a limited access fishery in 2013 except for open-access incidental catch permits. In 2015, there were approximately 31 Tier 1 permits, 24 Tier 2 permits, and 80

Tier 3 permits. When the directed fishery is open, there are no trip limits for Tier 1, Tier 2 has a 135,000-pound trip limit and Tier 3 has a 100,000-pound trip limit. Tier 3's trip limit is reduced to 20,000 pounds if it catches 7% of the commercial quota. Open access incidental permits have a 20,000 pound per trip limit (MAFMC 2015b).

Participation in the fishery was low in 2014, due to the low availability of mackerel. The tables and figures below and on the following pages describe vessel participation, vessel dependency, distribution of landings by state and gear, dealer participation, and the general at-sea location of recent mackerel landings/catches.

Table 9: 2014 permitted and active vessels for various landings thresholds, Maine through North Carolina.

	Commercial Landings			
Principal Port State (from permit data)	**1,000,000+ lb**	**100,000 - 1,000,000 lb**	**50,000-100,000 lb**	**10,000-50,000 lb**
All states	6	5	1	14

Source: Unpublished NMFS dealer reports and permit data. Data confidentiality rules do not allow state by state breakdowns.

Table 10: 2014 vessel dependence on mackerel (revenue-based).

Dependence on Mackerel	**Number of Vessels in Each Dependency Category**
1%-5%	10
5%-25%	12
25%-50%	3
More than 50%	1

Source: Unpublished NMFS dealer reports. Not at state level due to data confidentiality issues.

Table 11: Recent landings by state (mt).

Year	**CT**	**MA**	**ME**	**NJ**	**NY**	**RI**	**OTHER**
2012	4	1,874	19	915	25	2,493	2
2013	9	3,302	465	21	9	324	5
2014	9	4,924	622	13	57	245	71

Table 12: Recent (2012-2014) mackerel landings by gear type (mt).

Year	**Gill Nets**	**Bottom Trawl**	**Single Mid-Water Trawl**	**Pair Mid-Water Trawl**	**Trap/Pots/ Pound Nets/Weir**	**Other/ Unknown**
2012	4	3,059	576	1,488	24	181
2013	6	965	166	2,338	15	883
2014	33	1,126	1,299	1,484	16	1,981

Source: Unpublished NMFS dealer reports.

Due to data confidentiality issues, details for port revenues from mackerel cannot be provided. NMFS dealer data indicates that ports with at least $100,000 in ex-vessel revenues from mackerel over 2012-2014 (combined) included (from more mackerel dollars to less): North Kingstown, RI; Gloucester, MA; New Bedford, MA; Portland, ME, Cape May, NJ; Marshfield, MA; Provincetown, MA; and Point Judith, RI.

Table 13: Recent (2012-2014) number of active dealers buying more than $10,000 or $100,000 mackerel.

Year	Number of dealers buying at least $10,000 mackerel	Number of dealers buying at least $100,000 mackerel
2012	5	5
2013	16	4
2014	18	5

Source: Unpublished NMFS dealer reports

Data confidentiality concerns preclude listing mackerel catch by statistical area, but statistical areas with more than 1,000 mt of mackerel catch combined over 2012-2014 include (in descending order of catch amounts) 522, 612, 521, 616, and 514 (NMFS Statistical Areas are shown in Figure 13).

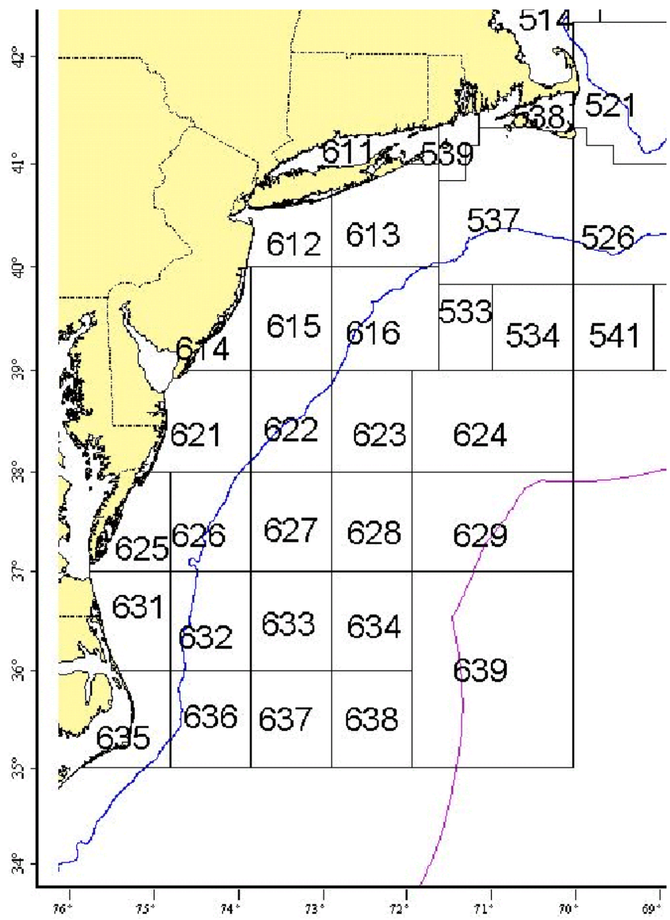


Figure 13. NMFS Statistical Areas.

Recent Amendments to the MSB FMP contain additional information about the MSB fisheries, especially demographic information on ports that land MSB species. See Amendments 11 and 14 at http://www.mafmc.org/msb/ for more information or visit NMFS' communities page at: http://www.nefsc.noaa.gov/read/socialsci/community_profiles/. Additional information on the

social and economic aspects of this fishery can be found in the 2016-2018 Specifications EA for MSB, available at:
http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16msb2016specsea.pdf.

6.4.2 Atlantic Butterfish

Butterfish are harvested primarily with bottom otter trawl gear. Harvest is widespread with concentrations of landings from southern New England shelf break areas near 40°N and in/near Long Island Sound. Butterfish are landed year-round, with no apparent seasonal patterns. Butterfish is managed using a phased system, which triggers butterfish possession limit reductions at different points to ensure quota is available for directed harvest throughout the fishing year.

During the period 1965-1976, U.S. Atlantic butterfish landings averaged 2,051 mt. From 1977-1987, average U.S. landings doubled to 5,252 mt, with a historical peak of slightly less than 12,000 mt landed in 1984. Low abundance and reductions in Japanese demand for butterfish probably had a negative effect on butterfish landings in the 1990s-early 2000s, but regulations kept butterfish catches low from 2005-2012 (Figure 14). Quotas were increased somewhat each year between 2012 and 2014, and more substantially in 2015 based on a new assessment.

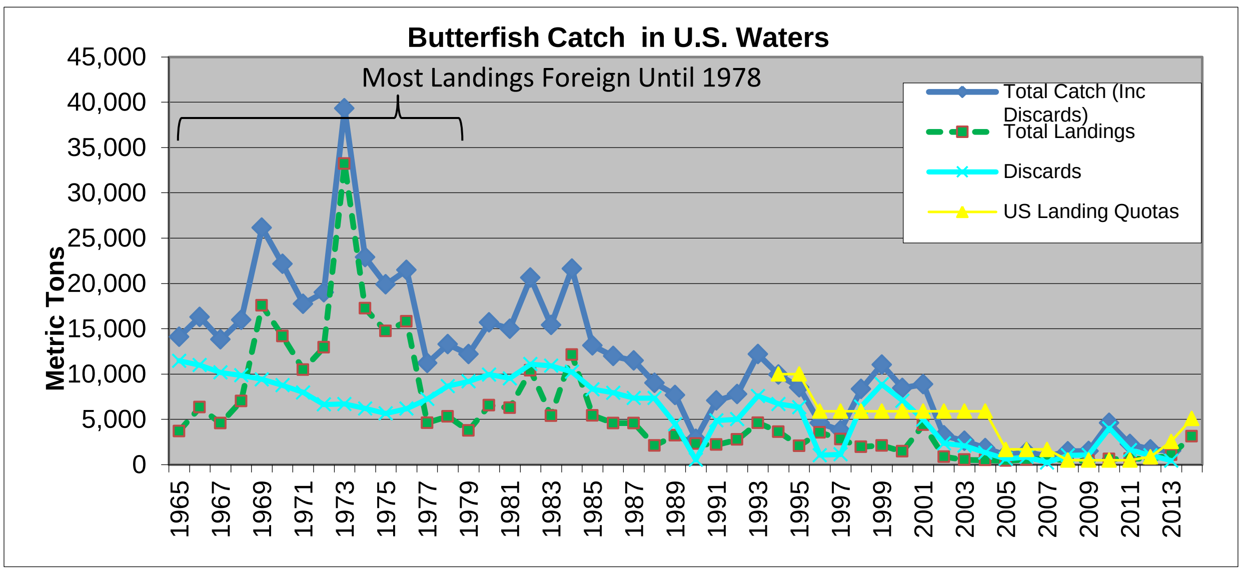


Figure 14. Historical Butterfish Landings in the U.S. EEZ.

Nominal ex-vessel price has generally ranged from $1,400-$1,700/mt ($0.69-$0.77/lb) from 2006-2014. However, when adjusted for inflation, it is clear that prices began a long downward trend in 1986. 2014 landings totaled 3,122 mt (6.88 million lb) and generated $4.6 million in ex-vessel revenues (approximately $0.67/lb or $1,473/mt; Didden 2015b).

Table 14-Table 19 describe vessel participation, vessel dependency, distribution of landings by state and gear type, dealer participation, and the general at-sea location of most recent catches. In 2014 there were approximately 337 potentially active butterfish/longfin squid limited access or "moratorium" permits. Another 64 were not potentially active but have had their history documented under CPH or "Confirmation of Permit History."

Table 14: 2014 permitted and active vessels for various landings thresholds, Maine through North Carolina.

	Commercial Landings	
Principal Port State (from permit data)	**10,000+ lb**	**1,000-10,000 lb**
All states	53	79

Source: Unpublished NMFS dealer reports and permit data. Data confidentiality rules do not allow state by state breakdowns.

Table 15: 2014 vessel dependence on butterfish (revenue-based).

Dependence on Butterfish	Number of Vessels in Each Dependency Category
1%-5%	60
5%-25%	12
25%-50%	2
More than 50%	0

Table 16: Recent (2012-2014) landings by state (mt).

Year	CT	MA	NJ	NY	RI	OTHER
2012	51	80	34	207	249	18
2013	50	59	75	174	711	22
2014	46	94	58	261	2,653	11

Source: Unpublished NMFS dealer reports

Table 17: Recent (2012-2014) butterfish landings by gear type (mt).

Year	Bottom Trawl	Dredge	Unknown/Other
2012	456	20	163
2013	939	14	138
2014	2,847	9	266

Table 18. Recent (2012-2014) numbers of active dealers.

Year	Number of dealers buying at least $10,000 butterfish	Number of dealers buying at least $50,000 butterfish
2012	13	6
2013	17	7
2014	11	12

Source: Unpublished NMFS dealer reports.

Table 19: Recent butterfish ex-vessel revenues (US dollars) by port for all ports with at least $100,000 butterfish ex-vessel sales combined over last three years. CI = Confidential Information.

YEAR	POINT JUDITH, RI	MONTAUK, NY	NORTH KINGSTOWN, RI	NEW BEDFORD, MA	HAMPTON BAYS, NY	STONIN-GTON, CT	AMAGA-NSETT, NY	NEW LONDON, CT
2012	302,847	231,844	CI	75,764	59,724	CI	CI	CI
2013	376,175	300,495		67,917	39,704			
2014	594,633	451,212		137,040	42,038			

Source: Unpublished NMFS dealer reports.

Recent Amendments to the MSB FMP contain additional information about the MSB fisheries, especially demographic information on ports that land MSB species. See Amendments 11 and 14 at http://www.mafmc.org/msb/ for more information or visit NMFS' communities page at: http://www.nefsc.noaa.gov/read/socialsci/community_profiles/. Additional information on this fishery can be found in the 2016-2018 Specifications EA for MSB, available at http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16msb2016specsea.pdf.

6.4.3 Longfin Squid

U.S. fishermen have been landing squid along east coast of the U.S. since the 1880s but early fisheries were minor in scope. Focused effort began in 1968 by The Union of Soviet Socialist Republics (USSR) and Japanese vessels. Reported foreign landings of longfin squid increased from 2,000 mt in 1964 to a peak of 36,500 mt in 1973. Foreign longfin squid landings averaged 29,000 mt for the period 1972-1975.

Foreign fishing for longfin squid began to be regulated with the advent of extended fishery jurisdiction in the U.S. in 1977. Initially, U.S. regulations restricted foreign vessels fishing for squid (and other species) to certain areas and times, primarily to reduce spatial conflicts with domestic fixed gear fishermen and minimize bycatch of non-target species. Later, foreign allocations were reduced and then eliminated as the domestic fishery became established. The development and expansion of the U.S. squid fishery occurred relatively slowly as the U.S. industry did not develop the appropriate technology to catch and process squid in offshore waters until the 1980s (Figure 15).

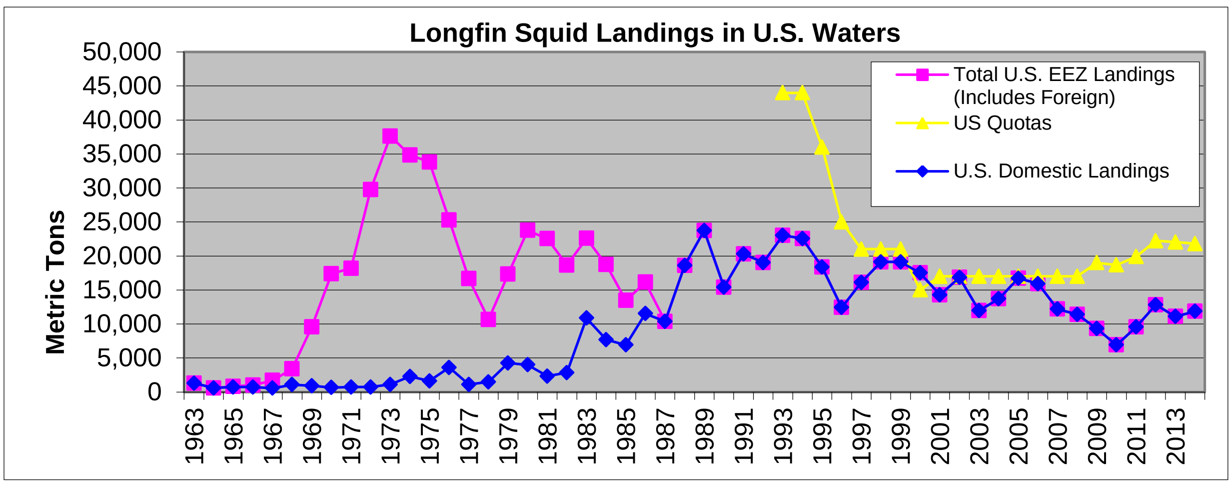


Figure 15. Historical longfin squid landings in the U.S. EEZ.

Longfin squid landings in 2014 totaled 11,858 mt (26.14 million lb) and generated $25.9 million in ex-vessel revenues ($0.99/lb or $2,184/mt).

Table 20-Table 25 describe vessel participation, vessel dependency, distribution of landings by state and gear type, dealer participation, and the general at-sea location of most recent catches. There were approximately 337 potentially active butterfish/longfin squid limited access or "moratorium" permits. Another 64 were not potentially active but have had their history documented under CPH or "Confirmation of Permit History." Ex-vessel price per metric ton, adjusted for inflation, generally trended up in the 1980s and 1990s, and remained relatively flat since the early 2000s (Figure 16; Didden 2015c).

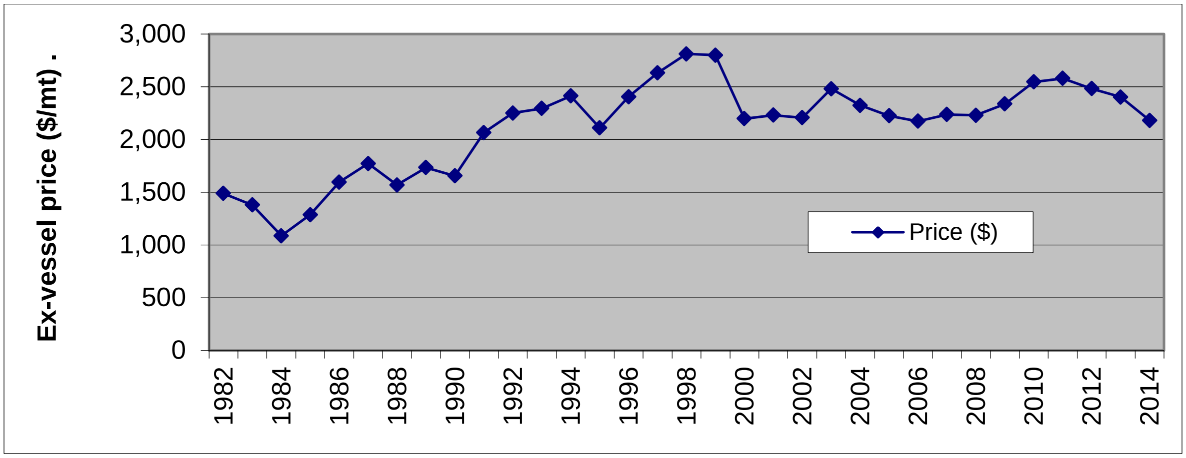


Figure 16. U.S. longfin ex-vessel prices (Producer Price Index adjusted, 2014 dollars). Source: Unpublished NMFS dealer reports.

Table 20: 2014 permitted and active vessels for various landings thresholds, Maine through North Carolina.

	Commercial Landings			
Principal Port State (from permit data)	**500,000+ lb**	**100,000 - 500,000 lb**	**50,000-100,000 lb**	**10,000-50,000 lb**
All states	12	58	30	54

Source: Unpublished NMFS dealer reports and permit data. Data confidentiality rules do not allow state by state breakdowns.

Table 21: 2014 Vessel dependence on longfin squid (revenue-based).

Dependence on Longfin	Number of Vessels in Each Dependency Category
1%-5%	20
5%-25%	70
25%-50%	49
More than 50%	26

Source: Unpublished NMFS dealer reports. Based on vessels with at least $5,000 in longfin squid revenues.

Table 22: Recent (2012-2014) longfin squid landings by state (mt).

Year	CT	MA	NJ	NY	RI	OTHER
2012	688	1,335	1,893	3,556	5,302	42
2013	487	393	2,169	2,180	5,712	155
2014	589	1,093	1,254	2,167	6,655	100

Source: Unpublished NMFS dealer reports.

Table 23: Recent (2012-2014) longfin squid landings by gear type (mt).

Year	Bottom Trawl	Mid-Water Trawl	Dredge	Trap/Pots/ Pound Nets/Weir	Other/Unknown
2012	10,480	99	131	47	2,060
2013	9,371	19	184	1	1,521
2014	9,211	0	244	2	2,401

Source: Unpublished NMFS dealer reports.

Table 24. Recent (2012-2014) numbers of active dealers.

Year	Number of dealers buying at least $10,000 Longfin	Number of dealers buying at least $100,000 Longfin	Number of dealers buying at least $1,000,000 Longfin
2012	20	25	8
2013	20	18	6
2014	23	21	6

Source: Unpublished NMFS dealer reports.

Table 25. Recent longfin squid ex-vessel revenues (US dollars) by port for all ports with at least $200,000 longfin squid ex-vessel sales combined over last three years. CI = Confidential Information.

YEAR	POINT JUDITH, RI	MONTAUK, NY	CAPE MAY, NJ	HAMPTON BAYS, NY	NORTH KINGSTOWN, RI	NEW BEDFORD, MA	NEW LONDON, CT
2012	$10,661,735	$4,739,505	$3,666,660	$3,080,859	$1,837,346	$1,195,242	$998,311
2013	$9,842,162	$3,268,002	$4,348,453	$2,237,947	$3,251,086	$848,885	$725,914
2014	$12,342,134	$3,204,462	$2,279,576	$1,610,180	$1,607,453	$844,635	$926,609
YEAR	BARNSTABLE, MA	STONINGTON, CT	POINT LOOKOUT, NY	BELFORD, NJ	WOODS HOLE, MA	POINT PLEASANT, NJ	SHINNECOCK, NY
2012	$1,100,494	$689,303	$537,550	CI	CI	CI	CI
2013	$71,755	$403,915	$161,679	CI	CI	CI	CI
2014	$768,778	$347,707	$202,213	CI	CI	CI	CI
YEAR	NEWPORT, RI	HAMPTON, VA	FALMOUTH, MA	EAST LYME, CT	EAST LYME, CT		
2012	CI	CI	CI	CI	CI		
2013	CI	CI	CI	CI	CI		
2014	CI	CI	CI	CI	CI		

Source: Unpublished NMFS dealer reports.

Recent Amendments to the MSB FMP contain additional information about the MSB fisheries, especially demographic information on ports that land MSB species. See Amendments 11 and 14 at http://www.mafmc.org/msb/ for more information or visit NMFS' communities page at: http://www.nefsc.noaa.gov/read/socialsci/community_profiles/. Additional information on this fishery can be found in the 2016-2018 Specifications EA for MSB, available at http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16msb2016specsea.pdf.

6.4.4 *Illex* Squid

Foreign fishing fleets became interested in exploitation of the squid stocks of the Northwest Atlantic Ocean when the USSR first reported squid bycatches in the mid-1960s. By 1972, foreign fishing fleets reported landing 17,200 thousand mt of *Illex* from Cape Hatteras to the Gulf of Maine. During the period 1973-1982, foreign landings of *Illex* in U.S. waters averaged about 18,000 mt, while U.S. fisherman averaged only slightly more than 1,100 mt per year. Foreign landings from 1983-1986 were part of the U.S. joint venture fishery which ended in 1987. The domestic fishery for *Illex* increased fitfully during the 1980's as foreign fishing was eliminated in the U.S. EEZ. Since 1987, landings of *I. illecebrosus* have been solely from a domestic small-mesh bottom trawl fishery which occurs primarily during May-November, when the species is available on the US continental shelf and upper slope. *Illex* landings are heavily influenced by year-to-year availability and world-market activity and vary substantially year to year.

During 2003-2013 landings averaged 13,810 mt and reached a peak of 26,097 mt in 2004. In recent years, landings declined substantially from 18,797 mt in 2011 to 3,792 mt in 2013. During 2014, landings increased to 8,772 mt (19.34 million lb), representing 38% of the annual quota (Figure 17; NEFSC 2015b).

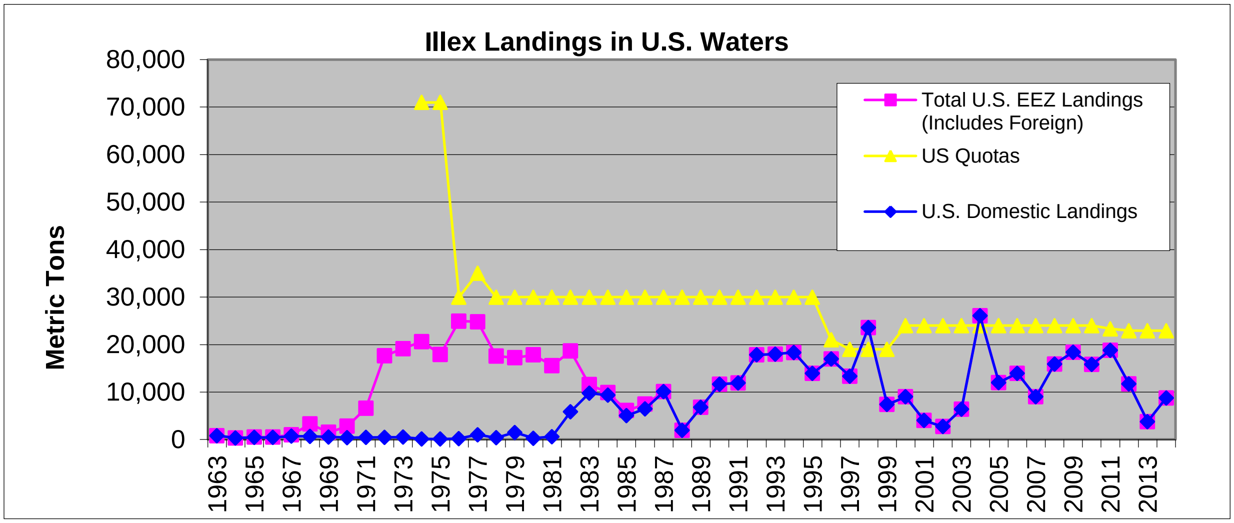


Figure 17: *Illex* landings within 200 miles of U.S. Coast, 1963-2014. Source: TRAC 2010; unpublished dealer data.

Nominal ex-vessel price has increased from $200-$500 per mt ($0.09/lb) in the 1980s to $600-$1,000 per mt ($0.27-$0.45/lb) in recent years. In inflation adjusted dollars, prices have varied from $600-$1,000 per mt without trend. 2013 ex-vessel prices were about $610/mt ($0.28/lb) (Figure 18). Total ex-vessel value tracks both price and the quantity of fish landed (see Didden 2015d for more details).

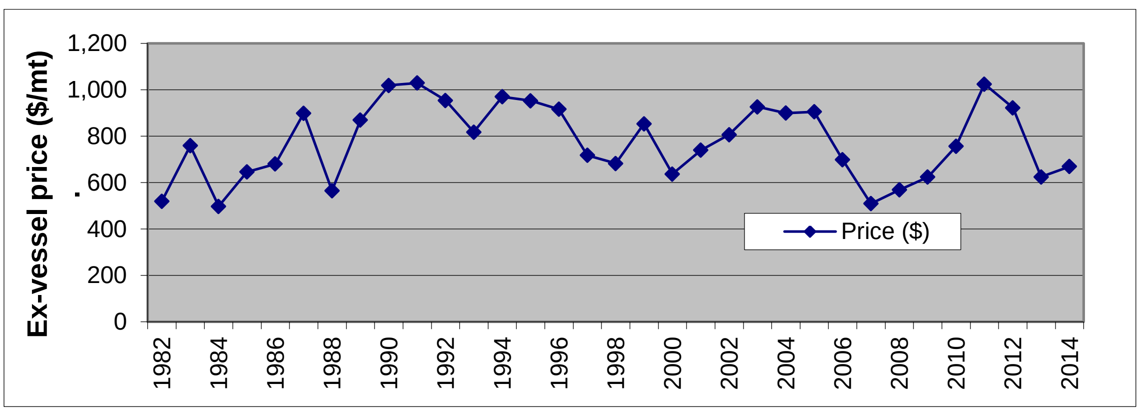


Figure 18: U.S. Illex ex-vessel prices (Producer Price Index adjusted, 2014 dollars). Source: Unpublished NMFS dealer reports.

The *Illex* fishery is a limited access fishery with 74 current permits except for open access incidental permits. As long as the fishery is open there is no trip limit for moratorium permits. Open access incidental permits have a 10,000 pound per trip limit. Only a few vessels accounted for most *Illex* landings in 2013 (Table 26). Table 27 and Table 28 describe vessel dependency on

Illex and distribution of landings by gear type. Landings are usually provided by state but since there are few dealers that buy *Illex*, confidentiality rules do not allow precise descriptions. However, it can be reported that most *Illex* landings occur in New Jersey and Rhode Island.

Table 26: 2014 permitted and active vessels for various landings thresholds, Maine through North Carolina.

	Commercial Landings			
Principal Port State (from permit data)	**500,000+ lb**	**100,000 - 500,000 lb**	**50,000-100,000 lb**	**10,000-50,000 lb**
All states	5	3	2	3

Source: Unpublished NMFS dealer reports and permit data. Data confidentiality rules do not allow state by state breakdowns.

Table 27: 2013 Vessel dependence on *Illex* squid (revenue-based).

Dependence on *Illex*	**Number of Vessels in Each Dependency Category**
1%-5%	9
5%-25%	5
25%-50%	2
More than 50%	0

Table 28: Recent (2011-2013) *Illex* landings by gear type (mt).

Year	**Bottom Trawl**	**Mid-Water Trawl**	**Other/ Unknown**
2011	18,192	486	118
2012	11,390	319	0
2013	3,597	5	190

Source: Unpublished NMFS dealer reports.

Due to data confidentiality issues, details for port revenues from *Illex* cannot be provided. Ports that had at least $100,000 in ex-vessel revenues from *Illex* over 2011-2013 (combined) included (from more mackerel dollars to less): North Kingstown, RI; May, NJ; Hampton, VA; and Wanchese, NC. From 2011 to 2013, a small number of dealers reported buying more than $10,000 or $100,000 worth of *Illex* (Table 29).

Table 29. Recent (2011-2013) numbers of active dealers.

Year	**Number of dealers buying at least $10,000 *Illex***	**Number of dealers buying at least $100,000 *Illex***
2011	2	3
2012	2	2
2013	2	3

Source: Unpublished NMFS dealer reports.

Vessel trip report data indicate that NMFS statistical areas with more than 1,000 mt of *Illex* catch combined over 2011-2013 include (in descending order of catch amounts) 622, 632, 626, and 611 (NMFS Statistical Areas are shown in Figure 13).

Recent Amendments to the MSB FMP contain additional information about the MSB fisheries, especially demographic information on ports that land MSB species. See Amendments 11 and 14 at http://www.mafmc.org/msb/ for more information or visit NMFS' communities page at: http://www.nefsc.noaa.gov/read/socialsci/community_profiles/. Additional information on this fishery can be found in the 2016-2018 Specifications EA for MSB, available at http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16msb2016specsea.pdf.

6.4.5 Summer Flounder, Scup, and Black Sea Bass

The Summer Flounder, Scup, and Black Sea Bass FMP uses output controls (catch and landings limits) as the primary management tool, with landings divided between the commercial and recreational fisheries. The FMP also includes minimum fish sizes, bag limits, seasons, gear restrictions, permit requirements, and other provisions to prevent overfishing and ensure sustainability of the fisheries.

Otter trawls are utilized in the commercial fisheries for all three species. In addition, floating traps and pots/traps are used to capture scup and black sea bass, respectively. Information on commercial landings and economic value is provided in Table 30.

Table 30: Landings (million lb) and revenues (millions of U.S. dollars) for summer flounder, scup, and black sea bass, 2009-2014.

	Summer Flounder		Scup		Black Sea Bass	
	Landings	**Ex-vessel value**	**Landings**	**Ex-vessel value**	**Landings**	**Ex-vessel value**
2009	11.05	21.05	8.20	6.27	1.17	3.52
2010	13.55	27.44	10.73	7.11	1.75	5.34
2011	16.57	29.86	15.03	8.23	1.69	5.40
2012	12.91	30.23	14.88	10.43	1.72	5.75
2013	12.49	29.17	17.87	9.79	2.26	7.36
2014	10.91	30.00	15.93	9.54	2.38	7.70

Source: Unpublished NMFS dealer reports.

For summer flounder in 2014, commercial fishermen from Maine through North Carolina landed about 10.91 million pounds of summer flounder, valued at about $30.0 million (an average of $2.75/pound). NMFS VTR data indicate that summer flounder were caught on 14,660 trips with four major gear types. The majority of the trips and catch were made by bottom otter trawls (71.08% of trips, 95.6% of catch), followed by handlines (10.83% of trips, 0.83% of catch), gillnets (10.78% of trips, 1.27% of catch), and scallop dredges (3.07% of trips, 0.53% of catch). All other gears accounted for less than 1% of the trips and less than 1% of the summer flounder catch in 2014 (MAFMC 2015a).

For scup in 2014, commercial fishermen from Maine through North Carolina landed 15.93 million pounds of scup, valued at $9.54 million (an average of $0.60/pound). VTR data indicate that scup were caught on a total of 8,214 trips, mostly with bottom otter trawls (70.85% of trips, 95.90% of catch, in weight). Pots and traps accounted for 7.68% of trips and 1.34% of the total catch. Sink gill nets accounted for 6.59% of trips and about 1.03% of the catch. Handlines accounted for 11.55% of the trips, and 0.63% of the catch. Offshore lobster traps accounted for about 1.39% of the trips and 0.03% of the catch. All other gear types accounted for less than 1% of the catch and landings in 2014 (MAFMC 2015a).

For black sea bass in 2014, NMFS VTR data indicate that commercial fishermen took 7,278 trips that caught black sea bass, the majority by bottom otter trawls (52.18% of trips, 64.37% of catch in weight), followed by pots and traps (16.53% of trips, 20.97% of catch), offshore lobster traps (6.43% of trips, 8.05% of catch), handlines (17.97% of trips, 4.60% of catch), and sink gill nets

(4.15% of trips, 0.63% of catch). All other gear types accounted for less than 1% of the trips and catch in 2014 (MAFMC 2015a).

Eleven NMFS statistical areas (Figure 13) individually accounted for greater than 5% of the summer flounder, scup, or black sea bass catch in 2014 (Table 31). Collectively, these eleven areas accounted for 85% of the summer flounder catch, 93% of the scup catch, and 86% of the black sea bass catch in 2014.

Table 31. Statistical areas that accounted for at least 5% of the summer flounder, scup, or black sea bass catch in 2014, according to NMFS VTR data.

Statistical Area	Summer Flounder (%)	Scup (%)	Black Sea Bass (%)
537	23.96	22.45	6.22
538	1.15	1.98	2.63
539	3.41	13.34	4.22
611	2.30	11.43	2.79
612	6.64	0.97	2.38
613	8.30	8.96	2.55
615	2.73	6.05	13.24
616	23.3	24.73	31.43
621	2.73	0.40	9.75
622	10.72	2.87	4.88
631	0.25	0.25	5.48

Table 32 shows all ports where at least 100,000 pounds of summer flounder, scup, or black sea bass were landed by commercial fishermen in 2014. The ports and communities that are dependent on summer flounder, scup, and black sea bass are described in Section 3.4 of Amendment 13 to the Summer Flounder, Scup, and Black Sea Bass FMP (MAFMC 2002). Additional information on ports and communities can be found at: www.nefsc.noaa.gov/read/socialsci/communityProfiles.html.

Table 32. Ports, and associated landings, where at least 100,000 pounds of summer flounder, scup, or black seabass were landed in 2014, according to NMFS dealer data. Blank cells indicate that a port did not land at least 100,000 pounds of a given species (not necessarily zero landings).

	Summer flounder		Scup		Black sea bass	
Port name	**Landings (pounds)**	**Number of vessels**	**Landings (pounds)**	**Number of vessels**	**Landings (pounds)**	**Number of vessels**
Ammagansett, NY			C	C		
Beaufort, NC	806,150	29				
Belford, NJ	323,379	17	175,671	16		
Bristol, RI			113,599	4		
Cape May, NJ	483,879	56	1,021,392	28	227,536	39
Chincoteague, VA	567,127	36	370,087	21	131,678	19
Engelhard, NC	508,370	12				
Hampton Bays, NY	128,076	26	313,103	30		
Hampton, VA	843,060	40	218,108	28		
Hobucken, NC	272,200	10				
Hyannis, MA	104,711	12				
Indian River, DE					102,722	3
Little Compton, CT			361,070	13		
Long Beach/ Barnegat Light, NJ	146,970	24				
Mattituck, NY			259,046	4		
Montauk, NY	492,440	77	2,160,084	85	127,041	94
New Bedford, MA	292,116	59	826,025	59		
New London, CT			344,898	8		
Newport News, VA	744,103	37	166,023	14		
Newport, RI			199,349	11		
Ocean City, MD	164,380	19	530,761	5	230,099	15
Oriental, NC	273,929	7				
Other Currituck, NC	102,118	7				
Point Judith, RI	1,824,045	129	5,872,354	131	195,168	139
Point Lookout, NY			122,825	5		
Point Pleasant, NJ	821,659	46	1,144,608	32	215,705	46
Providence, RI			C	C		
Stonington, CT	169,898	20	342,791	20		
Wanchese, NC	848,648	28				

Note: Landings associated with less than three vessels are labeled "C" for confidential.

Federal permit data indicate that 1,144 commercial vessels were permitted to land summer flounder, scup, and/or black sea bass in 2014 from Maine through North Carolina (Table 33). A subset of those federally-permitted vessels were active in 2014. Dealer reports indicate that 1,002 commercial vessels with summer flounder, scup, and/or black sea bass permits actually landed those species in 2014.

Table 33. Federally permitted summer flounder, scup, and/or black sea bass commercial vessels and commercial vessels that landed these species, by state for 2014, Maine through North Carolina.

State	Permitted Vessels	Vessels that Landed Summer Flounder, Scup, and/or Black Sea Bass
Maine	49	-
New Hampshire	24	C
Massachusetts	344	197
Rhode Island	128	198
Connecticut	29	30
New York	134	170
New Jersey	213	155
Pennsylvania	C	-
Delaware	11	3
Maryland	16	22
Virginia	90	129
North Carolina	99	97
Other	7	1
Total	1,144	1,002

Note: States with less than 3 reporting entities are not reported due to confidentiality issues (C). Source: NMFS Permit data and Dealer data.

In 2014, 265 Federally-permitted dealers purchased approximately $30.0 million of summer flounder; $9.5 million of scup; and $7.7 million of black sea bass. These dealers were distributed by state as indicated in Table 34. Employment data for these specific firms are not available.

Table 34. Number of dealers that purchased summer flounder, scup, and/or black sea bass, by state for 2014, Maine through North Carolina.

State	Number of dealers that purchased summer flounder, scup, and/or black sea bass in 2014
Maine	-
New Hampshire	C
Massachusetts	42
Rhode Island	42
Connecticut	21
New York	62
New Jersey	41
Pennsylvania	-
Delaware	C
Maryland	4
Virginia	19
North Carolina	30
Other	4
Total	265

Note: States with less than 3 reporting entities are not reported due to confidentiality issues (C). Note: Other, includes confidential values. Includes 1 dealer from an area south of NC. Source: Permit data and Dealer data.

Additional information on this fishery can be found in the 2016-2018 Specifications EA for summer flounder, scup, and black sea bass, at: http://www.greateratlantic.fisheries.noaa.gov/regs/2015/November/15sfcbsb20162018specspr.html.

6.4.6 Golden Tilefish

From 1970 to 2015, commercial golden tilefish landings have ranged from 128,000 lb (1970) to 8.7 million lb (1979). Since 2001, golden tilefish landings have been relatively stable, averaging 1.9 million lb and ranging from 1.5 million lb in 2005 to 2.5 million lb in 2004 (MAFMC 2016; Figure 19).

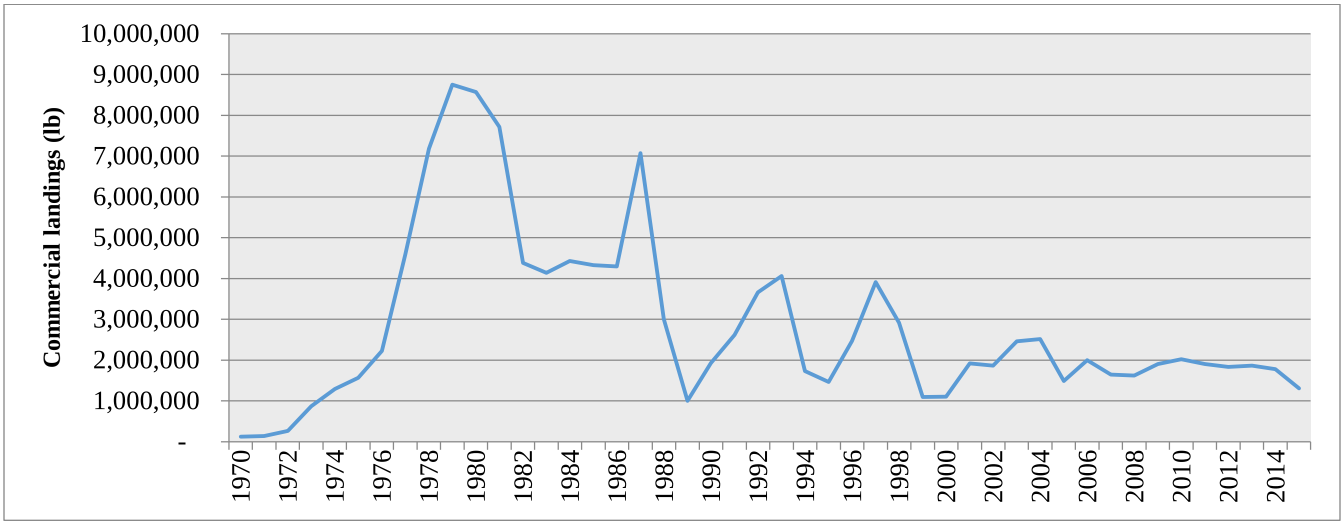


Figure 19: Commercial U.S. Golden Tilefish Landings (live weight) from Maine-Virginia, 1970-2015. Source: 1970-1993 Tilefish FMP. 1994-2015 NMFS unpublished dealer data.

The directed fishery is managed via an IFQ program. If a permanent IFQ allocation is exceeded, including any overage that results from tilefish landed by a lessee in excess of the lease amount, the permanent allocation will be reduced by the amount of the overage in the subsequent fishing year. If a permanent IFQ allocation overage is not deducted from the appropriate allocation before the IFQ allocation permit is issued for the subsequent fishing year, a revised IFQ allocation permit reflecting the deduction of the overage will be issued. If the allocation cannot be reduced in the subsequent fishing year because the full allocation had already been landed or transferred, the IFQ allocation permit would indicate a reduced allocation for the amount of the overage in the next fishing year (MAFMC 2016).

Based on dealer data from 2011 through 2015, the bulk of the golden tilefish landings are taken by longline gear (98%) followed by bottom trawl gear (~1%). No other gear had any significant commercial landings. Minimal catches were also recorded for hand line and gillnets (Table 35).

Table 35: Golden tilefish commercial landings (thousands of pounds live weight) by gear type, Maine through Virginia, 2011-2015 combined.

Gear Type	lb	Percent
Otter Trawl Bottom, Fish	108	1.3
Gillnet, Anchored/Sink/Other	11	*
Lines Hand	17	*
Lines Long Set with Hooks	8,550	98.4
Unknown, Other Combined Gears	3	*
All Gear	8,689	100

Note: * = less than 1,000 lb or less than 1 percent.

Commercial golden tilefish ex-vessel revenues have ranged from $2.5 million in 2000 to $5.9 in 2013 for the 1999 through 2015 period. The mean price for golden tilefish (adjusted for inflation) has ranged from $1.11 per pound in 2004 to $4.26 per pound in 2015 (Figure 20).

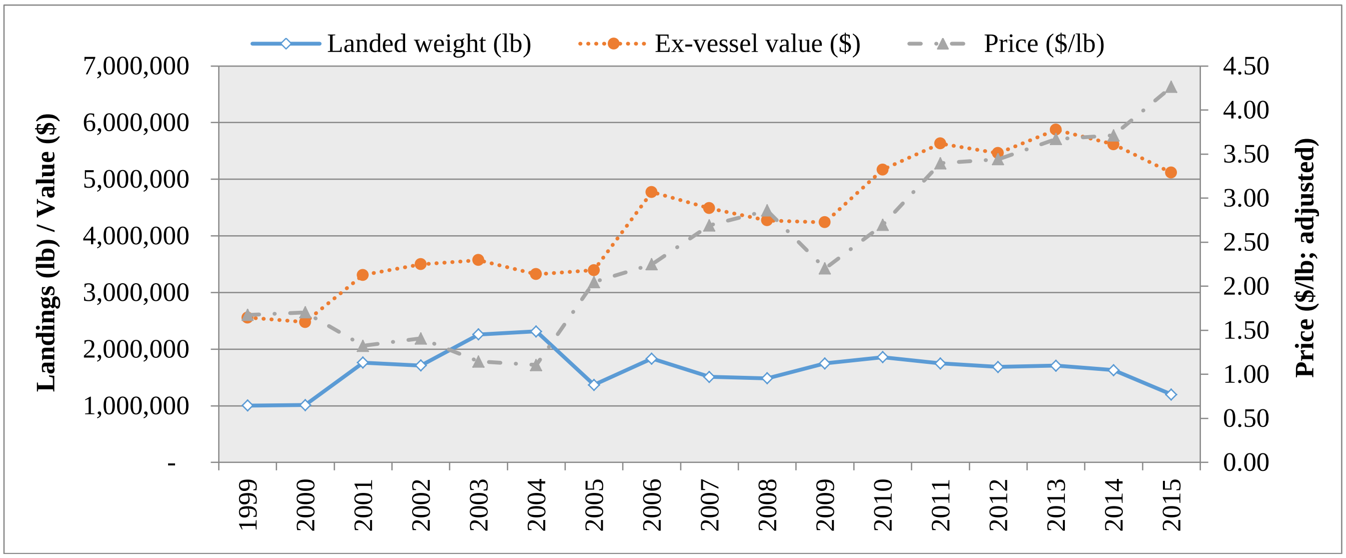


Figure 20: Landings, ex-vessel value, and price for golden tilefish, Maine through Virginia combined, 1999-2015. Note: Prices were adjusted to 2015 values using the Bureau of Labor Statistics Producer Price Index.

The 2011 through 2015 coastwide average ex-vessel price per pound for all market categories combined was $3.47. Price differential indicates that larger fish tend to bring higher prices (Table 36). Nevertheless, even though there is a price differential for various sizes of golden tilefish landed, golden tilefish fishermen land all fish caught as the survival rate of discarded fish is very low. Furthermore, Amendment 1 to the Golden Tilefish FMP prohibited the practice of highgrading (MAFMC 2009).

Table 36: Landings, ex-vessel value, and price of tilefish by size category, from Maine through Virginia, 2011 through 2015.

Size Category	Landed Weight (pounds)	Value ($)	Price ($/lb)
Extra large	308,830	1,287,824	4.17
Large/Medium	371,189	1,509,810	4.07
Large	2,445,307	9,918,655	4.06
Medium	2,588,999	8,414,090	3.25
Small or Kittens	1,404,182	3,802,300	2.71
Small-Kitten	139,649	333,758	2.39
Unclassified	716,299	2,434,470	3.40
All	7,974,455	27,700,907	3.47

According to NMFS VTR data, approximately 55 percent of the landings for 2015 were caught in statistical area 616, which includes Hudson Canyon; statistical area 626 had 6 percent; statistical areas 525 and 539 had 3 percent. NMFS statistical areas are shown in Figure 13.

The commercial fisheries for tilefish are fully described in Amendment 1 to the FMP (MAFMC 2009) and are also outlined by principal port in section 6.4 of that document. Montauk, NY and Barnegat Light, NJ continue to be the ports with the most landings (Table 37). Additional information on "Community Profiles for the Northeast U.S. Fisheries" can be found at http://www.nefsc.noaa.gov/read/socialsci/community_profiles/.

Table 37: Top ports of landing (in lb) for golden tilefish, based on NMFS 2014-2015 dealer data. Since this table includes only the "top ports," it may not include all of the landings for the year. (Note: values in parenthesis correspond to IFQ vessels). C=Confidential.

Port	2014		2015	
	Landings	# Vessels	Landings	# Vessels
MONTAUK, NY	1,181,086 (1,177,286)	14 (4)	822,677 (821,195)	7 (4)
BARNEGAT LIGHT/LONG BEACH, NJ	376,226 (372,013)	12 (8)	362,979 (362,976)	10 (9)
HAMPTON BAYS, NY	168,883 (C)	4 (1)	56,930 (C)	3 (1)
POINT JUDITH, RI	14,406 (0)	45 (0)	4,929 (0)	47 (0)
SHINNECOCK, NY	C (C)	2 (1)	C (C)	1 (1)
EAST HAMPTON, NY	0 (0)	0 (0)	C (C)	1 (1)

In 2015 there were 43 federally permitted dealers who bought golden tilefish from 97 vessels that landed this species from Maine through Virginia. In addition, 64 dealers bought golden tilefish from 112 vessels in 2014. These dealers bought approximately $5.1 and $5.7 million of golden tilefish in 2015 and 2014, respectively, and are distributed by state as indicated in Table 38. Table 39 shows relative dealer dependence on tilefish.

Table 38: Dealers reporting buying golden tilefish, by state in 2014-2015. Note: C = Confidential.

# of Dealers	MA		RI		CT		NY		NJ		MD		VA		Other	
	'14	'15	'14	'15	'14	'15	'14	'15	'14	'15	'14	'15	'14	'15	'14	'15
	7	6	9	8	10	6	20	13	9	6	3	C	4	3	2	1

Table 39: Dealer dependence on tilefish, 2011-2015.

Number of Dealers	Relative Dependence on Tilefish
84	<5%
4	5%-10%
5	10% - 25%
2	25% - 50%
1	50% - 75%
1	90%+

Source: Unpublished NMFS dealer reports.

Additional information on this fishery can be found in the Specifications EA at http://www.greateratlantic.fisheries.noaa.gov/regs/2014/September/14tilefish20152017specspr.html.

6.4.7 Deep Sea Red Crab

The red crab fishery is managed by the New England Fishery Management Council. There has been a small directed fishery off the coast of New England and in the Mid-Atlantic for deep-sea red crab since the early 1970s. Though the size and intensity of this fishery has fluctuated, it has remained consistently small relative to more prominent New England fisheries such as groundfish, sea scallops, and lobster. In 1999, at the request of members of the red crab fishing industry, the NEFMC began development of an FMP to prevent overfishing of the red crab resource and address a threat of overcapitalization of the red crab fishery. The FMP was implemented in 2002.

The primary management control is a limited access permit program for qualifying vessels with documented history in the fishery. Other measures included days-at-sea limits, trip limits, gear restrictions, and limits on processing crabs at sea. Amendment 3 was implemented in 2011 to bring the FMP into compliance with the revised Magnuson-Stevens Act by implementing Annual Catch Limits and accountability measures. Amendment 3 also revised the management measures, by eliminating days-at-sea and the vessel trip limit.

As described in Section 6.2.7, the directed, limited access red crab fishery is a male-only fishery, currently managed under a "hard" quota (i.e., the fishery is closed when the quota is reached), gear restrictions, and limits on processing crabs at sea. Although there is an open access permit category, the small possession limit of 500 pounds per trip has kept this sector of the fishery very small. The directed red crab fishery is limited to using parlor-less crab pots, and is considered to have little, if any, incidental catch of other species. There is no known recreational fishery for deep sea red crab. Landings of red crab varied somewhat before the implementation of the FMP, but have stabilized (NEFMC 2016).

The fishery is a small, market-driven fishery, and landings are very closely tied to market demand. As a result, the landings have been lower than the Total Allowable Landings (TAL) recently. Almost all red crab landings occur in New Bedford, MA. The few boats with limited access permits in the red crab fishery have overlapping ownership and operate as a voluntary cooperative. The cooperative relationship fosters a strong incentive to harvest red crab in a way that maximizes profits for the fleet as a whole. It is understood that primarily the current market conditions, not the landings limit, constrain the catch of red crab (NEFMC 2013a).

Since implementation of the FMP, four vessels have harvested the total red crab landings. Although this is a small fishery in terms of the number of vessels that participate, the individuals that are involved in this fishery have a very high dependence on the red crab resource. The handful of vessels that received limited access permits were surveyed during the development of the FMP, and the majority of harvesters reported that revenues from the red crab fishery make up the vast majority of their annual income. Since implementation of the FMP, vessel owners still report red crab as the primary fishery that supports their annual income (NEFMC 2011).

There are currently five limited access permit issued for red crab, three of which are currently active: two active full-time vessels and one active part-time vessel. The fishery operates from Cape Hatteras to the US-Canadian border. The vessels use conical mesh traps, set about 150 feet apart with 150 traps on each line. Each vessel fishes 600 traps, and haul each line daily. Traps are set along the 350 fathom (640 meter) depth contour. This depth is targeted because red crabs segregate by sex and depth, and take of female crabs is prohibited. Targeting this depth allows for male-only harvest. Vessels move north or south fishing along this contour several times per year, resulting in a relatively even distribution of reported landings (J. Williams, personal communication, April 2015).

Figure 21 gives a general overview of the locations of reported red crab landings from 2002 to 2009, based on VTR data (note that more precise location information is not provided given confidentiality concerns). Figure 22 shows commercial landings relative to the Total Allowable Landings from 2002-2012. Table 40 gives revenues and average prices for red crab from 2002-2012.

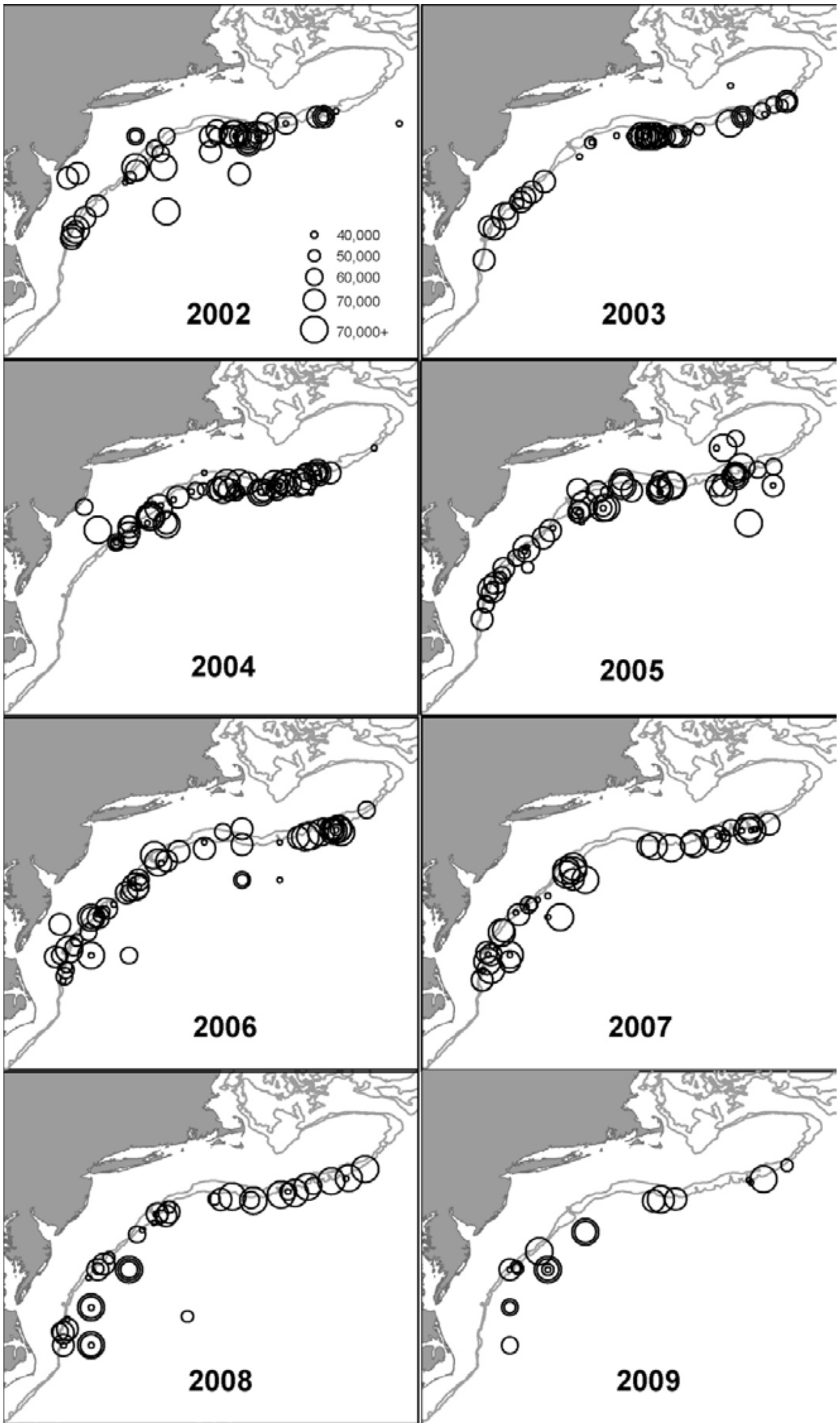


Figure 21: Locations of reported red crab trips, 2002-2009 (partial). Note some reported trip locations overlap and some reported trip locations are obviously incorrect.[26]

[26] Figure from Red Crab Amendment 3, available at: http://www.nefmc.org/library/amendment-3-4.

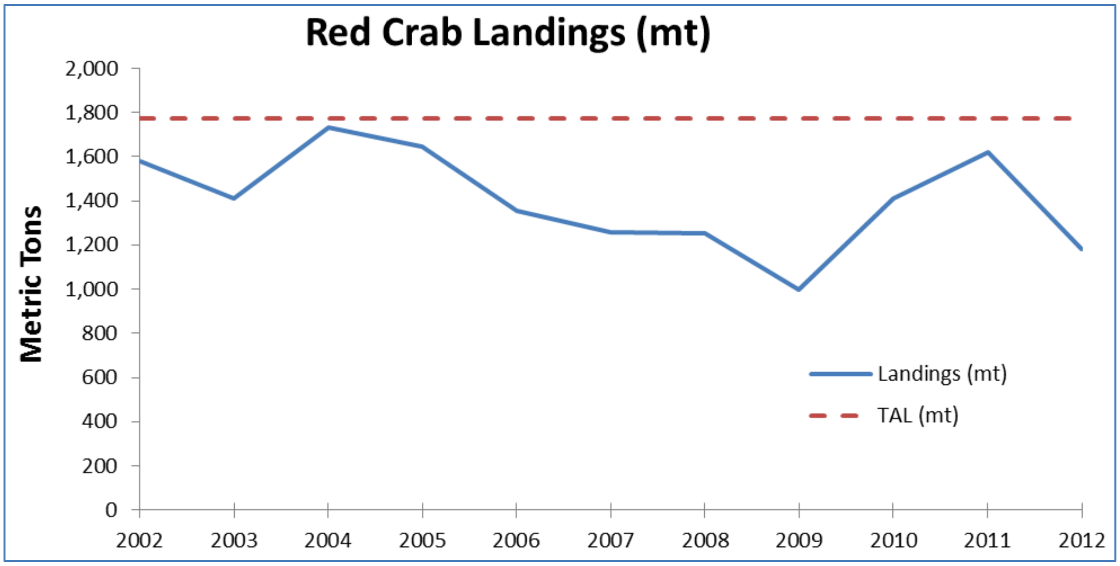


Figure 22. Red Crab Landings 2002-2012. Source: NEFMC 2013a.

Table 40. Red crab price per pound, inflation adjusted price (based on 2010 dollars), Vessel Trip Report (VTR) landings in pounds and estimated revenue, fishing years 2002-2012. Source: NEFMC 2013a.

Fishing year	Price per Pound	* Inflation Adjusted Price	** VTR Reported Landings	*** Revenue
2002	$0.86	$1.04	3,484,283	$3,623,654
2003	$0.85	$1.00	3,111,953	$3,111,953
2004	$0.94	$1.08	3,815,415	$4,120,648
2005	$0.90	$1.00	3,631,754	$3,631,754
2006	$0.90	$0.97	2,984,084	$2,894,561
2007	$0.92	$0.96	2,777,723	$2,666,614
2008	$1.01	$1.03	2,763,519	$2,846,425
2009	$0.96	$0.97	2,202,021	$2,135,960
2010	$0.97	$0.97	3,111,892	$3,018,535
2011	$0.97	$0.95	3,575,278	$3,396,514
2012	$1.00	$0.97	2,602,352	$2,524,281
Average	$0.93	$0.99	3,096,389	$3,065,425

* The consumer price index (CPI) used to convert nominal dollars to 2010 equivalent dollars is from the Bureau of Economic Analysis Table 1.1.9 (www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1).
** Landings data is from VTRs, which do not exactly match dealer data.
*** Revenue is estimated based on VTR reported landings and prices calculated from dealer data.

6.4.8 Silver Hake (Whiting)

As described in Section 6.2.8, the small-mesh multispecies fishery consists of three species: Silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and offshore hake (*Merluccius albidus*). There are two stocks of silver hake (northern and southern), two stocks of red hake (northern and southern), and one stock of offshore hake, which primarily co-occurs with the southern stock of silver hake.

As previously noted, analysis conducted for this document identified silver hake (*Merluccius bilinearis*) as a primary species caught within the proposed coral zones. However, there is little to no separation between silver and offshore hake in the fishery or the market. Catches of silver and offshore hake are generally known and sold as "whiting," while the fishery that harvests any of these species is known as the "whiting fishery." The southern silver hake ABC is adjusted by 4 percent to account for the average catches of offshore hake, which are often mixed with silver hake or have often been misreported as landings of silver hake. As such, information about both silver hake and offshore hake is provided in the description of the affected environment and the mixed fishery is generally referred to as the "whiting" fishery.

The whiting fishery in the U.S. operates from Maine to Cape Hatteras, North Carolina. Fishing is conducted with small-mesh trawl gear with a number of specific requirements to reduce bycatch of larger groundfish species. Because vessels participating in the fishery use small-mesh, they are regulated through a series exemptions from the Northeast Multispecies, or Groundfish FMP. A comprehensive approach to their management was first adopted in early 2000 with the implementation of Amendment 12 to the Groundfish FMP.

Prior to 1960, the commercial exploitation of whiting in the Northwest Atlantic was exclusively by U.S. fleets. Distant water fleets reached the banks of the Scotian Shelf by the late 1950s, and by 1961, scouting/research vessels from the former USSR were fishing on Georges Bank. By 1962, factory freezer fleets (ranging from 500 to 1,000 Gross Registered Tonnage, or GRT) intensively exploited the whiting and red hake stocks on the Scotian Shelf and on Georges Bank. Led by the former USSR, the distant water fleet landed an increasingly larger share of silver hake catch from the Gulf of Maine, Georges Bank, and northern Mid- Atlantic waters. In 1962, the distant water fleet landed 41,900 tons of whiting (43% of the total whiting landings), but that number had increased to 299,200 tons (85% of the total silver hake landings) in 1965. That year marked the year of the highest total commercial silver hake landings, 351,000 tons. Unable to sustain such high rates of fishing, the abundance of silver hake off the U.S. Atlantic coast began to decline. As a result, total commercial catches decreased significantly after 1965 and reached a 20-year low of 55,000 tons in 1970.

After 1970, catches of whiting by the distant water fleet in U.S. waters increased again, with distant water fleet landings from the southern stock averaging 75,000 tons annually between 1971 and 1977. The size and efficiency of distant water fleet factory ships also increased. In 1973, the International Commission for the Northwest Atlantic Fisheries established temporal and spatial restrictions that reduced the distant water fleet to small "windows" of opportunity to fish for U.S. silver hake. These windows restricted the distant water fleet to the continental slope of Georges Bank and the Mid-Atlantic. As effort control regulations increased, foreign fleets gradually left most areas of Georges Bank.

Although foreign fishing had ceased on Georges Bank by about 1980 and in the Mid-Atlantic by about 1986, the U.S. groundfish fleet's technologies and fishing practices began to advance, and between 1976 and 1986, fishing effort (number of days) increased by nearly 100% in the Gulf of Maine, 57% on Georges Bank, and 82% in southern New England. Such increases in effort, although directed primarily towards principal groundfish species (cod, haddock, yellowtail flounder), were accompanied by a 72% decline in silver hake biomass. In turn, U.S. landings of silver hake began to decline, dropping to 16,100 tons in 1981. Since that time, landings have remained relatively stable, but at much lower levels in comparison to earlier years (Figure 23).

Northern silver hake catch decreased from 2,199 mt in 2012 to 1,734 mt in 2013 and landings also decreased from 1,906 mt to 1,434 mt. Despite this, catches of northern silver hake have generally increased in recent years (since 2009) and discards have generally decreased. The fall survey biomass of northern silver hake has significantly increased since 2008 and is accompanied by a decrease in the relative exploitation index. Southern silver hake landings have decreased since 2009, with a recent decrease from 5,430 mt in 2012 to 4,790 mt in 2013. Total catch of southern silver hake has also decreased since 2009, specifically from 6,450 mt in 2012 to 5,420 mt in 2013. Stock status for both the northern and southern stocks of silver hake continues to improve with increasing trends in population biomass and relatively stable catches in recent years.

Southern whiting[27] landings increased from 5.041 mt in 2012 to 5,110 mt in 2013 while catch decreased from 6,496 mt to 5,746 mt. Compared to the 2008-2010 discard estimates, the 2012-2013 average southern whiting discards did not change, remaining at 13%.

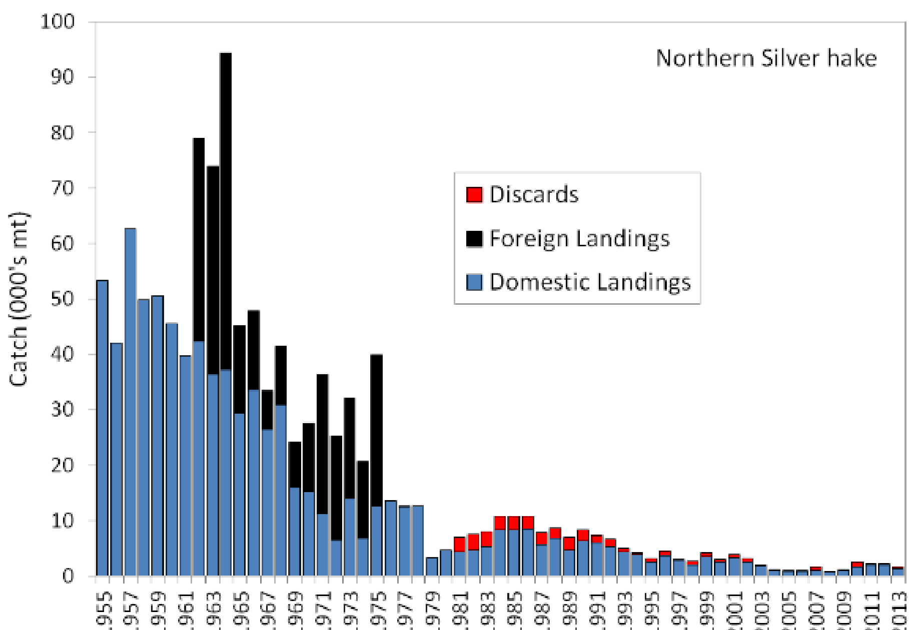


Figure 23. Northern Silver Hake Catch.

[27] "Whiting landings" refers to the total landings of both silver and offshore hake.

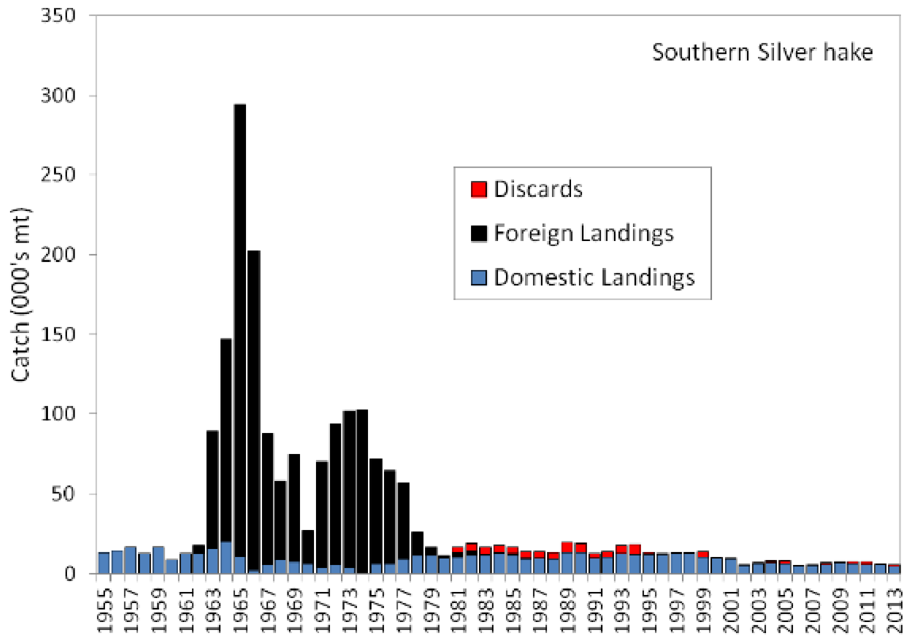


Figure 24. Southern Silver Hake Catch.

U.S. whiting catches are taken almost exclusively by otter trawls, either as bycatch from other fisheries or through directed fisheries targeting a variety of sizes of silver hake (NEFMC 2014). Landings and revenues of silver hake in the northern and southern area have been increasing since 2006. Landings in the northern area have been greater than 1,000 mt, earning $1.2 – 2.3 million in revenue. Landings in the southern area have ranged from 2,600 mt to 13,000 mt (in 2009), earning $7.6 – 15.5 million in revenue. Most of the high landings on trips targeting whiting are made by vessels fishing along the Mid-Atlantic continental shelf edge and along the southern edge and eastern portion of Georges Bank. Almost all trips landing more than 28,000 lb and targeting whiting occurred in the Southern New England Exemption Area. Trips targeting whiting and landing less than 28,000 lb are more spread out. These are spread out along the Southern New England shelf edge and also within statistical area 537 (NMFS Statistical Areas are shown in Figure 13). There is an increasing trend of trips targeting whiting in the southern stock area and landing closer to 30,000 lbs.

New Bedford, MA reported the highest total landings of silver hake in 2009 and 2010 (1,746 and 1,933 mt). New Bedford also has the highest total revenue from silver hake in 2010 and the second-highest in 2009 (behind Montauk, NY). Montauk, NY and Point Judith, RI made up the other two most successful ports in terms of silver hake revenue and landings in 2009 and 2010. Since 2010, the top three ports in terms of small-mesh trawl revenue have been New Bedford, MA, Montauk, NY and Point Judith, RI, respectively. Total revenue has dropped moderately since 2010 in these three ports, and an increase in small-mesh trawl revenue in New London, CT almost surpassed the revenue in Point Judith, RI in 2012.

The number of vessels landing small-mesh multispecies has been steadily decreasing since 1996 (Figure 25), from 736 vessels in 1996 to 381 vessels in 2013. However, while there has been an overall decrease since 1996, the number of vessels landing small-mesh multispecies has increased in recent years, from a low of 336 vessels in 2005. A similar trend is seen in the number of dealers reporting buying small-mesh multispecies, ranging from a high of 140 dealers in 1996, to a low of 78 in 2005, and back up to 92 in 2013. The highest number of unique permits landing silver, offshore or red hake were highest Gloucester, MA, Point Judith, RI and Montauk, NY (in 2009 and 2010).

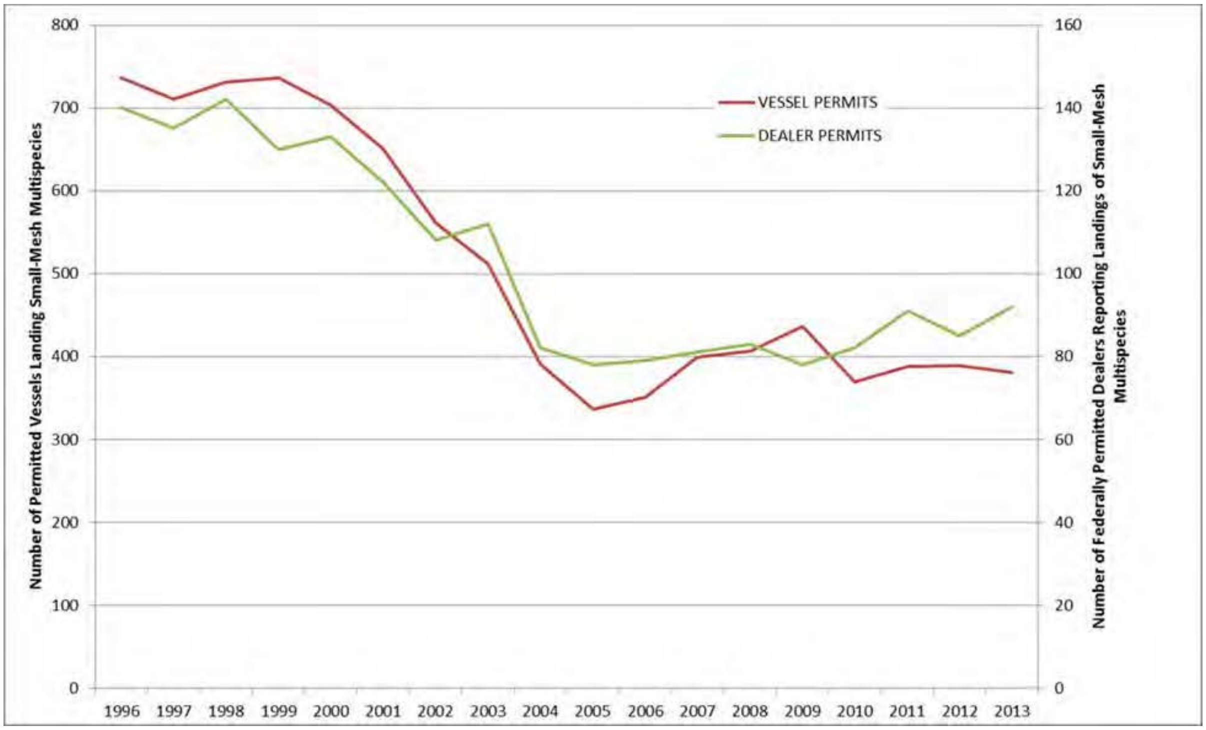


Figure 25: Number of federally permitted vessels and dealers reporting small-mesh multispecies by calendar year, 1996-2013.

Silver hake landings and revenues from 1996-2010 are shown in Table 41. Because small-mesh multispecies are landed both as directed stocks as well as incidentally to several other fisheries, it can be useful to examine the level of dependence vessel owners have on this fishery. For confidentiality reasons, some of the dependence categories have been combined. In general, for the overwhelming majority of vessels that land small-mesh species, it contributes only a fraction of their overall revenue. There are a handful of vessels that appear to depend heavily on small-mesh multispecies, but especially with historical data, the information as displayed should be interpreted with caution. Figure 26 shows the proportion of total annual dealer-reported revenue derived from small-mesh multispecies of vessels that had at least one dealer-reported small-mesh multispecies targeted trip in a calendar year (a small-mesh multispecies targeted trip is defined as a trip with 50% or more of revenue derived from small-mesh multispecies).

On average, from 1994-2013, 73 percent of vessels, with at least one reported small-mesh multispecies targeted trip, generate less than 20 percent of their overall revenue from this fishery. Of those, 56 percent of vessels generate less than 10 percent of their revenue from the small-mesh multispecies fishery. On average, only 7 percent of vessels generate 50 percent or more of their revenue from the small-mesh multispecies fishery (Figure 26). There are so few vessels in any given year that are highly dependent on revenue from this fishery, that they cannot be displayed by 10 percent categories, due to confidentiality reasons. Likewise, there are very few, if any, dealers who heavily depend on the revenue generated by small-mesh multispecies. The percentage of dealers whose reported revenue from small-mesh multispecies between 0 and 10 percent averaged 78 percent over the time period (Figure 27). Again, the percent dependence categories needed to be collapsed to protect confidentiality. As seen with the previous information, there is a peak around 1997, a low between 2005 and 2006, a steady increase to 2010, and a decline from 2010 to 2013 (Figure 26 and Figure 27; NEFMC 2014).

Table 41. Silver hake landings and revenues.

Year	Silver hake landings (mt)	Silver hake revenue ($)
1996	16,181	13,567,329
1997	15,565	15,045,264
1998	14,867	13,259,078
1999	14,020	14,243,589
2000	12,362	11,644,431
2001	12,908	13,211,153
2002	7,938	7,410,730
2003	8,643	9,326,001
2004	8,163	10,006,343
2005	6,902	8,493,180
2006	5,153	6,727,695
2007	6,217	7,880,472
2008	5,915	8,035,894
2009	7,441	8,602,262
2010	8,014	10,951,987

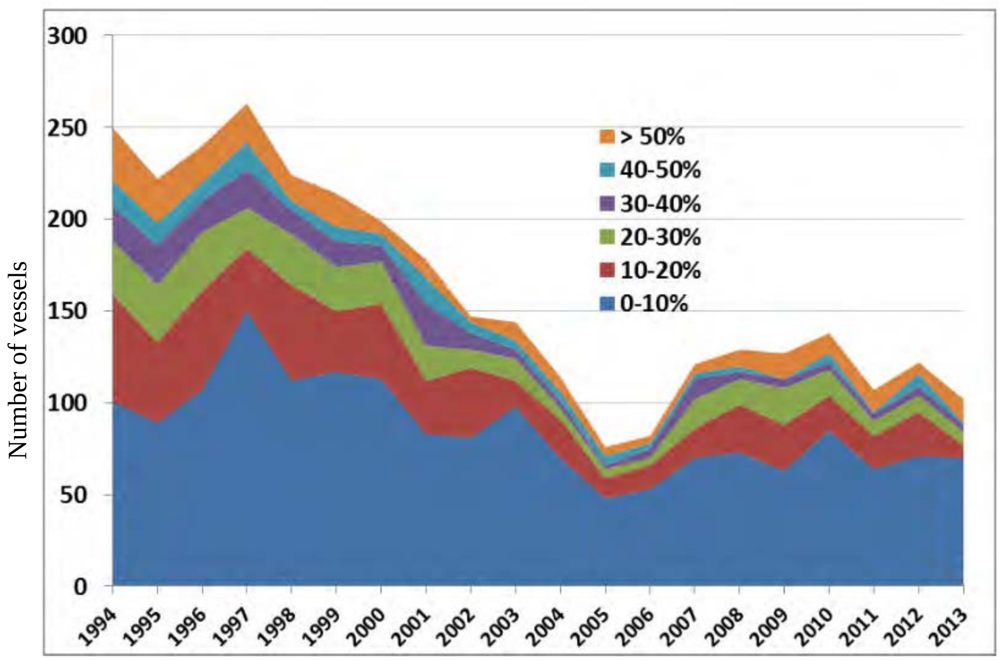


Figure 26. Total number of vessels, by dependence on small mesh (hake) multispecies fishery.

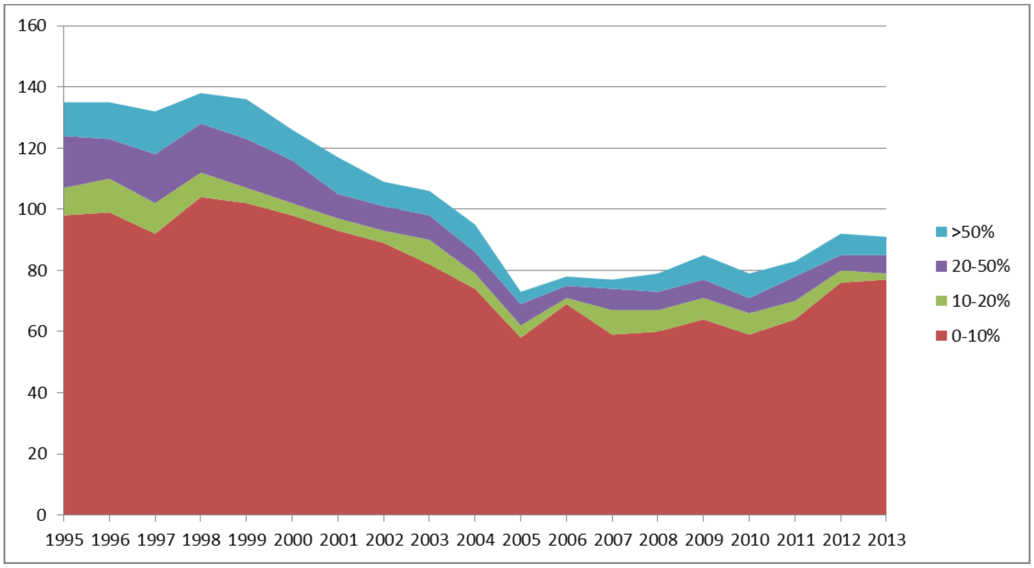


Figure 27: Number of dealers by revenue percent-dependence on small-mesh multispecies.

6.4.9 Atlantic Sea Scallops

The Atlantic Sea Scallop FMP was implemented in 1982 to restore adult scallop stocks and reduce year-to-year fluctuations in stock abundance caused by variation in recruitment. One of the foundations of the Scallop FMP is its area rotational management programs, established in 2004 under Amendment 10. Under this program, areas are defined, then closed and reopened to fishing on a rotational basis, depending on the condition and size of the scallop resource in the areas. As a result of Amendment 10, controls on scallop effort differ depending on whether a fishing trip occurs in an access area or in an open area. Vessels either fish in access areas under allocated trips, or in open areas under DAS. Amendment 11, implemented in 2008, included measures to control capacity and mortality in the general category scallop fishery. Primary measures included a limited entry program for general category vessels, as well as other permit provisions including an IFQ program. The most recent amendment, Amendment 15, introduced Annual Catch Limits and accountability measures to the Scallop FMP in 2011, as required by the MSA.

Under current regulations, the scallop fleet can be differentiated by vessel permit category: limited access vessels that are subject to area-specific days-at-sea controls and trip allocations; and limited access general category (LAGC) vessels that are not subject to days at sea controls, but are subject to a possession limit per fishing trip. There are three types of limited access general category permits: individual fishing quota permits with a possession limit of 600 lb per trip; Northern Gulf of Maine permits with a possession limit of 200 lb per trip; and incidental permits with a possession limit of 40 lb per trip. The limited access and limited access general category scallop fleets receive total allocations of 94.5 percent and 5 percent, respectively, of the scallop fishery's Annual Catch Limit, with the remaining 0.5 percent allocated to IFQ permits on vessels that have both LAGC IFQ and limited access scallop permits. There are no open access permits in this fishery.

Most limited access effort is from vessels using scallop dredges, including small dredges. The number of vessels using scallop trawl gear has decreased continuously and has been at 11 full-time trawl vessels since 2006. In comparison, there has been an increase in the number of full-time and part-time small dredge vessels after 2002. About 80% of the scallop pounds are landed by full-time dredge and about 13% landed by full-time small dredge vessels since fishing year 2007.

Most LAGC effort is, and has been, from vessels using scallop dredge and other trawl gear. The percentages of scallop landings show that landings made with a scallop dredge in 2012 continue to be the highest compared to other general category gear types. The majority of limited access vessels are based in Massachusetts, Virginia, New Jersey, and North Carolina, and the primary scallop ports are located in New Bedford, Massachusetts, Cape May, New Jersey, and Newport News, Virginia.

In fishing years 2003-2011, the landings from the northeast sea scallop fishery stayed above 50 million pounds, surpassing the levels observed historically. The recovery of the scallop resource and consequent increase in landings and revenues was striking given that average scallop landings per year were below 16 million pounds during the 1994-1998 fishing years, less than one-third of the present level of landings. The increase in the abundance of scallops coupled with higher scallop prices increased the profitability of fishing for scallops by the general category vessels. As a result, general category landings increased from less than 0.4 million pounds during the 1994-1998 fishing years to more than 4 million pounds during fishing years 2005-2009, peaking at 7 million pounds in 2005 or 13.5% of the total scallop landings. Landings from general category vessels declined after 2009 as a result of the Amendment 11 implementation that restricts Total Allowable Catch for the limited access general category fishery to 5.5 percent of the total Annual Catch Limit. However, the landings by limited access general category IFQ fishery increased in 2011 from its levels in 2010 due to a higher projected catch and a higher Annual Catch Target for all permit categories.

For the first time since 2001, the landings from the northeast sea scallop fishery fell to 40 million pounds in the 2013 fishing year (Figure 28). In the previous nine years, scallop landings had exceeded 50 million pounds each year, peaking at over 60 million lb in 2004. The recovery of the scallop resource and consequent increase in landings and revenues was striking given that average scallop landings per year were below 16 million pounds during the 1994-1998 fishing years, less than one-third of the average landings during 2004-2012 and only about 40% of the landings in the 2013 fishing year.

The increase in the abundance of scallops coupled with higher scallop prices increased the profitability of fishing for scallops by the general category vessels. As a result, general category landings increased from less than 0.4 million pounds during the 1994-1998 fishing years to more than 4 million pounds during the fishing years 2005-2009, peaking at 7 million pounds in 2005 or 13.5% of the total scallop landings. The landings by the general category vessels declined after 2009 as a result of the Amendment 11 implementation that restricts Total Allowable Catch for the limited access general category fishery to 5.5% of the total Annual Catch Limit. The landings by limited access general category fishery including by IFQ, Northern Gulf of Maine (NGOM) and incidental permits, declined to about 2.7 million lb in 2013 from about 3.3 million lb in the 2012 fishing year (Figure 28).

Figure 29 shows that total fleet revenue more than quadrupled in 2011 ($601 million, in inflation adjusted 2011 dollars) fishing year from its level in 1994 ($127 million, in 2011 dollars). Scallop ex-vessel prices increased after 2001 as the composition of landings changed to larger scallops that in general command a higher price than smaller scallops. However, the rise in prices was not the only factor that led to the increase in revenue in the recent years compared to 1994-1998. In fact, inflation adjusted ex-vessel prices in 2008-2009 were lower than prices in 1994 (Figure 29). The increase in total fleet revenue was mainly due to the increase in scallop landings and the increase in the number of active limited access vessels during the same period.

The ex-vessel prices increased significantly to over $10/lb of scallops in 2011 fishing year as the decline in the value of the dollar led to an increase in exports of large scallops to the European countries resulting in record revenues from scallops reaching to $601 million for the first time in scallop fishing industry history. The scallop ex-vessel prices peaked to $11.5/lb in 2013 due to the decline in landings by almost 30% in the same year. As a result, scallop revenue declined by a smaller percentage (18%) relative to the decline in decline in landings, from about $568 million in 2012 to $464 million in 2013, a level which still could be considered high by historical standards (Figure 29).

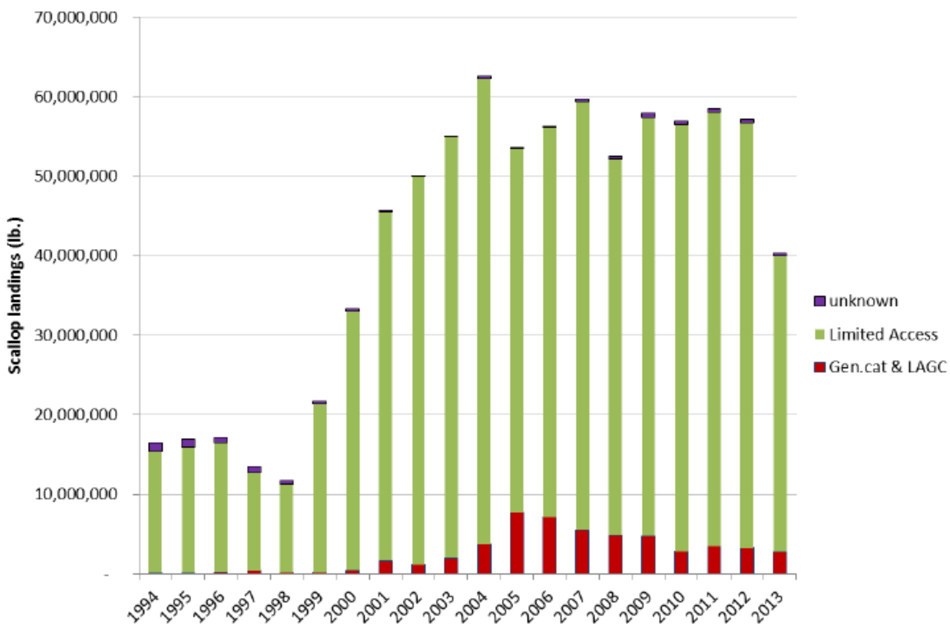


Figure 28: Scallop landings by permit category and fishing year (in lb, from dealer data).

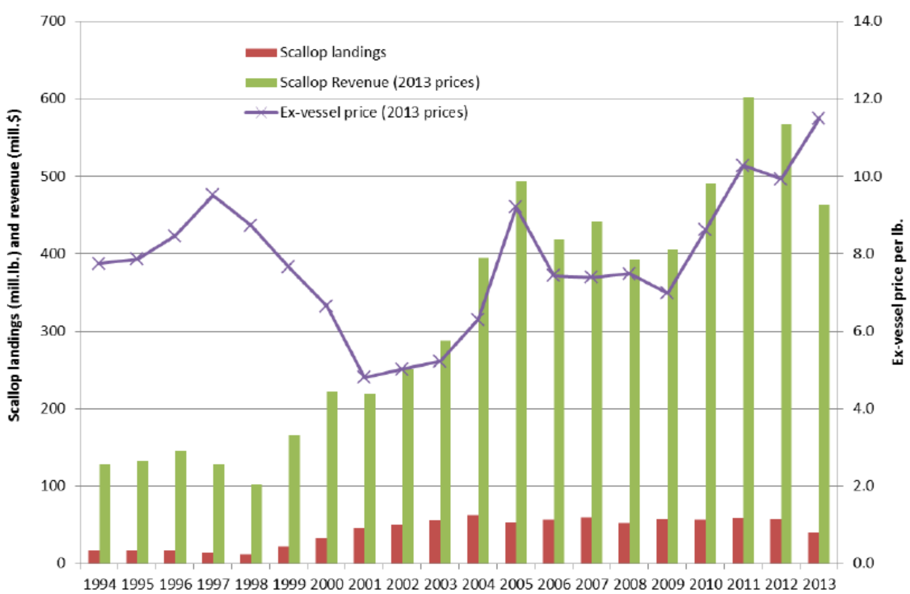


Figure 29: Trends in total scallop revenues (left bar, left axis), landings (right bar, left axis) and ex-vessel price (line, right axis) by fishing year (including limited access and general category fisheries, revenues and prices are expressed in 2013 constant prices.

The limited access scallop fishery consisted of 350 vessels in 2014. It is primarily full-time, with 251 full-time dredge, 52 full-time small dredge vessels and 12 full-time net boats.

Table 42 shows the percent of limited access landings by permit and year. In terms of gear, majority of the scallop landings by the limited access vessels were with dredge gear including the small dredges, with significant amounts also landed by full-time (FT) and part-time trawls (PT) until 2000. Table 42 shows that the percentage of landings by FT trawl permits declined after 1998 to about 3% of total limited access scallop landings in 2011. There were only 11 FT trawl permits in 2011. However, 2009-2011 VTR data also show that over 90% of the scallop pounds by the FT trawl permitted vessels are landed using dredge gear (10 vessels) since these vessels are allowed to use dredge gear even though they have a trawl permit. Similarly, all of the part-time trawl and occasional trawl permits are converted to small dredge vessels. Over 80% of the scallop pounds are landed by vessels with full-time dredge and close to 13% landed by vessels with full-time small dredge permits since the 2007 fishing year. Including the full-trawl vessels that use dredge gear, the percentage of scallop pounds landed by dredge gear amounted to over 99% of the total scallop landings in 2009-2011.

Table 42: Percentage of scallop landings (lb) by limited access vessels by permit category. FT = full time; PT = part time.

Fishyear	FT	PT	FT Small Dredge	PT Small Dredge	FT Trawl	PT Trawl	Occasional Trawl
1994	85.93%	0.51%		0.02%	11.94%	1.27%	0.03%
1995	87.74%	1.31%		0.06%	9.43%		0.29%
1996	87.35%	1.60%		0.08%	7.90%	2.32%	0.57%
1997	90.35%	1.21%		0.16%	6.31%	1.98%	0.00%
1998	85.92%	0.77%		0.00%	10.06%	3.19%	0.03%
1999	89.21%	1.43%		0.07%	6.53%	2.67%	0.08%
2000	89.88%	1.84%		0.25%	5.76%	2.18%	0.04%
2001	88.21%	1.96%		0.47%	5.88%		0.04%
2002	86.75%	1.88%	3.60%	0.55%	6.11%		0.07%
2003	85.96%	1.76%	5.91%	0.91%	4.94%		0.00%
2004	83.90%		9.71%	1.42%	4.18%		0.03%
2005	83.18%		10.50%	3.02%	2.74%		0.03%
2006	83.72%		10.70%	2.67%	2.75%		0.00%
2007	80.58%		12.94%	2.99%	3.14%		0.00%
2008	80.41%		13.08%	2.78%	3.29%		0.00%
2009	79.84%		13.49%	2.70%	3.52%		0.00%
2010	79.84%		12.73%	3.62%	3.36%		0.00%
2011	80.29%		12.77%	3.04%	3.51%		0.00%
2012	80.35%		13.30%	2.61%	3.34%		0.00%
2013	82.85%		10.91%	2.52%	3.30%		0.00%
2014	83.83%		10.49%	2.34%	3.01%		0.00%

*Note: Although these vessels have trawl permits, majority used dredge gear in 2009-2010 and over 90% of the scallop landings by the FT trawl permitted vessels are caught using dredge gear during the same years.

Many scallop vessels have permits in other fisheries, but most are not very active in other fisheries. For example, most LA scallop vessels have some type of bluefish, dogfish, herring, monkfish, multispecies, skate, squid-mackerel-butterfish, summer flounder, surf clam, and tilefish permit. Similarly, most LAGC permits also have other permits.

Both full-time and part-time limited access vessels had a high dependence on scallops as a source of their income. Full-time limited access vessels had a high dependence on scallops as a source of their income and the majority of the full-time vessels (90%) derived more than 90% of their revenue from the scallop fishery in 2013, as well as previous years. Comparatively, part-time limited access vessels were less dependent on the scallop fishery in 2013, with only 39% of part-time vessels earning more than 90% of their revenue from scallops (Table 43).

Table 43: Number of limited access vessels based on level of dependence on scallop revenue for 2008-2013 (FT= full time vessels; PT = part time vessels).

	2008		2009		2010		2011		2012		2013	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
<75%	9	14	5	15	8	11	9	11	5	14	16	15
<90%	14	7	18	4	12	9	12	11	22	4	14	5
90-100%	288	12	288	16	294	15	294	13	289	16	283	13
Total	311	33	311	35	314	35	315	35	316	34	343	33

6.4.10 Conservation Community and Other Interested Stakeholders

In addition to participants in potentially affected fisheries, there are other human communities that have an interest in the measures considered in this action. During amendment development, the Council received a large amount of public comments from a diverse array of individuals and organizations, representing stakeholder groups that took an interest in this action for a variety of reasons. Among these individuals and groups were environmental NGOs, scientists, recreational anglers, commercial fishing organizations, aquarium and zoo visitors, government employees, and other interested parties. In addition to comments received from Mid-Atlantic and New England stakeholders, comments were also received from several states beyond the Atlantic coast, as well as from outside the U.S.

In general, the largest volume of comments received on this action were generated through petitions and form letters created by various environmental NGOs or other conservation-oriented organizations. During the final public comment period, the Council received a total of 120,035 written comments, the vast majority of those consisting of signed or modified form letters, petition signatures, or other signatures to several sets of identical comments. These comment letters originated from organizations including, but not limited to: Citizens Campaign for the Environment, Earthjustice, Marine Conservation Institute, Natural Resources Defense Council, Ocean River Institute, Oceana, Save Our Environment, the Pew Charitable Trusts, the Endangered Species Coalition, Wildlife Conservation Society, and Wild Oceans Action. These groups aimed to convey the support of individuals interested in conservation of deep sea marine resources. In addition, many of these groups were actively involved in amendment development via participation on the Council's Advisory Panels or through participation at meetings.

It is clear that there is a strong interest in the conservation goals of this amendment from stakeholders beyond those in the fishing communities described in the sections above. Due to the volume and diversity of interested stakeholders, in-depth information is not provided here, but additional information regarding individuals and groups interested in the Council's Deep Sea Corals Amendment can be found in the scoping and public hearing comment summaries, available at: http://www.mafmc.org/actions/msb/am16.

6.5 PROTECTED RESOURCES

There are numerous species of fish, marine mammals, and sea turtles which inhabit the environment within the management unit of this FMP and are afforded protection under the Endangered Species Act (ESA) of 1973 (i.e., for those designated as threatened or endangered) and/or the Marine Mammal Protection Act (MMPA) of 1972. Again, because of the spatial nature of the alternatives proposed in this action, the affected environment includes the habitats, species, and fisheries that occur in deep offshore waters, near and beyond the continental shelf break. Species and habitats that do not occur in the vicinity of the proposed coral areas are not described here, given that the proposed measures are not expected to impact nearshore fisheries, species, or habitats.

A subset of the species identified in Table 44 are known to have the potential to interact with gear types considered in this amendment (bottom trawls, dredges, bottom longlines, traps, and sink gillnets). The following sections describe these protected resources and their potential for interactions with these gear types. For additional information on the species provided in Table 44 (e.g., life history, distribution, and stock status information), please visit: http://www.greateratlantic.fisheries.noaa.gov/Protected/ and http://www.nmfs.noaa.gov/pr/sars/region.html.

Table 44. Species protected under the ESA and/or MMPA that may occur in the Affected Environment of this action.

Species	***Status***	***Potentially affected by this action?***[1]
Cetaceans		
North Atlantic right whale (*Eubalaena glacialis*)	Endangered	Yes
Humpback whale (*Megaptera novaeangliae*)[2]	Endangered	Yes
Fin whale (*Balaenoptera physalus*)	Endangered	Yes
Sei whale (*Balaenoptera borealis*)	Endangered	Yes
Blue whale (*Balaenoptera musculus*)	Endangered	No
Sperm whale (*Physeter macrocephalus*	Endangered	No
Minke whale (*Balaenoptera acutorostrata*)	Protected	Yes
Pilot whale (*Globicephala spp.*)[3]	Protected	Yes
Pygmy sperm whale (*Kogia breviceps*)	Protected	No
Dwarf sperm whale (*Kogia sima*)	Protected	No
Risso's dolphin (*Grampus griseus*)	Protected	Yes
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected	Yes
Short Beaked Common dolphin (*Delphinus delphis*)[4]	Protected	Yes
Atlantic Spotted dolphin (*Stenella frontalis*)	Protected	No
Striped dolphin (*Stenella coeruleoalba*)	Protected	No
Beaked whales (*Ziphius and Mesoplodon spp*)[5]	Protected	No
Bottlenose dolphin (*Tursiops truncatus*)[6]	Protected	Yes
Harbor porpoise (*Phocoena phocoena*)	Protected	Yes
Sea Turtles		
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Yes
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Yes

Species	Status	Potentially affected by this action?[1]
Green sea turtle, North Atlantic DPS (*Chelonia mydas*)	Threatened[7]	Yes
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Ocean DPS	Threatened	Yes
Hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	No
Fish		
Porbeagle shark (*Lamna nasus*)	Candidate	Yes
Thorny skate (*Amblyraja radiate)*	Candidate	Yes
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Critical Habitat		
Northwest Atlantic DPS of Loggerhead Sea Turtle		No

[1] The determination for whether a species may be affected by a Council fishery is based on whether there has been confirmed fishery related interactions with gear types primarily used in that fishery (see Waring et al. 2014; Waring et al. 2015; NMFS 2012; NMFS 2013; NMFS 2014; NMFS 2015; NMFS NEFSC FSB 2015).

[2] On April 21, 2015, a proposed rule was issued to change the ESA listing status of humpback whales (80 FR 22303). After an extensive scientific status review, 14 DPSs were identified: 2 proposed as threatened, 2 as endangered, and 10 as not warranted for listing. The DPS found in U.S. Atlantic waters, the West Indies DPS, is proposed to be delisted.

[3] There are 2 species of pilot whales: short finned (*G. melas melas*) and long finned (*G. macrorhynchus*). Due to the difficulties in identifying the species at sea, they are often just referred to as *Globicephala spp*.

[4] Prior to 2008, this species was called "common dolphin."

[5] There are multiple species of beaked whales in the Northwest Atlantic. They include the cuvier's (*Ziphius cavirostris*), blainville's (*Mesoplodon densirostris*), gervais' (*Mesoplodon europaeus*), sowerbys' (*Mesoplodon bidens*), and trues' (*Mesoplodon mirus*) beaked whales. Species of *Mesoplodon*; however, are difficult to identify at sea, and therefore, much of the available characterization for beaked whales is to the genus level only.

[6] Includes only the Western North Atlantic Offshore stock of bottlenose dolphins.

[7] On April 6, 2016, a final rule was issued removing the current range-wide listing of green sea turtles and, in its place, listing eight green sea turtle DPSs as threatened and three DPSs as endangered (81 FR 20057). The green sea turtle DPS located in the Northwest Atlantic is the North Atlantic DPS of green sea turtles; this DPS is considered threatened under the ESA..

Porbeagle shark and thorny skate are NMFS "candidate species" under the ESA. Candidate species are those petitioned species for which NMFS has determined that listing may be warranted under the ESA and those species for which NMFS has initiated an ESA status review through an announcement in the Federal Register. If a species is proposed for listing the conference provisions under Section 7 of the ESA apply (see 50 C.F.R. 402.10); however, candidate species receive no substantive or procedural protection under the ESA. As a result these species will not be discussed further in this and the following sections; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed action. Additional information on porbeagle shark, and thorny skate can be found at http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm.

6.5.1 Species and Critical Habitat Not Likely to be Affected by the Proposed Action

As summarized in Table 44, based on available information, designated critical habitat and several protected species of marine mammals, fish, and sea turtles have been identified as habitats or species that are not expected to be affected by the action. These species and critical habitat include: hawksbill sea turtles; Atlantic spotted and striped dolphins; pygmy sperm, dwarf sperm, beaked, blue, and sperm whales; and the Northwest Atlantic (NWA) Distinct Population Segment (DPS) of loggerhead sea turtle critical habitat. This determination was made because either the occurrence of the species is not known to overlap with the fisheries operating in the mid-Atlantic region, and/or there have never been documented interactions between the species and these fisheries (Waring et al. 2014, 2015; NMFS 2012; NMFS 2013; NMFS NEFSC FSB 2015; see http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html). In the case of critical habitat, this determination has been made because the fisheries considered in this action will not affect the primary constituent elements of the critical habitat, and therefore, will not result in the destruction or adverse modification of critical habitat (NMFS 2014). Information to support this rationale is summarized below, and additional information is available at: http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm.

Large Whales

Blue whales do not regularly occur in waters of the U.S. EEZ (Waring et al. 2010). During the Cetacean and Turtle Assessment Program (CeTAP) surveys of the mid- and North Atlantic areas of the outer continental shelf, no blue whales were observed (Cetacean and Turtle Assessment Program 1982). Calving for the species also occurs in low latitude waters and therefore, outside of the area where Council fisheries operate. Blue whales also feed on euphausiids (krill) which are too small to be captured in fishing gear used in the fisheries (Sears 2002) and therefore, it is unlikely that the forage base of blue whales will be removed by the operation of any Council fishery. Based on this information, fisheries considered in this action will not overlap with blue whale occurrence or habitat, and therefore, direct (e.g., interaction with gear) or indirect (e.g., prey removal, habitat modification) effects to blue whales from the operation of any of the Council fisheries is not expected. This conclusion is supported further by the fact that there have been no observed U.S. Atlantic fishery-related mortalities or serious injuries to blue whales to date (Waring et al. 2010).

Sperm whales regularly occur in waters of the U.S. EEZ, but primarily are found on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring et al. 2015). Sperm whales primarily occur in waters greater than 1,000 meters; however seasonal incursions onto continental shelf waters are known to occur in the Northwest Atlantic (CeTAP 1982; Waring et al. 2015). Although the occurrence and distribution of sperm whales overlap with NEFMC and MAFMC managed fisheries potentially affected by this action (i.e., squid, mackerel, butterfish, summer flounder, scup, black sea bass, golden tilefish, whiting, red crab, and scallops) that operate at depths greater than 200 meters, interactions are not expected. The primary gear types used to prosecute Council fisheries in the affected environment of the deep sea coral amendment are bottom trawls, dredges, bottom longlines, traps, and sink gillnets. To date, observed or reported gear interactions with sperm whales are rare to non-existent and are primarily associated with pelagic fisheries (e.g., pelagic longline, trawl, and drift gillnet).[28] In the most recent marine mammal stock assessment, which includes human caused mortality records of sperm whales from 2008-2012 (due to entanglement or ship strike), only several sperm whales have been observed entangled in pelagic longline gear associated with Canadian fisheries (Waring et al. 2015). As pelagic fisheries are not managed by the Council and none of the Council fisheries are prosecuted with pelagic gear types characteristic of a pelagic fishery (i.e., pelagic longline, drift gillnet, trawl), sperm whale interactions with any of the Council fisheries operating in waters greater than 200 meters are not expected. Based on this, as none of the Council fisheries and their associated gear types

[28] See http://www.nmfs.noaa.gov/pr/sars/species.htm for sperm whale stock assessment reports since 1995.

(e.g., bottom trawl, sink gillnet, scallop dredge, pot/trap) are expected pose an interaction risk to sperm, adverse effects (e.g., entanglement, serious injury/mortality) to this species from the operation of any of the Council fisheries is not expected.

Small Cetaceans

In the Greater Atlantic Region, pygmy and dwarf sperm whales occur in oceanic waters (≥1,000 meters; Mullin and Fulling 2003; Waring et al. 2014). Striped dolphins are distributed along the continental shelf edge from Cape Hatteras to the southern margin of Georges Bank, and also occur offshore over the continental slope and rise in the mid-Atlantic region (CeTAP 1982; Mullin and Fulling 2003; Waring et al. 2014). The average depth of striped dolphin sightings observed during the CeTAP surveys was centered along the 1,000 m depth contour in all seasons (CeTAP 1982). Atlantic spotted dolphins regularly occur in continental shelf waters south of Cape Hatteras; however, in waters north of this region, this species of dolphin occurs in continental shelf edge and continental slope waters (≥ 1,000 meters; Payne et al. 1984; Mullin and Fulling 2003; Waring et al. 2014). Beaked whale sightings in the Greater Atlantic Region have occurred principally along the continental shelf edge and deeper oceanic waters (CeTAP 1982; Waring et al. 2014; Waring et al. 2015; Hamazaki 2002; Palka 2006).

Taking into consideration the above information, it is evident that these dolphin and whale species are primarily deep water (≥ 1,000 meters), continental shelf edge and/or slope inhabitants. Although the occurrence and distribution of these marine mammal species overlap with NEFMC and MAFMC managed fisheries potentially affected by this action (i.e., squid, mackerel, butterfish, summer flounder, scup, black sea bass, golden tilefish, whiting, red crab, and scallops) that operate at depths greater than 200 meters, interactions are not expected. The primary gear types used to prosecute Council fisheries in the affected environment of the Deep Sea Coral Amendment are bottom trawls, dredges, bottom longlines, traps, and sink gillnets. Observed or reported gear interactions with the above noted small cetaceans have only been observed seriously injured and/or killed in fisheries prosecuted by pelagic longline and/or pelagic drift gillnet; these latter fisheries are not managed by the Council. These forms of fishing gear are also not primary gear types used to prosecute any of the Council fisheries, including those likely to operate in the affected environment of the Deep Sea Coral Amendment. As a result, none of the Council fisheries and their associated gear types (e.g., bottom trawl, sink gillnet, scallop dredge, pot/trap) are expected pose an interaction risk to these species. Based on this information, adverse effects (e.g., entanglement, serious injury/mortality) to the small cetacean species provided above from the operation of any of the Council fisheries is not expected.

Hawksbill Sea Turtle

Hawksbill sea turtles are uncommon in the northern waters of the continental U.S., but are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental U.S., in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (Lund 1985; Plotkin and Amos 1988; Amos 1989; Groombridge and Luxmoore 1989; Plotkin and Amos 1990; NMFS and USFWS 1998b; Meylan and Donnelly 1999). Hawksbills prefer tropical coral reefs, such as those found in the Caribbean and Central America.

Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. The Culebra Archipelago of Puerto Rico contains especially important foraging habitat for hawksbills. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands. There are accounts of hawksbills in South Florida and individuals have been sighted along the East Coast as far north as Massachusetts, although sightings north of Florida are rare. Hawksbills have been found stranded as far north as Cape Cod, Massachusetts; however, many of these strandings were observed after hurricanes or offshore storms.

None of the managed fisheries considered in this action occur in waters typically used by hawksbill sea turtles. As a result, we do not expect any of the measures considered in this action to cause adverse effects (e.g., serious injury or mortality) to hawksbill sea turtles.

Northwest Atlantic DPS of Loggerhead Sea Turtle Critical Habitat

NMFS issued a final rule to designate critical habitat for the Northwest Atlantic Ocean DPS of the loggerhead sea turtle within the Atlantic Ocean and the Gulf of Mexico on July 10, 2014 (79 FR 39856). Specific areas designated include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat types: nearshore reproductive habitat, overwintering habitat, breeding habitat, migratory habitat (i.e., constricted migratory corridor), and/or *Sargassum* habitat.[29]

Fishing activities have the potential to affect the five types of marine areas described above and included in the critical habitat designation (79 FR 39856, July 10, 2014). The operation area for Council fisheries overlap with one or more of the five types of marine areas identified as critical habitat for the NWA DPS of loggerhead sea turtles. However, since the vast majority of fishing activities managed by the Council occur north of Cape Hatteras, North Carolina, there is very little overlap with more than just the northernmost portions of the *Sargassum* and migratory habitat areas. Even the fisheries that extend south of North Carolina (Atlantic bluefish, spiny dogfish, Atlantic mackerel/squid/butterfish, and summer flounder/scup/black sea bass) expend little effort in areas identified as overwintering, breeding, and nearshore reproductive critical habitat (NMFS 2013; NMFS 2014b).

The Council fisheries primarily use trawls (bottom and mid-water), gillnets, traps/pots, dredges, rod and reel, and bottom longline. While these gears are known to be deployed within certain areas of the critical habitat for NWA DPS loggerheads, the occasional placement and wide-ranging operation of gear types within these fisheries is not expected to prevent the passage of loggerheads through the critical habitat areas or inhibit their usage of those areas. While commercial fishing gear (mainly trawls and gillnets) may have some interactions with pelagic *Sargassum* during deployment and retrieval, these effects will be temporary and isolated in nature and, because of the fluid nature of the pelagic environment, recovery time is expected to be rapid. In regards to effects on benthic habitat in the other four marine areas, there is no evidence that bottom trawls or any other types of gears utilized by the above fisheries will adversely affect sandy, muddy, or hard bottom habitats where NWA DPS loggerheads routinely forage and rest (NREFHSC 2002). In addition to the actions of setting and hauling gear, fishing vessel movements are not expected to significantly alter the physical or biological features of the critical habitat areas to levels that would affect life history patterns of individual turtles or the health of prey species found in these habitats. Additionally, there is no evidence that any Council fishery and its associated gear types are likely to impact water depth, water temperature, or any other physical or biological features identified as essential for the conservation of critical habitat for the NWA DPS of loggerhead sea turtles in these regions. Based on this information, none of the Council fisheries are expected to affect the essential physical or biological features of any marine area designated as critical habitat for the NWA DPS of loggerhead sea turtles. As a result, none of the Greater Atlantic Region

[29] Detailed maps of the marine critical habitat are available online at: http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm.

Council fisheries are likely to adversely modify or destroy designated critical habitat for the NWA DPS of loggerhead sea turtles (NMFS 2014b).

6.5.2 Species Potentially Affected by the Proposed Action

The fisheries of interest in this action have the potential to affect the sea turtle and cetacean species provided in Table 44. Of primary concern is the potential for the fishery to interact (e.g., bycatch, entanglement) with these species. To understand the potential risk of an interaction, it is necessary to consider (1) species occurrence in the affected environment of the fishery and how the fishery will overlap in time and space with this occurrence; and (2) records of protected species interaction with particular fishing gear types. Information on species occurrence within the affected environment of this amendment is presented in this section, while information on protected species interactions with fishery gear will be presented in Section 6.4.3.

6.5.2.1 Marine Mammals

Large Whales

Table 45 provides the species of large whales that occur in the affected environment of the deep sea coral amendment. For additional information on the biology, status, and range wide distribution of each whale species please refer to: Waring et al. 2014; Waring et al. 2015; NMFS 1991, 2005, 2010, 2011, 2012.

Table 45: Large whale species present in the affected environment of this action.

Species	Listed Under the ESA	Protected Under the MMPA	MMPA Strategic Stock[1]
North Atlantic Right Whale	Yes-Endangered	Yes	Yes
Humpback Whale	Yes-Endangered	Yes	Yes
Fin Whale	Yes-Endangered	Yes	Yes
Sei Whale	Yes-Endangered	Yes	Yes
Minke Whale	No	Yes	No

***Notes*:**
[1]A strategic stock is defined under the MMPA as a marine mammal stock: for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; or which is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA.

***Source*:** Waring *et al*. 2014; Waring *et al*. 2015

Humpback, North Atlantic right, fin, sei, and minke whales are found throughout the waters of the Northwest Atlantic Ocean. In general, these species follow an annual pattern of migration between low latitude (south of 35^{o}N) wintering/calving grounds and high latitude spring/summer foraging grounds (primarily north of 41^{o}N; Waring et al. 2015; NMFS 1991, 2005, 2010, 2011, 2012). This is a simplification of whale movements, particularly as it relates to winter movements. It is unknown if all individuals of a population migrate to low latitudes in the winter, although increasing evidence suggests that for some species (e.g., right and humpback whales), some portion of the population remains in higher latitudes throughout the winter (Brown et al. 2002; Clapham et al. 1993; Cole et al. 2013; Khan et al. 2010, 2011, 2012; Khan et al. 2009; NOAA 2008; Swingle et al. 1993; Vu et al. 2012; Waring et al. 2014, 2015). Although further research is needed to provide a clearer understanding of large whale movements and distribution in the winter, the distribution and movements of large whales to foraging grounds in the spring/summer is well understood (i.e., coincides with peak prey productivity; Baumgartner et al. 2003; Baumgartner & Mate 2003; Brown et al. 2002; Kenney 2001; Kenney et al. 1986; Kenney et al. 1995; Mayo & Marx 1990; Payne et al. 1986; Payne et al. 1990; Schilling et al. 1992).Large whales consistently return to these foraging areas each year, therefore these areas can be considered important, high use areas for whales (Baumgartner et al. 2003; Baumgartner & Mate 2003; Brown et al. 2002; Kenney 2001; Kenney et al. 1986; Kenney et al. 1995; Mayo & Marx 1990; Payne et al. 1986; Payne et al. 1990; Schilling et al. 1992). For additional information on the biology, status, and range wide distribution of each whale species please refer to: Waring et al. 2015; NMFS 1991, 2005, 2010, 2011, 2012.

To further assist in understanding how fisheries may overlaps in time and space with the occurrence of large whales, a general overview on species occurrence and distribution in the affected environment of the deep sea coral amendment is provided in the following table (Table 46).

Table 46: Large whale occurrence in the affected environment of the deep sea coral amendment.

Species	Prevalence and Approximate Months of Occurrence
North Atlantic Right Whale	• Distributed throughout all continental shelf waters from the GOM to the South Atlantic Bight (SAB) throughout the year. • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern calving grounds (primarily November-April).
Humpback	• Distributed throughout all continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB throughout the year. • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern (West Indies) calving grounds. • Increasing evidence of wintering areas (for juveniles) in Mid-Atlantic (e.g., waters in the vicinity of Chesapeake and Delaware Bays; peak presence approximately January through March) and Southeastern coastal waters.
Fin	• Distributed throughout all continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB throughout the year. • Mid-Atlantic waters: › Migratory pathway to/from northern (high latitude) foraging and southern (low latitude) calving grounds. › Possible offshore calving area (October-January) › Mid-shelf area off the east end of Long Island is an area identified as an important foraging ground; others exist in New England waters. › Evidence of wintering areas in mid-shelf areas east of New Jersey, Stellwagen Bank; and eastern perimeter of GB.
Sei	• Uncommon in shallow, inshore waters of the Mid-Atlantic (SNE included), GB, and GOM; however, occasional incursions during peak prey availability and abundance. • Primarily found in deep waters along the shelf edge, shelf break, and ocean basins between banks. • Spring through summer, found in greatest densities in offshore waters of the GOM and GB (eastern margin into the Northeast Channel area; along the southwestern edge in the area of Hydrographer Canyon).
Minke	• Widely distributed throughout continental shelf waters of the Mid-Atlantic (SNE included), GOM, and GB during the spring, summer and fall; however, spring through summer found in greatest densities in the GOM and GB.
***Sources*:** NMFS 1991, 2005, 2010, 2011, 2012; Hain et al. 1992; Payne 1984; Good 2008; McLellan et al. 2004; Hamilton and Mayo 1990; Scheville *et al*. 1986; Watkins and Schevill 1982; Payne *et al*.1990; Winn et al. 1986; Kenney et al. 1986, 1995; Khan *et al*. 2009, 2010, 2011, 2012; Brown *et al*. 2002; NOAA 2008; 50 C.F.R. 224.105; CeTAP 1982; Clapham *et al*. 1993; Swingle *et al*. 1993; Vu *et al*. 2012; Baumgartner *et al*. 2011; Cole *et al*. 2013; Risch *et al*. 2013; Waring *et al*. 2014; Waring *et al*. 2015; 81 FR 4837(January 27, 2016); NMFS 2015.	

Small Cetaceans

Species of small cetaceans that occur in the affected environment of the proposed action are provided in Table 47.

Table 47: Small cetacean species that occur in the affected environment of the proposed action. Source: Waring et al. 2014; Waring et al. 2015.

Species	Listed Under the ESA	Protected Under the MMPA	MMPA Strategic Stock
Atlantic White Sided Dolphin	No	Yes	No
Short-Finned Pilot Whale	No	Yes	No
Long-Finned Pilot Whale	No	Yes	No
Rissos Dolphin	No	Yes	No
Short Beaked Common Dolphin	No	Yes	No
Harbor Porpoise	No	Yes	No
Bottlenose Dolphin (*Western North Atlantic Offshore Stock*)	No	Yes	No

Small cetaceans can be found throughout the year in waters of the Northwest Atlantic Ocean (Waring et al. 2014; Waring et al. 2015). Within this range; however, there are seasonal shifts in species distribution and abundance. To further assist in understanding how fisheries may overlap in time and space with the occurrence of small cetaceans, a general overview of species occurrence and distribution in the affected environment of the proposed action is provided in Table 48. For additional information on the biology, status, and range wide distribution of each species please refer to Waring et al. 2014 and Waring et al. 2015.

Table 48: Small cetacean occurrence in the affected environment of the proposed action.

Species	*Prevalence and Approximate Months of Occurrence*
Atlantic White Sided Dolphin	• Distributed throughout the continental shelf waters (primarily to 100 meter isobath) of the Mid-Atlantic (north of 35°N), Southern New England, GB, and GOM ; however, most common in continental shelf waters from Hudson Canyon (~ 39°N) onto GB, and into the GOM. • **January-May**: low densities found from GB to Jeffreys Ledge. • **June-September**: Large densities found from GB, through the GOM. • **October-December**: intermediate densities found from southern GB to southern GOM. • South of GB (SNE and Mid-Atlantic), low densities found year round, with waters off VA and NC representing southern extent of species range during winter months.
Short Beaked Common Dolphin	• Regularly found throughout the continental shelf-edge-slope waters (primarily between the 100-2,000 meter isobaths) of the Mid-Atlantic, SNE, and GB (esp. in Oceanographer, Hydrographer, Block, and Hudson Canyons). • Less common south of Cape Hatteras, NC, although schools have been reported as far south as the Georgia (GA)/South Carolina (SC) border. • **January-May**: occur from waters off Cape Hatteras, NC, to GB (35° to 42°N). • **Mid-summer-autumn**: Occur primarily on GB with small numbers present in the GOM; *Peak abundance* found on GB in the autumn.
Risso's Dolphin	• Distributed along the continental shelf edge from Cape Hatteras, NC, northward to GB during the spring, summer, and fall. • **Spring through fall**: distributed along continental shelf edge from Cape Hatteras, NC, to GB. • **Winter: distributed in the Mid-Atlantic Bight, extending into oceanic waters.** • .

Harbor Porpoise	• Distributed throughout the continental shelf waters of the Mid-Atlantic (north of 35°N), SNE, GB, and GOM. • **July-September**: Concentrated in the northern GOM (generally in waters less than 150 meters); low numbers can be found on GB. • **October-December**: widely dispersed in waters from New Jersey (NJ) to Maine (ME); seen from the coastline to deep waters (>1,800 meters). • **January-March**: intermediate densities in waters off NJ to NC; low densities found in waters off New York (NY) to GOM. • **April-June**: widely dispersed from NJ to ME; seen from the coastline to deep waters (>1,800 meters)..
Bottlenose Dolphin	**Western North Atlantic Offshore Stock** Distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic from GB to FL; Depths of occurrence: ≥40 meters.
Pilot Whales: ***Short- and Long-Finned***	**Short- Finned Pilot Whales** • Primarily occur south of 40°N (Mid-Atl and SNE waters); although low numbers have been found along the southern flank of GB, but no further than 41°N. • May through December (approximately): distributed primarily near the continental shelf break of the Mid-Atlantic and SNE; individuals begin shifting to southern waters (i.e., 35°N and south) beginning in the fall. **Long-Finned Pilot Whales** • Except for area of overlap (see below), primarily occur from 42°N to 44°N • Winter to early spring (November through April): primarily distributed along the continental shelf edge-slope of the Mid-Atlantic, SNE, and GB. • Late spring through fall (May through October): movements and distribution shift onto/within GB, the Great South Channel, and the GOM. **Area of Species Overlap:** between 38°N and 41°N

Notes: [1] Information presented in Table 22 is representative of small cetacean occurrence in the Northwest Atlantic continental shelf waters out to the 2,000 meter isobath.

***Sources*:** Waring et al. 1992, 2007, 2014, 2015; Payne and Heinemann 1993; Payne 1984; Jefferson et al. 2009.

6.5.2.2 Sea Turtles

This section contains a brief summary of the occurrence and distribution of sea turtles in the affected environment of the proposed action. Additional background information on the range-wide status of affected sea turtles species, as well as a description and life history of each of these species, can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995; Hirth 1997; TEWG 1998, 2000, 2007, 2009; NMFS and USFWS 2007a-d; NMFS and USFWS 2015; Conant et al. 2009; NMFS and USFWS 2013; Seminoff et al. 2015), and recovery plans for the loggerhead sea turtle (Northwest Atlantic DPS; NMFS and USFWS 2008), leatherback sea turtle (NMFS and USFWS 1992, 1998a), Kemp's ridley sea turtle (NMFS et al. 2011), and green sea turtle (NMFS and USFWS 1991, 1998b).

Hard-Shelled Sea Turtles

Distribution

In U.S. Northwest Atlantic waters, hard-shelled turtles commonly occur throughout the continental shelf from Florida (FL) to Cape Cod, Massachusetts (MA), although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly et al. 1995a, 1995b; Braun and Epperly 1996; Mitchell et al. 2003; Braun-McNeill et al. 2008; TEWG 2009). While hard-shelled turtles are most common south of Cape Cod, MA, they are known to occur in the Gulf of Maine (GOM). Loggerheads, the most common hard-shelled sea turtle in the GAR, feed as far north as southern Canada. Loggerheads have been observed in waters with surface temperatures of 7 °C to 30 °C, but water temperatures ≥11 °C are most favorable (Shoop and Kenney 1992; Epperly et al. 1995b). Sea turtle presence in U.S. Atlantic waters is also influenced by water depth. While hard-shelled turtles occur in waters from the beach to beyond the continental shelf, they are most commonly found in neritic waters of the inner continental shelf (Mitchell et al. 2003; Braun-McNeill and Epperly 2004; Morreale and Standora 2005; Blumenthal et al. 2006; Hawkes et al. 2006; McClellan and Read 2007; Mansfield et al. 2009; Hawkes et al. 2011; Griffin et al. 2013).

Seasonality

Hard-shelled sea turtles occur year-round in waters off Cape Hatteras, North Carolina (NC) and south. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the southeast United States and also move up the Atlantic Coast (Epperly et al. 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004; Morreale and Standora 2005; Griffin et al. 2013), occurring in Virginia (VA) foraging areas as early as late April and on the most northern foraging grounds in the GOM in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the GOM by September, but some remain in Mid-Atlantic and Northeast areas until late fall. By December, sea turtles have migrated south to waters offshore of NC, particularly south of Cape Hatteras, and further south (Shoop and Kenney 1992; Epperly et al. 1995b; Hawkes et al. 2011; Griffin et al. 2013).

Leatherback Sea Turtles

Leatherback sea turtles also engage in routine migrations between northern temperate and tropical waters (Dodge et al. 2014; James et al. 2005; James et al. 2006; NMFS & USFWS 1992). Leatherbacks, a pelagic species, are known to use coastal waters of the U.S. continental shelf (Dodge et al. 2014; Eckert et al. 2006; James et al. 2005; Murphy et al. 2006). Leatherbacks have a greater tolerance for colder water than hard-shelled sea turtles. They are also found in more northern waters later in the year, with most leaving the Northwest Atlantic shelves by mid-November (Dodge et al. 2014; James et al. 2005; James et al. 2006).

6.5.2.3 Atlantic Sturgeon

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. All five DPSs of Atlantic sturgeon have the potential to be located anywhere in this marine range (ASSRT 2007; Dovel and Berggren 1983; Dadswell et al. 1984; Kynard et al. 2000; Stein et al. 2004a; Dadswell 2006; Laney et al. 2007; Dunton et al. 2010; Erickson et al. 2011; Wirgin et al. 2012; Waldman et al. 2013; O'Leary et al. 2014; Wirgin et al. 2015). Based on fishery-independent and dependent data, as well as data collected from tracking and tagging studies, in the marine environment, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Stein et al. 2004 a,b; Erickson et al. 2011; Dunton et al. 2010); however, Atlantic sturgeon are not restricted to these depths, as excursions into deeper continental shelf waters have been documented (Timoshkin 1968; Collins and Smith 1997; Stein et al. 2004a,b; Dunton et al. 2010; Erickson et al. 2011). Data from fishery-independent surveys and tagging and tracking studies also indicate that Atlantic sturgeon may undertake seasonal movements along the coast (Dunton et al. 2010; Erickson et al. 2011); however, there is no evidence to date that all Atlantic sturgeon make these seasonal movements and therefore, may be present throughout the marine environment throughout the year. For additional information on the biology, status, and range wide distribution of each DPS of Atlantic sturgeon please refer to 77 FR 5880 and 77 FR 5914, as well as the Atlantic Sturgeon Status Review Team's (ASSRT) 2007 status review of Atlantic sturgeon (ASSRT 2007).

6.5.3 Gear Interactions and Protected Species

Protected species described in Section 6.4 are all known to be vulnerable to interactions with various types of fishing gear. Gear types considered in this amendment include: bottom trawls, dredges, and bottom longlines, trap, sink gillnet. In the following sections, available information on protected species interactions with these gear types will be provided. Please note, these sections are not a comprehensive review of all fishing gear types known to interact with a given species; emphasis is only being placed on those gear types that are known to pose the greatest risk to the species under consideration

6.5.3.1 Marine Mammals

Pursuant to the MMPA, NMFS publishes a List of Fisheries (LOF) annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injuries and/or mortalities of marine mammals in each fishery (i.e., Category I=frequent; Category II=occasional; Category III=remote likelihood or no known interactions; 81 FR 20550 (April 8, 2016)). The categorization in the LOF 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. The following table (Table 49) provides fishing gear types considered in this amendment and the prescribed LOF fishery Category.

Table 49: LOF fisheries likely to occur in the affected environment of the deep sea coral amendment.

Fishery	Category
Northeast sink gillnet[1]	I
Mid-Atlantic gillnet	I
Northeast bottom trawl[2]	II
Mid-Atlantic bottom trawl	II
Atlantic mixed species trap/pot	II
Gulf of Maine, U.S. Mid-Atlantic sea scallop dredge	III
Northeast/Mid-Atlantic Bottom longline/hook-and-line	III

Notes: [1,2] Northeast sink gillnet and northeast bottom trawl fisheries, as defined by the MMPA LOF, are included in Table 49, as the LOF describes the spatial/temporal distribution of effort in these fisheries as extending into portions of the Mid-Atlantic (as defined by the MSA).
Source: 81 FR 20550 (April 8, 2016

Large Whales

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 fishing. Below we provide the best available information on large whale interaction risks with gear types primarily used in the Council fisheries affected by the proposed action (i.e., sea scallop dredge, sink gillnet, bottom trawl, bottom longline, and trap/pot).

Scallop Dredge and Bottom Longline

Based on information provided by Waring *et al*. (2014), Waring *et al*. (2015), and information provided on the Northeast Fisheries Observer Program website (http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html), there has been no confirmed serious injury or mortality, or documented interactions, in general, with large whales from dredge (scallop) or bottom longline gear. Based on this information, dredge (scallop) or bottom longline gear is not expected to pose a significant interaction risk to any large whale species and therefore, is not expected to be source of serious injury or mortality to any large whale.

Trawl (Bottom) Gear

With the exception of one species, there has been no confirmed serious injury or mortality, or documented interactions with large whales and trawl gear. The one exception is minke whales. Minke whales are the only species of large whales that have been observed seriously injured or killed in trawl gear. In bottom trawl gear, to date, interactions have only been observed in the northeast bottom trawl fisheries. From the period of 2008-2012, the estimated annual mortality attributed to this fishery was 7.8 minke whales for 2008, and zero minke whales from 2009-2012; no serious injuries were reported during this time (Waring *et al*. 2015). Based on this information, from 2008-2012, the estimated annual average minke whale mortality and serious injury attributed to the northeast bottom trawl fishery was 1.6 (CV=0.69) whales (Waring *et al*. 2015). Lyssikatos (2015) estimated that from 2008-2013, mean annual serious injuries and mortalities from the northeast bottom trawl fishery were 1.40 (CV=0.58) minke whales. Based on above information, trawl gear is likely to pose a low interaction risk to any large whale species and therefore, is expected to be a low source of serious injury or mortality to any large whale.

Sink Gillnet and Trap Gear

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. The greatest entanglement risk to large whales is posed by fixed fishing gear (e.g., sink gillnet and trap/pot gear) comprised of lines (vertical or ground) that rise into the water column. Any line can become entangled in the mouth (baleen), flippers, and/or tail of the whale when the animal is transiting or foraging through the water column (Johnson et al. 2005; NMFS 2014; Kenney and Hartley 2001; Hartley et al. 2003; Whittingham et al. 2005a,b; Waring et al. 2014). For instance, in a study of right and humpback whale entanglements, Johnson et al. 2005 attributed: (1) 89% of entanglement cases, where gear could be identified, to fixed gear consisting of pot and gillnets and (2) entanglement of one or more body parts of large whales (e.g., mouth and/or tail regions) to four different types of line associated with fixed gear (the buoy line, groundline, floatline, and surface system lines).[30] Although available data, such as Johnson et al. 2005, provides insight into large whale entanglement risks with fixed fishing gear, to date, due to uncertainties surrounding the nature of the entanglement event, as well as unknown biases associated with reporting effort and the lack of information about the types and amounts of gear being used, determining which part of fixed gear creates the most entanglement risk for large whales is difficult (Johnson et al. 2005). As a result, any type or part of fixed gear is considered to create an entanglement risk to large whales and should be considered potentially dangerous to large whale species (Johnson et al. 2005).

The effects of entanglement to large whales range from no injury to death (NMFS 2014; Johnson et al. 2005; Angliss and Demaster 1998; Moore and Van der Hoop 2012). The risk of injury or death in the event of an entanglement may depend on the characteristics of the whale involved (species, size, age,

[30] Buoy line connects the gear at the bottom to the surface system. Groundline in trap/pot gear connects traps/pots to each other to form trawls; in gillnet gear, groundline connects a gillnet or gillnet bridle to an anchor or buoy line. Floatline is the portion of gillnet gear from which the mesh portion of the net is hung. The surface system includes buoys and high-flyers, as well as the lines that connect these components to the buoy line.

health, etc.), the nature of the gear (e.g., whether the gear incorporates weak links designed to help a whale free itself), human intervention (e.g., the feasibility or success of disentanglement efforts), or other variables (NMFS 2014). Although the interrelationships among these factors are not fully understood, and the data needed to provide a more complete characterization of risk are not available, to date, available data indicates that entanglement in fishing gear is a significant source of serious injury or mortality for Atlantic large whales (Waring et al. 2015).

Table 50 summarizes confirmed human-caused serious injury and mortality to humpback, fin, sei, minke, and North Atlantic right whales along the Gulf of Mexico Coast, U.S. East Coast, and Atlantic Canadian Provinces from 2009 to 2013 (Henry et al. 2015); the data provided in Table 45 is specific to confirmed serious injury or mortality to whales from entanglement in fishing gear. As many entanglement events go unobserved, and because the gear type, fishery, and/or country of origin for reported entanglement events are often not traceable, it is important to recognize that the information presented in Table 45 likely underestimates the rate of large whale serious injury and mortality due to entanglement. Further studies looking at scar rates for right whales and humpbacks suggests that entanglements may be occurring more frequently than the observed incidences indicate (i.e., Table 50; NMFS 2014) (Robbins et al. 2009; Knowlton et al. 2012).

Table 50: Summary of confirmed serious injury or mortality to fin, minke, humpback, sei, and North Atlantic right whales from 2009-2013 due to fisheries entanglements.[1]

Species	Total Confirmed Entanglement: Serious Injury	Total Confirmed Entanglement: Mortality	Entanglement Events: Total Annual Injury and Mortality Rate
North Atlantic Right Whale	12	6	3.4
Humpback Whale	33	8	7.4
Fin Whale	7	3	1.75
Sei Whale	0	0	0
Minke Whale	23	13	6.5

Notes:
[1]Information presented in Table 12 is based on confirmed serious injury and mortality events along the Gulf of Mexico Coast, US East Coast, and Atlantic Canadian Provinces; it is not specific to US waters only.
***Sources*:** Henry et al. 2015; Waring *et al*. 2015.

As noted above, pursuant to the MMPA, NMFS publishes a LOF annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injurious and mortalities of marine mammals in each fishery. Large whales, in particular, humpback, fin, minke, and North Atlantic right whales, are known to interact with Category I and II fisheries in the (Northwest) Atlantic Ocean. As humpback, fin, and North Atlantic right whales are listed as endangered under the ESA, these species are considered strategic stocks under the MMPA. Section 118(f)(1) of the MMPA requires the preparation and implementation of a Take Reduction Plan (TRP) for any strategic marine mammal stock that interacts with Category I or II fisheries. In response to its obligations under the MMPA, in 1996, NMFS established the Atlantic Large Whale Take Reduction Team (ALWTRT) to develop a plan (Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan)) to reduce serious injury to, or mortality of large whales, specifically, humpback, fin, and North Atlantic right whales, due to incidental entanglement in U.S. commercial fishing gear.[31] In 1997, the ALWTRP was implemented; however, since 1997, the Plan has been modified as NMFS and the ALWTRT learn more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. Recent adjustments include the Sinking Groundline Rule and Vertical Line Rules (72 FR 57104, October 5, 2007; 79 FR 36586, June 27, 2014; 79 FR 73848, December 12, 2014; 80 FR 14345, March 19, 2015; 80 FR 30367, May 28, 2015).[32]

The Plan consists of regulatory (e.g., universal gear requirements, modifications, and requirements; area-and season- specific gear modification requirements and restrictions; time/area closures) and non-regulatory measures (e.g., gear research and development, disentanglement, education and outreach) that, in combination, seek to assist in the recovery of North Atlantic right, humpback, and fin whales by addressing and mitigating the risk of entanglement in gear employed by commercial fisheries, specifically trap/pot and gillnet fisheries (73 FR 51228; 79 FR 36586; 79 FR 73848; 80 FR 14345; 80 FR 30367; http://www.greateratlantic.fisheries.noaa.gov/Protected/whaletrp/). The Plan recognizes trap/pot and gillnet Management Areas in Northeast, Mid-Atlantic, and Southeast regions of the U.S, and identifies gear modification requirements and restrictions for Category I and II gillnet and trap/pot fisheries in these regions; these Category I and II fisheries must comply with all regulations of the Plan.[33] For further details on the ALWTRP please see: http://www.greateratlantic.fisheries.noaa.gov/Protected/whaletrp/.

[31] The measures identified in the ALWTRP are also beneficial to the survival of the minke whale, which are also known to be incidentally taken in commercial fishing gear.

[32] The most recent rule (Vertical Line Rule) focused on trap/pot vertical line reduction as the ALWTRT determined that gillnets represent less than 1% of the total vertical lines on the east coast and that the impacts from this gear on large whales is minimal (see Appendix 3A, NMFS 2014); however, even with the new Rule, gear will still be subject to existing restrictions under the ALWTRP for gillnet gear.

[33] The fisheries currently regulated under the ALWTRP include: Northeast/Mid-Atlantic American lobster trap/pot; Atlantic blue crab trap/pot; Atlantic mixed species trap/pot; Northeast sink gillnet; Northeast anchored float gillnet; Northeast drift gillnet; Mid-Atlantic gillnet; Southeastern U.S. Atlantic shark gillnet; and Southeast Atlantic gillnet (NMFS 2014).

Small Cetaceans

Small cetaceans are found throughout the waters of the Northwest Atlantic (see Section 6.4.2.1). As they feed, travel and breed in many of the same ocean areas utilized for fishing, they are at risk of becoming entangled or bycaught in various types of fishing gear, with interactions resulting in serious injury or mortality to the animal. Below we provide the best available information on small cetaceans interaction risks with gear types primarily used in fisheries of interest in this action (i.e., sea scallop dredge, sink gillnet, bottom trawl, bottom longline, and trap/pot).

Sink Gillnet and Bottom Trawl Gear

Small cetaceans are vulnerable to interactions with various forms of gillnet or trawl gear (Table 48). Small cetacean species that have been observed incidentally injured and/or killed by Category I and II gillnet or trawl fisheries (see LOF 81 FR 20550 (April 8, 2016)) that operate in the affected environment of the deep sea coral amendment are provided in Table 48.[34] Based on the best available information provided in Waring et al. (2014), Waring et al. (2015), and the April 8, 2016 LOF (81 FR 20550), of the fisheries considered in Table 48, Northeast and Mid-Atlantic gillnet fisheries, followed by the Northeast and Mid-Atlantic bottom trawl fisheries (Category I and II fisheries, respectively) pose the greatest risks of serious injury and mortality to small cetaceans (i.e., approximately 83.0% of the estimated total mean annual mortality to marine mammals (small cetaceans, large whales excluded) is attributed to gillnet fisheries, 16% attributed to bottom trawl, 0.41% attributed to mid-water trawl (0.41%); Figure 30).[35]

[34] Northeast gillnet, Mid-water trawl, bottom trawl, and anchored float gillnet fisheries were included in Table 48 as the MMPA LOF (81 FR 20550 (April 8, 2016)) describes the spatial/temporal distribution of effort in these fisheries as extending into portions of the Mid-Atlantic (as defined by the MSA).

[35] The Northeast anchored float gillnet fishery was not included in the analysis as mean annual mortality estimates have not been provided for the species affected by this fishery (Waring et al. 2014; Waring et al. 2015).

Table 51: Small cetacean species observed seriously injured and/or killed by Category I and II gillnet or trawl fisheries operating in the affected environment of the deep sea coral amendment.

Fishery	Category	Species Observed or reported Injured/Killed
Northeast Sink Gillnet	I	Bottlenose dolphin (offshore)
		Harbor porpoise
		Atlantic white sided dolphin
		Short-beaked common dolphin
		Risso's dolphin
		Pilot whales (spp)
Mid-Atlantic Gillnet	I	White-sided dolphin
		Bottlenose dolphin (offshore)
		Harbor porpoise
		Short-beaked common dolphin
		Risso's dolphin
Mid-Atlantic Mid-Water Trawl-Including Pair Trawl	II	Risso's dolphin
		White-sided dolphin
		Bottlenose dophin (offshore)
		Short-beaked common dolphin
		Pilot whales (spp)
Northeast Mid-Water Trawl-Including Pair Trawl	II	White-sided dolphin
		Short-beaked common dolphin
		Pilot whales (spp)
Northeast Bottom Trawl	II	Pilot whales (spp)
		Short-beaked common dolphin
		White-sided dolphin
		Harbor porpoise
		Bottlenose dolphin (offshore)
		Risso's dolphin
Mid-Atlantic Bottom Trawl	II	White-sided dolphin
		Pilot whales (spp)
		Short-beaked common dolphin
		Risso's dolphin
		Bottlenose dolphin (offshore)
Northeast Anchored Float Gillnet	II	White-sided dolphin
Sources: Waring et al. 2014; Waring et al. 2015; LOF 81 FR 20550 (April 8, 2016).		

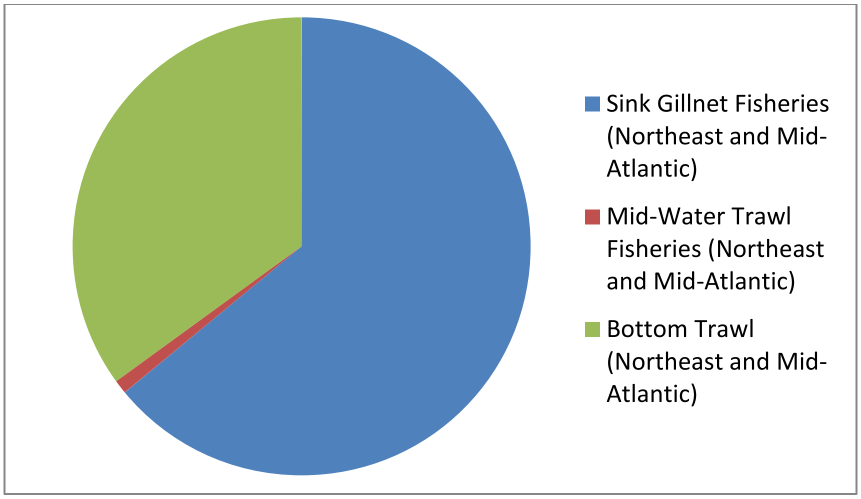


Figure 30: 2008- 2012 estimated total mean annual mortality of small cetaceans by Category I and II gillnet or trawl fisheries operating in the affected environment of the deep sea coral amendment.

As noted, provided in Table 51, numerous species of small cetaceans interact with Category I and II fisheries. Of these species, harbor porpoise have suffered some of the largest losses to their population as a result of interactions with commercial gillnet gear. Section 118(f)(1) of the MMPA requires the preparation and implementation of a take reduction plan (TRP) for any strategic marine mammal stock that interacts with Category I or II fisheries.[36] Until recently (see Waring et al. 2015), harbor porpoise were identified as a strategic stock due to the high levels of incidental take in commercial gillnet gear in New England and Mid-Atlantic waters; this resulted in the development and implementation of the Harbor Porpoise TRP (HPTRP).[37] The HPTRP is still in place and all fishing operations in New England and the Mid-Atlantic must comply with the regulations provided in this plan. For additional information on the HPTRP and specific gillnet management measures required in the New England or Mid-Atlantic management, see: http://www.greateratlantic.fisheries.noaa.gov/protected/porptrp/

Atlantic Trawl Gear Take Reduction Strategy (ATGTRS)

In addition to the HPTRP, in 2006, the Atlantic Trawl Gear Take Reduction Team (ATGTRT) was convened to address the incidental mortality and serious injury of long-finned pilot whales (*Globicephala melas*), short-finned pilot whales (*Globicephala macrorhynchus*), common dolphins (*Delphinus delphis*), and white sided dolphins (*Lagenorhynchus acutus*) incidental to bottom and mid-water trawl fisheries operating in both the Northeast and Mid-Atlantic regions. Because none of the marine mammal stocks of concern to the ATGTRT are classified as a "strategic stock," nor do they currently interact with a Category I fishery, it was determined at the time that development of a take reduction plan was not necessary.

[36] A strategic stock is defined under the MMPA as a marine mammal stock: for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; or which is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA.

[37] A rule (63 FR 66464) to implement the Harbor Porpoise Take Reduction Plan was published on December 2, 1998, and became effective on January 1, 1999; the Plan was amended on February 19, 2010 (75 FR 7383), and October 4, 2013 (78 FR 61821).

In lieu of a take reduction plan, the ATGTRT agreed to develop an ATGTRS. The ATGTRS identifies informational and research tasks, as well as education and outreach needs the ATGTRT believes are necessary, to provide the basis for decreasing mortalities and serious injuries of marine mammals to insignificant levels approaching zero mortality and serious injury rates. The ATGTRS also identifies several potential voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals. For additional details on the ATGTRS, please visit: http://www.greateratlantic.fisheries.noaa.gov/Protected/mmp/atgtrp/.

Bottom Longline and Sea Scallop Dredge

Based on information provided by Waring et al. (2014), Waring et al. (2015), and information provided at: http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html, there has been no confirmed serious injury or mortality, or documented interactions, in general, with small cetaceans from dredge (scallop or clam) or bottom longline gear types. Based on this information, dredge (scallop) or bottom longline gear is not expected to pose a significant interaction risk to any small cetacean species and therefore, is not expected to be source of serious injury or mortality to any small cetacean.

Pot/Trap Gear

Over the past several years, observer coverage has been limited for trap/pot fisheries. In the absence of extensive observer data for these fisheries, stranding data provides the next best source of information on species interactions with trap/pot gear. Stranding data underestimates the extent of human-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions are discovered, reported, or show signs of entanglement. Additionally, if gear is present, it is often difficult to definitively attribute the animal's death or serious injury to the gear interaction, or to a specific fishery. Therefore, the conclusions below should be taken with these considerations in mind and with an understanding that interactions may occur more frequently than what we are able to detect and provide at this time.

Table 44 provides the list of small cetacean and pinniped species that may occur and be affected by the fisheries considered in this action. Of these species, only several bottlenose dolphin stocks have been identified as species at risk of becoming seriously injured or killed by trap/pot gear. Stranding data provides the best source of information on species interaction history with these gear types. Based on stranding data from 2007-2011, estimated mean annual mortality for each stock was less than one animal (Waring et al. 2014).[38] Based on this and the best available information, interactions with trap/pot gear, resulting in the serious injury or mortality to small cetaceans are believed to be infrequent (for bottlenose dolphin stocks) to non-existent (for all other small cetacean). Based on this information, pot/trap gear is not expected to pose a significant interaction, and thus, serious injury or mortality risk to small cetaceans.

6.5.3.2 Sea Turtles

As described in Section 6.4.2.3, sea turtles are widely distributed in the waters of the Northwest Atlantic. As a result, sea turtles often occupy many of the same ocean areas utilized for fishing and

[38] Mean annual mortality estimates from stranding data are not provided by Waring et al. 2014 for each bottlenose dolphin stock affected by hook and line or trap/pot gear. Estimates were calculated based on the total number of animals stranded between 2007-2011 and were determined to have incurred serious injuries or mortality as a result of animals interacting with hook and line or trap/pot gear. For bottlenose dolphin stocks, Waring et al. (2014) provides two categories for trap/pot gear: (Atlantic Blue) Crab Pot, and Other Pot gear. The two were combined to get an overall number of interactions associated with trap/pot gear in general. Any animals released alive with no serious injuries were not included in the estimate. If maximum or minimum number of animals stranded were provided, to be conservative, the maximum estimated number was used when calculating the mean annual estimate of mortality.

therefore, interactions with fishing gear are possible. Below we provide the best available information on sea turtle interaction risks with gear types primarily used in fisheries considered in this action (i.e., sea scallop dredge, sink gillnet, bottom trawl, bottom longline, and trap/pot).

Sea Scallop Dredge, Sink Gillnet, and Bottom Trawl

Sea turtle interactions with gillnet, trawl, and/or dredge gear have been observed in the GOM, GB, and the Mid-Atlantic; however, most of the observed interactions have occurred in the Mid-Atlantic (see Murray 2011; Warden 2011a,b; Murray 2013; Murray 2015a, Murray 2015b). As few sea turtle interactions have been observed in the GOM and GB regions of the Northwest Atlantic, there is insufficient data available to conduct a robust model-based analysis on sea turtle interactions with gillnet, trawl, and/or dredge gear in these regions and therefore, produce a bycatch estimate for these regions. As a result, the bycatch estimates and discussion below are based on observed sea turtle interactions in sink gillnet, trawl, or dredge gear in the Mid-Atlantic.

Sea Scallop Dredge Gear

Atlantic sea scallop dredge gear poses a serious injury and mortality risk to sea turtles (Henwood and Stuntz 1987; Lutcavage and Lutz 1997; Epperly *et al*. 2002; Sasso and Epperly 2006; Haas *et al*. 2008; Murray 2011; Murray 2015a; NMFS 2012a). Northeast Fisheries Observers have documented green, Kemp's ridley, loggerhead, and unidentified hard-shelled sea turtle species interacting with sea scallop dredge gear (NMFS NEFSC FSB 2015); loggerhead sea turtles are the most commonly taken species. Two Kemp's ridley sea turtles have been documented taken on Georges Bank; all other observed interactions were in the Mid-Atlantic (NMFS NEFSC FSB 2015; Murray 2015a).

Two regulations have been implemented by NMFS to reduce serious injury and mortalities to sea turtles resulting from interactions with sea scallop dredges: (1) **Chain mat modified dredge** (71 FR 50361, August 25, 2006; 71 FR 66466, November 15, 2006; 73 FR18984, April 8, 2008; 74 FR 20667, May 5, 2009; 76 FR 22119, April 21, 2015): Requires federally permitted scallop vessels fishing with dredge gear to modify their gear by adding an arrangement of horizontal and vertical chains (referred to as a "chain mat"). The purpose of the chain mat is to prevent captures in the dredge bag and injury and mortality that results from such capture; and (2) **Turtle Deflector Dredge** (77 FR 20728, April 6, 2012; 76 FR 22119, April 21, 2015)**:** All limited access scallop vessels, as well as Limited Access General Category vessels with a dredge width of 10.5 feet or greater, must use a Turtle Deflector Dredge (TDD) to deflect sea turtles over the dredge frame and bag rather than under the cutting bar, so as to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). As of May 2015, both gear modifications are now required in waters west of 71°W from May 1 through November 30 each year (76 FR 22119, April 21, 2015). It should be noted, although the chain mat and TDD modifications are designed to reduce the serious injury and mortality to sea turtles interacting with dredge gear, it does not eliminate the take of sea turtles. NMFS continues to monitor the sea scallop fishery and its effects on sea turtles; however, to date, available data does indicate that since implementation of these regulations, sea turtle interactions with sea scallop dredge gear have gone down.

Based on Northeast Fisheries Observer Program data, Murray (2011) assessed loggerhead and hard-shell turtle interactions with sea scallop dredge gear in the Mid-Atlantic sea scallop fishery from 2001-2008 (see Table 52). Prior to implementation of the chain mat regulations, the average annual observable interactions of hard shelled sea turtles and scallop dredge gear was 288 turtles (95% CI=209-363; 49

adult equivalents[39]; Table 52). After the implementation of the chain-mat requirements, the average annual observable interactions of hard shelled sea turtles and scallop dredge gear dropped to 20 turtles (95% CI=3-42; 3 adult equivalents; Table 52). Further, as stated by Murray (2011), “if the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled species after chain mats were implemented would have been 125 turtles per year (95% CI: 88–163; 22 adult equivalents; Table 52).” Based on the results of this analysis, Murray (2011) suggested that the decline in estimated turtle interactions after 2006 is likely a result of the implementation of the chain mat rule as well as fishing effort reductions in the Mid-Atlantic since 2006. It should be noted that the estimates provided in Murray (2011) are prior to the implementation of the TDD.

Table 52: Average annual estimated interactions of hard-shelled (unidentified and loggerhead species pooled) and loggerhead turtles in the Mid-Atlantic scallop dredge fishery before and after chain mats were required on dredges (CV and 95% Confidence Interval). *AE* = adult equivalent estimated interactions. *A*= estimated interactions from dredges without chain mats; *B* = estimated observed interactions from dredges with or without chain mats; *C* = estimated observed and unobserved, quantifiable interactions from dredges without chain mats, to estimate the mat’s maximum conservation value (*Source*: Murray 2011).

	Interactions			
Time Period	Hard-shelled (including loggerheads)	AE	Loggerhead	AE
(A) 2001-25 Sept 2006	288 (0.14, 209-363)	49	218 (0.16, 149-282)	37
(B) 26 Sept 2006-2008	20 (0.48, 3-42)	3	19 (0.52, 2-41)	3
(C) 26 Sept 2006-2008	125 (0.15, 88-163)	22	95 (0.18, 63-130)	16

Most recently, Murray (2015a) estimated loggerhead interactions in the Mid-Atlantic scallop dredge fishery from 2009-2014. The average annual estimate of observable turtle interactions in scallop dredge gear was 11 loggerhead sea turtles per year (95% CI: 3-22; Murray 2015a). When the observable interaction rate from dredges without chain mats was applied to trips that used chain mats and TDDs, the estimated number of loggerhead interactions (observable and unobservable but quantifiable) was an average annual of 22 loggerheads per year (95% CI: 4-67; Murray 2015a). These 22 loggerheads equate to an average annual of 2 adult equivalent interactions per year, and 1-2 adult equivalent mortalities (Murray 2015a).

Bottom Trawl Gear

Green, Kemp’s ridley, leatherback, loggerhead, and unidentified sea turtles have been documented interacting with bottom trawl gear. However, estimates are available only for loggerhead sea turtles. Warden (2011a) estimated that from 2005-2008, the average annual loggerhead interactions in bottom trawl gear in the Mid-Atlantic[40] (i.e., south of Cape Cod, Massachusetts, to approximately the North

[39] Adult equivalence considers the reproductive value of the animal (Warden 2011a; Murray 2013), providing a “common currency” of expected reproductive output from the affected animals (Wallace *et al*. 2008), and is an important metric for understanding population level impacts (Haas 2010).

[40] Warden (2011) and Murray (2013) define the mid-Atlantic slightly differently, but both include waters north to Massachusetts. See the respective papers for a more complete description of these areas.

Carolina/South Carolina border) was 292 (CV=0.13, 95% CI=221-369), with an additional 61 loggerheads (CV=0.17, 95% CI=41-83) interacting with trawls, but released through a Turtle Excluder Device (TED)[41]. Of the 292 average annual observable loggerhead interactions, approximately 44 of those were adult equivalents (Warden 2011a). Most recently, Murray (2015b) estimated that from 2009-2013, the total average annual loggerhead interactions in bottom trawl gear in the Mid-Atlantic (i.e., defined by the boundaries of the Mid-Atlantic Ecological Production; roughly waters west of 71^{o}W to the North Carolina/South Carolina border) was 231 (CV=0.13, 95% CI=182-298). Of the 231 total average annual loggerhead interactions, approximately 33 of those were adult equivalents (Murray 2015b). Bycatch estimates provided in Warden (2011a) and Murray (2015b) are a decrease from the average annual loggerhead bycatch in bottom otter trawls during 1996-2004, which Murray (2008) estimated at 616 sea turtles (CV=0.23, 95% CI over the nine-year period: 367-890). This decrease is likely due to decreased fishing effort in high-interaction areas (Warden 2011a).

Sink Gillnet Gear

Observers have documented green, Kemp's ridley, leatherback, loggerhead, and unidentified sea turtles in various types of gillnet gears (drift sink, drift float, anchored sink, and drift large pelagic). This section; however, does not include information on the large pelagic drift gillnet fishery, instead the focus of this section is on sea turtle interactions with gillnet gear situated on the ocean bottom (anchored or unanchored).

Murray (2013) conducted an assessment of loggerhead and unidentified hard-shell turtle interactions in Mid-Atlantic gillnet gear from 2007-2011. Based on Northeast Fisheries Observer Program data from 2007-2011, interactions between loggerhead and hard-shelled sea turtles (loggerheads plus unidentified hard-shelled) and commercial gillnet gear in the Mid-Atlantic averaged 95 hard-shelled turtles and 89 loggerheads (equivalent to 9 adults) annually (Murray 2013).[42] However, average estimated interactions in large mesh gear in warm, southern Mid-Atlantic waters have declined relative to those from 1996-2006 (Murray 2009), as did the total commercial effort (Murray 2013). Murray (2013) also estimated interactions by managed species landed in gillnet gear from 2007-2011. For instance, an estimated average annual bycatch of loggerhead and non-loggerhead hard shelled sea turtles for trips primarily landing monkfish was 27 loggerheads (95% CI =16-41) and two non-loggerhead hard shelled sea turtles (95% CI=1-2); primarily landing skates was 16 loggerheads (95% CI =9-23) and one non-loggerhead hard shelled sea turtle (95% CI =1-2); and primarily landing spiny dogfish was five loggerheads (95% CI =2-8) and zero non-loggerhead hard shelled sea turtles (95% CI =0-1).

Summary of Observed Locations of Turtle Interactions with Scallop Dredge, Bottom Trawl, and Sink Gillnet Gear

Figure 31 provides a depiction of the overall observed locations of sea turtle interactions with gillnet, bottom trawl, and sea scallop dredge (bottom tending) gear in the GAR from 1989-2014.

[41] TEDs allow sea turtles to escape the trawl net, reducing injury and mortality resulting from capture in the net. Approved TEDs are required in the shrimp trawl and summer flounder fisheries. For additional details see 50 C.F.R. 223.206 and 68 FR 8456 (February 21, 2003).

[42] At Sea Monitoring (ASM) data was also considered in Murray (2013); however, as the ASM program began 1 May 2010, trips (1,085 hauls), trips observed by at-sea monitors from May 2010 – December 2011 were pooled with the NEFOP data. Further, as most of the ASM trips occur in the Gulf of Maine, only a small portion (9%) of ASM data was used in the Murray (2013) analysis.

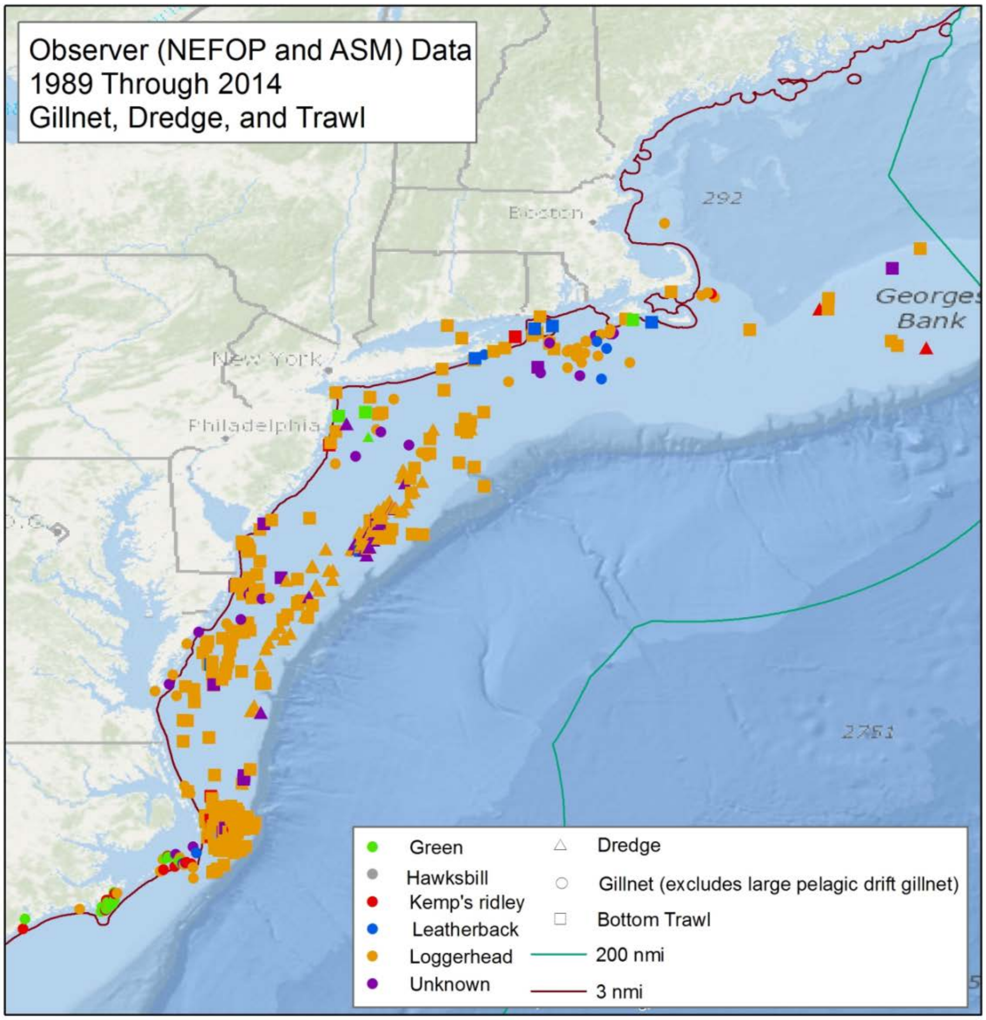


Figure 31: Observed location of turtle interactions in bottom tending gears in the GAR (1989-2014).

Bottom Longline

Sea turtles are vulnerable to interacting with bottom longline gear; however, the risk is tied to where the gear is placed relative to where and when sea turtles are present. As sea turtles are commonly found in neritic waters of the inner continental shelf (Braun-McNeill and Epperly 2002; Morreale and Standora 2005; Blumenthal et al. 2006; Hawkes et al. 2006; McClellan and Read 2007; Mansfield et al. 2009; Hawkes et al. 2011; Griffin et al. 2013; James et al. 2005; Eckert et al. 2006; Murphy et al. 2006; Dodge et al. 2014)[43], bottom longline gear placed in continental shelf waters (<200 meters) poses a greater risk of an interaction than bottom longline gear placed in deep waters greater than 200 meters. This is evidenced by the large number of sea turtle interactions observed in the South Atlantic and Gulf of Mexico (under NMFS Southeast Regional Office jurisdiction; NMFS 2006, NMFS 2001), where numerous fisheries prosecuted by bottom longline gear (e.g., HMS fishery-Atlantic shark bottom

[43] Also see sea turtle species status reviews and recovery plans at te following websites: http://www.nmfs.noaa.gov/pr/listing/reviews.htm#species; http://www.nmfs.noaa.gov/pr/recovery/plans.htm#turtles

longline component; Gulf of Mexico reef fishery) operate in nearshore southern continental shelf waters (<200 meters) where sea turtles are commonly present year round. Under such conditions, the co-occurrence of gear and sea turtles is high, thereby causing increased interaction risks. In contrast, in the GAR, no sea turtles have been observed in bottom longline gear from 1989-2014 (NMFS NEFSC FSB 2015). This is likely due to the fact that fisheries (e.g., tilefish spp.) prosecuted by bottom longline gear in the GAR primarily operate in deep waters (>200 meters). In deeper waters, sea turtle (primarily loggerhead and leatherback) behaviors are primarily directed at migratory movements and therefore, sea turtles are more likely to be present in the water column than near the deep benthos where bottom longline is present, thereby reducing the co-occurrence of bottom longline gear and sea turtles and thus, the potential for an interaction (Braun-McNeill and Epperly 2002; McClellan and Read 2007; Mansfield et al. 2009; Hawkes et al. 2011; Griffin et al. 2013; http://seamap.env.duke.edu/). Based on this, although sea turtle interactions with bottom longline gear are possible, due to the fishing behavior of Council fisheries prosecuted by bottom longline gear (i.e., fishing and setting gear in deep waters), sea turtle interactions with this gear type are not expected in the GAR. This is supported further by the lack of observed interactions with this gear type over the last 25 years (NMFS NEFSC FSB 2015).

Trap/Pot

Leatherback, loggerhead, green and kemp's ridley sea turtles are known to interact with trap/pot gear, with interactions primarily associated with entanglement in buoy lines, although sea turtles can also become entangled in groundline or surface systems. Records of stranded or entangled sea turtles indicate that fishing gear can wrap around the neck, flipper, or body of the sea turtle and severely restrict swimming or feeding (Balazs 1985, STDN 2014). As a result, sea turtles can incur serious injuries and in some case, mortality immediately or at a later time.

NMFS Northeast Region Sea Turtle Disentanglement Network's (STDN) database, a component of the Sea Turtle Stranding and Salvage Network, provides the most complete dataset on sea entanglements. Based on information provided in this database, between 2002 and 2013, a total of 263 sea turtle entanglements in vertical line gear were reported to the STDN and NMFS GARFO (STDN 2014). Of the 263 reports, 246 were classified with a probable or confirmed, high confidence rating. Out of the 246 confirmed and probable events, there were 135 cases in which the gear type associated with the entanglement could be assigned to a specific fishery. The majority of interactions involved leatherback sea turtles (119), followed by loggerhead (15), and green (1) sea turtles. Of the 119 leatherbacks, 64.0 % of the interactions involved lobster trap/pot gear (vertical line), 17.6 % whelk trap/pot gear; 13.4% fish (seabass primarily) trap/pot gear; 2.5 % crab trap/pot gear; 1.7% research trap/pot gear; and 0.84 % whelk and lobster trap/pot gear. Of the 15 loggerheads, 53.3% involved whelk trap/pot gear, and 46.7% crab trap/pot gear. The one green sea turtle case involved an interaction with a whelk trap/pot.

Factors Affecting Sea Turtle Interactions

As provided above, sea turtles have the potential to interact with multiple gear types. The risk of an interaction is affected by multiple factors; however, including where and when fishing effort is focused, the type of gear being used, environmental conditions, and sea turtle occurrence and distribution. Murray and Orphanides (2013) recently evaluated fishery-independent and dependent data to identify environmental conditions associated with turtle presence and the subsequent risk of a bycatch encounter if fishing effort is present; It was concluded that fishery independent encounter rates were a function of latitude, sea surface temperature (SST), depth, and salinity. When the model was fit to fishery dependent data (gillnet, bottom trawl, and scallop dredge), Murray and Orphanides (2013) found a decreasing trend in encounter rates as latitude increases; an increasing trend as SST increases; a bimodal relationship between encounter rates and salinity; and higher encounter rates in depths between 25 and 50 m. Similar findings were found in Warden (2011a), Murray (2013), and Murray (2015a,b).

6.5.3.3 Atlantic Sturgeon

As described in Section 6.4.2.3, the marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. All five DPSs of Atlantic sturgeon have the potential to be located anywhere in this marine range, although genetic analyses suggests that the distribution of each varies within that range (King et al. 2001; Laney et al. 2007; Dunton et al. 2012; Wirgin et al. 2012; Waldman et al. 2013; O'Leary et al. 2014; Wirgin et al. 2015). Three separate publications using different information sources reached the same conclusion; Atlantic sturgeon occur primarily in waters less than 50 meters (although deeper waters are also used), aggregate in certain areas, and exhibit seasonal movement patterns (see Stein et al. 2004b; Dunton et al. 2010; Erickson et al. 2011). These characteristics of Atlantic sturgeon occurrence and distribution result in Atlantic sturgeon occupying many of the same ocean areas utilized for fishing and therefore, occupying areas in which interactions with fishing gear are possible. Below we provide the best available information on Atlantic sturgeon interaction risks with gear types primarily used in fisheries considered in this action (i.e., sea scallop dredge, sink gillnet, bottom trawl bottom, bottom longline, and trap/pot).

Sink Gillnets and Bottom Trawls

There are three documents, covering three time periods, that use data collected by the Northeast Fisheries Observer Program to describe bycatch of Atlantic sturgeon: Stein et al. (2004b) for 1989-2000; ASMFC (2007) for 2001-2006; and Miller and Shepard (2011) for 2006-2010. None of these provide estimates of Atlantic sturgeon bycatch by DPS. Information provided in all three documents indicate that sturgeon bycatch occurs in gillnet and trawl gear, with Miller and Shepard (2011) estimating, based on fishery observer data and VTR data from 2006-2010, that annual bycatch of Atlantic sturgeon was 1,342 and 1,239, respectively. Specifically, Miller and Shepard (2011) observed Atlantic sturgeon interactions in trawl gear with small (< 5.5 inches) and large (≥ 5.5 inches) mesh sizes, as well as gillnet gear with small (< 5.5 inches), large (5.5 to 8 inches), and extra-large mesh (>8 inches) sizes. Although Atlantic sturgeon were observed to interact with trawl and gillnet gear with various mesh sizes, based on observer data, Miller and Shepard (2011) concluded that gillnet gear, in general, posed a greater risk of mortality to Atlantic sturgeon than did trawl gear. Estimated mortality rates in gillnet gear were 20.0%, while those in otter trawl gear were 5.0% (Miller and Shepard 2011). Similar conclusions were reached in Stein et al. (2004b) and ASMFC (2007) reports, in which both studies also concluded, after review of observer data from 1989-2000 and 2001-2006, that observed mortality is much higher in gillnet gear than in trawl gear. Based on the information presented in these three documents, factors thought to increase the risk of Atlantic sturgeon bycatch, and therefore death, in gillnet gear include:

- Setting gillnet gear at depths <40 meters;
- Using gillnet gear with mesh sizes >10 inches;
- Setting gillnet gear during spring, fall, and winter months;
- Long soak times (i.e., >24 hours); and
- Setting gear during warmer water temperatures

Although Atlantic sturgeon deaths have rarely been reported in otter trawl gear (ASMFC 2007; Dunton et al. 2015; NMFS NEFSC FSB 2015), it is important to recognize that effects of an interaction may occur long after the interaction (Davis 2002; Broadhurst et al. 2006; Beardsall et al. 2013). Based on physiological data obtained from Atlantic sturgeon captured in otter trawls, Beardsall et al. (2013)

suggests that factors such as longer tow times (i.e., > 60 minutes), prolonged handling of sturgeon (> 10 minutes on deck), and the type of trawl gear/equipment used, may increase the risk of physiological disruption or impairment (e.g., elevated cortisol levels, immune suppression, impaired osmoregulation, exhaustion) to Atlantic sturgeon captured in otter trawls and therefore, may result in an increased risk of post-release mortality. The authors also note that post-release exhaustion, even after a 60 minute trawl capture, results in behavioral disruption to Atlantic sturgeon and caution that repeated bycatch events may compound post-release behavioral effects to Atlantic sturgeon which in turn, may affect essential life functions of Atlantic sturgeon (e.g., predator avoidance, foraging, migration to foraging or spawning sites) and therefore, Atlantic sturgeon survival (Beardsall et al. 2013). Although the study conducted by Beardsall et al. (2013) provides some initial insight into the post-release effects to Atlantic sturgeon captured in trawl gear, additional studies are needed to clearly identify the “after” effects of a trawl interaction. As it is remains uncertain what the overall impacts to Atlantic sturgeon survival are from trawl interactions, trawls should not be completely discounted as a form of gear that poses a mortality risk to Atlantic sturgeon.

Trap/Pot and Bottom Longline

To date, there have been no observed/documented interactions with Atlantic sturgeon and trap/pot or bottom longline gear (NMFS NEFSC FSB 2015). Based on this information, trap/pot or bottom longline gear is not expected to pose a significant interaction risk to Atlantic sturgeon and therefore, is not expected to be source of serious injury or mortality to any DPS of Atlantic sturgeon.

Scallop Dredge

Capture of sturgeon in scallop dredge gear type is possible; however, interactions have been extremely rare over the past 25 years. NEFOP and ASM observer data from 1989-2014 have recorded one (1) Atlantic sturgeon interaction with scallop dredge gear targeting Atlantic sea scallops; this sturgeon was released alive (NMFS NEFSC FSB 2015). Based on this information, although Atlantic sturgeon interactions with scallop dredge gear are possible, the risk of an interaction is expected to be low. Therefore, scallop dredge gear is not expected to pose a significant serious injury or mortality risk to this species.

7.0 ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

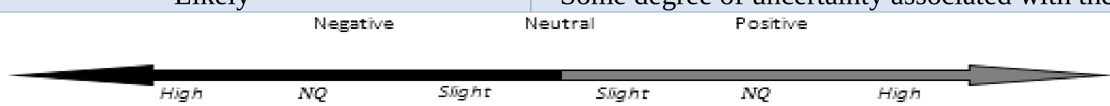
This section analyzes the impacts to the affected environment of the alternatives described in section 5.0. These alternatives contain options for designating deep sea coral zones, as well as options to restrict bottom-tending gear within the zones in order to protect deep sea corals. In addition, the alternatives contain options to allow transit through restricted areas and to require Vessel Monitoring Systems in the *Illex* squid fishery. Environmental impacts are analyzed with respect to five valued ecosystem components (VECs):

- The **physical environment and habitat**, including Essential Fish Habitat (EFH);
- The **managed resources,** including the managed species potentially affected by the measures under consideration;
- The **deep sea corals** proposed for protection;
- The **human environment**, including socioeconomic aspects of the fisheries targeting the above managed species and the communities associated with those fisheries, as well as other human communities with an interest in coral conservation;
- **Protected resources**, including ESA-listed and MMPA-protected large and small cetaceans, pinnipeds, sea turtles, fish, and critical habitat occurring in the Mid-Atlantic Council Region in offshore waters where proposed management measures are under consideration.

In the following sections, the impacts are described both in terms of direction and magnitude. The direction of the impacts on each of the VECs are described as negative, neutral, or positive. If the magnitude of the impact is expected to be moderate, the impact is described with only a directional indicator (i.e., “positive” and “negative” should be read as “moderate positive” and “moderate negative”). If the magnitude of the impact is expected to be minor, the impact is described as “slight”, as in “slight negative” or “slight positive.” If the magnitude of the impact is expected to be substantial, the impact is described as “high”, as in “high positive” or “high negative.” If there is some degree of uncertainty associated with the impact, it is described as “likely.” A summary of how impacts to the VECs are described in shown in Table 53.

Table 53. Impact definitions and impact qualifiers.

Directional Impact			
VEC	**Positive (+)**	**Negative (-)**	**Neutral (0)**
Physical Environment / Habitat / EFH	Actions that improve the quality or reduce disturbance of habitat	Actions that degrade the quality or increase disturbance of habitat	Actions that have no positive or negative impacts on habitat quality
Managed Resources	Actions that increase stock/population size	Actions that decrease stock/population size	Actions that have no positive or negative impacts on stock/populations size
Deep Sea Corals	Actions that decrease interactions between deep sea corals and fishing gear	Actions that increase interactions between deep sea corals and fishing gear	Actions that have no overall effect on interactions between deep sea corals and fishing gear
Protected Resources	Actions that increase stock/population size	Actions that decrease stock/population size	Actions that have no positive or negative impacts on stock/populations size
Human Communities (Socioeconomic)	Actions that increase revenue and social well-being of fishermen and/or associated business, or have positive impacts on other stakeholders	Actions that decrease revenue and social well-being of fishermen and/or associated business	Actions that have no positive or negative impacts on revenue and social well-being of fishermen and/or associated business, or have negative impacts on other stakeholders
Magnitude Impact Qualifiers			
Slight (Sl), as in slight positive or slight negative		To a lesser degree / minor	
No qualifier, as in positive or negative		To a moderate degree (i.e., more than "slight", but not "high")	
High (H), as in high positive or high negative		To a substantial degree	
Likely		Some degree of uncertainty associated with the impact	



Throughout Section 7.0, the preferred and non-preferred alternatives are compared to the *status quo* alternatives and the current environmental baseline conditions (baseline conditions). As described in section 5.0, all of the *status quo* alternatives described in this document represent the current state of management and fishery operations, with no management measures or framework provisions in place specifically for the protection of deep sea corals, and no VMS requirement for the *Illex* squid fishery. Deep sea corals receive limited protection from existing gear-restricted areas, such as the Tilefish GRAs, that have been implemented to achieve other management goals. The baseline conditions are the conditions of the affected fisheries and their interactions with the VECs over the most recent 3-5 years. For the economic environment, the most recent complete economic data (2012-2014) are used as a quantitative baseline condition. More information on the baseline conditions for the VECs (i.e., affected environment) can be found in Section 6.0.

The baseline condition does not describe "what if" the affected fisheries did not exist and those interactions between the fisheries and the specific VEC were not occurring. That would be an unrealistic baseline because these fisheries do occur, have occurred for many decades, and are expected to continue to occur into the foreseeable future. This document was developed to evaluate the consequences of implementing a reasonable range of alternatives for deep sea coral protections, which necessitates comparison to a realistic and reasonable baseline condition.

The alternatives are compared to the baseline conditions in recent years to determine if the extent of the interactions with the VECs are expected to be different as a result of implementing the proposed alternatives for deep sea coral protections. More specifically, the comparison to the baseline condition is used as a metric to determine if there are additional negative or positive impacts associated with the proposed measures (i.e., preferred, non-preferred, and *status quo* measures).

Grouping of Alternatives for Analysis

Section 5.0 describes the alternatives proposed for coral protection, including the framework for designating both broad and discrete coral zones. The alternatives are structured in a manner that separates the boundary designations (Alternative sets 1 and 3 for broad and discrete zones, respectively) from the management measures to be applied within the zones (Alternatives sets 2 and 4 for broad and discrete zones, respectively). Following these separate analyses for each VEC, however, the boundary designations and management measures are generally analyzed together, because it is most logical to consider them in combination. A coral protection zone designation without any applicable management measures would have few, if any, substantive impacts. Impacts of the Framework Provisions alternatives and VMS requirement for the *Illex* fishery are also described under each VEC.

7.1 IMPACTS TO THE PHYSICAL ENVIRONMENT AND HABITAT

The gear restriction measures proposed in this action, though designed to protect deep sea corals, would also protect deep-sea habitat types that are vulnerable to disturbance from fishing gear. The impact analysis below is focused on benthic habitat types, as the proposed measures would only restrict bottom-tending gear. The affected environment does not include pelagic habitats, thus, these habitat types are not included in the analysis. Because they are the focus of protections proposed in this action, impacts on deep sea corals are considered separately in Section 7.3. However, it should be noted that these two VECs are highly interrelated, and thus the impacts described in this section and Section 7.3 are similar.

7.1.1 Broad Coral Zones and Management Measures

7.1.1.1 Broad Zone Designation Alternatives

Alternatives for broad zone designations (Alternative set 1) can be compared in terms of their expected impacts to the physical environment and habitat by qualitatively assessing the degree to which each one would protect EFH for managed species with benthic life stages that extends beyond the 200, 300, 400, and 500 meter landward boundaries from the effects of fishing gears that would be prohibited in a broad zone alternative. Information regarding offshore and deep sea habitat types is limited. General benthic sediment types within the affected environment are described in Section 6.1, as well as EFH designations for managed resources that occur or may occur in the affected areas.

Because of the large degree of spatial overlap among all broad zone designation alternatives, the overall impacts to benthic habitat from each of the broad coral zone boundary options is expected to be somewhat similar, with some variation in habitat and EFH protections depending on the designation alternative. All of the broad zone designation options (other than the no action alternative) would result in a large precautionary protected area (Table 54), the vast majority of which would consist of areas that do not currently experience fishing activity (or experience very little fishing activity). However, differences in impacts among broad zone designation options can be assessed based on differences in the landward boundary, near the heads of the canyons and the shelf/slope break between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there would be no expected differences in the amount of types of habitat that would be protected between any of the broad zone designation alternatives, as all of the alternatives overlap in this area. In addition, little to no fishing activity currently takes place deeper than 500 meters.

Table 54: Approximate area of proposed broad zone alternatives. Note that the total areas listed represent the surface water area of the boundaries, and are used as a proxy for total benthic habitat area.

Broad Zone Designation Alternative	Approx. total area (km^2)
200 m broad zone (1B)	101,372
300 m broad zone (1C)	100,165
400 m broad zone (1D)	99,218
500 m broad zone (1E)	98,444
Council preferred broad zone (1F)	98,934

Figure 32 shows the overlap of proposed broad zone boundary options with designated EFH for two managed species (golden tilefish and red crab) with depth-defined designations on the outer continental shelf and slope in the Mid-Atlantic that may be impacted by the proposed measures. For these two species, the amount of EFH area that would be protected by the various broad zone alternatives is shown in Table 55.[44] For red crab, designated EFH occurs within every broad zone option, while for golden tilefish, EFH occurs only down to 300 meters and therefore is present only within the 200m and Council-preferred broad zones (Alternatives 1B and 1F, respectively). EFH for pelagic species and life stages listed in Table 5 (Section 6.1.2) would not be affected by the management measures being considered. EFH for the remaining managed benthic species that occupy the outer shelf and slope in the affected area would be protected from bottom-tending gear within the deep-water areas defined by the various broad zone alternatives.

In combination with gear restrictions, all of the broad zone designation action alternatives (1B through 1F) are expected to result in direct positive impacts to habitat and EFH. All of these designations would result in areas that protect some amount of EFH and additional non-designated habitat from current gear impacts, prevent future impacts, and prevent the expansion of current fishing effort into deeper waters. Alternative 1A, no designation of a broad zone, would be expected to result in neutral impacts relative to the baseline conditions, under which ongoing gear interactions with habitat are likely to be occurring, in particular near the shelf/slope break.

The magnitude of the positive impacts is expected to vary based on the designation alternative selected. This variation is due to both differences in the degree to which the broad zone area boundaries overlap EFH, and an unequal distribution of fishing effort across the total area under consideration for broad zone protection. Specifically, EFH designation for many managed species does not extend beyond the depths where the proposed broad areas begin, and thus the deeper proposed broad zones do not

[44] Potential areas of EFH for all the other managed species in the Mid-Atlantic region are currently defined by ten minute squares of latitude and longitude. Any location within a square that satisfies the habitat requirements for a given species and life stage as defined in its EFH text description is designated as EFH. EFH maps for several managed species in the Mid-Atlantic include ten minute squares that overlap the edge of the continental shelf, but EFH for these species is limited by depths such as those listed in Table 5. For this reason, it would be misleading to include these maps in this document or to calculate the amount (area) of EFH that overlaps with any of the broad zone alternatives.

encompass EFH for many species, as detailed below. In addition, analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the primary exception of the red crab fishery; as described below). Thus, the areas within the proposed broad zones where fishing gear is most likely to currently interact with benthic habitats includes primarily areas shallower than 400 meters near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas. Therefore, the magnitude of positive impacts is expected to increase as designation alternatives extend into shallower water, both because more EFH is protected and because more fishing effort occurs in shallower areas of the broad zones, meaning that the proposed action will have more of an impact in these areas. The specific and relative expected impacts from each of the designation alternatives are described below.

- **Alternative 1A** would include no broad zone designation and would have neutral impacts to habitat relative to baseline conditions. Current habitat-gear interactions under the baseline conditions are likely to continue, particularly near the shelf/slope break and the heads of the canyon where more fishing effort occurs.
- **Alternative 1B** (200m landward boundary) would encompass EFH for all nine bottom-dwelling managed species listed in Table 5. Of the broad zone designation alternatives, Alternative 1B would encompass the highest total area as well as the highest total area of designated EFH. In combination with gear restriction alternatives, Alternative 1B would also restrict the most current fishing effort and thus reduce gear interactions with bottom habitat more than the other four action alternatives. However, fishing effort near the landward boundary of this area, though higher than in the other zone alternatives, is still somewhat limited. Thus, the expected impacts from this designation would be moderate positive, but would be more positive than any of the other broad zone designation alternatives.
- **Alternative 1C** (300m landward boundary) would not include any EFH for tilefish, ocean quahogs, juvenile silver hake, adult witch flounder, or juvenile white hake, and would lose some of the area designated as red crab EFH relative to Alternative 1B (Table 55). Alternative 1C encompasses some areas of fishing effort, but slightly less than Alternative 1B. Thus, Alternative 1C would be expected to have moderate positive habitat impacts but to a slightly lesser extent than Alternative 1B.
- **Alternative 1D** (400m landward boundary) would “lose” EFH protection for an additional three species and life stages (redfish, offshore hake, and adult silver hake), and would lose some of the area designated as red crab EFH relative to Alternative 1C (Table 55). Alternative 1D encompasses some areas of fishing effort, but much less than Alternative 1B and somewhat less than Alternative 1C. Beyond 400 meters depth, fishing effort appears to drop off to a degree that would lower the magnitude of positive impacts for this alternative. Thus, Alternative 1D would be expected to have slight positive habitat impacts.
- **Alternative 1E** (500m landward boundary): No additional EFH protection would be “lost” at 500 meters with the exception of some area of red crab EFH (Table 55). Beyond 500 meters, EFH is designated for red crabs, juvenile witch flounder, and rosette skates. Thus, Alternative 1E would be expected to have slight positive habitat impacts, but to a lesser degree than Alternative 1D, and less positive impacts than any other designation alternative other than the no action.
- **Alternative 1F** (Council-preferred) has a landward boundary that is not defined by depth and in some canyons extends into much shallower water than in other canyons; thus, it is much more

difficult to evaluate, overall, how well it overlaps with EFH for managed species or how well it would protect benthic habitats from current or future fishing impacts. In some canyons, such as Hudson Canyon (Figure 46, Section 7.3.2.1), for example, the Alternative 1F boundary in many places is deeper than 500 meters. However, in others, such as Norfolk Canyon (Figure 52) the boundary extends into depths less than 200 meters in several places. Between proposed discrete zones, the Council-preferred broad zone boundary falls between the 400m and 500m depth contour, centered near the 450-meter contour. Alternative 1F would protect a relatively small amount of golden tilefish EFH, but more than Alternatives 1C, 1D, and 1E, which do not overlap tilefish EFH. Alternative 1F would protect less red crab EFH than Alternative 1D, but more than Alternative 1E (Table 55). Similarly, Alternative 1F would reduce more gear interactions from bottom fishing compared to Alternative 1E, but a comparison to other proposed broad zones is less clear due to the boundary line that is not entirely depth-based. It is expected that given the extension of this area into shallower water in the heads of the canyons, gear interactions would be reduced under this alternative more so than under Alternative 1D or 1E. Overall, the best estimate of expected impacts to habitat and EFH resulting from the Council-preferred boundary (Alternative 1F) would be moderate direct positive impacts, similar in magnitude to those under Alternative 1C (300m broad zone).

Thus, in summary, the broad zone alternatives that extend into shallower water are expected to have higher positive habitat impacts than those that begin in deeper water, particularly in the canyons, due to differences in total habitat area protected and differential fishing effort occurring within each of the proposed areas. For the preferred alternative (1F), greater habitat protection is provided in those canyons where the boundaries extend into shallower water (e.g., in Norfolk Canyon) than in areas where they don't (e.g., Hudson Canyon). The relative impacts to EFH and other habitats from the various designation alternatives are expected to be most positive for Alternative 1B (moderate positive), followed by Alternative 1C and 1F (similar to each other, with moderate positive impacts to a lesser extent than 1B), then 1D (slight positive impacts), then Alternative 1E (slight positive impacts to a lesser extent than Alternative 1D). Lastly, Alternative 1A (*status quo*/no designation) would have no positive impacts (neutral impacts relative to *status quo*, with expected continued gear interactions under the baseline conditions). Section 7.1.1.3 summarizes the expected impacts to habitat of various specific combinations of gear restriction alternatives and broad zone designation alternatives.

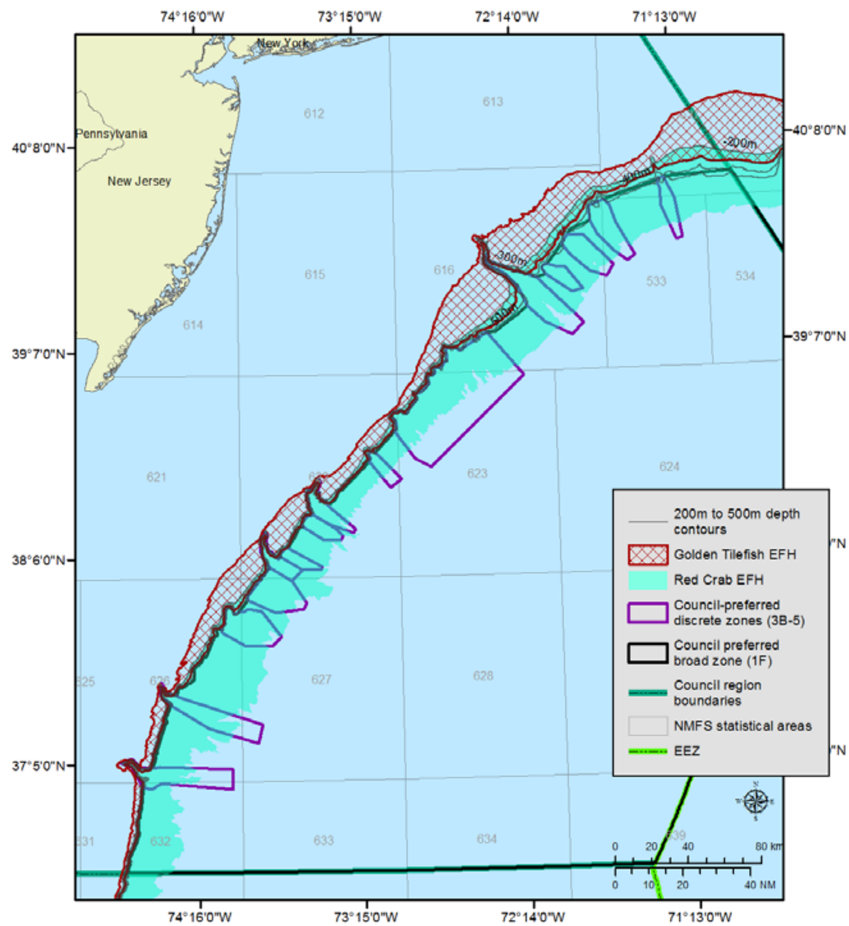


Figure 32: Golden tilefish and red crab EFH designations relative to proposed coral areas. Note: All life stages depicted, as GIS data not available by life stage.

Table 55: Approximate benthic EFH area (km^2) for two federally managed species encompassed by each broad zone designation alternative.

	1B (200m)	1C (300m)	1D (400m)	1E (500m)	1F (Council preferred)
Golden Tilefish (all)	2,258	0	0	0	173
Red Crab (all)	24,585	22,638	21,066	19,771	20,534

7.1.1.2 Broad Zone Management Measure Alternatives

For management measures to be applied within the broad zones, both gear restriction alternatives (Alternative 2B/prohibition on all bottom-tending gear and Alternative 2C/prohibition on mobile bottom-tending gear) would be expected to result in direct slight to moderate positive impacts to benthic habitats and EFH relative to the *status quo* and baseline environmental conditions, depending on the boundary designation and exemptions selected in combination. In general, alternatives restricting the use of more gear types within the broad zones, with fewer exemptions, are expected to result in greater positive impacts to habitat. Alternatives that improve the compliance with and enforcement of gear restriction measures are expected to result in indirect positive impacts to habitat. However, given the vast amount of broad zone area that is currently unfished, as well as the natural protections afforded to many unique habitat areas located at unfishable depths and slopes, the proposed measures are primarily precautionary and positive impacts are not expected to be significant.

Gear Restriction and Exemption Alternatives

In general terms, the physical environment and benthic habitats, including benthic EFH designations, are expected to benefit from any alternative that reduces the likelihood of damage or disruption by commercial fishing gear. In order to evaluate the extent to which the proposed gear restriction measures may protect habitat, it is necessary to consider the extent of the proposed areas that are actually fished and how fishing effort may shift under potential gear restrictions. The exact nature of potential impacts to habitat from gear restriction alternatives are difficult to define, because although the total gear-restricted area under a broad zone would be very large, very little fishing effort currently occurs in the vast majority of the broad zone area. This is by design; the broad zone alternatives were developed under the precautionary "freeze the footprint of fishing" principle (see Section 5.0) primarily in order to protect deep sea corals and their habitats from future expansion of fishing effort, including the potential development of new deep sea fisheries. Each of the broad zone designation alternatives was chosen for consideration based on their potential to exclude most current fishing effort.

As described above in Section 7.1.1.1, analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the primary exception of the red crab fishery). Thus, the areas within the proposed broad zones where fishing gear is most likely to currently interact with benthic habitats includes primarily areas shallower than 400 meters near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort generally takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas.

In addition, within the proposed broad zones, there are many benthic habitats consisting of steep slopes that are likely to have a substantial degree of natural protection from many commercial fishing gear types, as very steep slopes cannot be trawled and may be difficult to access with other gear types. Areas of higher three-dimensional complexity tend to be actively avoided by fishermen for fear of damage and loss of their gear. This natural protection likely limits the current extent of habitat interactions under the baseline environmental conditions, and somewhat limits the extent of positive impacts expected from the implementation of gear restricted areas.

Under the no action/*status quo* Alternative 2A, one would expect some ongoing direct negative impacts to habitats near the shelf/slope break under baseline conditions. Bottom fishing on the shallower middle and inner shelf is more likely to be conducted in high energy mobile sand habitats, where gear impacts tend to be minimal and/or temporary in nature.

Under gear restriction Alternatives 2B and 2C, direct positive impacts to habitat and EFH would be expected relative to the *status quo* resulting from reduced habitat interactions with bottom-tending gear. The expected magnitude of this impact varies based on which designation and exemption options are selected in conjunction. In general, Alternative 2B (prohibition on all bottom-tending gear) is expected to result in greater positive impacts to habitat relative to Alternative 2C (prohibition on mobile bottom-tending gear), and both action alternatives would have a greater positive impact on habitat compared to Alternative 2A (*status quo*/no gear restrictions). The differences in the magnitude of positive impacts between Alternative 2B and 2C may not be substantial given that the adverse impacts of mobile bottom-tending gear on benthic habitat features are typically greater than the impacts of stationary bottom-tending gear (NEFSC 2002, Morgan and Chuenpagdee 2003, also see Section 6.3.4). Stationary gear types do pose more of a threat to particularly fragile habitat types, including structure-forming deep sea coral communities described in Section 7.3, compared to more resilient habitats such as soft sediment.

For both gear restriction alternatives 2B and 2C, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort for many species around the heads of the canyons typically takes place in very strategic, specific areas around the edges of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient-rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, Council industry advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (under the Council preferred broad and discrete zones). Some displacement of effort into non-designated areas would potentially reduce the positive habitat impacts of coral zone closures. However, effort is expected to be displaced largely to areas that already experience relatively heavy fishing effort. Thus, any additional concentration of effort from any displacement would not be expected to cause substantive additional negative impacts.

Sub-alternatives under Alternative 2B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 2B-1) and the golden tilefish bottom longline fishery (Alt. 2B-2). These exemptions would not be necessary under Alternative 2C (prohibition on mobile bottom tending gear).

Red Crab Exemption (Alt. 2B-1)

The exemption for red crab was proposed given the small size of the red crab fleet (three vessels) (see Section 6.4) and because all red crab effort takes place at depths entirely within all of the proposed broad zone areas. Given the limited number of pots employed and the small size of each pot, the total area of the seafloor contacted by the gear is small, so it is likely that the red crab fishery has a small impact on benthic habitats relative to other bottom-tending fisheries.

As described in Section 6.4.7, there are currently five limited access permit issued for red crab, three of which are currently active: two active full-time vessels and one active part-time vessel. The fishery operates from Cape Hatteras to the US-Canadian border. The vessels use conical mesh traps, set about 150 feet apart with 150 traps on each line. Each vessel fishes 600 traps, and with typical soak times of approximately 24 hours. Traps are set along the 350 fathom (640 meter) depth contour. This depth is targeted because red crabs segregate by sex and depth, and take of female crabs is prohibited, so targeting this depth allows for male-only harvest. Given this targeted depth, the red crab fishery would have no ability to displace effort within the mid-Atlantic to avoid broad zone restricted areas. Vessels move north or south fishing along this contour several times per year, resulting in a relatively even distribution of reported landings (J. Williams, personal communication, April 2015). Due to the soft-sided nature of the traps and the use of float line to connect traps (vs. sink line that lies along the bottom), it is believed that these types of traps may have less of an impact on habitat than other trap gear types (such as lobster traps).

However, the fishery operates on a broad range of sediment types and has operated at the same depths up and down the coast for many years, thus it is likely that some negative impacts occur under the baseline environmental conditions. In addition to the expected disturbance from traps contacting the bottom during deployment, soaking, and retrieval, traps may also move along the bottom due to natural disturbance such as currents and storms, though the extent of this movement is unknown. Any existing negative impacts to habitat resulting specifically from the red crab fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 2A), the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 2C (prohibitions on only mobile bottom-tending gear). Thus, the magnitude and direction of habitat impacts resulting specifically from red crab fishing effort would be functionally equivalent under all of these alternatives. However, overall, long-term impacts to habitat would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected under the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and to a slightly lesser extent from Alternative 2C which would allow fishing with all fixed gear types, including red crab pots, but prohibit the use of mobile, bottom-tending gears.

The Council considered the potential habitat impacts in combination with the practicality of restricting the red crab fishery throughout half of its operating range, and determined that an exemption for this fishery under Alternative 2B-1 was warranted. Though the current fishery is limited access with participation limited to a few vessels, if effort were to increase in terms of frequency or spatial extent of hauls, an increase in direct negative impacts to habitat would be expected.

Golden Tilefish Exemption (Alt. 2B-2)

The golden tilefish bottom longline fishery was also considered for an exemption given the relatively small footprint of this fishery within any of the broad zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around a few of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered in the event that a 200m or 300m broad zone was selected, as tilefish longline effort currently occurs at or near those depths. Industry members indicated that an exemption would likely be unnecessary if a deeper broad zone was designated, as little or no tilefish longline effort currently takes place beyond 300m.

Habitat disturbance is possible from bottom longlines, through disruption of sediments, entanglement with structure, or gear loss. However, the impacts of hook gear types on benthic habitat is much lower compared to mobile gear types, and hooks likely have little impact on the sand, silt, and mud environments common in many of the proposed areas (see Section 6.3.4). Thus, continued slight direct negative impacts to habitat are possible under the baseline conditions when considering the impacts specifically resulting from the golden tilefish longline fishery; however, the fishery has operated in the same areas for many years, and these impacts are likely to be minor when considering the overall distribution of coral communities and the areas proposed for protection. As indicated above for red crab, long-term positive impacts would be expected under the combination of Alternative 2B and 2B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and to a slightly lesser extent from Alternative 2C, due to closing these areas to other gear types and freezing the current footprint of fishing. Though the current fishery is limited access with limited participation, if effort were to increase in terms of frequency or spatial extent of hauls, direct negative impacts to habitat may increase.

<u>Gear Restriction and Exemption Alternatives Summary</u>

Overall, the impacts of these gear restriction and exemption alternatives are expected to range from slight to moderate positive impacts on habitat and EFH, as described above. In relative terms, the magnitude of these positive impacts is expected to be greatest from Alternative 2B alone (without an exemption sub-option), which would prohibit the most gear types with no exemptions. The next highest positive impacts would be expected from the combination of Alternative 2B and 2B-2 (prohibition on all bottom-tending gear with an exemption for golden tilefish). Alternative 2B with exemption for tilefish only is expected to have greater positive impacts than Alternative 2B in combination with an exemption for red crab, given that the spatial footprint of the tilefish fishery within the proposed areas is much smaller and does not extend into the deeper broad zones. The combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for red crab) would have the next highest positive impacts, followed by the combination of 2B, 2B-1, and 2B-2. Alternative 2C would have impacts similar in magnitude to the combination of Alternatives 2B, 2B-1, and 2B-2; however, Alternative 2C would restrict the future expansion of fewer fisheries and thus would have slightly lower positive impacts. Finally, no positive habitat impacts would be expected under the no action/*status quo* alternative for gear restrictions (Alt. 2A; neutral impacts relative to the baseline conditions with continued gear-habitat interactions expected under the baseline conditions).

Section 7.1.1.3 summarizes the expected impacts to habitat of various specific combinations of gear restriction alternatives and broad zone designation alternatives.

VMS Requirement Alternative

Alternative 2D would require VMS for all federally permitted vessels fishing within broad coral zones (regardless of gear type). If implemented in combination with gear restriction alternatives, requiring VMS within broad coral zones would be expected to improve enforcement of such measures. Increased VMS data from offshore fisheries would also be expected to aid in future analysis of any gear restricted areas and their potential impacts on habitat. However, many vessels and fisheries operating in the areas in question are already required to use VMS as a condition for holding certain permits, so the actual impacts of this alternative would be limited in magnitude. Thus, Alternative 2D would be expected to have neutral to indirect slight positive impacts to habitat relative to the *status quo*, depending on the degree to which monitoring is actually improved. If Alternative 2D is not implemented, neutral impacts related to monitoring and enforcement would be expected.

Transit Alternatives

Alternatives 2E and 2F would allow for vessel transit either under the condition that gear be stowed (Alt. 2E) or that a VMS declaration for “transit” be submitted (Alt. 2F). Regardless of the broad zone designation alternative implemented, both of these transit alternatives would be expected to have neutral to slight indirect negative impacts to habitat relative to the *status quo* and baseline environment conditions, since these provisions are not expected to change the rate of interactions with habitat but may make gear restrictions more difficult to enforce. The more vessels present within a restricted area, the more difficult it may be for enforcement vessels to intercept them and verify that the vessels are not fishing using a prohibited gear type. Alternative 2E may have slightly more negative indirect impacts compared to Alternative 2F, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

7.1.1.3 Summary of Broad Zone Impacts

Based on the analysis described above, this section summarizes the impacts from the various specific combinations of alternatives for broad zones. Overall, the impacts to habitat from any combination of the various broad zone designation alternatives 1B through 1F, in combination with gear restriction Alternatives 2B or 2C, are likely to result in direct positive impacts to habitat and EFH relative to the *status quo* alternatives. The magnitude of these positive impacts would range from slight to moderate positive, with higher positive impacts expected from alternatives that protect a greater area overall, and particularly a greater area near the shelf/slope break and in the heads of canyons. Higher positive impacts are expected from restricting more gear types with fewer exemptions.

A summary of expected impacts from various specific combinations of designation alternatives (Alts. 1A through 1F) and gear restriction and exemption alternatives (Alts. 2A through 2C) is shown in Table 56. All combinations of designation options with gear restrictions would be expected to result in direct positive impacts to the physical environment and EFH. The exact magnitude of impacts is complicated to assess, given that the vast majority of the proposed broad coral zones are not currently experiencing fishing activity, and the alternatives are primarily designed to protect corals against future expansion of fishing or development of new deep sea fisheries. The likelihood and extent of potential future fishing-related disturbances is difficult to predict, but would be expected to be relatively minor, as high costs associated with developing new deep sea fisheries and operating far from shore would be expected to deter development of new fisheries or expanding effort into deeper waters. Thus, the overall magnitude of the direct positive impacts to the physical environment resulting from the implementation of broad coral zones with bottom fishing restrictions is likely slight positive to moderate positive, depending on the broad zone designated and exemptions implemented. In summary, because more current fishing activity takes place within the 200m, 300m and Council preferred broad zones (Alternatives 1B, 1C, and 1F,[45] respectively), these designations would be expected to result in moderate direct positive impacts to habitat and EFH due to their potential to limit gear interactions with habitat. Because relatively little fishing activity occurs deeper than 400m, the impacts from Alternatives 1D and 1E are expected to result in slight positive impacts to habitat (Table 56). The relative impacts of all designation alternatives are described in Section 7.1.1.1.

The prohibition on all bottom-tending gear (Alternative 2B) would be expected to have slightly greater positive impacts on habitat than a prohibition on mobile bottom-tending gear (Alternative 2C). Because the number of fisheries and spatial extent of passive or stationary bottom-tending gear types in these areas is limited, and because mobile bottom-tending gear is believed to be more detrimental to benthic habitats than passive gear types, the magnitude of this difference in impacts is likely minor. Any fishing exemption alternatives (2B-1 or 2B-2) implemented under a restriction on all bottom-tending gear would reduce the positive habitat impacts associated with gear restricted areas. However, given the relatively small footprint of known passive gear effort potentially impacted by this action,[46] the overall difference in the magnitude of positive habitat impacts with and without exemptions is likely to be minor. The relative impacts of gear restriction and exemption alternatives are described above in Section 7.1.1.2.

[45] The Council-preferred zone (Alternative 1F) has relatively higher fishing activity compared to Alternatives 1D and 1E (400 and 500 meter zones). This is because although it approximates the 450-meter contour in between canyons, and is designated deeper than 500m in some canyon areas, it also includes many canyon areas shallower than 200 meters, due to incorporation of the workshop discrete zone boundaries.

[46] This does not include the footprint of lobster gear, which would not be affected by this action and thus is not analyzed here.

For transit and enforcement alternatives, a summary of expected impacts from various specific combinations with broad zone designation alternatives (Alts. 2D through 2F) is shown in Table 57. The impacts of these action alternatives are not expected to vary perceptibly based on the broad zone designation implemented, and would be as described in Section 7.1.1.2 above.

Table 56: Summary of impacts to the physical environment and EFH from broad zone designation alternatives in combination with broad zone gear restriction alternatives. BTG= bottom-tending gear.

<table>
<tr><th>Alt.</th><th>2A (No action/Status quo)</th><th>2B (Prohibit all BTG; Council preferred)</th><th>Sub-Alt 2B-1 (Exempt red crab fishery under 2B; Council preferred)</th><th>Sub-Alt 2B-2 (Exempt tilefish fishery under 2B)</th><th>2C (Prohibit mobile BTG)</th></tr>
<tr><td>1A (No action/status quo)</td><td>No designation; no management measures. Neutral impacts relative to the baseline conditions.</td><td colspan="4">NA: These would not be reasonable combinations of alternatives given that gear restrictions within a broad zone would not be implemented unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">Broad zone would be designated, but no management measures would be applied. Neutral impacts to habitat expected relative to the status quo and baseline environmental conditions.</td><td rowspan="2">Moderate direct positive impacts: reduced habitat interactions and prevention of effort expansion. 1B associated with higher positive impacts than 1C. Alt. 2B associated with higher positive impacts than 2C.</td><td rowspan="5">Habitat impacts from red crab fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less so than 2B alone. Current baseline conditions likely result in direct slight negative impacts from existing gear interactions at depths targeted by the red crab fishery. Impacts would not vary under alternatives 1B-1F, as red crab effort occurs exclusively in deeper waters.</td><td rowspan="2">Habitat impacts from tilefish fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less than 2B alone. 1B associated with higher positive impacts than 1C.</td><td rowspan="2">Moderate direct positive impacts: reduced habitat interactions and prevention of effort expansion. 1B associated with higher positive impacts than 1C. 2B associated with higher positive impacts than 2C.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td><td rowspan="2">Slight direct positive impacts expected due to slight reduction in habitat interactions and prevention of potential future interactions. 1D associated with higher positive impacts relative to 1E. Alt. 2B associated with higher positive impacts than 2C.</td><td rowspan="2">Tilefish fishery does not currently operate at these depths; thus, neutral impacts expected impacts relative to status quo; Overall impacts positive long-term in combination with 2B, similar to 2B alone.</td><td rowspan="2">Slight direct positive impacts expected due to slight reduction in habitat interactions and prevention of potential future interactions. 1D associated with higher positive impacts relative to 1E. 2B associated with higher positive impacts than 2C..</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td><td>Moderate direct positive impacts from reduction in habitat interactions and prevention of potential future interactions. Uncertain magnitude but likely similar to Alt. 1C (greater positive impacts vs. Alts. 1E and 1D, less than 1B).</td><td>Habitat impacts from tilefish fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less than 2B alone. Designation alt. similar magnitude as 1C.</td><td>Moderate direct positive impacts from reduction in habitat interactions and prevention of potential future interactions. Uncertain magnitude but likely similar to Alt. 1C (greater positive impacts vs. Alts. 1E and 1D, less than 1B).</td></tr>
</table>

Table 57: Summary of impacts to the physical environment and habitat of broad zone designation alternatives in combination with broad zone VMS and vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>2D (Require VMS within broad zones)</th><th>2E (Transit with gear stowage; Council preferred)</th><th>2F (Transit with VMS declaration)</th></tr>
<tr><td>1A (No broad zone designation)</td><td colspan="3">NA: VMS measures within a broad zone would not be necessary or practical unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">No direct impacts expected on habitat from VMS requirements. In combination with any broad zone designation, neutral to slight positive indirect impacts expected given increased ability to monitor and enforce current and future gear restriction measures.</td><td rowspan="5">Alt. 2E in combination with any broad zone designation alternative is expected to have neutral to indirect slight negative impacts to habitat, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 2E slightly more negative in magnitude vs. Alt. 2F.</td><td rowspan="5">Alt. 2F in combination with any broad zone designation alternative is expected to have neutral to indirect slight negative impacts to habitat, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 2F slightly less negative in magnitude vs. Alt. 2E.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td></tr>
</table>

7.1.2 Discrete Coral Zones and Management Measures

7.1.2.1 Discrete Zone Designation Alternatives

Alternatives for discrete zone designation (Alternative set 3) consist of a no action alternative (3A) and a discrete zone designation Alternative 3B with a series of sub-options for various boundaries. The sub-alternatives under Alternative 3B were assessed in a similar manner to those in Section 7.1.1 for the broad zone alternatives, but using mainly qualitative assessment given the caveats associated with depth-based and non-depth-based EFH designations described in Section 7.1.1. Information regarding offshore and deep sea habitat types is limited. General benthic sediment types within the affected environment are described in Section 6.1, as well as EFH designations for managed resources that occur or may occur in the affected areas.

All of the discrete zone designation options (other than the no action alternative), if implemented in combination with gear restrictions, would protect large combined areas of benthic habitat (Table 58). Similar to the broad zones, there are large portions of the discrete zone boundary options in each canyon that overlap. Portions of the discrete zones (in particular the deeper portions beyond approximately 400 meters) consist of areas that do not currently experience fishing activity (or experience very little fishing activity). Thus, like the broad zones, the overall impacts to benthic habitat from each of the discrete zone boundary options is expected to be somewhat similar, with the main differences in expected impacts resulting primarily from the varying boundaries at the landward edge of each discrete zone, near the heads of the canyons between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there would be no expected differences in the amount or types of habitat that would be protected between any of the broad zone designation alternatives, as all of the alternatives overlap in this area. In addition, little to no fishing activity currently takes place deeper than 500 meters.

Table 58: Total area (km^2) proposed for gear-restricted discrete zones across all boundary options.

Alternative	3B-1 (Advisor 2013)	3B-2 (FMAT)	3B-3 (GSSA)	3B-4 (NGO 2015)	3B-5 (Council preferred)
Total Area (all discrete zones combined)	5,736	7,882	4,838	7,912	7,099

As described in Section 6.1, the Mid-Atlantic region contains both “shelf-sourced” and “slope-sourced” canyons. Because the slope-sourced canyons tend to begin in deeper waters with little or no protrusion onto the shelf or shelf break where the majority of fishing effort occurs, the habitats in shelf-sourced canyons are expected to benefit more from discrete zones that protect larger portions of these canyons. Thus, the expected overall impacts are weighted somewhat by the expected effects on Norfolk, Baltimore, Washington, Wilmington, and Hudson canyons.

In combination with gear restrictions, all of the discrete zone designation sub-alternatives under 3B (3B-1 through 3B-5) are expected to result in direct positive impacts to habitat and EFH. All of these designations would result in areas that protect some amount of designated EFH and additional non-designated habitat from current gear impacts, prevent future impacts, and to varying extents prevent the expansion of current fishing effort into deeper waters. Alternative 3A, no designation of discrete zones, would be expected to result in neutral impacts relative to the baseline conditions, under which ongoing gear interactions with habitat are likely to be occurring, in particular near the shelf/slope break.

The magnitude of the positive impacts is expected to vary based on the designation sub-alternative selected. This variation is due to both differences in the amount of overlap of designation boundaries with EFH, and an unequal distribution of fishing effort across the total area under consideration for discrete zone protections. Specifically, EFH designations for many managed species do not extend far or at all into the discrete zones, and thus sub-options that include more shallower habitat are more likely to encompass EFH for more species, as detailed below.[47] In addition, analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the primary exception of the red crab fishery as described below). Thus, the areas within the proposed discrete zones where fishing gear is most likely to currently interact with benthic habitats includes primarily areas shallower than 400 meters near the shelf/slope break; i.e., areas near the landward boundary of each proposed discrete coral zone. More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas. Therefore, the magnitude of positive impacts is expected to increase as designation alternatives extend into shallower water, both because more EFH is designated and because more fishing effort occurs in shallower areas of the discrete zones, meaning that the action alternatives will have more of a positive impact in these areas.

The expected magnitude of positive impacts from Alternatives 3B-2 (FMAT boundaries), 3B-4 (NGO coalition boundaries) and 3B-5 (Workshop boundaries) are very similar. In comparison, the boundaries under Alternative 3B-1 (Advisor 2013) for the Mey-Lindenkohl Slope, Baltimore Canyon, and Norfolk Canyon (the only three areas for which boundaries were proposed in 2013) include comparable habitat protected for these three specific canyons compared to Alternatives 3B-2, 3B-4, and 3B-5. However,

[47] For example, EFH for golden tilefish is designated between 100 and 300 meters on the outer continental shelf, so portions of any discrete zone alternative that extend into water shallower than 300 meters would include EFH for this species, but portions that are deeper than 300 meters would not.

only these three areas are proposed under Alternative 3B-1, thus, this sub-alternative would overall protect much less EFH compared to sub-alternatives 3B-2, 3B-4, and 3B-5, which would protect fifteen discrete areas in total. The proposed boundaries for Alternative 3B-3 (GSSA boundaries), are generally deeper and smaller than the other sub-alternatives, and therefore, exclude a fair amount of habitat that is encompassed by Alternatives 3B-2, 3B-4, and 3B-5.

In summary, all boundary sub-alternatives are likely to result in direct positive impacts to habitat, but to varying degrees. Impacts from alternatives 3B-2, 3B-4, and 3B-5 are generally equivalent in terms of magnitude, with slight to moderate positive impacts expected from these area designations in combination with the various gear restrictions options. Alternative 3B-3 and 3B-1 would result in less positive impacts, with 3B-1 having less positive impacts than 3B-3 due to the limited number of canyons proposed for protection under that alternative.

Section 7.1.1.3 summarizes the expected impacts to habitat of various specific combinations of gear restriction alternatives and discrete zone designation alternatives.

7.1.2.2 Discrete Zone Management Measure Alternatives

For management measures to be applied within the discrete zones, impacts are similar to those described in Section 7.1.1.2 for broad zones. Both gear restriction alternatives (Alternative 4B/prohibition on all bottom-tending gear and Alternative 4C/prohibition on mobile bottom-tending gear) would be expected to result in direct positive impacts to benthic habitats relative to the *status quo* and baseline environmental conditions. In general, alternatives restricting the use of more gear types within the discrete zones, with fewer exemptions, are expected to result in greater positive impacts to habitat. Alternatives that improve the compliance with and enforcement of gear restriction measures are expected to result in indirect positive impacts to habitat. However, given that portions of the proposed discrete zones are currently unfished, and that natural protections are afforded to many unique habitat areas located at unfishable depths and slopes, the habitat benefits from the proposed measures are not expected to be significant.

Gear Restriction and Exemption Alternatives

As described in Section 7.1.1.2 for broad zones, the physical environment and benthic habitats, including benthic EFH designations, are expected to benefit from any alternative that reduces the likelihood of damage or disruption by commercial fishing gear. The impacts for gear restriction alternatives on the discrete zones are similar to those described for broad zones; however, many discrete zone boundary options extend shallower than those for the broad zone options, overlapping with more current fishing effort. Although the discrete zones were not proposed under the “freeze the footprint of fishing” principle, there are still major deeper portions of the canyons that are currently unfished, complicating the evaluation of impacts from gear restriction measures. Again, very little fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the exception of the red crab fishery as described below). Thus, portions of the proposed discrete zones where fishing gear is most likely to currently come in contact with benthic habitats are located primarily near the shelf/slope break; i.e., near the landward boundary of each proposed discrete zone.

In addition, within the proposed discrete zones, there are many benthic habitats consisting of steep slopes that are likely to have a substantial degree of natural protection from many commercial fishing gear types, as very steep slopes cannot be trawled and may be difficult to access or fish with other gear types. Areas of higher three-dimensional complexity tend to be actively avoided by fishermen for fear of damage and loss of their gear. This natural protection likely limits the current extent of habitat interactions under the baseline environmental conditions, and somewhat limits the extent of positive impacts expected from the implementation of gear restricted areas.

Under the no action/*status quo* management measure Alternative 4A, one would expect some ongoing direct negative impacts to habitats, mostly near the shelf/slope break where more fishing effort occurs. Bottom fishing on the shallower middle and inner shelf is more likely to be conducted in high energy mobile sand habitats, where gear impacts tend to be minimal and/or temporary in nature.

Under gear restriction Alternatives 4B and 4C, direct positive impacts to habitat and EFH would be expected resulting from reduced interactions with bottom-tending gear. The expected magnitude of this impact varies based on which designation and exemption options are selected in conjunction. In general, Alternative 4B (prohibition on all bottom-tending gear) is expected to result in greater positive impacts to habitat relative to Alternative 4C (prohibition on mobile bottom-tending gear), and both action alternatives would have a greater positive impact on habitat compared to Alternative 4A (*status quo*/no gear restrictions). The differences in the magnitude of positive impacts between Alternative 4B and 4C may not be substantial given that the adverse impacts of mobile bottom-tending gear on benthic habitat features are typically greater than the impacts of stationary bottom-tending gear (NEFSC 2002, Morgan and Chuenpagdee 2003, also see Section 6.3.4). Stationary gear types do pose more of a threat to particularly fragile habitat types, including structure-forming deep sea coral communities described in Section 7.3, compared to more resilient habitats such as soft sediment.

For both gear restriction alternatives 4B and 4C, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort for many species around the heads of the canyons typically takes place in very strategic, specific areas around the edges of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (under the Council preferred broad and discrete zones). Some displacement of effort into non-designated areas would potentially reduce the positive habitat impacts of coral zone closures. However, effort is expected to be displaced largely to areas that already experience relatively heavy fishing effort. Thus, any additional concentration of effort from any displacement would not be expected to cause substantive additional negative impacts.

Sub-alternatives under Alternative 4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-2). These exemptions would not be necessary under Alternative 4C (prohibition on mobile bottom tending gear).

Red Crab Exemption (Alt. 4B-1)

The exemption for red crab was proposed given the small size of the red crab fleet (three vessels) (see Section 6.4) and because all red crab effort takes place at depths entirely within all of the proposed broad zone areas. Given the limited number of pots employed and the small size of each pot, the total area of the seafloor contacted by the gear is small, so it is likely that the red crab fishery has a small impact on benthic habitats relative to other bottom-tending fisheries. The operating procedures for this fishery and a description of the reasoning behind the proposed exemption is the same as that for the broad zone exemption, as described in Section 7.1.1.2. Due to the limited spatial footprint of the fishery and the soft-sided nature of the traps, with the use of float line to connect traps (vs. sink line that lies along the bottom), it is believed that these types of traps may have less of an impact on habitat than other trap gear types (such as lobster traps).

However, the fishery operates on a broad range of sediment types and has operated at the same depths up and down the coast for many years, thus it is likely that some negative impacts occur under the baseline environmental conditions. In addition to the expected disturbance from traps contacting the bottom during deployment, soaking, and retrieval, traps may also move along the bottom due to natural disturbance such as currents and storms, though the extent of this movement is unknown. Any existing negative impacts to habitat resulting specifically from the red crab fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). Thus, the magnitude and direction of habitat impacts resulting specifically from red crab fishing effort would be functionally equivalent under all of these alternatives. Due to the limited footprint of red crab effort and the fishing methods used, these impacts are expected to be limited in magnitude. Overall, long-term impacts to habitat would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected under the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and to a slightly lesser extent from Alternative 4C, which would allow fishing with all fixed gear types, including red crab pots, but prohibit the use of mobile, bottom-tending gears.

The Council considered the potential habitat impacts in combination with the practicality of restricting the red crab fishery in a series of fifteen designated discrete zones, and determined that an exemption for this fishery was warranted, at least in the short term. The Council for this exemption specified that the Council intended to review this exemption, specific to the discrete zones, after a 2-year period. Though the current fishery is limited access with participation limited to a few vessels, if effort were to increase in terms of frequency or spatial extent of hauls, an increase in direct negative impacts to habitat would be expected.

<u>Golden Tilefish Exemption (Alt. 4B-2)</u>

The golden tilefish bottom longline fishery was also considered for an exemption given the relatively small footprint of this fishery within any of the broad zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around a few of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered given that some of the discrete zone boundary alternatives would restrict important access in a few of these northernmost canyons.

Habitat disturbance is possible from bottom longlines, through disruption of sediments, entanglement with structure, or gear loss. However, the impacts of hook gear types on benthic habitat is much lower compared to mobile gear types, and hooks likely have little impact on the sand, silt, and mud environments common in many of the proposed areas (see Section 6.3.4). Thus, continued slight direct negative impacts to habitat are possible under the baseline conditions when considering the impacts specifically resulting from the golden tilefish longline fishery; however, the fishery has operated in the same areas for many years, and these impacts are likely to be minor when considering the overall distribution of coral communities and the areas proposed for protection. As indicated above for red crab, long-term positive impacts would be expected under the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and to a slightly lesser extent from Alternative 4C, due to closing these areas to other gear types and preventing expansion of fishing effort. Though the current fishery is limited access with limited participation, if effort were to increase in terms of frequency or spatial extent of hauls, direct negative impacts to habitat may increase.

Gear Restriction and Exemption Alternatives Summary

Overall, the impacts of these gear restriction and exemption alternatives are expected to range from slight to moderate positive impacts on habitat and EFH, as described above. In relative terms, the magnitude of these positive impacts is expected to be greatest from Alternative 4B alone (without an exemption sub-option), which would prohibit the most gear types with no exemptions. The next highest positive impacts would be expected from the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for golden tilefish). Alternative 4B with exemption for tilefish only is expected to have greater positive impacts than Alternative 4B in combination with an exemption for red crab, given that the spatial footprint of the tilefish fishery within the proposed areas is much smaller. The combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for red crab) would have the next highest positive impacts, followed by the combination of 4B, 4B-1, and 4B-2. Alternative 4C would have impacts similar in magnitude to the combination of Alternatives 4B, 4B-1, and 4B-2; however, Alternative 4C would theoretically restrict fewer fisheries and thus would have slightly lower positive impacts. Finally, no positive habitat impacts would be expected under the no action/*status quo* alternative for gear restrictions (Alt. 4A; neutral impacts relative to the baseline conditions with continued gear-habitat interactions expected under the baseline conditions).

Section 7.1.2.3 summarizes the expected impacts to habitat of various combinations of gear restriction alternatives and broad zone designation alternatives.

Transit Alternatives

Alternatives 4D and 4E would allow for vessel transit either under the condition that gear be stowed (Alt. 4D) or that a VMS declaration for “transit” be submitted (Alt. 4E). Regardless of the discrete zone designation sub-alternative implemented, both of these transit alternatives would be expected to have neutral to slight indirect negative impacts to habitat relative to the *status quo* and baseline environment conditions, since any provisions that allow for transit may make gear restrictions more difficult to enforce. The more vessels present within the closed area, the more difficult it may be for enforcement vessels to intercept them and verify that the vessels are not fishing using a prohibited gear type. Alternative 4D may have slightly more negative indirect impacts compared to Alternative 4E, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

7.1.2.3 Summary of Discrete Zone Impacts

Based on the analysis described above, this section summarizes the impacts from the various specific combinations of alternatives for discrete zones. Overall, the impacts to habitat from any combination of the various discrete zone designation alternatives 3B-1 through 3B-5, in combination with gear restriction Alternatives 4B or 4C, are likely to result in direct positive impacts to habitat and EFH relative to the *status quo* alternatives. The magnitude of these positive impacts would range from slight to moderate positive, with higher positive impacts expected from alternatives that protect a greater area overall, and particularly a greater area near the shelf/slope break and in the heads of canyons. Higher positive impacts are expected from restricting more gear types with fewer exemptions.

A summary of expected impacts from various combinations of designation alternatives (Alts. 3B-1 through 3B-5) and gear restriction and exemption alternatives (Alts. 4A through 4C) are shown in Table 59. If implemented in combination with gear restriction alternatives (Alts. 4B or 4C), all of the discrete zone action alternatives would be expected to result in direct positive impacts to the physical environment and EFH, given the expected reduction in bottom contact in those areas. The magnitude of impacts is complicated to assess, given that portions of the discrete zones are not currently experiencing fishing activity, and the alternatives are designed to protect habitat types that in many places are inaccessible to bottom-tending gear. Thus, the conservation benefits of gear restrictions in the discrete zones are primarily limited to the shelf/slope break area, in and around the heads of the canyons.

In combination, the overall magnitude of the direct positive impacts to the physical environment resulting from the implementation of discrete coral zones with bottom fishing restrictions is likely slight positive to moderate positive, depending on the set of discrete zone boundaries designated and exemptions implemented. In summary, because more current fishing activity takes place within the shallower areas encompassed by Alternatives 3B-2, 3B-4, and 3B-5, and because these alternatives would protect the most total area and designated benthic EFH, these three alternatives would likely result in moderate positive impacts to EFH. Alternatives 3B-1 and 3B-3 would protect the least amount of habitat, but would still reduce interactions with bottom habitats to some extent, likely resulting in slight positive impacts (Table 59).

The prohibition on all bottom-tending gear (Alternative 4B) would be expected to have slightly greater positive impacts on habitat than a prohibition on mobile bottom-tending gear. However, because the number of fisheries and spatial extent of effort using bottom-tending passive gear types in these areas is limited, and because mobile bottom-tending gear is believed to be much more detrimental to benthic habitats than passive gear types, the magnitude of this difference in impacts is likely minor. Any fishing exemption alternatives (4B-1 or 4B-2) implemented under a restriction on all bottom-tending gear would likely reduce the positive habitat impacts associated with gear restricted areas. However, given the relatively small footprint of known passive gear effort in the proposed areas, the overall magnitude of the impacts with and without exemptions is likely to be minor.

For transit alternatives (Alts. 4D and 4E), a summary of expected impacts from various combinations with discrete zone designation alternatives is shown in Table 60. The impacts of these action alternatives are not expected to vary perceptibly based on the discrete zone designation implemented, and would be as described above in Section 7.1.2.2.

Table 59: Summary of impacts to the physical environment and habitat from discrete zone designation alternatives in combination with discrete zone gear restriction alternatives. BTG= bottom-tending gear.

Alt.	**4A (No action/*Status quo*)**	**4B (Prohibit all BTG; *Council preferred*)**	**Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)**	**Sub-Alt 4B-2 (Exempt tilefish fishery)**	**4C (Prohibit mobile BTG)**
3A (No discrete zone designation)	No designation; no management measures. **Neutral impacts relative to the baseline conditions.**	NA: These would not be reasonable combinations of alternatives given that gear restrictions within a discrete zone would not be implemented unless a discrete zone is designated.			
3B-1 (Advisor 2013 boundaries)	Discrete zone would be designated, but no management measures would be applied. **Neutral impacts** to habitat expected relative to the *status quo* and baseline environmental conditions.	**Slight direct positive impacts** expected from reduction in habitat interactions and prevention of potential future interactions. 3B-1 associated with fewer positive impacts relative to other designation alts. 4B associated with higher positive impacts than 4C.	Habitat impacts from red crab fishing neutral relative to the *status quo*; **Overall impacts positive long-term in combination with 4B**, but less so than 4B alone. Current baseline conditions likely result in direct slight negative impacts from existing gear interactions at depths targeted by the red crab fishery. Impacts would not vary under alternatives 3B-1 to 3B-5, as red crab effort occurs exclusively in deeper waters intersecting all discrete zone boundaries.	Habitat impacts from tilefish fishing neutral relative to the *status quo*; **Overall impacts positive long-term in combination with 4B**, but less than 4B alone**.**	**Slight direct positive impacts** expected from reduction in habitat interactions and prevention of potential future interactions. 3B-1 associated with fewer positive impacts relative to other designation alts. 4B associated with higher positive impacts than 4C.
3B-2 (FMAT boundaries)		**Moderate direct positive impacts:** reduced habitat interactions and prevention of effort expansion. 3B-2, 3B-4 and 3B-5 associated with comparable positive impacts (higher than 3B-1 or 3B-3). 4B associated with higher positive impacts than 4C.			**Moderate direct positive impacts:** reduced habitat interactions and prevention of effort expansion. 3B-2, 3B-4 and 3B-5 associated with comparable positive impacts (higher than 3B-1 or 3B-3). 4B associated with higher positive impacts than 4C.

Continued next page

Alt.	4A (No action/*Status quo*)	4B (Prohibit all BTG; *Council preferred*)	Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)	Sub-Alt 4B-2 (Exempt tilefish fishery)	4C (Prohibit mobile BTG)
3B-3 (GSSA boundaries)	See above	**Slight direct positive impacts** expected from reduction in habitat interactions and prevention of potential future interactions. 3B-3 associated with fewer positive impacts relative to 3B-2, 3B-4, and 3B-5, but more than 3B-1. 4B associated with higher positive impacts than 4C.	See above	See above	**Slight direct positive impacts** expected from reduction in habitat interactions and prevention of potential future interactions. 3B-3 associated with fewer positive impacts relative to 3B-2, 3B-4, and 3B-5, but more than 3B-1. 4B associated with higher positive impacts than 4C.
3B-4 (NGO coalition boundaries)		**Moderate direct positive impacts:** reduced habitat interactions and prevention of effort expansion. 3B-2, 3B-4 and 3B-5 associated with comparable positive impacts (higher than 3B-1 or 3B-3). 4B associated with higher positive impacts than 4C.			**Moderate direct positive impacts:** reduced habitat interactions and prevention of effort expansion. 3B-2, 3B-4 and 3B-5 associated with comparable positive impacts (higher than 3B-1 or 3B-3). 4B associated with higher positive impacts than 4C.
3B-5 (Workshop boundaries; *Council preferred*)					

Table 60: Summary of impacts to the physical environment and habitat from discrete zone designation alternatives in combination with discrete zone vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>4D (Transit with gear stowage; Council preferred)</th><th>4E (Transit with VMS declaration)</th></tr>
<tr><td>3A (No discrete zone designation)</td><td colspan="2">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within discrete zones would not be necessary or practical unless discrete zones are designated.</td></tr>
<tr><td>3B-1 (Advisor 2013 boundaries)</td><td rowspan="5">Alt. 4D in combination with any discrete zone designation alternative is expected to have neutral to indirect slight negative impacts to habitat, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 4D slightly more negative in magnitude vs. Alt. 4E.</td><td rowspan="5">Alt. 4E in combination with any discrete zone designation alternative is expected to have neutral to indirect slight negative impacts to habitat, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 4E slightly less negative in magnitude vs. Alt. 4D..</td></tr>
<tr><td>3B-2 (FMAT boundaries)</td></tr>
<tr><td>3B-3 (GSSA boundaries)</td></tr>
<tr><td>3B-4 (NGO coalition boundaries)</td></tr>
<tr><td>3B-5 (Workshop boundaries; Council preferred)</td></tr>
</table>

7.1.3 Framework Provisions

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. This action proposes to modify the list of items in the FMP that could be modified through a framework, to allow for future consideration of deep sea coral measures through a framework action.

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. The purpose of modifying the list of "frameworkable items" in the FMP is to demonstrate that the concepts included on the list have previously been considered in an amendment (i.e., they are not novel). Any proposed action or future change will be analyzed through a separate NEPA process.

Because the framework provision alternatives are administrative, they are not expected to result in any direct impacts to the physical environment or EFH, though indirect impacts are possible from some of the alternatives if they allow for more efficient responses to immediate threats to coral communities or other vulnerable habitat types. Specifically, because the administrative process for an amendment is longer, it is possible that any immediate conservation concerns arising in the future could be addressed in a timelier manner through a framework action rather than an amendment. In addition, because amendments typically take more Council and NMFS time and resources, it is possible that the Council may decide not to prioritize future adjustments to the coral measures if such actions would require an amendment. It is not possible to predict the magnitude and direction of any future deep sea coral actions; however, to the extent that framework provisions may allow more efficient responses to arising conservation concerns, the framework provision action alternatives 5B through 5D would be expected to result in neutral to indirect slight positive impacts to habitat, all to a similar degree. Action alternative 5E, an allowance for special access program development through a framework action, is expected to result in neutral impacts to habitat, as this would not be explored to address an immediate conservation need (Table 61). The impacts of any future special access program developed under this framework provision would be described in a future NEPA analysis.

Table 61: Expected impacts to the physical environment and habitat from framework provision alternatives (alternative set 5).

Alternative	Expected Impacts
Alt. 5A: No action/*status quo*	**Neutral**. Administrative in nature; no direct impacts on habitat. Due to time/resource requirements for amendments, future needs for coral protections may be delayed or de-prioritized.
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on habitat. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on habitat. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on habitat. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	**Neutral.** Administrative in nature; timeline and process to implement future access programs not expected to impact habitat directly or indirectly.

7.1.4 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. *Illex* vessels are not currently required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). Alternative 6B could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. This alternative set focuses exclusively on the *Illex* fishery because most other fisheries that operate in these deep water, offshore environments considered in this action are already required to use VMS. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

Because the action alternative is focused on monitoring *Illex* vessel activity and does not include any monitoring or reporting requirements related directly to habitat or the physical environment, it would not result in direct impacts to the physical environment or EFH. However, a VMS requirement for the *Illex* squid fishery, if implemented in combination with coral protection measures, may increase effective enforcement of coral zones, which would have indirect positive impacts on deep sea benthic habitats including EFH. In addition, improved VMS coverage for offshore fisheries may allow for more refined analysis of fishing activity, and thus potentially more effective future habitat protection measures. Because most or all *Illex* vessels currently already have VMS to comply with requirements for other permits they hold (e.g., longfin squid or mackerel), the magnitude of these indirect positive impacts is expected to be small. However, standardizing the VMS requirement across the *Illex* fleet would ensure that these vessels maintain VMS systems even if they no longer need or use them in the future for other permits.

Thus, Alternative 6B could have indirect slight positive impacts on habitat and the physical environment and EFH stemming from improved ability to enforce gear-restricted areas, and improved ability to evaluate the effectiveness of such areas. Because most *Illex* vessels currently already use VMS, the magnitude of this positive impact is expected to be small. Alternative 6A (no action/*status quo*) would have no direct impacts on protected resources, and would also be unlikely to result in either positive or negative indirect impacts, relative to baseline environmental conditions (Table 62).

Table 62: Expected impacts to the physical environment and habitat from *Illex* VMS alternatives (alternative set 6).

Alternative	Description	Expected Impacts
Alt. 6A	No action/status quo	**Neutral.** No direct impacts on the physical environment or habitat. Relative to baseline conditions, no indirect impacts are expected as lack of VMS for *Illex* vessels is unlikely to affect habitat interactions.
Alt. 6B	Require VMS for federally-permitted *Illex* squid vessels *(Council preferred)*	**Neutral to indirect slight positive.** No direct impacts on the physical environment or habitat. Indirect slight positive impacts possible from increased ability to monitor, enforce, and evaluate other management measures and fishing activity that may impact habitat.

7.2 IMPACTS TO THE MANAGED RESOURCES

7.2.1 Broad Coral Zones and Management Measures

Broad Zone Designations, Gear Restrictions, and Exemptions

In general, the designation of broad zones, and the implementation of gear restrictions within them, are not expected to have direct impacts to the managed resources, though these measures may have some indirect positive impacts as described below. The measures proposed in this action are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). Each of the species will continue to be managed to achieve the objectives of their respective FMPs, with necessary management actions taken to continue to implement annual catch limits, accountability measures, habitat measures, and other measures designed to manage the stocks sustainability under the MSA and associated National Standards. None of the measures proposed here are intended to address any conservation concerns associated with any of the managed stocks, and none of the measures considered here would jeopardize any existing or proposed measures to address stock sustainability.

If no broad zones are designated and no management measures implemented (Alternatives 1A and 2A; no action/*status quo*) the managed species will continue to be sustainably managed under their own control rules under the appropriate Council's risk policy and other regulations that govern their catches. For most managed species, impacts from this suite of alternatives are expected to be neutral relative to the baseline conditions.

Under the action alternatives considered for broad coral zone designations and gear restrictions, it is possible that some managed species would experience indirect positive impacts from the measures proposed in this action, resulting from increased habitat quality and possible refugia from fishing. If some currently fished portions of canyons and slope areas are closed to bottom fishing, it is possible that those areas would experience enhanced productivity due to refuge provided to various life stages of a given species. If potential closed areas are very beneficial to a particular life stage of a certain species (e.g., larvae or juveniles), it is possible that this could have positive impacts on the population dynamics of the stocks as a whole.

Because the managed resources are generally highly mobile, widely distributed, and vary in their reproductive strategies, it is not possible to quantify the extent to which gear-restricted areas may indirectly benefit the stocks as a whole. As described in Section 7.1.1, the vast majority of the area within the proposed broad coral zones is not currently fished, and the broad zones are proposed for gear restrictions as a precautionary measure. In addition, many of the species considered as potentially affected in this action are targeted mostly inshore of the continental shelf/slope break. Thus, the expected magnitude of any positive impacts to managed resources from gear restrictions within a broad zone would be small for most species. Indirect positive impacts would be expected to be relatively greater for some species, particularly for red crab and golden tilefish which have specific habitat and distributional considerations in the areas considered.

As described in Section 6.2, golden tilefish are generally found on the outer continental shelf and around the heads of submarine canyons where they occupy burrows in the sedimentary substrate. Golden tilefish EFH, as discussed in Section 6.0, is designated between 100-300 meters depth. Tilefish are shelter-seeking and somewhat distributed according to substrate type. Although tilefish are relatively non-migratory, they may move within a local area. Given these considerations, it appears likely that restricting bottom-tending gear near the shelf/slope break and around the heads of canyons where tilefish form their burrows may provide an increased level of habitat protection sufficient to provide positive impacts to the stock. Tilefish EFH is currently protected from the effects of bottom-tending fishing gear in Norfolk Canyon (plus Lydonia, Oceanographer, and Veatch canyons in New England). Discrete zone alternatives being considered in this action, especially those with boundaries that include depths less than 300 meters, would extend protection of tilefish EFH to five additional shelf-sourced canyons in the Mid-Atlantic. Red crab are found over a variety of different sediment types, but in particular are affiliated with unconsolidated and consolidated silt-clay sediments. Red crab are distributed along the continental shelf edge and slope of the western Atlantic, with EFH designated for multiple life stages between 200m and 1800m. Any designated broad zone would encompass substantial areas of red crab EFH (see Section 7.1.1). Overall impacts to the managed resources are described here for all managed species occurring in the proposed designated coral zones, but with particular consideration given to these two species given these habitat considerations.

Overall, any broad zone designation-gear restriction combination is likely to have neutral to indirect slight positive impacts to the managed resources. The magnitude of potential indirect positive impacts may vary slightly between different combinations of broad zone and gear restriction alternatives.

For designation alternatives 1A through 1F, the magnitude of impacts is affected by the distribution of current fishing effort and the potential for each zone alternative to restrict effort within a designated broad zone. As described above, little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the primary exception of the red crab fishery). In addition, within the proposed broad zones, there are many areas of steep slopes that are unfished by most or all commercial fishing gear types, as very steep slopes cannot be trawled and may be difficult to access with other gear types. Areas of higher three-dimensional complexity tend to be actively avoided by fishermen for fear of damage and loss of their gear. In general, more fishing effort generally takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas, and thus more fishing effort is likely to be restricted by designation alternatives extending further onto the shelf/slope. However, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. This effort displacement may limit the positive impacts to the managed resources resulting from gear-restricted broad coral zones.

In relative terms, designation Alternatives 1B, 1C, and 1F are likely to have similar neutral to slight indirect positive impacts to the managed resource relative to the *status quo* Alternative 1A (if implemented in combination with gear restriction alternatives). Of these alternatives, slightly higher indirect positive impacts would be expected under Alternative 1B when compared to Alternative 1C due to more restrictions on fishing effort near the shelf/slope break and on the slope, as well as differences in overlap with the distribution of tilefish and red crab and their habitats. Alternative 1F is difficult to evaluate relative to other alternatives, because unlike the others, it is not strictly depth-based; however, the impacts of 1F would be expected to be very similar to Alternative 1C given the similar net coverage of shallower vs. deeper areas. Under Alternatives 1D and 1E, neutral to slight indirect positive impacts are expected, to a lesser magnitude than Alternatives 1B, 1C, and 1F. In summary, the most positive indirect impacts are expected to be possible under Alternative 1B, followed by Alternative 1C = 1F, then 1D, then 1E. No positive impacts are expected under the *status quo* Alternative 1A (neutral impacts).

For gear restriction alternatives, in general, Alternative 2B (prohibition on all bottom-tending gear) is expected to result in slightly greater indirect positive impacts to the managed resources relative to Alternative 2C (prohibition on mobile bottom-tending gear), due to additional reduction of fishing activity within the broad coral zones. Both action alternatives would have a greater positive impacts compared to Alternative 2A (*status quo*/no gear restrictions). Under the no action/*status quo* Alternative 2A, one would expect ongoing sustainable management of the managed resources under baseline conditions.

Sub-alternatives under Alternative 2B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 2B-1) and the golden tilefish bottom longline fishery (Alt. 2B-2). These exemptions would not be necessary under Alternative 2C (prohibition on mobile bottom tending gear).

In general, the combination of alternatives that provide a larger area of refuge and habitat protection in areas that overlap with fishing have a higher possibility of providing indirect positive impacts to the managed resources. Sub-alternative 2B-1 (exemption for red crab) restricts less effort within the proposed areas compared to sub-alternative 2B-2 (exemption for tilefish). Thus, in relative terms, among these alternatives, the indirect positive impacts would be highest under Alternative 2B alone, followed by the combination of 2B and 2B-2, then by the combination of 2B and 2B-1, then by the combination of 2B, 2B-1, and 2B-2, then by Alternative 2C, then Alternative 2A. The effects of the exemption for red crab would not be expected to vary with the designation alternative, since all red crab fishing effort takes place deeper than 500 meters, the depth that is common to all the broad zone alternatives. For tilefish, the exemption would have somewhat variable impacts under designation alternatives, as effort does not currently occur within the 400m or 500m broad zones and therefore tilefish effort would not be displaced under those designation alternatives (Table 63). The overall impacts of the tilefish exemption are expected to be neutral to slight indirect positive long-term in combination with 2B**,** but for Alternatives 1D and 1E these impacts would be equivalent to 2B alone, while in combination with Alternatives 1C, 1B, and 1F, these impacts would be less than 2B alone.

VMS Requirement Alternative

For the VMS requirement within broad zones (Alternative 2D), no direct impacts would be expected on the managed resource. In combination with any broad zone designation, neutral to indirect slight positive impacts would be expected relative to the *status quo*, given an expected increased ability to monitor and enforce current and future management measures.

Transit Alternatives

Both Alternatives 2E (transit with gear stowage) and 2F (transit with VMS transit declaration), in combination with any broad zone designation alternative, would be expected to have neutral impacts to the managed resources, relative to the *status quo.* These measures will not impact stock status or affect implementation of other management measures.

Summary of Broad Zone Impacts

Table 63 summarizes the expected impacts to the managed resources for various specific combinations of gear restriction and broad zone designation alternatives, while Table 64 summarizes the expected impacts from combinations of designation alternatives and transit or VMS alternatives.

Table 63: Summary of impacts to the managed resources from broad zone designation alternatives in combination with broad zone gear restriction alternatives. BTG= bottom-tending gear.

<table>
<tr><th>Alt.</th><th>2A (No action/Status quo)</th><th>2B (Prohibit all BTG; Council preferred)</th><th>Sub-Alt 2B-1 (Exempt red crab fishery under 2B; Council preferred)</th><th>Sub-Alt 2B-2 (Exempt tilefish fishery under 2B)</th><th>2C (Prohibit mobile BTG)</th></tr>
<tr><td>1A (No broad zone designation)</td><td>No broad zone designation; no management measures. Neutral impacts relative to the baseline conditions. Continued positive impacts of sustainable management regime expected under baseline conditions.</td><td colspan="4">NA: These would not be reasonable combinations of alternatives given that gear restrictions within a broad zone would not be implemented unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">Broad zone would be designated, but no management measures would be applied. Neutral impacts to managed resources expected relative to the status quo and baseline environmental conditions.</td><td rowspan="5">Neutral to slight indirect positive impacts expected from increased habitat quality and possible areas of refugia for some managed resources (particularly red crab and tilefish). Alt. 2B likely higher positive than Alt. 2C. Alt. 1B designation highest positive, followed by 1C=1F, 1D, 1E, then 1A.</td><td rowspan="5">Overall impacts neutral to slight indirect positive long-term in combination with 2B, but less so than 2B alone. Impacts would not vary under designation alternatives 1B-1F, as red crab effort occurs exclusively in deeper waters.</td><td rowspan="2">Managed resource impacts from tilefish fishing neutral relative to status quo; Overall impacts neutral to slight indirect positive long-term in combination with 2B, but less so than 2B alone. Alt. 1B associated with slightly higher positive impacts vs. 1C.</td><td rowspan="5">Neutral to slight indirect positive impacts expected from increased habitat quality and possible areas of refugia for some managed resources (particularly red crab and tilefish). Alt. 2B likely higher positive than Alt. 2C. Alt. 1B designation highest positive, followed by 1C=1F, 1D, 1E, then 1A.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td><td rowspan="2">Tilefish fishery does currently operate at these depths; neutral impacts expected relative to status quo from tilefish fishing; Overall impacts neutral to slight indirect positive long-term in combination with 2B, equivalent to 2B alone.</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td><td>Managed resource impacts from tilefish fishing neutral relative to status quo; Overall impacts neutral to slight indirect positive long-term in combination with 2B, but less so than 2B alone. Expected impacts similar in magnitude overall to Alt. 1C.</td></tr>
</table>

Table 64: Summary of impacts to the managed resources for broad zone designation alternatives in combination with broad zone VMS and vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>2D (Require VMS within broad zones)</th><th>2E (Transit with gear stowage; Council preferred)</th><th>2F (Transit with VMS declaration)</th></tr>
<tr><td>1A (No broad zone designation)</td><td colspan="3">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within a broad zone would not be necessary or practical unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">No direct impacts expected on the managed resource from VMS requirements. In combination with any broad zone designation, neutral to slight indirect positive impacts expected given increased ability to monitor and enforce current and future management measures.</td><td rowspan="5">Alt. 2E in combination with any broad zone designation alternative is expected to have neutral impacts to the managed resource, as it will not impact stock status or effect implementation of other management measures.</td><td rowspan="5">Alt. 2F in combination with any broad zone designation alternative is expected to have neutral impacts to the managed resource, as it will not impact stock status or effect implementation of other management measures.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td></tr>
</table>

7.2.2 Discrete Coral Zones and Management Measures

Discrete Zone Designation, Gear Restriction, and Exemption Alternatives

As described for the broad zones above, the designation of discrete zones, and the implementation of gear restrictions within them, are not expected to have direct impacts to most of the managed resources. The measures proposed in this action are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). None of the measures proposed here are intended to address any conservation concerns associated with any of the managed stocks, and none of the measures considered here would jeopardize any existing or proposed measures to address stock sustainability. The impacts to the managed resources described above in Sections 7.2.1 for the broad zones are similar for the discrete zone designations and measures (with the exception of the VMS requirement for broad zones in Alternative 2D, for which there is not an equivalent alternative proposed for the discrete zones).

If no discrete zones are designated and no management measures implemented (Alternatives 3A and 4A; no action/*status quo*) the managed species will continue to be sustainably managed under their own control rules under the appropriate Council's risk policy and other regulations that govern their catches. For most managed species, impacts from this suite of alternatives are expected to be neutral relative to the baseline conditions.

Under the action alternatives considered for discrete coral zone designations and gear restrictions, it is possible that some managed species would experience indirect positive impacts from the measures proposed in this action, resulting from increased habitat quality and possible refugia from fishing. If some currently fished portions of canyons and slope areas are closed to bottom fishing, it is possible that those areas would experience enhanced productivity due to refuge provided to various life stages of a given species. If potential closed areas are very beneficial to a particular life stage of a certain species (e.g., larvae or juveniles), it is possible that this could have positive impacts on the population dynamics of the stocks as a whole.

Because the managed resources are generally highly mobile, widely distributed, and vary in their reproductive strategies, it is not possible to quantify the extent to which gear-restricted areas may benefit the stocks as a whole. As described in Section 7.1.2, many portions of the discrete coral zone boundary alternatives are not currently fished, both due to extreme depths and the presence of complex three-dimensional habitat not suitable for fishing gear. In addition, many of the species potentially affected by this action are harvested mostly inshore of the continental shelf/slope break. Thus, the expected magnitude of any positive impacts to managed resources from gear restrictions within designated discrete zones would be small for most species. Indirect positive impacts would be expected to be relatively greater for some species, particularly for red crab and golden tilefish which have specific habitat and distributional considerations in the areas considered, as described above in Section 7.2.1.

Overall, any discrete zone designation sub-alternative in combination with gear restrictions are likely to have neutral to slight indirect positive impacts to the managed resources. The magnitude of potential indirect positive impacts may vary slightly between designation and gear restriction alternatives.

For designation alternatives 3B-1 through 3B-5, impacts are affected by the distribution of current fishing effort and the potential for each zone alternative to restrict effort within a designated discrete zone. As described above, little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the primary exception of the red crab fishery). In general, more fishing effort generally takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas, and thus more fishing effort is likely to be restricted by designation alternatives extending further onto the shelf/slope. However, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. This effort displacement may limit the positive impacts to the managed resources resulting from gear-restricted discrete coral zones.

In relative terms, designation Alternatives 3B-2, 3B-4, and 3B-5 are likely to have the same magnitude of slight indirect positive impacts to the managed resource relative to the *status quo* Alternative 3A (if implemented in combination with gear restriction alternatives). The total area designated among these three alternatives is very similar, and although the boundaries vary slightly, this variation is unlikely to make an appreciable difference in the magnitude of impacts to the managed resources. Under Alternative 3B-3, neutral to slight indirect positive impacts are expected, to a lesser degree than Alternatives 3B-2, 3B-4, and 3B-5 given the much smaller area and less overlap with current fishing activity. Alternative 3B-1 would be expected to result in the smallest possible slight indirect positive impacts, given that only three canyons are proposed for designation under this alternative. Neutral impacts are expected under the *status quo* designation Alternative 3A.

For gear restriction alternatives, in general, Alternative 4B (prohibition on all bottom-tending gear) is expected to result in slightly greater indirect positive impacts to the managed resources relative to Alternative 4C (prohibition on mobile bottom-tending gear), due to additional reduction of fishing activity within the discrete coral zones. Both action alternatives would have greater positive impacts compared to Alternative 4A (*status quo*/no gear restrictions). Under the no action/*status quo* Alternative 4A, one would expect ongoing sustainable management of the managed resources under baseline conditions.

Sub-alternatives under Alternative 4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-

2). These exemptions would not be necessary under Alternative 4C (prohibition on mobile bottom tending gear).

In general, the combination of alternatives that provide a larger area of refuge and habitat protection in areas that overlap with fishing have a higher possibility of providing indirect positive impacts to the managed resources. Sub-alternative 4B-1 (exemption for red crab) restricts less effort within the proposed areas compared to sub-alternative 4B-2 (exemption for tilefish). Thus, in relative terms, among these alternatives, the indirect positive impacts would be highest under Alternative 4B alone, followed by the combination of 4B and 4B-2, then by the combination of 4B and 4B-1, then by the combination of 4B, 4B-1, and 4B-2, then by Alternative 4C, then Alternative 4A. The effects of the exemption for red crab would not be expected to vary slightly with the designation alternative, since red crab fishing effort and habitat would not be covered to the same extent by Alternatives 3B-1 and 3B-3 compared to the other designation alternatives (Table 65).

Transit Alternatives

Both Alternatives 4D (transit with gear stowage) and 4E (transit with VMS transit declaration), in combination with any set of discrete zone designation alternative or sub-alternative, would be expected to have neutral impacts to the managed resources, relative to the *status quo* Alternative, as it will not impact stock status or effect implementation of other management measures.

Summary of Discrete Zone Impacts

Table 65 summarizes the expected impacts to the managed resources for various specific combinations of gear restriction alternatives and discrete zone designation alternatives, while Table 66 summarizes the expected impacts from combinations of designation alternatives and transit alternatives.

Table 65: Summary of impacts to the managed resources from discrete zone designation alternatives in combination with discrete zone gear restriction alternatives. BTG= bottom-tending gear.

<table>
<tr><th>Alt.</th><th>4A (No action/Status quo)</th><th>4B (Prohibit all BTG; Council preferred)</th><th>Sub-Alt 4B-1 (Exempt red crab fishery under 4B; Council preferred)</th><th>Sub-Alt 4B-2 (Exempt tilefish fishery under 2B)</th><th>4C (Prohibit mobile BTG)</th></tr>
<tr><td>3A (no designation)</td><td>No designation; no management measures. Neutral impacts relative to the baseline conditions.</td><td colspan="4">NA: These would not be reasonable combinations of alternatives given that gear restrictions within a discrete zone would not be implemented unless a discrete zone is designated.</td></tr>
<tr><td>3B-1 (Advisor 2013 boundaries)</td><td rowspan="5">Discrete zones would be designated, but no management measures would be applied. Neutral impacts to managed resources expected relative to the status quo and baseline environmental conditions.</td><td rowspan="5">Neutral to slight indirect positive impacts expected from increased habitat quality and possible areas of refugia for some managed resources (particularly red crab and tilefish). Alt. 4B likely higher positive than Alt. 4C. Relative impacts highest under 3B-2, 3B-4, and 3B-5 (equivalent magnitude), then 3B-3, and lowest under Alt. 3B-1.</td><td rowspan="5">Overall impacts neutral to slight indirect positive long-term in combination with 2B, but less so than 2B alone. Relative impacts similar under 3B-2, 3B-4, and 3B-5 (equivalent magnitude), and slightly lower under 3B-3 and Alt. 3B-1 (similar magnitude).</td><td rowspan="5">Overall impacts neutral to slight indirect positive long-term in combination with 2B, but less so than 2B alone. Relative impacts similar under 3B-2, 3B-4, and 3B-5 (equivalent magnitude), and slightly lower under 3B-3 and Alt. 3B-1 (similar magnitude).</td><td rowspan="5">Neutral to slight indirect positive impacts expected from increased habitat quality and possible areas of refugia for some managed resources (particularly red crab and tilefish). Alt. 4B likely higher positive than Alt. 4C. Relative impacts highest under 3B-2, 3B-4, and 3B-5 (equivalent magnitude), then 3B-3, and lowest under Alt. 3B-1.</td></tr>
<tr><td>3B-2 (FMAT boundaries)</td></tr>
<tr><td>3B-3 (GSSA boundaries)</td></tr>
<tr><td>3B-4 (NGO coalition boundaries)</td></tr>
<tr><td>3B-5 (Workshop boundaries; Council preferred)</td></tr>
</table>

Table 66: Summary of impacts to the managed resources for discrete zone designation alternatives in combination with discrete zone vessel transit alternatives.

Alternative	4D (Transit with gear stowage; *Council preferred*)	4E (Transit with VMS declaration)
3A (no designation)	NA: These would not be reasonable combinations of alternatives given transit measures within a discrete zone would not be implemented unless a discrete zone is designated.	
3B-1 (Advisor 2013 boundaries)	Alt. 4D in combination with any discrete zone designation alternative is expected to have **neutral impacts** to the managed resource, as it will not impact stock status or effect implementation of other management measures.	Alt. 4E in combination with any discrete zone designation alternative is expected to have **neutral impacts** to the managed resource, as it will not impact stock status or effect implementation of other management measures.
3B-2 (FMAT boundaries)		
3B-3 (GSSA boundaries)		
3B-4 (NGO coalition boundaries)		
3B-5 (Workshop boundaries; *Council preferred*)		

7.2.3 Framework Provisions

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. Thus, they are not expected to result in any direct impacts to any of the managed resources. The framework provision alternatives are also unlikely to have indirect impacts on managed resources, as the process and timeline for any future coral action is unlikely to impact actions that may impact the managed stocks. Any immediate need to address issues with stock status or other managed resource issues would be addressed by NMFS and/or the Councils through a separate action not related to deep sea corals. Thus, the no action alternative 5A as well as the framework provision action alternatives 5B through 5E would be expected to result in neutral impacts to managed resources relative to the *status quo* and baseline environmental conditions (Table 67). The impacts of any future special access program developed under this framework provision would be described in a future NEPA analysis.

Table 67: Expected impacts to the managed resources from framework provision alternatives (alternative set 5).

Alternative	Expected Impacts
Alt. 5A: No action/*status quo*	**Neutral.** No direct or indirect impacts on managed resources are expected. Alternatives are administrative in nature and would primarily affect the process and timeline to complete future coral related actions. Any future action would undergo a separate NEPA process.
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	

7.2.4 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. *Illex* vessels are not currently required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). Alternative 6B could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

The action alternative is focused on monitoring *Illex* vessels, which also interact intentionally or unintentionally with other managed resources. A VMS requirement for the *Illex* squid fishery, regardless of whether or not it was implemented in combination with coral protection measures, could increase effective enforcement and monitoring of other fishery regulations. In addition, improved VMS coverage for offshore fisheries may allow for more refined analysis of fishing activity, and thus potentially more effective future management of managed resources. Thus, Alternative 6B could have indirect positive impacts on managed resources stemming from improved ability to enforce other management measures, and improved ability to evaluate various implemented and proposed fishery measures. Because most or all *Illex* vessels currently already use VMS, the magnitude of this positive impact is expected to be small. Alternative 6A (no action/*status quo*) would have no direct impacts on protected resources, and would also be unlikely to result in either positive or negative indirect impacts, relative to baseline environmental conditions. A lack of a VMS requirement for the *Illex* fishery is unlikely to have an impact on the interactions with deep sea benthic habitats (Table 68).

Table 68: Expected impacts to the managed resources from *Illex* VMS alternatives (alternative set 6).

Alternative	Expected Impacts
Alt. 6A: No action/status quo	**Neutral.** No direct impacts on the managed resources. Relative to baseline conditions, no indirect impacts are expected as lack of VMS for *Illex* vessels is unlikely to affect the managed resources.
Alt. 6B: Require VMS for federally-permitted *Illex* squid vessels *(Council preferred)*	**Indirect slight positive** impacts possible from increased ability to monitor, enforce, and evaluate management measures and fishing activity that may benefit the resources.

7.3 IMPACTS TO DEEP SEA CORALS

Impacts to deep sea corals were evaluated primarily by mapping and quantifying information on known deep sea coral distribution and abundance from both the historical DSCRTP database and recent research surveys, relative to proposed coral zones. In addition, the NOAA habitat suitability model for deep sea corals was used to evaluate the presence and amount of likely suitable habitat for each area alternative (see Section 6.3 for a more detailed description of the habitat suitability model, as well as a description of the data sources for known deep sea coral observations). This information was assessed relative to the boundary option alternatives for broad deep sea coral protection zones (alternative set 1), and considered in the context of the various proposed management alternatives (alternative set 2), as described in the sections below. Impacts were also evaluated taking into consideration current and expected fishing locations and practices, including the potential for effort displacement resulting from any gear restricted areas.

As noted in the introduction to Section 7.0, for the purposes of this analysis, the designation of boundaries and management measures are considered together, as their impacts are highly interrelated. Section 7.3.1 describes the differences between the various broad zone boundary designations, the expected impacts of the alternatives for management measures within broad zones, and the expected impacts of the various combinations of broad zone boundary designations and management measures. Section 7.3.2 describes similar expected impacts to deep sea corals from discrete zones. Section 7.3.3 and 7.3.4 describe the expected impacts of the framework provision measures (Alternative set 5) and VMS requirement for the *Illex* fishery (Alternative set 6).

7.3.1 Broad Coral Zones and Management Measures

7.3.1.1 Broad Zone Designation Alternatives

Alternatives for broad zone designation (Alternative set 1) can be compared in terms of their expected impacts to deep sea corals by assessing the overlap of coral observations and modeled suitable habitat. Because of the large degree of spatial overlap among all broad zone designation alternatives, the overall impacts to deep sea corals from each of the broad coral zone boundary options are expected to be somewhat similar. All of the broad zone designation options (other than the no action alternative) would provide a large precautionary protected area (Table 54), the vast majority of which would consist of areas that currently experience little or no fishing activity. Differences in impacts among broad zone designation options can be assessed based on differences in the landward boundary, near the heads of the canyons and the shelf/slope break between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there would be no expected differences between any of the broad zone designation alternatives, as all of the alternatives overlap in this area. In addition, little to no fishing activity currently takes place deeper than 500 meters. The differences between broad zones in terms of historical coral records, recent coral observations, and modeled habitat suitability are described below.

DSCRTP Database Records

Coral presence data from the DSCRTP database were analyzed to determine the overlap of historical coral records with proposed broad coral zones. The DSCRTP database[48] contains 870 records of deep sea corals within the MAFMC management region; of these, 635 records are included within the combined proposed broad coral zones (73%). Database observations are broken down by specific proposed broad zone alternative in Table 69.

DSCRTP database records should be interpreted with caution. The database records are presence-only, as little absence or abundance information is available. Many areas in the mid-Atlantic have not been explored for the presence of corals, thus, a lack of historical records does not necessarily indicate a lack of deep sea corals. Although each record is associated with a set of geographic coordinates, some historical records have uncertainties associated with their exact position. Furthermore, identifying deep sea coral taxa down to genus and species levels is difficult and problematic, especially through the use of photographs or video alone, and deep sea coral taxonomy is constantly evolving. Additionally, given the nature of this type of data collection, many of the records tend to be spatially clustered and may display a bias toward areas that have been more heavily sampled. The DSCRTP database does not

[48] As of June 10, 2013; DSCRTP database does not yet contain observations from recent research surveys.

currently include the results of recent survey work (2012-2014), as data from these cruises are still being processed and validated; however available information from these surveys, relative to proposed broad zones, is presented below under “Recent Research Surveys.”

DSCRTP coral records within the total combined area of the proposed broad zones are composed of sea pens (40%), soft corals/gorgonians (34%), and hard/stony corals (26%). Outside of the proposed zones, there are 232 total records, the majority of which are stony corals or sea pens. Because the proposed broad zone alternatives are largely overlapping, there are large numbers of records that are present in all proposed broad zones; thus, all proposed broad zones designations (in combination with a gear restriction alternative) would offer a substantial degree of protection for known deep sea corals.

Information is provided in Table 69 about DSCRTP records falling between proposed broad zone boundaries, which can be considered a rough approximation of how protection for corals may change with each proposed boundary alternative. In general, the largest “loss” in terms of the number of historical observations occurs between the 300m broad zone and 400m broad zone. The Council preferred broad zone (Alternative 1F) falls between the 300m and 400m zones in terms of number of coral records, with 566 records (Table 69). In summary, the most historical records would be protected by the boundary of Alternative 1B, followed by Alternative 1C, then Alternative 1F, then Alternative 1D, and finally Alternative 1E.

Table 69: Deep sea coral presence records within proposed MAFMC broad coral zones, in number (a) and percent, relative to the total number of records in the MAFMC region (b). Data from DSCRTP database as of June 2013.

a.		Total records (all types)	Soft corals and gorgonians	Stony corals	Sea pens
Broad zone (depth contour as landward boundary)	*[Shallower than 200 m]*	*235*	*24*	*118*	*93*
	Alt 1B: 200 meter broad zone	**635**	**214**	**167**	**255**
	[between 200 m and 300 m]	*40*	*1*	*17*	*23*
	Alt 1C: 300 meter broad zone	**595**	**213**	**150**	**232**
	[between 300 m and 400 m]	*51*	*10*	*26*	*15*
	Alt 1D: 400 meter broad zone	**544**	**203**	**124**	**217**
	[between 400 m and 500 m]	*25*	*15*	*4*	*6*
	Alt 1E: 500 meter broad zone	**519**	**188**	**120**	**211**
	Alt 1F: Council-pref. broad zone[a]	**566**	**209**	**144**	**213**
	TOTAL (MAFMC Region)	**870**	**238**	**285**	**348**

b.		% of total records (all types)	% Soft corals and gorgonians	% Stony corals	% Sea pens
Broad zone (depth contour as landward boundary)	*[Shallower than 200 m]*	*27%*	*10%*	*38%*	*27%*
	Alt 1B: 200 meter broad zone	**73%**	**90%**	**62%**	**73%**
	[between 200 m and 300 m]	*5%*	*0%*	*6%*	*7%*
	Alt 1C: 300 meter broad zone	**68%**	**89%**	**56%**	**67%**
	[between 300 m and 400 m]	*6%*	*4%*	*10%*	*4%*
	Alt 1D: 400 meter broad zone	**62%**	**85%**	**46%**	**62%**
	[between 400 m and 500 m]	*3%*	*6%*	*5%*	*2%*
	Alt 1E: 500 meter broad zone	**60%**	**79%**	**40%**	**61%**
	Alt 1F: Council-pref. broad zone[a]	***65%***	***89%***	***51%***	***61%***
	TOTAL (MAFMC Region)	**100%**	**100%**	**100%**	**100%**

[a] Alternatives 1B through 1E include proposed broad zones that are fully nested within the zone shallower. As described in Section 5.0, the Council preferred broad zone (Alternative 1F) was designed slightly differently. This zone approximates the 450 m depth contour, but also follows the workshop discrete zone boundaries from Alternative 3B-5. Due to following workshop discrete zone boundaries which are drawn at various depths and sometimes extend shallower than all broad zone options, the area "between" zones is not easily analyzed. This also explains why the number of coral records within the Council-preferred zone differs from what would be expected if this boundary only approximated the 450 meter contour and did not incorporate the shallower discrete zone areas.

Recent Research Surveys

As described in Section 6.3.2.2, there have been several recent research surveys that have resulted in new coral observations in the Mid-Atlantic Council region. These included ROV and towed camera surveys, mostly within canyon environments.

Locations of recent research dives were assessed relative to proposed broad zone boundaries using the best available location data for these surveys. Table 70 provides a summary of this assessment. It is clear that whether or not discrete zones are also implemented, the vast majority of the recent observations have occurred in waters deep enough to be protected by all five of the broad zone designation alternatives. However, a few dives near the heads of the canyons in the Mey-Lindenkohl Slope, Ryan Canyon, Baltimore Canyon, and Norfolk Canyon may not be completely encompassed by the deeper broad zone options (400 and 500m broad zones), and some of the recent observations in Norfolk and Baltimore Canyons would also approach the 300m broad zone boundary (Table 70; Figure 33). In terms of recently observed deep sea coral communities, all of the proposed broad zones would be expected to have similar magnitudes of positive impacts on corals, with slightly higher conservation benefits offered by the Council-preferred zone (Alt. 1F), the 200 m zone (Alt. 1B), and the 300 m zone (Alt. 1C). The Council-preferred Alternative 1F, though in part depth-based at the 450-meter contour, also includes shallower canyon areas due to the incorporation of the workshop discrete zone boundaries, as described in Section 5.0. In summary, the most recent observations would be protected equally by Alternatives 1B and 1F, followed closely by Alternative 1C, then followed by 1D and finally 1E (Table 70). If discrete zones were also implemented in combination with broad zones, the differences in impacts to corals among the broad zone designation alternatives would be minimal.

Table 70: Overview of deep sea coral observations from recent surveys within each broad zone alternative.[a]

Alternative	Summary of recent dive locations relative to broad zone boundary alternative
1A	None of the recent fieldwork would be encompassed (no broad zone designated).
1B (200m broad zone)	The 200m broad zone would likely encompass all dive locations from all recent surveys.
1C (300m broad zone)	The 300m broad zone would likely encompass the vast majority of dive locations from all recent surveys; however some portions of dive locations from the BOEM surveys in Baltimore and Norfolk Canyons may be excluded or be very near the boundary.
1D (400m broad zone)	The 400m broad zone would likely encompass the vast majority of dive locations from all recent surveys; however some dive locations from the BOEM surveys in Baltimore and Norfolk Canyons would be excluded or be very near the boundary.
1E (500m broad zone)	The 500m broad zone captures most recent dive locations, but excludes some portions of dive locations from the EX1404 (in Washington Canyon, Norfolk Canyon), HB1302 (Ryan Canyon), the BOEM survey (Baltimore and Norfolk Canyons).
1F (Council preferred broad zone)	The Council preferred broad zone would likely encompass all dive locations from all recent surveys (due to the incorporation of shallower workshop discrete zone boundaries).

[a] Because full dive tracks are not yet available for all surveys, approximate midpoint coordinates were analyzed where dive tracks were not available. Thus it is possible that some observations occurred in areas on or near the boundary line of a given broad zone alternative, hence the description of "*likely* encompassed by each broad zone boundary."

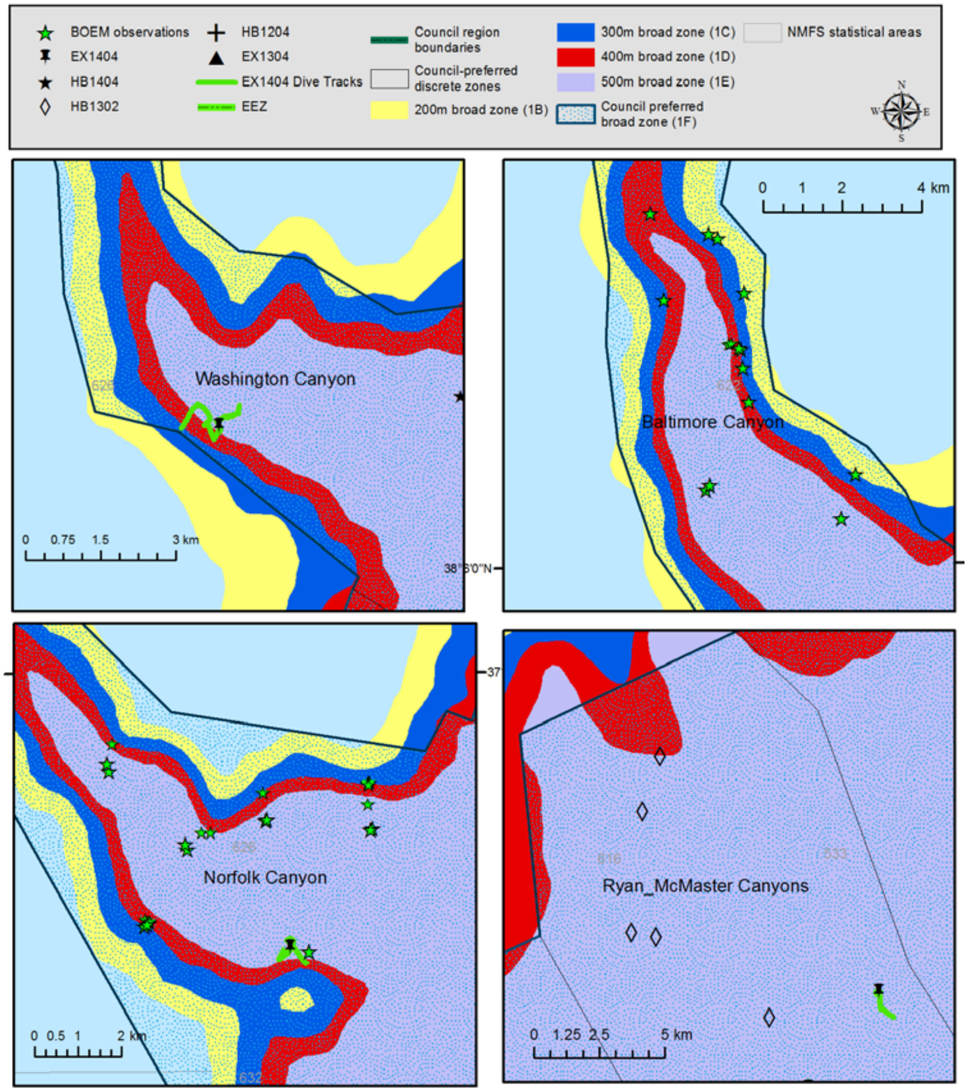


Figure 33: Map of deep sea coral observations from recent surveys that may fall outside some broad zone alternatives.

Habitat Suitability

As described in Section 6.3.2.4, NOAA has developed a habitat suitability model for deep sea corals by relating 1) known deep sea coral presence locations from the DSCRTP database, and 2) environmental and geological predictor variables (such as slope, depth, depth change, rugosity, salinity, oxygen, substrate, temperature, turbidity, and others). For areas where the presence of deep sea corals is likely but not proven, the occurrence of modeled deep sea coral habitat provides the best measure for inferring actual deep sea coral presence. Deep sea research dives have, however, validated that coral is likely to be found in areas predicted to have suitable habitat by the model. Therefore, for any of the coral zones defined in the alternatives, the total area of predicted high or very high deep sea coral habitat serves as a measure of the importance of the zone for deep sea corals. The impacts of the broad zone alternatives can be assessed as the protection afforded to corals by eliminating or reducing access to those areas by vessels using bottom tending fishing gear.

In the Greater Atlantic Region, the habitat suitability of several different taxonomic groups of deep sea corals were modeled. Some of these model outputs are better predictors of coral presence than others, due to different sample sizes of coral records of each type in the DSCRTP database. The model output for Gorgonian and Alcyonacean corals is expected to be the model with the best predictive ability for structure-forming deep sea corals, as it is based on a sizeable number of data points from known structure-forming species. Therefore, the model outputs for Gorgonian and Alcyonacean corals were used in this analysis to evaluate the habitat suitability of each proposed broad zone. Model outputs relative to proposed broad zones are displayed in Figure 34 and reflect the predicted likelihood of deep sea coral habitat for a given area. In this map, predicted likelihood of coral habitat suitability is displayed in thresholded logistic maps, meaning the likelihood values are displayed by the following likelihood categories: very low, low, medium, high, and very high.[49]

It should be noted that the exact location of deep coral hotspots on the seafloor often depends on fine-scale seabed features (e.g., ridges or ledges of exposed hard substrate) that are smoothed over in this regional-scale model. The current resolution of the model is grid cells of approximately 370 m^2. Model outputs should be viewed as representing only the general locations of predicted suitable coral habitat, within one or two model grid cells (370-740 meters). For this reason, the total area of high/very high habitat suitability within a proposed zone is an approximation using the best available data. In addition, model predictions are of coral presence, and high likelihood of presence will not necessarily correlate with high abundance.

While seafloor slope is a variable included in the inputs of the habitat suitability model, areas of high slope (>30 degrees) are believed to be a particularly important indicator of coral habitat. Thus, the amount of high slope areas in the potential coral zones is another way to gauge the effectiveness of a given boundary in protecting potential coral habitat. Developers of the habitat suitability model have indicated that areas of overlap between high slope and high or very high habitat suitability are very likely to contain corals. Because the slope data is available at a finer resolution ($25m^2$ as opposed to $370m^2$ for the habitat suitability model), this combination allows for a finer scale evaluation of key areas for coral protection.

Table 71 compares each broad coral zone alternative in terms of total designated area, total DSCRTP records, total area of modeled high/very high suitable habitat, and total area of high slope (>30 degrees).

Table 71: Summary of total area, DSCRTP coral observations, area of high habitat suitability, and area of high slope across proposed broad zones under Alternative Set 1. Note: recent fieldwork observations are not included in the DSCRTP historical database.

Broad Zone Designation Alternative	Approx. total area (km^2)	Total Area of High/Very High Habitat Suitability (km^2)	Total area of slope >30 degrees (km^2)
200 m broad zone (1B)	101,372	3,555	775
300 m broad zone (1C)	100,165	3,546	769
400 m broad zone (1D)	99,218	3,390	755
500 m broad zone (1E)	98,444	3,291	726
Council preferred broad zone (1F)	98,934	3,427	751

[49] See Section 6.3.2 for a footnote with additional description of the thresholded logistic outputs.

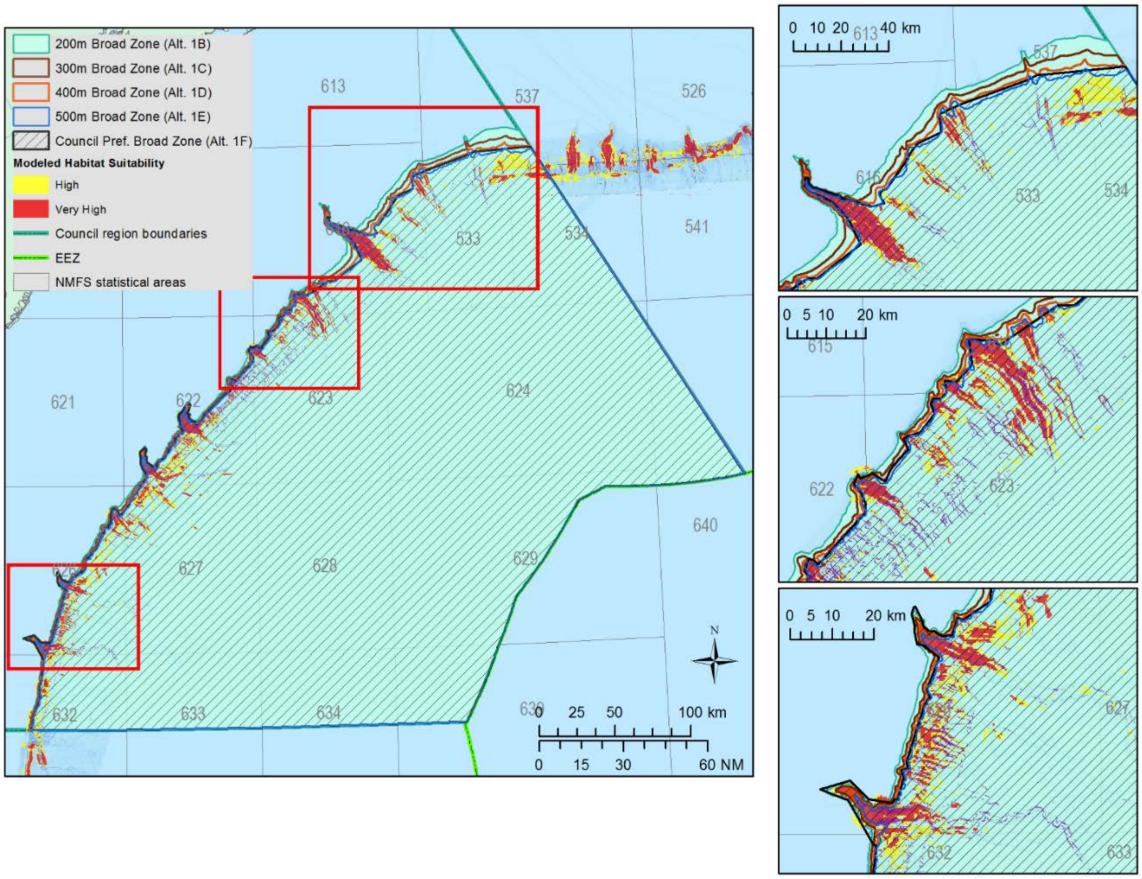


Figure 34: High and very high habitat suitability within proposed broad zone alternatives.

As can be seen in Figure 34, all of the broad zone designation alternatives would cover most of the high/very high suitability areas identified in the mid-Atlantic. The exceptions are the heads of the shelf-sourced canyons (those incising the shelf/slope break), including Hudson, Baltimore, Washington, and Norfolk. In these canyons, high/very high suitability areas extend into the shallower heads of the canyons (generally 300m and shallower). Based on the outputs of the habitat suitability model, the 200m broad zone would protect approximately 84.9% of areas in the MAFMC region predicted as having a high or very high likelihood of coral habitat suitability, the 300m broad zone would protect approximately 84.7% of high/very high likelihood areas, the 400m broad zone would protect 81% of high/very high likelihood areas, the 500m broad zone would protect 78.5% of high/very high likelihood areas, and the Council preferred broad zone would protect approximately 81.8% of high/very high likelihood areas. In summary, the most modeled habitat suitability would be protected by Alternatives 1B, followed by Alternative 1C, 1F, 1D and finally 1E (Table 71Table 70). If discrete zones were also implemented in combination with broad zones, the differences in impacts to corals among the broad zone designation alternatives would be smaller.

7.3.1.2 Broad Zone Management Measure Alternatives

For management measures to be applied within the broad zones, both gear restrictions alternatives (Alts. 2B and 2C) would be expected to result in direct positive impacts to deep sea corals relative to the *status quo* and baseline environmental conditions. In general, alternatives restricting the use of more gear types within the broad zones, with fewer exemptions, are expected to result in greater protections for deep sea corals. Alternatives that improve the compliance with and enforcement of gear restriction measures are expected to lead to indirect positive impacts to deep sea corals. However, given the vast amount of broad zone area that is currently unfished, as well as the natural protections afforded to many corals living at unfishable depths and slopes, the proposed measures are primarily precautionary and any positive impacts to corals are not expected to be significant.

Gear Restriction and Exemption Alternatives

In general terms, deep sea corals are expected to benefit from any alternative that reduces the likelihood of damage by commercial fishing gear. In order to evaluate the extent to which the proposed gear restriction measures may protect corals, it is necessary to consider the extent of the proposed areas that are actually fished and how fishing effort may shift under potential gear restrictions. The exact nature of potential impacts to corals from gear restriction alternatives are difficult to define, because although the total gear-restricted area under a broad zone would be very large, very little fishing effort currently occurs in the vast majority of the broad zone area. This is by design; the broad zone alternatives were developed under the precautionary "freeze the footprint of fishing" principle (see Section 5.0) primarily in order to protect corals from future expansion of fishing effort, including the potential development of new deep sea fisheries. Each of the broad zone designation alternatives was chosen for consideration based on their potential to exclude most current fishing effort.

Analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the exception of the red crab fishery; see "Fishery Exemption Alternatives" below). Thus, the areas within the proposed broad zones where fishing gear is most likely to interact (or have interacted in the past) with deep sea corals includes primarily areas near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas.

In addition, within the proposed broad zones, there are many corals growing on steep slopes that are likely to have a substantial degree of natural protection from many commercial fishing gear types, as very steep slopes cannot be trawled and may be difficult to access or fish with other gear types. Areas of higher three-dimensional complexity tend to be actively avoided by fishermen for fear of damage and loss of their gear. This natural protection likely limits the current extent of interactions with deep sea corals under the baseline environmental conditions, and somewhat limits the extent of positive impacts from gear restricted areas.

Under the no action/*status quo* management measure Alternative 2A, one would expect some ongoing direct negative impacts to deep sea corals near the shelf/slope break under the baseline conditions, and any potential expansion of effort into new deep water areas would be unconstrained and could increase impacts over time. New gear technologies could in theory increase access to more rugged terrain and areas where corals currently experience natural protections. Although little is known about the extent of gear interactions with corals in the Mid-Atlantic Council region, fishing gear's detrimental impact on deep sea corals (particularly from trawls) is well documented; Section 6.2.4 provides a review of information on the vulnerability of deep sea corals to fishing gear impacts.

Under gear restriction Alternatives 2B and 2C, direct positive impacts to deep sea corals would be expected relative to the *status quo* Alternative 2A resulting from reduced interactions with bottom-tending gear. Alternative 2B, prohibition on all bottom-tending gear types would be expected to result in greater positive impacts compared to Alternative 2C (prohibition on mobile bottom-tending gear only), and both action alternatives would have a greater positive impact on corals compared to Alternative 2A (*status quo*/no gear restrictions). The differences in the magnitude of positive impacts between Alternative 2B and 2C may not be substantial given that it is currently believed that interactions with corals by mobile bottom-tending gear are believed to be more detrimental than those of stationary bottom-tending gear. As described in Section 6.3.4, while passive gear types such as pots, traps, bottom longlines and sink gillnets can and do negatively impact deep sea corals, gear impact studies have demonstrated that generally, these gear types do not damage corals to the same degree that mobile bottom-tending gear does. Stationary gear types do pose more of a threat to particularly fragile habitat types, including structure-forming deep sea coral communities.

For both gear restriction alternatives 2B and 2C, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort around the heads of the canyons typically takes place in very strategic, specific areas around the bights of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (under the Council preferred broad and discrete zones). Because the proposed coral zones are not intended to protect the full extent of coral observations and habitat in the Mid-Atlantic Council region, some corals exist outside the proposed coral zones, and some displacement of effort into non-designated areas would potentially reduce the positive biological impacts of coral zone closures.

Sub-alternatives under Alternative 2B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 2B-1) and the golden tilefish bottom longline fishery (Alt. 2B-2). These exemptions would not be necessary under Alternative 2C (prohibition on mobile bottom tending gear).

Red Crab Exemption (Alt. 2B-1)

The exemption for red crab was proposed given the small overall scope of the red crab fishery (see Section 6.4) and because all red crab effort takes place at depths entirely within all of the proposed broad zone areas. Given the small physical footprint of gear contact with the seafloor, it is believed that the red crab fishery may currently have a smaller impact on corals relative to other bottom-tending fisheries.

The operating procedures for this fishery and a description of the reasoning behind the proposed exemption are the same as described in Section 7.1.1.2. Due to the limited spatial footprint of the fishery, the soft-sided nature of the traps, and the use of float line to connect traps (vs. sink line that lies along the bottom), it is believed that their impacts on deep sea corals are less than other trap gear types (such as lobster traps).

However, the fishery operates on a broad range of sediment types and has operated at the same depths up and down the coast for many years, thus it is likely that some negative impacts occur under the baseline environmental conditions. In addition to the possible disturbance from traps contacting corals during deployment, soaking, and retrieval, traps may also move along the bottom due to natural disturbance such as currents and storms, though the extent of this movement is unknown. Any existing negative impacts to corals resulting specifically from the red crab fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 2A), the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 2C (prohibitions on only mobile bottom-tending gear). Thus, the magnitude and direction of impacts to deep sea corals resulting specifically from red crab fishing effort would be functionally equivalent under all of these alternatives. However, overall, long-term impacts to deep sea corals would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected under the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and to a slightly lesser extent from Alternative 2C, which would allow fishing with all fixed gear types, including red crab pots, but prohibit the use of mobile, bottom-tending gears.

The Council considered the potential impacts to deep sea corals in combination with the practicality of restricting the red crab fishery throughout half of its operating range, and determined that an exemption for this fishery under Alternative 2B-1 was warranted. Though the current fishery is limited access with participation limited to a few vessels, if effort were to increase in terms of frequency or spatial extent of hauls, an increase in direct negative impacts to corals would be expected.

Golden Tilefish Exemption (Alt. 2B-2)

The golden tilefish bottom longline fishery was also considered for an exemption given the relatively small footprint of this fishery within any of the broad zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around a few of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered in the event that a 200m or 300m broad zone was selected, as tilefish longline effort currently occurs at or near those depths. Industry members indicated that an exemption would likely be unnecessary if a deeper broad zone was designated, as little or no tilefish longline effort currently takes place beyond 300m.

Coral disturbance is possible from bottom longlines, through disruption of sediments, entanglement with structure, or gear loss. However, the impacts of hook gear types on deep sea corals are believed to be lower compared to mobile gear types (see Section 6.3.4). Thus, continued slight direct negative impacts to deep sea corals are possible under the baseline conditions when considering the impacts specifically resulting from the golden tilefish longline fishery; however, the fishery has operated in the same areas for many years, and these impacts are likely to be minor when considering the overall distribution of coral communities and the areas proposed for protection. As indicated above for red crab, long-term positive impacts would be expected under the combination of Alternative 2B and 2B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and to a slightly lesser extent from Alternative 2C, due to closing these areas to other gear types and freezing the current footprint of fishing. Though the current fishery is limited access with limited participation, if effort were to increase in terms of frequency or spatial extent of hauls, direct negative impacts to corals may increase.

Gear Restriction and Exemption Alternatives Summary

Overall, the impacts of these gear restriction and exemption alternatives are expected to range from slight to high positive impacts on deep sea corals, as described above, depending on the specification combination of boundary designation and gear measures selected. In relative terms, the magnitude of these positive impacts is expected to be greatest from Alternative 2B alone (without an exemption sub-option), which would prohibit the most gear types with no exemptions. The next highest positive impacts would be expected from the combination of Alternative 2B and 2B-2 (prohibition on all bottom-tending gear with an exemption for golden tilefish). Alternative 2B with exemption for tilefish only is expected to have greater positive impacts than Alternative 2B in combination with an exemption for red crab, given that the spatial footprint of the tilefish fishery within the proposed areas is much smaller and does not extend into the deeper broad zones. In addition, hook and line gear types potentially have a lower impact corals compared to traps. The combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for red crab) would have the next highest positive impacts, followed by the combination of 2B, 2B-1, and 2B-2. Alternative 2C would have impacts similar in magnitude to the combination of Alternatives 2B, 2B-1, and 2B-2; however, Alternative 2C would restrict the future expansion of fewer fisheries and thus would have slightly lower positive impacts. Finally, no positive corals impacts would be expected under the no action/*status quo* alternative for gear restrictions (Alt. 2A; neutral impacts relative to the baseline conditions with continued gear-corals interactions expected under the baseline conditions).

Section 7.3.1.3 summarizes the expected impacts to deep sea corals of gear restriction alternatives in combination with broad zone designation alternatives.

VMS Requirement Alternatives

Alternative 2D would require VMS for all federally permitted vessels fishing within broad coral zones (regardless of gear type). If implemented in combination with gear restriction alternatives, requiring VMS within broad coral zones would be expected to improve enforcement of such measures. Increased VMS data from offshore fisheries would also be expected to aid in future analysis of any gear restricted areas and their potential impacts on corals. However, many vessels and fisheries operating in the areas in question are already required to use VMS as a condition for holding certain permits, so the actual impacts of this alternative would be limited in magnitude. Thus, Alternative 2D would be expected to have indirect slight positive impacts to deep sea corals. If Alternative 2D is not implemented, neutral indirect impacts related to monitoring and enforcement would be expected.

Transit Alternatives

Alternatives 2E and 2F would allow for vessel transit either under the condition that gear be stowed (Alt. 2E) or that a VMS declaration for "transit" be submitted (Alt. 2F). Regardless of the broad zone designation alternative implemented, both of these transit alternatives would be expected to have indirect slight negative impacts to deep sea corals, since any provisions that allow for transit may make gear restrictions more difficult to enforce. The more vessels there are present within the closed area, the more difficult it may be for enforcement vessels to intercept them and verify that the vessels are not fishing using a prohibited gear type. Alternative 2E may have slightly more negative indirect impacts compared to Alternative 2F, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

7.3.1.3 Summary of Broad Zone Impacts

Based on the analysis described above, all proposed broad zone designation alternatives are likely to have direct positive impacts to corals when combined with gear restriction alternatives. The magnitude of these impacts will vary based on the designation alternative applied and the specific combinations of gear restrictions and exemptions. The exact magnitude of impacts is complicated to assess, given that large portions of the proposed broad coral zones are not currently experiencing fishing activity, and the alternatives are primarily designed to protect corals against future expansion of fishing or development of new deep sea fisheries. The likelihood and extent of potential future fishing-related disturbances is difficult to predict, but would be expected to be relatively minor, as high costs associated with developing new deep sea fisheries and operating far from shore would be expected to dampen interest in developing new fisheries or expanding effort into deeper waters. Thus, the expected conservation benefits of gear restrictions in the deeper portions of broad zones are somewhat limited.

However, evaluation of the intersection of historical records, recent observations, and the habitat suitability model with broad zone designation alternatives indicates that the vast majority of known or predicted deep sea coral habitat in the Mid-Atlantic Council region falls within areas covered by all broad zone designation alternatives (1B through 1F). All proposed broad zone designation alternatives would provide a substantial amount of coverage of deep sea coral habitats and protect corals against potential expansion of effort. Designation of broad coral zones would likely have additional indirect benefits to deep sea corals, including focusing increased public, academic, and governance attention on these ecosystems. Overall, given the particular vulnerability of deep sea corals to the impacts of fishing gear, their specific habitat requirements, and their relatively limited distribution, the magnitude of impacts to deep sea corals from the combinations of the broad zone designation and gear restriction alternatives is expected to range from slight positive to high positive, as described below.

A summary of expected impacts from various combinations of designation alternatives (Alts. 1A through 1F) and gear restriction and exemption alternatives (Alts. 2A through 2C) are shown in Table 72. As described in Section 7.3.1.1, more current fishing activity takes place within the 200m, 300m and Council-preferred broad zones (Alternatives 1B, 1C, and 1F, respectively) compared to the deeper broad zones of Alternatives 1D and 1E (400m and 500 m broad zones). The Council-preferred broad zone is included with the shallower zones here due to the incorporation of the shallower portions of the canyons via the discrete zone workshop boundaries incorporated into this preferred broad zone. Based on the analysis described in Section 7.3.1.1, the magnitude of positive impacts from designation alternatives is expected to range from slight positive to high positive, with Alternatives 1D and 1E likely resulting in slight to moderate positive impacts, and Alternatives 1B, 1C, and 1F expected to result in moderate to high positive impacts to corals in combination with gear restrictions.

The prohibition on all bottom-tending gear (Alt. 2B) would be expected to have greater positive impacts to corals than a prohibition on mobile bottom-tending gear. However, because the number of fisheries and spatial extent of effort using bottom-tending passive gear types in these areas is limited, and because mobile bottom-tending gear is believed to be substantially more detrimental to coral communities than passive gear types, the magnitude of this difference in impacts is likely minor. Any fishing exemption alternatives implemented to a restriction on all bottom-tending gear would likely reduce the positive biological impacts associated with gear restricted areas. However, given the relatively small footprint of known passive gear effort potentially impacted by this action,[50] the overall difference in the magnitude of positive impacts with and without exemptions is likely to be minor. The relative impacts of gear restriction and exemption alternatives are described above in Section 7.3.1.2.

A summary of expected impacts from various combinations of designation alternatives and enforcement or transit alternatives (Alts. 2D through 2F) are shown in Table 73. The impacts of these action alternatives are not expected to vary based on the broad zone designation implemented, and would be as described above in Section 7.3.1.2.

[50] This does not include the footprint of lobster gear, which would not be affected by this action and thus is not analyzed here.

Table 72: Summary of impacts to the deep sea corals of broad zone designation alternatives in combination with broad zone gear restriction alternatives. BTG= bottom-tending gear.

<table>
<tr><th>Alt.</th><th>2A (No action/Status quo)</th><th>2B (Prohibit all BTG; Council preferred)</th><th>Sub-Alt 2B-1 (Exempt red crab fishery under 2B; Council preferred)</th><th>Sub-Alt 2B-2 (Exempt tilefish fishery under 2B)</th><th>2C (Prohibit mobile BTG)</th></tr>
<tr><td>1A (No action/status quo)</td><td>No designation; no management measures. Neutral impacts relative to the baseline conditions.</td><td colspan="4">NA: These would not be reasonable combinations of alternatives given that gear restrictions within a broad zone would not be implemented unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">Broad zone would be designated, but no management measures would be applied. Neutral impacts to deep sea corals expected relative to the status quo and baseline environmental conditions.</td><td rowspan="2">Moderate to high direct positive impacts: reduced coral interactions and prevention of effort expansion. 1B associated with higher positive impacts than 1C. Alt. 2B associated with higher positive impacts than 2C.</td><td rowspan="5">Impacts from red crab fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less so than 2B alone. Current baseline conditions likely result in direct slight negative impacts from existing gear interactions at depths targeted by the red crab fishery. Impacts would not vary under alternatives 1B-1F, as red crab effort occurs exclusively in deeper waters.</td><td rowspan="2">Coral impacts from tilefish fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less than 2B alone. 1B associated with higher positive impacts than 1C.</td><td rowspan="2">Moderate to high direct positive impacts: reduced coral interactions and prevention of effort expansion. 1B associated with higher positive impacts than 1C. Alt. 2B associated with higher positive impacts than 2C.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td><td rowspan="2">Slight to moderate direct positive impacts expected due to slight reduction in interactions and prevention of potential future interactions. 1D associated with higher positive impacts relative to 1E. Alt. 2B associated with higher positive impacts than 2C.</td><td rowspan="2">Tilefish fishery does not currently operate at these depths; thus, neutral impacts expected impacts relative to status quo; Overall impacts positive long-term in combination with 2B, similar to 2B alone.</td><td rowspan="2">Slight to moderate direct positive impacts expected due to slight reduction in interactions and prevention of potential future interactions. 1D associated with higher positive impacts relative to 1E. Alt. 2B associated with higher positive impacts than 2C.</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td><td>Moderate to high direct positive impacts from reduction in interactions and prevention of potential future interactions. Uncertain magnitude but likely similar to Alt. 1C (greater positive impacts vs. Alts. 1E and 1D, less than 1B).</td><td>Coral impacts from tilefish fishing neutral relative to the status quo; Overall impacts positive long-term in combination with 2B, but less than 2B alone. Designation alt. similar magnitude as 1C.</td><td>Moderate to high direct positive impacts from reduction in interactions and prevention of potential future interactions. Uncertain magnitude but likely similar to Alt. 1C (greater positive impacts vs. Alts. 1E and 1D, less than 1B).</td></tr>
</table>

Table 73: Summary of impacts to deep sea corals of broad zone designation alternatives in combination with broad zone VMS and vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>2D (Require VMS within broad zones)</th><th>2E (Transit with gear stowage; Council preferred)</th><th>2F (Transit with VMS declaration)</th></tr>
<tr><td>1A (No broad zone designation)</td><td colspan="3">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within a broad zone would not be necessary or practical unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">No direct impacts expected on deep sea corals from VMS requirements. In combination with any broad zone designation, indirect slight positive impacts to deep sea corals expected given increased ability to monitor and enforce gear restriction measures.</td><td rowspan="5">Alt. 2E in combination with any broad zone designation alternative is expected to have indirect slight negative impacts to deep sea corals, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 2E slightly more negative in magnitude vs. Alt. 2F.</td><td rowspan="5">Alt. 2F in combination with any broad zone designation alternative is expected to have indirect slight negative impacts to deep sea corals, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 2E slightly more negative in magnitude vs. Alt. 2F.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td></tr>
</table>

7.3.2 Discrete Coral Zones and Management Measures

7.3.2.1 Discrete Zone Designation Alternatives

Alternatives for discrete zone designation (alternative set 3) consist of a no action alternative (3A) and a discrete zone designation Alternative 3B with a series of sub-options for various boundaries. The sub-alternatives under Alternative 3B were assessed using the same methodologies as described in Section 7.3.1 for the broad zone alternatives. Similar to the broad zones, there are large portions of the discrete zone boundary options in each canyon that overlap. Portions of the discrete zones (in particular the deeper portions beyond approximately 400 meters) consist of areas that do not currently experience fishing activity (or experience very little fishing activity). Thus, like the broad zones, the overall impacts to deep sea corals from each of the discrete zone boundary options is expected to be somewhat similar, with the main differences in expected impacts resulting primarily from the varying boundaries at the landward edge of each discrete zone, near the heads of the canyons between approximately 100 and 500 meters depth. In the deep sea, beyond 500 meters, there is much less variation in the impacts of the discrete zone designation alternatives, as little to no fishing activity currently takes place deeper than 500 meters.

As described in Section 6.1, the Mid-Atlantic region contains both “shelf-sourced” and “slope-sourced” canyons. Because the slope-sourced canyons tend to begin in deeper waters with little or no protrusion onto the shelf or shelf break where the majority of fishing effort occurs, the coral habitats in shelf-sourced canyons are expected to benefit more from discrete zones that protect larger portions of these canyons. Thus, the expected overall impacts are weighted somewhat by the expected effects on these canyons, including Norfolk, Baltimore, Washington, Wilmington, and Hudson Canyons.

DSCRTP Database Records

Coral presence data from the DSCRTP database were analyzed to determine the overlap of historical coral records with proposed discrete coral zones. The vast majority of the historical records analyzed in

Section 7.3.1 for overlap with the proposed broad zones also fall within the proposed discrete zones. Figure 35 through Figure 43 show historical records from the DSCRTP database, relative to the discrete zone boundary alternatives for each proposed area.

The areas of highest historical coral observations include Baltimore Canyon, Norfolk Canyon, and the Mey-Linedenkohl Slope (Table 74; Table 76). By coral type, historical records within the Council preferred discrete zones are fairly evenly divided between gorgonians and alcyonaceans, sea pens, and stony corals. Baltimore and Norfolk Canyon, which have the most historical observations, appear to have a relatively higher proportion of structure-forming coral types (stony corals and gorgonians) compared to other proposed discrete areas; however, these areas have also been surveyed more than most other proposed discrete zones (Table 74). This breakdown is similar for other boundary alternatives.

DSCRTP records are compared across designation sub-alternatives in Table 76 under the heading "Comparison of Boundary Sub-Options" below.

Table 74: Deep sea coral historical presence records by proposed discrete zone (based on Council preferred boundary Alternative 3B-5). Note that these records reflect varying spatial concentrations of historical survey effort, and many areas have not been surveyed for corals. This data also does not contain any new records from recent research surveys (2012-2014).

Canyon or Complex	**Alcyonacea**	**Pennatulacea**	**Scleractinia**	**Total Records**
Block Canyon				**0**
Ryan-McMaster Canyons	5	7	4	16
Emery-Uchupi Canyons	1	3	2	6
Jones-Babylon Canyons			1	1
Hudson Canyon	2		1	3
Mey-Lindenkohl Slope	22	36	11	69
Spencer Canyon	1	9	2	12
Wilmington Canyon		2		2
North Heyes-South Wilmington Canyons				**0**
South Vries Canyon	1		1	**2**
Baltimore Canyon	28	1	25	**54**
Warr-Phoenix Canyon Complex		14		**14**
Accomac-Leonard Canyons	1	3	2	**6**
Washington Canyon			1	**1**
Norfolk Canyon	21	3	11	**35**
Grand Total	**82**	**84**	**64**	**230**

Recent Research Surveys

As described in Section 6.2.2.2, there are several recent research surveys, summarized in Table 7, which resulted in coral observations in the Mid-Atlantic Council region. These included ROV and towed camera surveys that mostly explored canyon areas within specific canyons proposed as discrete coral zones. As noted previously, deep sea corals were recently observed within the boundaries of several proposed discrete coral zones, including Block Canyon, Ryan and McMaster Canyons, the Mey-Lindenkohl Slope, Spencer Canyon, Wilmington Canyon, Baltimore Canyon, Phoenix Canyon, Accomac and Leonard Canyons, Washington Canyon, and Norfolk Canyon. Because of the substantial spatial overlap between proposed broad and discrete zones, the vast majority of new coral observations described as overlapping the proposed broad zones in Section 7.3.1 also fall within the proposed discrete zones.

Figure 35 through Figure 43 map the approximate central location of each dive from recent deep sea coral surveys, relative to the discrete zone boundary alternatives for each proposed area. Although general survey locations and some qualitative and preliminary quantitative results are available, some processed and/or georeferenced data from recent cruises are not yet available. However, new information has been incorporated into the evaluation of alternatives to the extent possible. Findings from each survey relative to proposed coral zone boundary options are summarized in Table 75, as well as in Table 76 under the heading "Comparison of Boundary Sub-Options" below. Dive-specific preliminary image survey data for from the TowCam surveys is provided in Appendix B.

Table 75: Summary of recent survey dives and coral observations relative to discrete zone boundary sub-alternatives.

Expedition Identifier	Proposed Discrete Areas Surveyed and Overlap with Discrete Zone Boundary Sub-Alternatives[a]
BOEM Survey (2012)	***Baltimore and Norfolk Canyons:*** ROV dives observed locally abundant corals, including the first observations of *Lophelia pertusa* in the Mid-Atlantic. Most recent observations are encompassed by most discrete zone boundary options. However, Advisor 2013 (Alt. 3B-1) and GSSA (Alt. 3B-3) exclude some dives with observed corals and some observations are on or very close to the boundary line. All other designation alternatives would provide protections for all observed corals from this survey.
HB1204 TowCam Survey (2012)[b]	***Mey-Lindenkohl Slope*** *(Middle Toms Canyon, Toms-Hendrickson inter-canyon Area, Toms Canyon, edge of Hendrickson Canyon)*: Most recent observations are encompassed by most discrete zone boundary options. However, Advisor 2013 (Alt. 3B-1; straight line option for Mey-Lindenkohl Slope) excludes the location of one dive with observed corals. However, this dive had a low percentage of images with corals (0.9%). All other designation alternatives would provide protections for all observed corals from this survey.
HB1302 TowCam Survey (2013)[b]	***Ryan Canyon:*** Most recent observations are encompassed by most discrete zone boundary options. GSSA (Alt. 3B-3) boundaries intersect the location of one dive; however, this dive had only one image with observed corals (0.04%). All other designation alternatives would provide protections for all observed corals from this survey.
EX1304 Okeanos Explorer (2013)	***Block Canyon and surrounding areas:*** Several dives occurred on the slope area outside of Block Canyon and thus are not encompassed by any of the proposed boundaries for this zone. These dives all observed corals, though with varying abundance. Of the dives conducted in Block Canyon, all designation alternatives would provide protections for all observed corals from this survey.
HB1404 TowCam Survey (2014)[b]	***Mey-Lindenkohl Slope*** *(Lindenkohl Canyon, Toms Canyon, Carteret Canyon)*: All designation alternatives cover all coral observations in this area. ***Washington Canyon:*** GSSA (Alt. 3B-3) excludes all three dives from this survey. All other designation alternatives cover these dives. ***Accomac & Leonard Canyons:*** GSSA (Alt. 3B-3) excludes two of three dives from this survey. All other designation alternatives cover all dives. ***Wilmington Canyon:*** GSSA (Alt. 3B-3) excludes four of five dives with observed corals from this survey; however, three of these excluded dives had very few observed corals. All other designation alternatives cover all dives. ***Spencer Canyon:*** One dive location is excluded by all boundary options; however, this dive only had one image with corals (0.15%). Another dive location is excluded by the GSSA (Alt. 3B-3) boundaries; however this dive had no observed corals. All designation alternatives would cover the remaining dive locations in this canyon.
EX1404 Okeanos Explorer (2014)	***Mey-Lindenkohl Slope*** *(Lindenkohl Canyon, Hendrickson Canyon)*, ***Washington Canyon, Norfolk Canyon, Phoenix Canyon, McMaster Canyon, and Ryan Canyon:*** All designation alternatives cover all dives and coral observations from this survey.

[a] Alternative 3B-1 (Advisor 2013) boundaries contain options only for the Mey-Lindenkohl Slope, Norfolk Canyon, and Baltimore Canyon.

[b] See Appendix B for dive-specific preliminary image survey data for from the TowCam surveys.

Habitat Suitability

Proposed discrete zones were analyzed for deep sea coral habitat suitability using the same methodology described in Section 7.3.1 (for analysis of the broad zones). Note that the vast majority of the proposed discrete zone boundary options overlap with the proposed broad zones, thus, there is a great degree of overlap in the modeled habitat suitability described for the broad and discrete zones. Figure 35 through Figure 43 include area of high or very high modeled habitat suitability, as well as areas of high slope (greater than 30 degrees).

The total areas of high habitat suitability and high slope are compared across sub-alternatives under Alternative 3B in Table 76 under the heading "Comparison of Boundary Sub-Options" below.

Comparison of Boundary Sub-Options

This section summarizes the analysis described above across the sub-alternatives for discrete zone boundary designations, summarized in Table 76.

As indicated in Table 76, the distribution of historical records by proposed discrete zone is uneven, primarily due to non-uniform past survey effort. Among canyons where coral observations are recorded in the DSCRTP database, the most historical observations have occurred in the Mey-Lindenkohl Slope, Baltimore Canyon, and Norfolk Canyon.

When comparing the boundary sub-options in terms of DSCRTP records, alternatives 3B-2 (FMAT boundaries), 3B-4 (NGO coalition boundaries) and 3B-5 (Workshop boundaries) are largely very similar in the number of historical records encompassed. In comparison, the boundaries under Alternative 3B-1 (Advisor 2013) for the Mey-Lindenkohl Slope, Baltimore Canyon, and Norfolk Canyon include slightly lower, but comparable, numbers of historical records. For Alternative 3B-3 (GSSA), because on the whole these boundaries are much smaller for each proposed discrete zone, many DSCRTP records tend to be excluded by these boundaries.

For recent survey observations, sub-Alternatives 3B-2, 3B-4, and 3B-5 are similar in terms of encompassing recent dive locations. Alternative 3B-5 excludes some recent dive locations in some canyons which would result in less positive impacts to deep sea corals. Alternative 3B-1, as it only encompasses 3 canyons, omits the most dive locations from recent surveys out of all the discrete zone boundary alternatives (Table 75; Figure 35 through Figure 43).

Analysis of modeled suitable habitat indicates that, as expected, the total area of high slope correlates with the total area of the proposed discrete zone, meaning that the largest areas, including the Mey-Lindenkohl Slope, Hudon Canyon, Warr and Phoenix Canyons, and Accomac and Leonard Canyons generally have the highest total amount of high habitat suitability. In comparing boundary sub-options, Table 76 indicates that many proposed discrete areas would have similar total amounts of suitable habitat protected under each boundary options. However, other areas show a more disparate level of coverage of suitable habitat areas. In particular, areas where the boundary Alternative 3B-3 (GSSA) provides substantially less coverage of modeled habitat include: Hudson Canyon, the Mey-Lindenkohl Slope, Wilmington Canyon, North Heyes and South Wilmington Canyons, South Vries Canyon, Accomac and Leonard Canyons, Washington Canyon, and Norfolk Canyon. The remaining boundary options are largely comparable in their coverage of modeled suitable habitat (Table 76; Figure 35 through Figure 43).

The total area of high slope generally correlates with the total area of the proposed discrete zone. In general, the Mey-Lindenkohl Slope and Hudson Canyon have the greatest areas of high slope. Areas of greater than 30-degree slope make up a small percentage of overall area of proposed discrete zone boundaries; however, these fine scale areas are likely to be very important for coral habitat. The percentage of high slope relative to the total area of each proposed discrete zone and boundary option was also evaluated. In general, the percentage of high slope within a proposed area appears to be lower in the southern canyons (south of Hudson Canyon) compared to the more northern canyons. Areas with a relatively higher percentage of high slope areas include Spencer Canyon, Block Canyon, and Ryan/McMaster Canyons; those with a relatively low percentage of high slope include Emery and Uchupi Canyons, North Heyes and South Wilmington Canyons, Warr and Phoenix Canyons, Accomac and Leonard Canyons, and Washington Canyon (Table 76; Figure 35 through Figure 43).

In summary, across all of the metrics used to evaluate discrete zone boundary alternatives, all are likely to result in direct positive impacts to deep sea corals, but to varying degrees. Impacts from alternatives 3B-2, 3B-4, and 3B-5 are generally equivalent in terms of magnitude, with high positive impacts expected from these designations and the combination of gear restrictions. Alternative 3B-3 and 3B-1 would result in less positive impacts to corals, ranging from slight to moderate positive impacts, with 3B-1 having less positive impacts than 3B-3 due to the limited number of canyons proposed for protection under that alternative.

Table 76: Summary of analysis across proposed discrete zones under alternative 3B for coral observations, habitat suitability, and areas of high slope. Note: recent fieldwork observations are not included in the DSCRTP historical database.

		Coral Observations		Habitat Suitability		Slope	
Canyon or Complex	**Total area (km^2)**	**Historical Coral Records (all)**	**Encompasses recent fieldwork?**	**Total Area of High/Very High Habitat Suitability**	**Percent High/Very High Habitat Suitability**	**Total area of slope >30 degrees (km^2)**	**Percent area of slope >30 degrees**
Block Canyon							
FMAT boundaries (3B-2)	231.6	0	Some, not all	19.2	8.3%	7.7	3.3%
GSSA boundaries (3B-3)	206.9	0	Some, not all	17.4	8.4%	7.7	3.7%
NGO boundaries (3B-4)	222	0	Some, not all	19.2	8.4%	7.7	3.5%
Workshop boundaries (3B-5)	200.6	0	Some, not all	17.4	8.7%	7.7	3.8%
Ryan and McMaster Canyons							
FMAT boundaries (3B-2)	390.3	16	Yes	121.0	31.0%	6.3	1.6%
GSSA boundaries (3B-3)	356.1	16	Yes	115.0	32.3%	6.3	1.8%
NGO boundaries (3B-4)	400.4	20	Yes	145.5	36.3%	6.3	1.6%
Workshop boundaries (3B-5)	365.2	16	Yes	143.8	39.4%	6.3	1.7%
Emery and Uchupi Canyons							
FMAT boundaries (3B-2)	369.2	6	NA	80.6	21.8%	2.1	0.6%
GSSA boundaries (3B-3)	349.2	6	NA	78.3	22.4%	2.1	0.6%
NGO boundaries (3B-4)	370.6	7	NA	86.5	23.3%	2.1	0.6%
Workshop boundaries (3B-5)	323.5	6	NA	77.3	23.9%	2.1	0.7%
Jones and Babylon Canyons							
FMAT boundaries (3B-2)	166.1	1	NA	46.8	28.2%	1.6	1.0%
GSSA boundaries (3B-3)	159.5	1	NA	46.8	29.3%	1.6	1.0%
NGO boundaries (3B-4)	162.4	1	NA	53.3	32.8%	1.6	1.0%
Workshop boundaries (3B-5)	159.4	1	NA	53.2	33.4%	1.6	1.0%
Hudson Canyon							
FMAT boundaries (3B-2)	770.8	5	NA	445.4	57.8%	12.7	1.7%
GSSA boundaries (3B-3)	237.2	0	NA	210.7	88.8%	6.3	2.6%
NGO boundaries (3B-4)	718.7	5	NA	543.4	75.6%	12.7	1.8%
Workshop boundaries (3B-5)	606.5	3	NA	492.7	81.2%	12.0	2.0%

Table 76 (continued):

Canyon or Complex	Total area (km^2)	Coral Observations		Habitat Suitability		Slope	
		Historical Coral Records (all)	Encompasses recent fieldwork?	Total Area of High/Very High Habitat Suitability	Percent High/Very High Habitat Suitability	Total area of slope >30 degrees (km^2)	Percent area of slope >30 degrees
Mey-Lindenkohl Slope							
2013 Advisor boundaries: Depth-based landward boundary approximating 250 ftm/457m (3B-1)	2445.3	62	Yes	503.9	20.6%	49.0	2.0%
2014 Advisor boundaries: Straight line landward boundary (3B-1)	2458.8	65	Some, not all	443.5	18.0%	48.5	2.0%
FMAT boundaries (3B-2)	2818.2	74	Yes	550.5	19.5%	50.2	1.8%
GSSA boundaries (3B-3)	2500.9	73	Yes	496.6	19.9%	50.1	2.0%
NGO boundaries (3B-4)	2934.5	76	Yes	635.6	21.7%	50.5	1.7%
Workshop boundaries (3B-5)	2495	69	Yes	575.1	23.0%	50.1	2.0%
Spencer Canyon							
FMAT boundaries (3B-2)	163.3	12	Yes	28.4	17.4%	8.3	5.1%
GSSA boundaries (3B-3)	50	0	Yes	25.7	51.4%	6.1	12.3%
NGO boundaries (3B-4)	149.1	12	Yes	29.7	19.9%	8.3	5.6%
Workshop boundaries (3B-5)	142.5	12	Yes	27.2	19.1%	8.3	5.8%
Wilmington Canyon							0.0%
FMAT boundaries (3B-2)	268.1	2	Yes	180.9	67.5%	6.2	2.3%
GSSA boundaries (3B-3)	103.9	2	Some, not all	90.9	87.5%	1.5	1.4%
NGO boundaries (3B-4)	270.7	2	Yes	208.3	77.0%	6.6	2.4%
Workshop boundaries (3B-5)	242.6	2	Yes	202.3	83.4%	6.6	2.7%
North Heyes and South Wilmington Canyon							0.0%
FMAT boundaries (3B-2)	183.4	0	NA	74.6	40.7%	1.4	0.8%
GSSA boundaries (3B-3)	50.6	0	NA	27.1	53.6%	0.8	1.6%
NGO boundaries (3B-4)	176.8	0	NA	76.2	43.1%	1.4	0.8%
Workshop boundaries (3B-5)	174.5	0	NA	76.1	43.6%	1.4	0.8%

Table 76 (continued):

Canyon or Complex	Total area (km^2)	Coral Observations: Historical Coral Records (all)	Coral Observations: Encompasses recent fieldwork?	Habitat Suitability: Total Area of High/Very High Habitat Suitability	Habitat Suitability: Percent High/Very High Habitat Suitability	Slope: Total area of slope >30 degrees (km^2)	Slope: Percent area of slope >30 degrees
South Vries Canyon							0.0%
FMAT boundaries (3B-2)	142.6	2	NA	61.4	43.1%	1.1	0.8%
GSSA boundaries (3B-3)	27.6	0	NA	11.7	42.4%	0.1	0.4%
NGO boundaries (3B-4)	138.1	2	NA	61.4	44.5%	1.1	0.8%
Workshop boundaries (3B-5)	129.2	2	NA	61.5	47.6%	1.1	0.8%
Baltimore Canyon							
2013 Advisor boundaries (3B-1)	220.7	50	Some, not all	130.6	59.2%	3.2	1.5%
FMAT boundaries (3B-2)	231	54	Yes	141.1	61.1%	3.4	1.5%
GSSA boundaries (3B-3)	189.7	53	Yes	135.3	71.3%	3.3	1.7%
NGO boundaries (3B-4)	211.3	54	Yes	160.7	76.1%	3.3	1.6%
Workshop boundaries (3B-5)	197.6	54	Yes	160.5	81.2%	3.3	1.7%
Warr and Phoenix Canyons							
FMAT boundaries (3B-2)	511.6	14	Yes	207.0	40.5%	2.5	0.5%
GSSA boundaries (3B-3)	475.5	14	Yes	203.5	42.8%	2.4	0.5%
NGO boundaries (3B-4)	501.9	14	Yes	223.5	44.5%	2.5	0.5%
Workshop boundaries (3B-5)	480.9	14	Yes	220.4	45.8%	2.5	0.5%
Accomac and Leonard Canyons							
FMAT boundaries (3B-2)	538.2	6	Yes	200.6	37.3%	1.6	0.3%
GSSA boundaries (3B-3)	30.9	0	Some, not all	19.2	62.1%	0.1	0.5%
NGO boundaries (3B-4)	528.7	6	Yes	220.2	41.6%	1.7	0.3%
Workshop boundaries (3B-5)	486.2	6	Yes	202.4	41.6%	1.6	0.3%
Washington Canyon							
FMAT boundaries (3B-2)	554.1	1	Yes	98.1	14.7%	3.3	0.6%
GSSA boundaries (3B-3)	43.3	0	Some, not all	25.7	59.4%	0.8	1.9%
NGO boundaries (3B-4)	550.4	1	Yes	118.2	21.5%	3.3	0.6%
Workshop boundaries (3B-5)	546.8	1	Yes	117.9	21.6%	3.3	0.6%

Table 76 (continued):

Canyon or Complex	Total area (km^2)	Coral Observations: Historical Coral Records (all)	Coral Observations: Encompasses recent fieldwork?	Habitat Suitability: Total Area of High/Very High Habitat Suitability	Habitat Suitability: Percent High/Very High Habitat Suitability	Slope: Total area of slope >30 degrees (km^2)	Slope: Percent area of slope >30 degrees
Norfolk Canyon							
2013 Advisor boundaries (3B-1)	598.4	37	Yes	132.4	22.1%	11.9	2.0%
FMAT boundaries (3B-2)	543.7	37	Yes	145.9	26.8%	12.1	2.2%
GSSA boundaries (3B-3)	57	7	Some, not all	48.8	85.5%	3.9	6.9%
NGO boundaries (3B-4)	576.3	38	Yes	190.8	33.1%	12.4	2.1%
Workshop boundaries (3B-5)	548.7	35	Yes	181.3	33.0%	12.3	2.2%

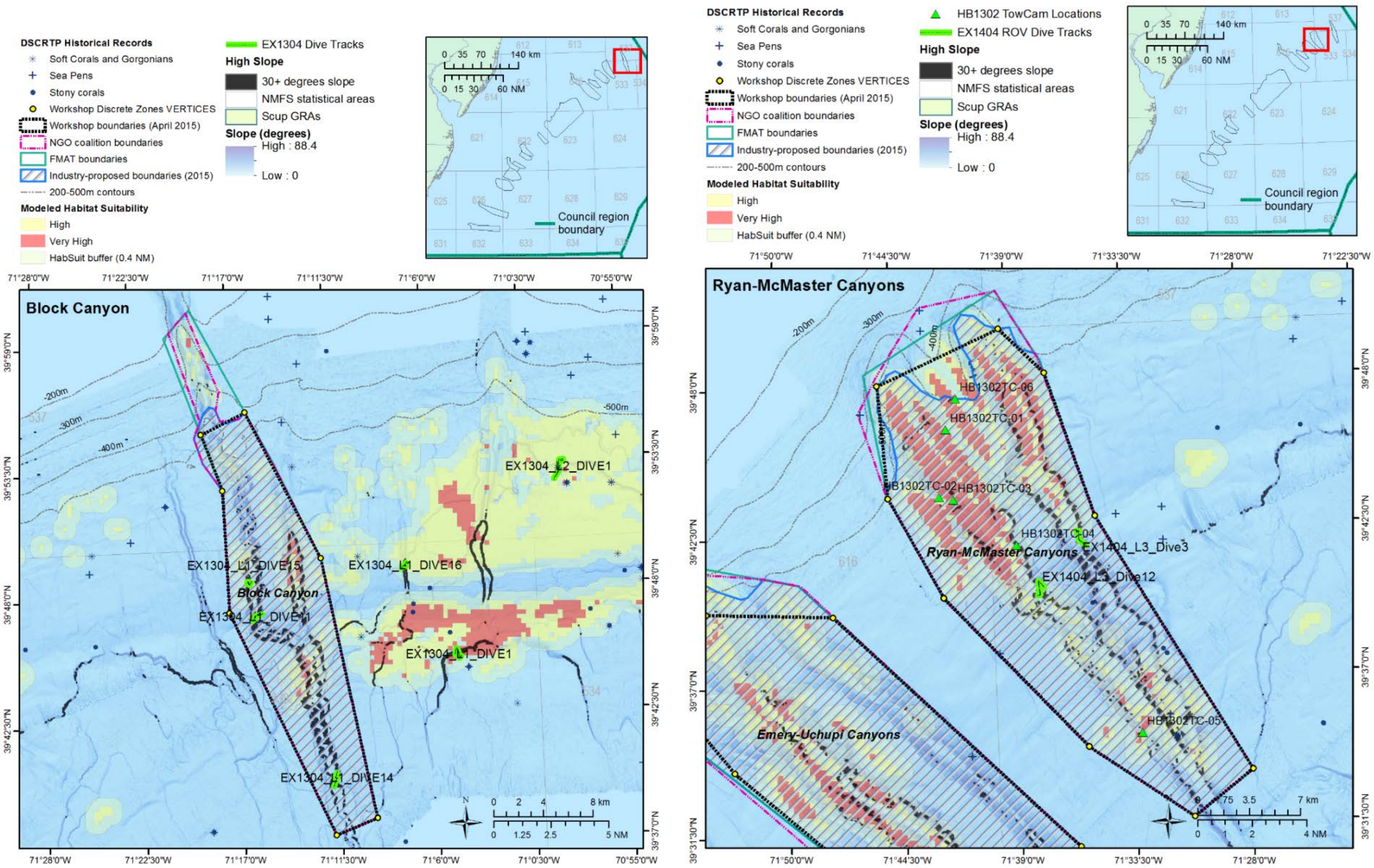


Figure 35: Block Canyon and Ryan-McMaster Canyons, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

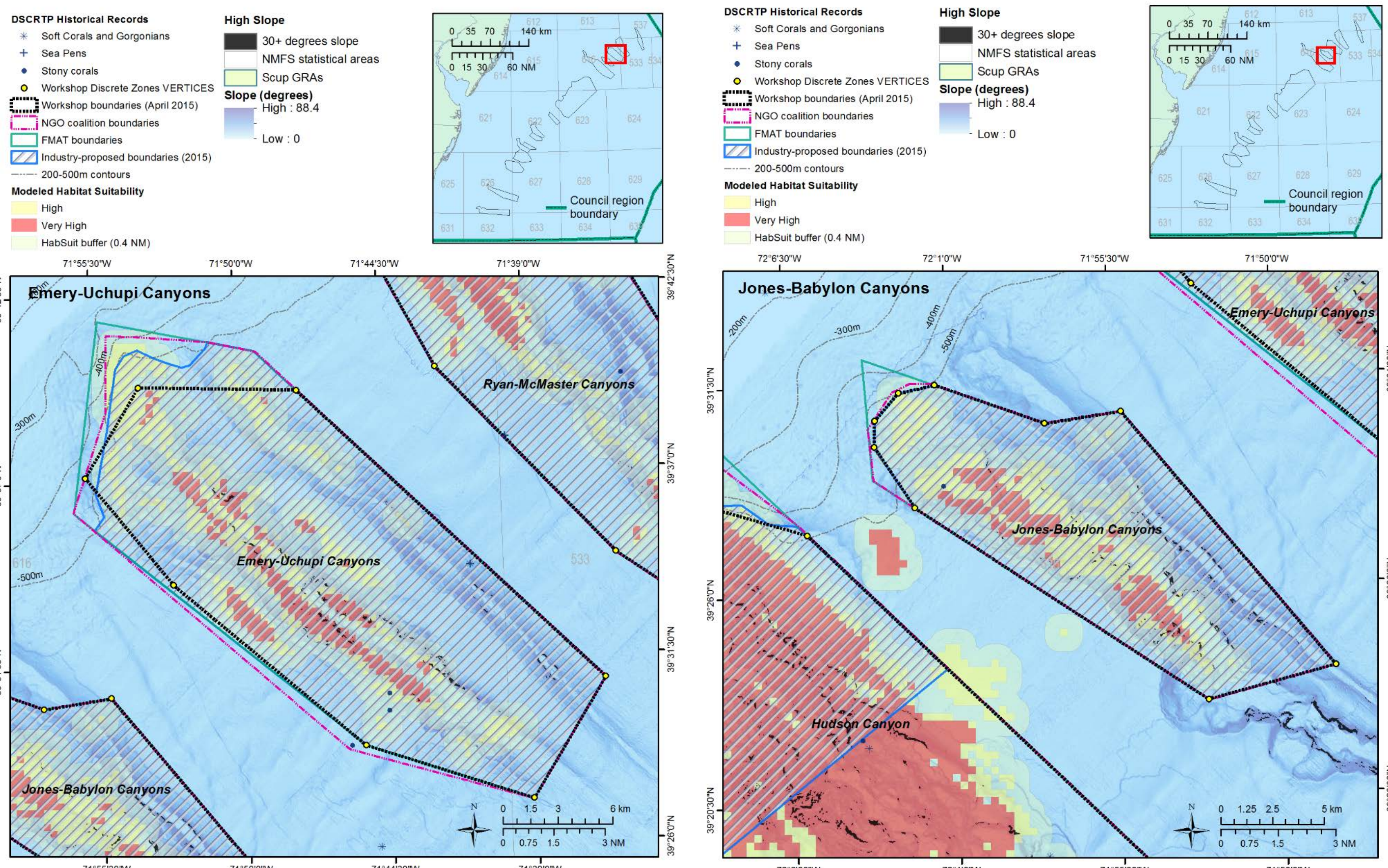


Figure 36: Emery-Uchupi Canyons and Jones-Babylon Canyons, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

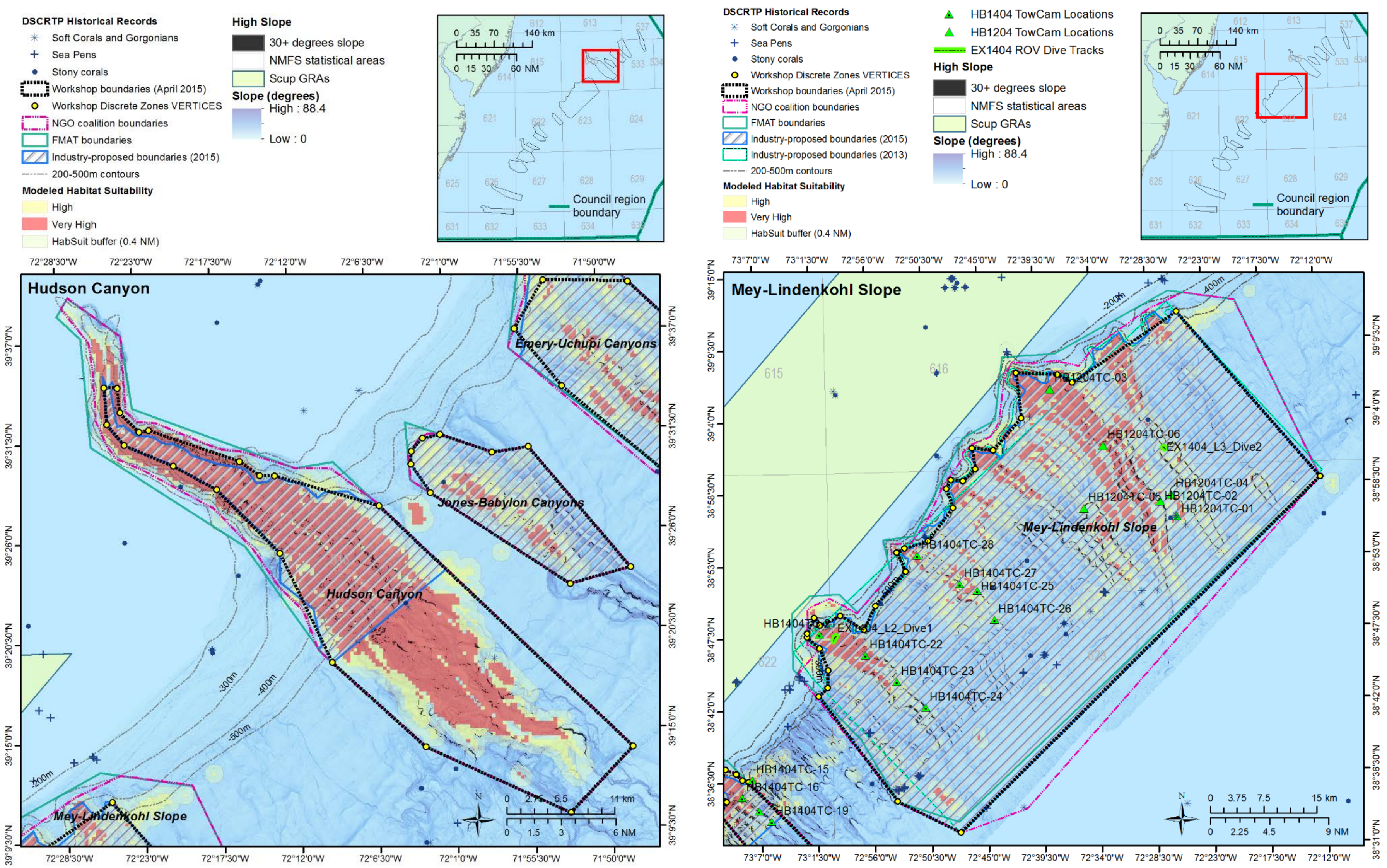


Figure 37: Hudson Canyon and the Mey-Lindenkohl Slope, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

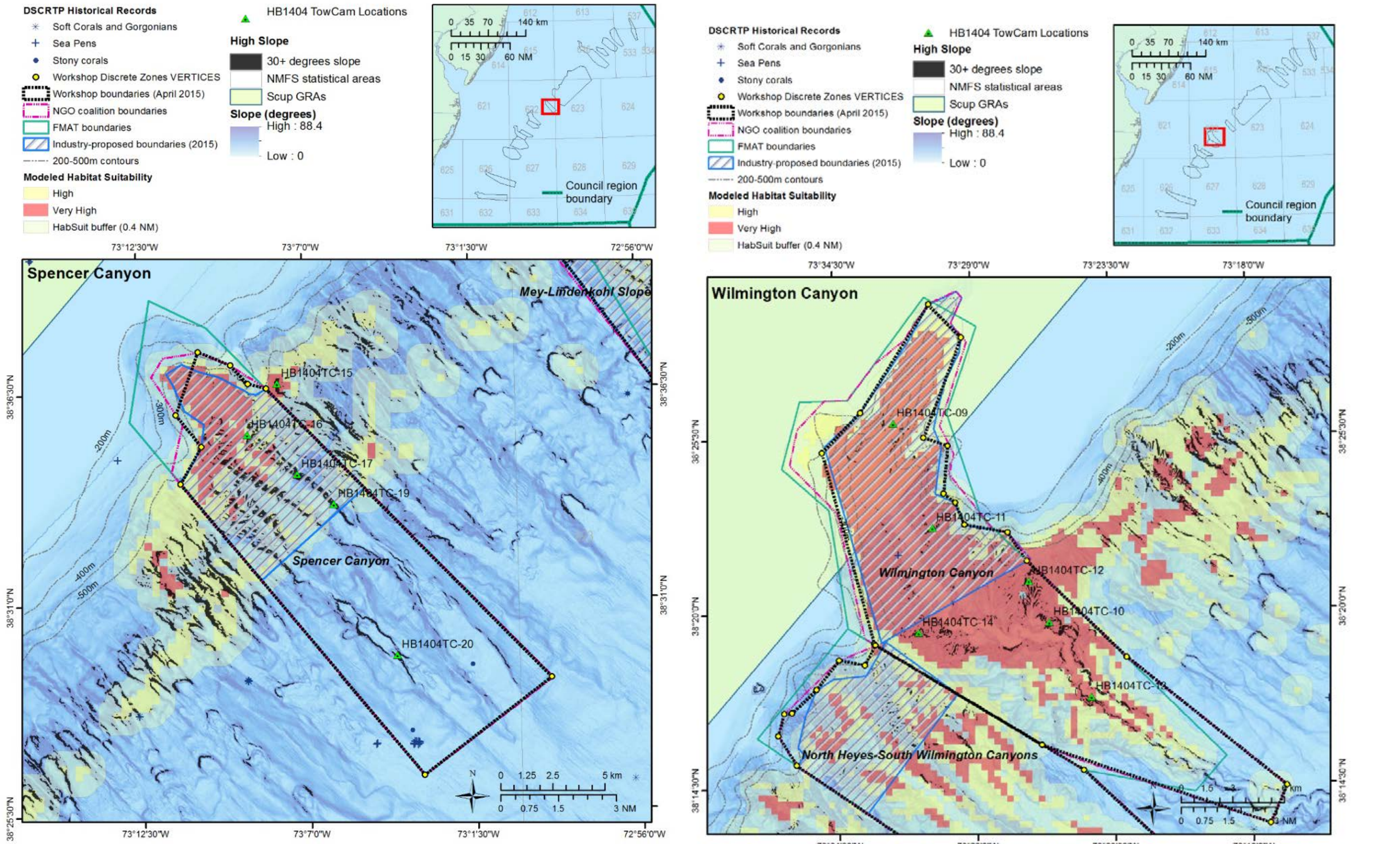


Figure 38: Spencer Canyon and Wilmington Canyon, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

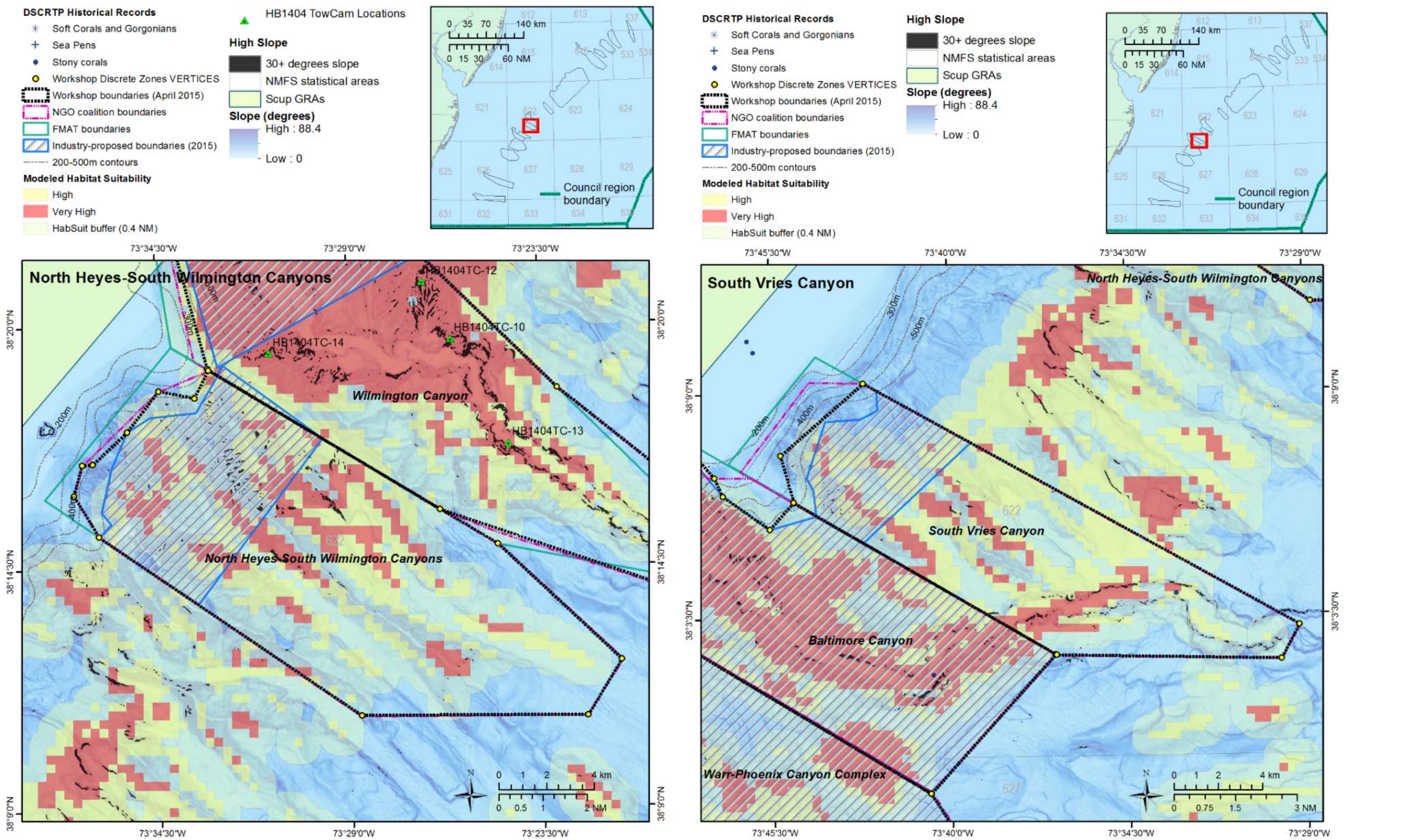


Figure 39: North Heyes-South Wilmington Canyons and South Vries Canyon, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

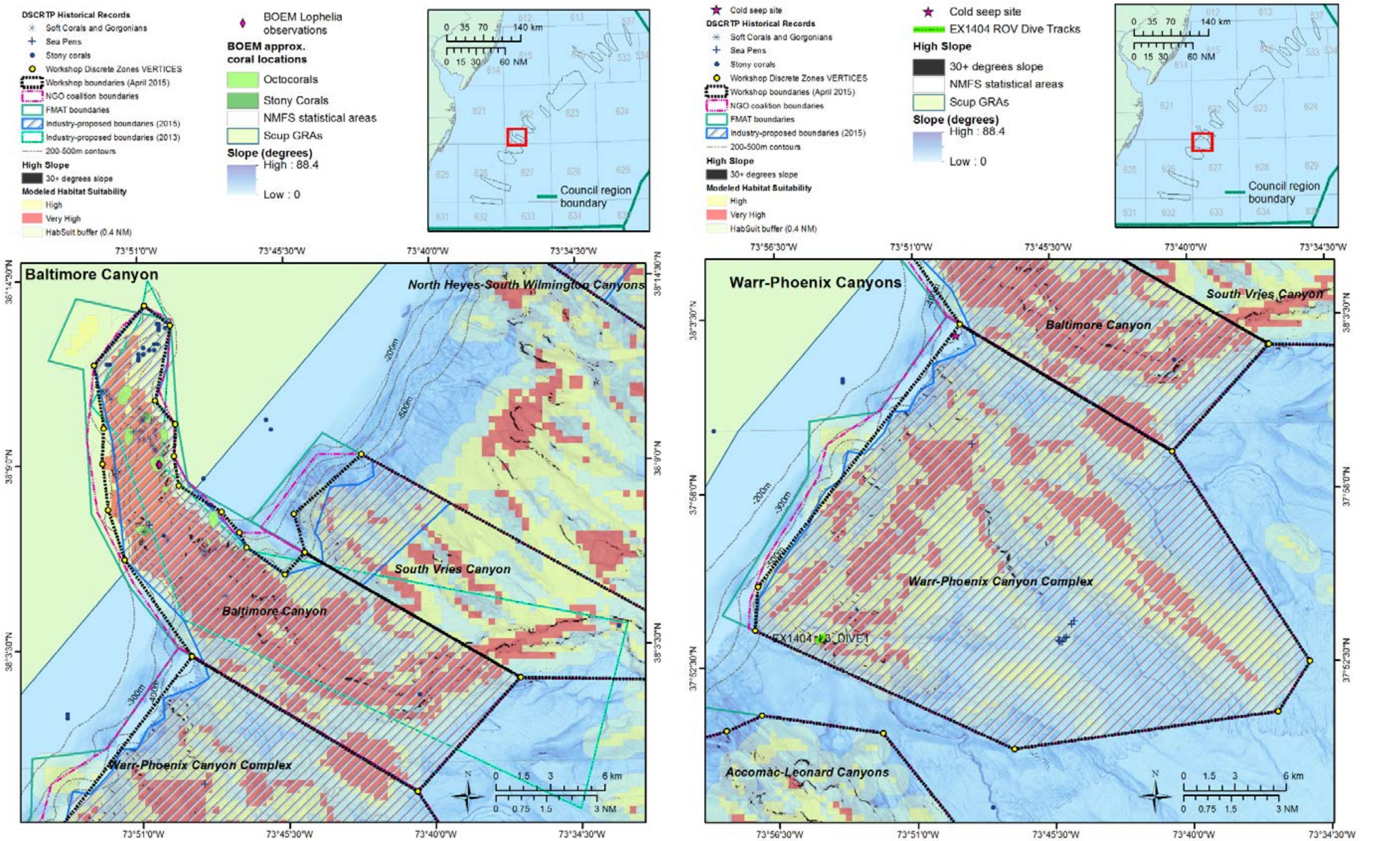


Figure 40: Baltimore Canyon and Warr-Phoenix Canyons, showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

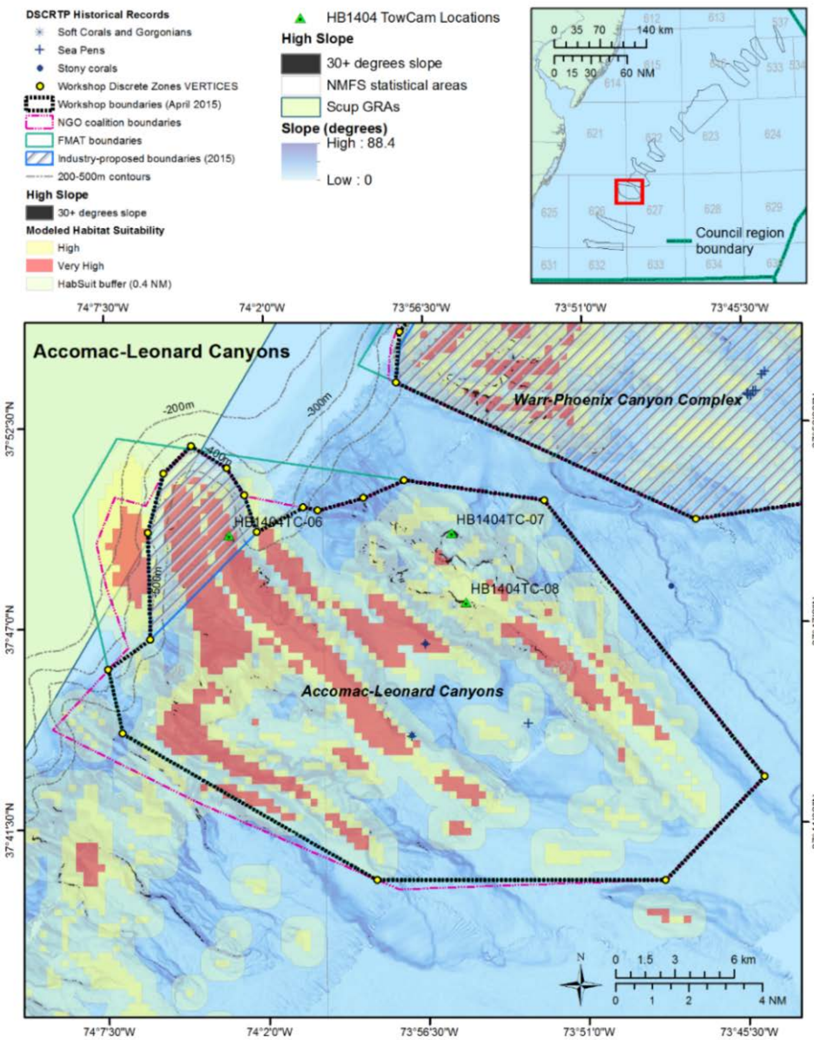


Figure 41: Accomac and Leonard Canyons showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

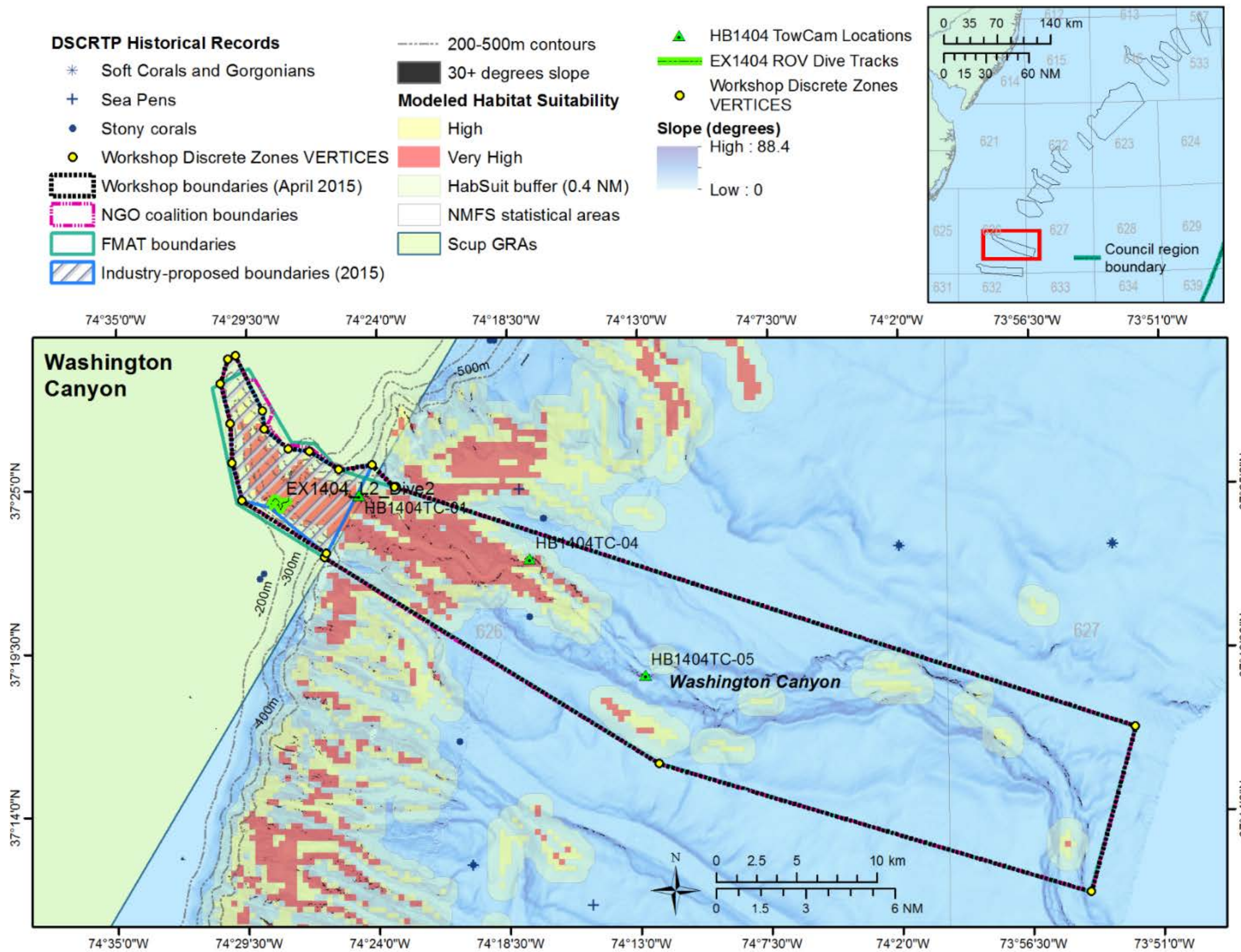


Figure 42: Washington Canyon showing areas of high slope, modeled deep sea coral habitat suitability, and discrete zone boundaries.

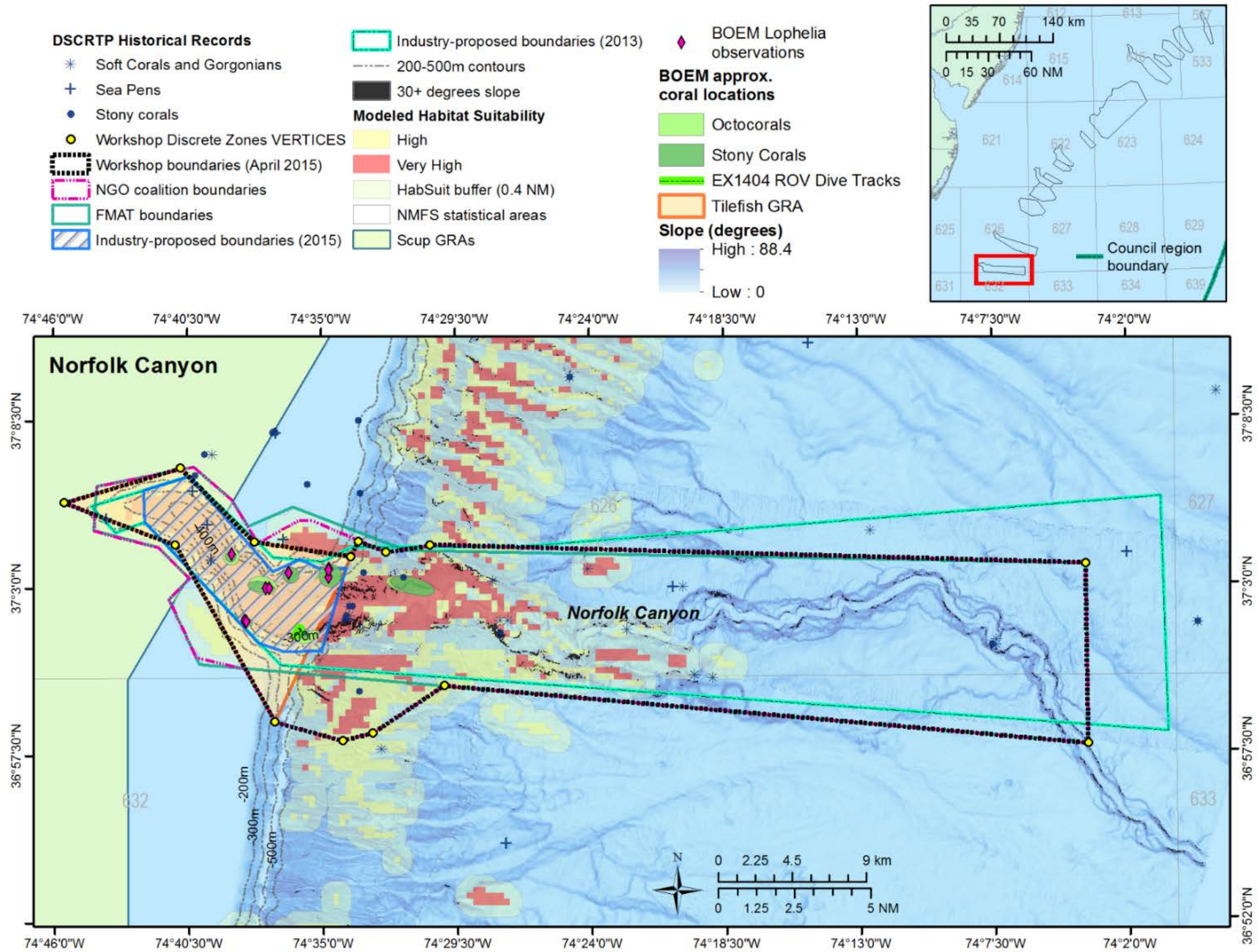


Figure 43: Norfolk Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

7.3.2.2 Discrete Zone Management Measure Alternatives

For management measures to be applied within the discrete zones, both gear restrictions alternatives (Alts. 4B and 4C) would be expected to result in direct positive impacts to deep sea corals relative to the *status quo* and baseline environmental conditions. In general, alternatives restricting the use of more gear types within the discrete zones, with fewer exemptions, are expected to result in greater protections for deep sea corals. Alternatives that improve the compliance with and enforcement of gear restriction measures are expected to lead to indirect positive impacts to deep sea corals. However, because there are substantial portions of the canyons that are currently unfished, as well as the natural protections afforded to many corals living at unfishable depths and slopes, the positive impacts to corals from the proposed measures are not expected to be significant.

Gear Restriction and Exemption Alternatives

As described in Section 7.3.1, deep sea corals are expected to benefit from any alternative that reduces the likelihood of damage by commercial fishing gear. Again, it is necessary to consider the extent of the proposed areas that are actually fished and how fishing effort may shift under potential gear restrictions. The exact nature of potential impacts to corals from gear restriction alternatives are difficult to define, because although the majority of major mid-Atlantic canyons would be protected under the Council preferred discrete zone options, the discrete zones, like the broad zones, do have large portions where very little fishing effort currently takes place. This mostly includes the deeper portions of the proposed discrete zones, as well as canyon areas where slopes are too steep or terrain too rugged for safe deployment of fishing gear.

Again, as described in Section 7.3.1.2, analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the exception of the red crab fishery). Thus, the areas within the proposed discrete zones where fishing gear is most likely to interact (or have interacted in the past) with deep sea corals includes primarily areas near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas. Unlike the broad zones, where some of the boundary options encompassed very little current fishing activity, the discrete zone boundary sub-alternatives all have some degree of overlap with shelf/slope break areas where some fishing currently occurs.

As within the proposed broad zones, there are many corals growing within the discrete zone boundaries on steep slopes that are likely to have a substantial degree of natural protection from many commercial fishing gear types, as very steep slopes cannot be trawled and may be difficult to access or fish with other gear types. Areas of higher three-dimensional complexity tend to be actively avoided by fishermen for fear of damage and loss of their gear. This natural protection likely limits the current extent of interactions with deep sea corals under the baseline environmental conditions, and somewhat limits the extent of positive impacts from gear restricted areas.

Under the no action/*status quo* management measure Alternative 4A, one would expect some ongoing direct negative impacts to deep sea corals near the shelf/slope break, and any potential expansion or increase of effort within the canyons or near the shelf/slope break would likely increase negative impacts to corals over time. New gear technologies could in theory increase access to more rugged terrain and areas where corals currently experience natural protections. Although little is known about the extent of gear interactions with corals in the Mid-Atlantic Council region, fishing gear's detrimental impact on deep sea corals (particularly from trawls) is well documented; Section 6.2.4 provides a review of information on the vulnerability of deep sea corals to fishing gear impacts.

Under gear restriction Alternatives 4B and 4C, direct positive impacts to deep sea corals would be expected, resulting from reduced interactions with bottom-tending gear, ranging from slight to high positive impacts depending on the boundary option selected. Alternative 4B, prohibition on all bottom-tending gear types would be expected to result in greater positive impacts compared to Alternative 4C (prohibition on mobile bottom-tending gear only). For both alternatives, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort around the heads of the canyons typically takes place in very strategic, specific areas around the bights of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (these boundaries are followed for the Council preferred broad and discrete zone alternatives, 1F and 3B-5). Because the proposed coral zones are not intended to protect the full extent of coral observations and habitat in the Mid-Atlantic Council region, some corals exist outside the proposed coral zones, and some displacement of effort into non-designated areas would potentially reduce the positive biological impacts of coral zone closures. However, effort is expected to be displaced to areas that already experience relatively heavy fishing effort, meaning the baseline environmental conditions of corals is likely to be negative.

Sub-alternatives under Alt.4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-2). These exemptions would be unnecessary under Alternative 4C (prohibition on mobile bottom tending gear).

Red Crab Exemption (Alt. 4B-1)

The exemption for red crab was proposed given the small overall scope of the red crab fishery (see Section 6.4) and because all red crab effort takes place entirely at depths that intersect all 15 proposed deep sea coral discrete zones; therefore, restrictions on this fishery would likely place a large logistical and economic burden on this fishery in avoiding closed areas. Given the small physical footprint of gear contact with the seafloor, it is believed that the red crab fishery may currently have a smaller impact on corals relative to other bottom-tending fisheries.

As described in Section 6.4.7 and Section 7.3.1.2, the fishery for red crab is a very small limited access fishery that uses conical mesh traps set along the 350 fathom (640 meter) depth contour. This depth is targeted because red crabs segregate by sex and depth, and take of female crabs is prohibited, so targeting this depth allows for male-only harvest. Given this targeted depth, the red crab fishery would have little ability to displace effort to avoid discrete zone restricted areas, and would need to constantly set and haul gear after “jumping” over a closed canyon. Due to the soft-sided nature of the traps and the use of float line to connect traps (vs. sink line that lies along the bottom), it is believed that these types of traps may have less of an impact on corals than other trap gear types (such as lobster traps). In addition, industry members indicate that traps are typically lifted straight off the bottom rather than dragged laterally across the seafloor.

As described in Section 6.0, adult red crabs appear to be primarily associated with soft sediments, but are associated with both hard and soft bottom. Industry participants have indicated that the fishery operates across a broad range of substrate types; however, if more red crabs are associated with soft sediment, fishing activity may have less impacts on structure-forming species that are the focus of this action, and more of an impact on species types that are more resilient to impacts, such as sea pens. A study conducted in the United Kingdom found that sea pens can survive interactions with lobster pot gear, as they bend in response to pressure (Eno et al. 2001).

Haefner and Musick (1974) and Gray (1970) reported that red crab appear to have a preference for inter-canyon habitat, finding lower catch rates within canyons than on the slope adjacent to the canyon. However, Valentine (1980) found that red crabs were more common in Oceanographer Canyon compared to the southern edge of Georges Bank. Auster et al. (1991) found a more random distribution around the 700-meter depth contour, without apparent aggregations. However, fishing effort appears to be evenly distributed within and outside the canyons. The fishery also operates on a broad range of sediment types and has operated at the same depths up and down the coast for many years, thus it is likely that some negative impacts occur under the baseline environmental conditions. In addition to the expected disturbance from traps contacting the bottom during deployment, soaking, and retrieval, traps may also move along the bottom due to natural disturbance such as currents and storms, though the extent of this movement is unknown. Any existing negative impacts to corals resulting specifically from the red crab fishery would likely continue to occur under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). Thus, the magnitude and direction of coral impacts resulting specifically from red crab fishing effort would be functionally equivalent under all of these alternatives. Due to the limited footprint of red crab effort and the fishing methods used, these impacts are expected to be limited in magnitude. Overall, long-term impacts to corals would be expected to differ somewhat under each of these combinations when other gear types and fisheries are considered. Long-term positive impacts would be expected under the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and to a slightly lesser extent from Alternative 4C, due to closing these areas to other gear types and preventing expansion of fishing effort in these canyons.

Although the Council recognized the potential negative impacts to corals within the canyons from the red crab fishery, they determined that an exemption for this fishery was warranted due to concerns about the practicality of requiring red crab vessels to continually haul in all gear and re-set in between discrete zones. In their motion, the Council recommended that this discrete zone exemption be approved for a minimum of two years with the intention to re-evaluate the exemption after that time. In other words, the exemption would apply indefinitely but at least for two years, at which point the Council intends to revisit this decision if new information becomes available regarding the red crab fishery and their potential impacts on corals. Though the current fishery is limited access with participation limited to a few vessels, if effort were to increase in terms of frequency or spatial extent of hauls, increased direct negative impacts to deep sea corals would be expected.

Golden Tilefish Exemption (Alt. 4B-2)

The golden tilefish bottom longline fishery was also considered for an exemption (sub-alternative 4B-2) given the relatively small footprint of this fishery within any of the discrete zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around two or three of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered for the discrete zones to avoid economic impacts from restricting tilefish gear in those canyons. However, industry members were present at the April 2015 workshop to refine the boundaries for discrete zones, and the resulting Council preferred boundary option 3B-5 appears to be unlikely to have substantial impacts on the tilefish fishery; thus, the Council did not select this exemption Alternative 4B-2 as a preferred alternative.

Less information is available regarding coral interactions with hook gear types (compared to mobile gear types); however, damage is known to be possible from bottom longlines (Section 6.3.4). The targeted depths for the golden tilefish fishery overlap only slightly with most of the boundary sub-options under Alternative 3B. Slight direct negative impacts to deep sea corals are possible under the *status quo* operation of the fishery; however, little is known about the extent of these possible interactions. The golden tilefish fishery has operated in the same areas for many years, alongside other fisheries operating with mobile gear types, meaning negative interactions are likely to be occurring under the baseline conditions. As indicated above for red crab, long-term positive impacts would be expected under the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and to a slightly lesser extent from Alternative 4C, due to closing these areas to other gear types and preventing expansion of fishing effort. Though the current fishery is limited access with limited participation, if effort were to increase in terms of frequency or spatial extent of hauls, direct negative impacts to corals may increase.

<u>Gear Restriction and Exemption Alternatives Summary</u>

Overall, the impacts of these gear restriction and exemption alternatives are expected to range from slight to high positive impacts on deep sea corals, as described above. In relative terms, the magnitude of these positive impacts is expected to be greatest from Alternative 4B alone (without an exemption sub-option), which would prohibit the most gear types with no exemptions. The next highest positive impacts would be expected from the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for golden tilefish). Alternative 4B with exemption for tilefish only is expected to have greater positive impacts than Alternative 4B in combination with an exemption for red crab, given that the spatial footprint of the tilefish fishery within the proposed areas is much smaller. In addition, hook and line gear types potentially have a lower impact on corals compared to traps. The combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for red crab) would have the next highest positive impacts, followed by the combination of 4B, 4B-1, and 4B-2. Alternative 4C would have impacts similar in magnitude to the combination of Alternatives 4B, 4B-1, and 4B-2; however, Alternative 4C would theoretically restrict fewer fisheries and thus would have slightly lower positive impacts. Finally, no positive impacts would be expected under the no action/*status quo* alternative for gear restrictions (Alt. 4A; neutral impacts relative to the baseline conditions with continued gear-coral interactions expected under the baseline conditions). Section 7.3.2.3 summarizes the expected impacts to deep sea corals of gear restriction alternatives in combination with discrete zone designation alternatives.

Transit Alternatives

Alternatives 4D and 4E would allow for vessel transit either under the condition that gear be stowed (Alt. 4D) or that a VMS declaration for "transit" be submitted (Alt. 4E). Regardless of the combination of discrete zones designation alternatives implemented, these transit alternatives would both be expected to have indirect slight negative impacts to deep sea corals, since any provisions that allow for transit may make gear restrictions more difficult to enforce. The more vessels there are present within the closed areas, the more difficult it may be for enforcement vessels to intercept them and verify that the vessels are not fishing using a prohibited gear type. Alternative 4D may have slightly more negative indirect impacts compared to Alternative 4E, since a VMS transit declaration would make enforcement somewhat easier than a gear stowage requirement.

7.3.2.3 Summary of Discrete Zone Impacts to Deep Sea Corals

Based on the analysis described above, this section summarizes the impacts from the various specific combinations of alternatives for discrete zones. Overall, the impacts to deep sea corals from any combination of the various discrete zone designation alternatives 3B-1 through 3B-5, in combination with gear restriction Alternatives 4B or 4C, are expected to result in direct positive impacts to deep sea corals ranging from slight positive to high positive. Higher positive impacts expected from alternatives that protect a greater area overall, and particularly a greater area near the shelf/slope break and in the heads of canyons. Higher positive impacts are expected from restricting more gear types with fewer exemptions. In addition, designation of discrete coral zones would likely have additional indirect benefits to deep sea corals, including focusing increased public, academic, and governance attention on these ecosystems. Designation of discrete coral zones may result in increased public awareness, conservation effort, monitoring, and research activity.

Evaluation of the intersection of historical records, recent observations, and the habitat suitability model with discrete zone designation alternatives indicates that the vast majority of known or predicted coral habitat within the proposed discrete zones falls within areas covered by alternatives 3B-2, 3B-4, and 3B-5. Alternative 3B-1 only contains proposed boundaries for the Mey-Lindenkohl Slope, Baltimore Canyon, and Norfolk Canyon. Among those canyons, levels of protection offered by alternative 3B-1 is comparable to that of 3B-2, 3B-4, and 3B-5; however, because this option protects fewer canyons, it would offer overall substantially less protections for corals. Alternatives 3B-2, 3B-4 and 3B-5 all cover large areas of highly suitable habitat, the majority of historical DSCRTP within a given canyon, and all recent dive locations from recent coral surveys, and are expected to have similar magnitudes of moderate to high direct positive impacts on deep sea corals.

For gear and exemption measures, the prohibition on all bottom-tending gear (Alternative 4B) would be expected to have slightly greater positive impacts on deep sea corals than a prohibition on mobile bottom-tending gear. However, because the number of fisheries and spatial extent of effort using bottom-tending passive gear types in these areas is limited, and because mobile bottom-tending gear is believed to be much more detrimental to corals than passive gear types, the magnitude of this difference in impacts is likely minor. Any fishing exemption alternatives (4B-1 or 4B-2) implemented under a restriction on all bottom-tending gear would likely reduce the positive habitat impacts associated with gear restricted areas. However, given the relatively small footprint of known passive gear effort in the proposed areas, the overall magnitude of the impacts with and without exemptions is likely to be minor. A summary of expected impacts from various combinations of designation alternatives (Alts. 3A through 3B-5) and gear restriction and exemption alternatives (Alts. 4A through 4C) are shown in Table 77.

For transit alternatives (Alts. 4D and 4E), a summary of expected impacts from various combinations with discrete zone designation alternatives is shown in Table 78. The impacts of these action alternatives are not expected to vary based on the discrete zone designation implemented, and would be as described above in Section 7.3.2.2.

Table 77: Summary of impacts to the deep sea corals of discrete zone designation alternatives in combination with discrete zone gear restriction alternatives. BTG= bottom-tending gear.

Alt.	4A (No action/*Status quo*)	4B (Prohibit all BTG; *Council preferred*)	Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)	Sub-Alt 4B-2 (Exempt tilefish fishery)	4C (Prohibit mobile BTG)
3A (No discrete zone designation)	No designation; no management measures. **Neutral impacts relative to the baseline conditions.**	NA: These would not be reasonable combinations of alternatives given that gear restrictions within a discrete zone would not be implemented unless a discrete zone is designated.			
3B-1 (Advisor 2013 boundaries)	Discrete zone would be designated, but no management measures would be applied. **Indirect slight positive impacts expected** from possible increased awareness, research, and/or monitoring for corals.	**Slight to moderate direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Less positive impacts compared to all other boundary designation Alts.	Impacts from red crab fishing neutral relative to the *status quo*; **Overall impacts positive long-term in combination with 4B**, but less so than 4B alone. Current baseline conditions likely result in direct slight negative impacts from existing gear interactions. Impacts would not vary under alternatives 3B-1 to 3B-5, as red crab effort occurs exclusively in deeper waters intersecting all discrete zone boundaries.	Habitat impacts from tilefish fishing neutral relative to the *status quo*; **Overall impacts positive long-term in combination with 4B**, but less than 4B alone**.**	**Slight to moderate direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Less positive impacts compared to all other boundary designation Alts.
3B-2 (FMAT boundaries)		**Moderate to high direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Impacts from Alts. 3B-2, 3B-4, and 3B-5 are comparable in magnitude and higher than 3B-1 and 3B-3. Alt. 2B higher positive impacts vs. 2C.			**Moderate to high direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Impacts from Alts. 3B-2, 3B-4, and 3B-5 are comparable in magnitude and higher than 3B-1 and 3B-3. Alt. 2B higher positive impacts vs. 2C.

Continued next page

Alt.	4A (No action/*Status quo*)	4B (Prohibit all BTG; *Council preferred*)	Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)	Sub-Alt 4B-2 (Exempt tilefish fishery)	4C (Prohibit mobile BTG)
3B-3 (GSSA boundaries)	See above	**Slight to moderate direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Less positive impacts compared to 3B-2, 3B-4, and 3B-5; more positive impacts vs. Alt. 3B-1.	See above	See above	**Slight to moderate direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Less positive impacts compared to 3B-2, 3B-4, and 3B-5; more positive impacts vs. Alt. 3B-1.
3B-4 (NGO coalition boundaries)		**Moderate to high direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Impacts from Alts. 3B-2, 3B-4, and 3B-5 are comparable in magnitude and higher than 3B-1 and 3B-3. Alt. 2B higher positive impacts vs. 2C.			**Moderate to high direct and indirect positive impacts** expected from reduction in interactions, prevention of future interactions, and increased conservation focus. Impacts from Alts. 3B-2, 3B-4, and 3B-5 are comparable in magnitude and higher than 3B-1 and 3B-3. Alt. 2B higher positive impacts vs. 2C.
3B-5 (Workshop boundaries; *Council preferred*)					

Table 78: Summary of impacts to deep sea corals of discrete zone designation alternatives in combination with discrete zone vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>4D (Transit with gear stowage; Council preferred)</th><th>4E (Transit with VMS declaration)</th></tr>
<tr><td>3A (No discrete zone designation)</td><td colspan="2">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within discrete zones would not be necessary or practical unless discrete zones are designated.</td></tr>
<tr><td>3B-1 (Advisor 2013 boundaries)</td><td rowspan="5">Alt. 4D in combination with any discrete zone designations alternative is expected to have indirect slight negative impacts to deep sea corals, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 4D slightly more negative in magnitude vs. Alt. 4E.</td><td rowspan="5">Alt. 4E in combination with any discrete zone designations alternative is expected to have indirect slight negative impacts to deep sea corals, as allowing transit complicates enforcement and monitoring of gear-restricted areas. Alt. 4D slightly more negative in magnitude vs. Alt. 4E.</td></tr>
<tr><td>3B-2 (FMAT boundaries)</td></tr>
<tr><td>3B-3 (GSSA boundaries)</td></tr>
<tr><td>3B-4 (NGO coalition boundaries)</td></tr>
<tr><td>3B-5 (Workshop boundaries; Council preferred)</td></tr>
</table>

7.3.3 Framework Provision Alternatives

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. This action proposes to modify the list of items in the FMP that could be modified through a framework, to allow for future consideration of deep sea coral measures through a framework action.

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. The purpose of modifying the list of "frameworkable items" in the FMP is to demonstrate that the concepts included on the list has previously been considered in an amendment (i.e., they are not novel). Any proposed action or future change would be analyzed through a separate NEPA process.

As described in Section 5.5, the Council's June 2015 motion identifying preferred alternatives for this alternative set specified that these framework adjustments "must be in keeping with the purpose of the amendment, to identify and implement measures that reduce to the extent practicable impacts of fishing gear on deep sea corals in the mid-Atlantic region." This indicates that the Council intends for any future framework actions falling under the preferred alternatives below would be consistent with the purpose and need of this amendment.

Because the framework provision alternatives are administrative, they are not expected to result in any direct impacts to deep sea corals, though indirect impacts are possible from some of the alternatives if they allow for more efficient responses to immediate threats to coral communities. Specifically, because the administrative process for an amendment is longer, it is possible that any immediate conservation concerns arising in the future could be addressed in a timelier manner through a framework action rather than an amendment. In addition, because amendments typically uses up more Council and NMFS time and resources, it is possible that the Council may decide not to prioritize future adjustments to the coral measures if such actions would require an amendment. It is not possible to predict the magnitude and direction of any future deep sea coral actions; however, to the extent that framework provisions may allow more efficient responses to arising conservation concerns, the framework provision action alternatives 5B through 5D would be expected to result in neutral to indirect slight positive impacts to deep sea corals. Action alternative 5E, an allowance for special access program development through a framework action, is expected to result in neutral impacts to deep sea corals, as this would not be explored to address an immediate conservation need for corals (Table 79). The impacts of any future special access program developed under this framework provision would be described in a future NEPA analysis.

Table 79: Expected impacts to deep sea corals from framework provision alternatives (alternative set 5).

Alternative	Expected Impacts
Alt. 5A: No action/*status quo*	**Neutral to indirect slight negative.** Administrative in nature; no direct impacts on deep sea corals. Due to time/resource requirements for amendments, future needs for coral protections may be delayed or de-prioritized.
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on deep sea corals. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on deep sea corals. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on deep sea corals. Indirect slight positive impacts expected if framework process allows for more efficiently addressing conservation concerns.
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	**Neutral.** Administrative in nature; timetable to implement future access programs not expected to impact corals directly or indirectly.

7.3.4 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. *Illex* vessels are not currently required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). Alternative 6B could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. This alternative set focuses exclusively on the *Illex* fishery because most other fisheries that operate in these deep water, offshore environments considered in this action are already required to use VMS. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

Because these alternatives are focused on monitoring and enforcing *Illex* vessel activity and do not include any monitoring or reporting requirements directly for deep sea corals, there would be no direct impacts to deep sea corals from this VMS requirement. However, a VMS requirement for the *Illex* squid fishery, if implemented in combination with coral protection measures, would increase effective enforcement of those conservation measures. In addition, improved VMS coverage for offshore fisheries may allow for more refined analysis of the location of fishing activity, and thus potentially more effective or efficient future coral measures. Thus, Alternative 6B would have indirect positive impacts on deep sea corals stemming from improved ability to enforce coral gear-restricted areas, and improved ability to evaluate the effectiveness of such areas. Because most *Illex* vessels currently already use VMS, the magnitude of this positive impact is expected to be small. Alternative 6A (no action/*status quo*) would have no direct impacts on corals, but could result in indirect negative impacts to corals if coral zones are implemented but unable to be properly enforced or evaluated (Table 80).

Table 80: Expected impacts to deep sea corals from *Illex* VMS alternatives (alternative set 6).

Alternative	Expected Impacts
Alt. 6A: No action/status quo	**Neutral to indirect slight negative.** No direct impacts on deep sea corals. Indirect slight negative impacts expected if coral gear-restricted areas are implemented due to reduced ability to enforce and monitor.
Alt. 6B: Require VMS for federally-permitted *Illex* squid vessels *(Council preferred)*	**Indirect slight positive.** No direct impacts on deep sea corals. Indirect slight positive impacts expected from increased ability to monitor, enforce, and evaluate gear-restricted areas.

7.4 IMPACTS TO THE HUMAN ENVIRONMENT

In general terms, fisheries that operate in offshore areas are expected to be negatively affected by any alternative that reduces access to those fishing areas. Of the fisheries that operate in or near the proposed areas, the squid and red crab fisheries are most likely to be economically affected by the measures proposed. The potential for revenue losses at gross fleet-wide levels should be proportionate to the relative reduction in areas that can be fished, though the exact losses would depend on which areas are closed and how vessels respond to area closures, given that participants would be expected to relocate harvest effort into areas that remain open to some degree. Net losses are then dependent on the degree of reduced efficiencies, i.e., if lower catches are made in the remaining areas and/or if it costs more to fish in those areas. Many of the fisheries operate in specific environments and locations, such as in specific areas near/around canyons that are known for being highly productive. Thus, alternative fishing locations may be limited depending on the measures selected by the Council. However, in general, effort would be expected to shift near/around other areas/canyons not impacted by the proposed measures. This effect would reduce both the negative socio-economic impacts to commercial fishermen and the protections to corals from closing particular areas.

Alternatively, socio-economic impacts may be increased because of how fishermen deploy and fish their nets to account for bottom contours, current, wind, and area restrictions. These factors may prevent them from fishing equally efficiently in all areas near a canyon. For example, squid vessels typically have gear in the water (but not in contact with the bottom) while their vessel is above a canyon during net deployment and/or retrieval, and preventing vessels from being within a closed area with gear deployed would mean that they may not be able to fish the non-restricted shelf areas immediately adjacent to the closed areas. Industry members have also reported that these areas are sometimes the most productive areas. While it is not possible to quantify the exact impacts relative to this fishing behavior, it would suggest that fishery impacts may be greater than is otherwise apparent because the effective closed area would be bigger than the mapped closed area.

7.4.1 Methods of Analysis

In order to analyze the impacts of a proposed closed or gear restricted area, fishing effort in the proposed areas must be evaluated relative to effort elsewhere. Here, impacts to fishing effort and associated economic impacts were analyzed by first mapping and quantifying recent fishing effort relative to all proposed coral zones (broad and discrete). Several data sources are available to analyze past effort. None of the sources are complete, and their strengths and weaknesses are discussed below.

Economic impacts of proposed coral zones were analyzed primarily using a VTR-based revenue mapping model produced by the Northeast Fisheries Science Center. A Technical Memo outlining the methodology behind this model is forthcoming from the NEFSC, and an overview is provided here.

Federally-permitted vessels are required to submit a VTR for each trip, the requirements of which include indicating a general fishing location as a set of geographic coordinates. These self-reported coordinates do not precisely indicate the location of fishing effort, given that only one point is provided regardless of trip length or distance covered during the trip. In the absence of spatially explicit fishery effort data for many fisheries, the VTR mapping model allows for more robust analysis using VTR data by taking into account some of the uncertainties around each reported point. Using observer data, for which precise locations are available, the model was developed to derive probability distributions for actual fishing locations, around a provided VTR point. Other variables likely to impact the precision of a given VTR point, such as trip length, vessel size, and fishery, were also incorporated into the model. This model allows for generation of maps that predict the spatial footprint of fishing. Price information from dealer reports was used to transform VTR catches into revenues. Trip information was used to incorporate information about revenue generated from each trip, resulting in a model that can produce maps of revenue generated for a given set of specified parameters such as gear type, species, or port of landing. The revenue-mapping model covers the years 2007-2012, and can be used to identify areas important to specific fishing communities, species, gears, and seasons to establish a baseline of commercial fishing effort.

This model does have important caveats. The probability distributions generated from each reported VTR point create a likelihood of actual fishing locations in all directions from a given point, and do not take into account any specific directionality that may be associated with specific fishing methods or specific locations. For example, the model does not take into account fishing behavior along depth contours or other specific habitat features. The model-estimated distribution of fishing effort would tend to be expanded beyond the shelf break or into the middle of canyons to deeper areas that are not actually fished. As such, the model likely overstates effort and revenue dependence in those deeper areas, suggesting that the values (i.e., contributions to overall revenue) described in the resulting analysis below are overestimates. The model should still illustrate the approximate relative value among potential closure areas and facilitate approximate relative comparisons.

For this analysis, first, gear and species combinations likely to be impacted by the proposed measures were identified. VTR-point data were used to identify the primary gear-species combinations that occur within proposed broad and discrete zones. The primary gear types reported within the proposed coral zones (broad and discrete combined) include bottom otter trawls, sea scallop dredges, crab pots and traps, lobster pots, and bottom longlines. The primary species caught include longfin squid, *Illex* squid, sea scallops, deep sea red crab, American lobster, summer flounder, silver hake (whiting), golden tilefish, Jonah crab, scup, and black sea bass.

Of these gear-species combinations, American lobster and Jonah crab were not included in further analysis due to the nature of the regulatory authority under which the alternatives in this document are proposed. As described in Section 4.4, management measures proposed in this document would not apply to the American lobster fishery. This is due to the Council developing this action under 2010 guidance indicating that the MSA discretionary provisions for deep sea coral zones could not be applied to lobster given that it is primarily managed by the Atlantic States Marine Fisheries Commission. Jonah crabs are caught as bycatch within the lobster pot fishery, and generally retained for sale.

Thus, the primary gear-species combinations identified for further analysis in the revenue-mapping model included:

1. Bottom otter trawl – Squid (*Illex* and longfin)
2. Bottom otter trawl – Silver hake (whiting)
3. Bottom otter trawl – Summer flounder, scup, and black sea bass
4. Pots/Traps – Red crab
5. Bottom longline – Golden tilefish
6. Dredge – Sea scallops

In earlier versions of analysis provided to the Council, raw VTR point data was also analyzed, over a longer range of years (2000-2013), to cross-check and support the conclusions of the VTR revenue mapping model. Because both methods produced very similar results and conclusions, that analysis is not repeated here.[51] However, observer data from NEFOP is also evaluated here to support and reinforce the conclusions of the model, as observer data provides more accurate spatial locations of fishing effort. Observer data typically provides accurate positional information for the start and end of haul locations; however, it does not include information about the full path of the haul (i.e., additional waypoints). In addition, observer coverage is limited to a subset of all trips, and coverage varies depending on the fishery. Especially for smaller fisheries and stationary gear types, coverage is not ideal to comprehensively evaluate the full extent of fishing effort. However, over a long time series, observer data can reveal more fine-scale and accurate spatial patterns of fishing than VTR data. In combination, the VTR revenue mapping model and the observer data provide a good picture of where fishing effort has historically and recently taken place, and which fisheries may be displaced by implementation of gear restricted areas.

7.4.2 Broad Coral Zones and Management Measures

7.4.2.1 Broad Zone Designation Alternatives

VTR Revenue Mapping Model

Proposed broad zones were analyzed first using the VTR revenue mapping model. The data in Table 81 are also illustrated in revenue intensity maps shown in Figure 44 through Figure 49. Both the values in the tables and the revenue intensity displayed in the figures are a direct product of the model. The tables show cumulative revenue over the time period 2007-2012, in a given area, for a given species-gear combination. The maps reveal spatial concentrations of effort that provide additional context for the estimates in the tables. When interpreting the maps, the appropriate interpretation is that most revenues would be contained by the areas of intense color, but it would not be correct to interpret the model as saying high effort definitely occurred in all areas of intense color (see description of caveats in Section 7.4.1 above). It should also be noted that each map uses different scales based on standard

[51] Previous amendment documents are available on the Council's website at: http://www.mafmc.org/actions/msb-am16.

deviations of the data for each species-gear combination; thus, the color intensity of the maps should not be directly compared across species. In other words, the "high" value for each map is relative to that specific fishery.

The percentage of coastwide scallop revenue impacted is very low. The spatial measures proposed are expected to overlap very little with scallop effort as this fishery occurs on the continental shelf (Figure 45); however, because of the overall very high value of the scallop fishery, it is included in the analysis for this document. For summer flounder, scup, black sea bass, and whiting, the amount of revenue expected to be impacted is relatively low, ranging from about 4-8%. Whiting effort is concentrated around the northern canyons (Hudson to Block; Figure 48), while summer flounder, scup, and black sea bass effort occurs mostly on the shelf, concentrated around some of the proposed canyons, especially Hudson Canyon (Figure 47). Bottom longline revenue for tilefish is slightly higher, and is concentrated mainly around the northern canyons, specifically Hudson and Block Canyons (Figure 49). As expected, the revenue model indicates that red crab and squid effort is relatively evenly spread over the Mid-Atlantic Council region near the shelf break, and that a higher percentage of their revenue comes from the areas proposed (Figure 44; Figure 46; Table 81).

For each individual gear-species combination as well as the sum of the fisheries together, the percentage of coastwide revenue impacted declines with a decrease in the area proposed for designation. As expected, this indicates that the proposed broad areas that extend further toward or onto the continental shelf (Alternatives 1B and 1C) would have more of an impact on revenue than Alternatives 1D and 1E. Alternative 1F, which is a mix of depth-based and negotiated workshop canyon boundaries, appears to have very similar expected impacts to Alternative 1D. Thus, Alternative 1B would result in the most negative economic impacts, followed by Alternative 1C, then Alternative 1F and 1E (with approximately equivalent magnitude of impacts), then Alternative 1D. There does not appear to be a significant jump between any of the alternatives, instead, the decrease in area corresponds to a steady decrease in revenue impacted. The percentage of coastwide revenues impacted from all gear types analyzed vs. mobile gear types is comparable (Table 81).

Table 81: VTR model-estimated cumulative revenue over 2007-2012 (in U.S. dollars), by proposed broad zone, shown as a percentage of coastwide revenues for each species-gear combination, Maine through North Carolina. BOT = bottom otter trawl; LL = longline; DRG = dredge; FSB = summer flounder, scup, and black sea bass. Note that percentages are not additive given the significant overlap in area across all broad zones.

BROAD ZONE ALT.	APPROX. AREA (km^2)	BOT-SQUID	DRG-SCALL	BOT-FSB	POT-RCRAB	LL-TILE	BOT-HAKE	TOTAL	Mobile gears only (trawl/ dredge)
Alt. 1B (200m zone)	101,372	24.56%	1.25%	7.44%	42.15%	16.83%	7.80%	3.80%	3.47%
Alt. 1C (300m zone)	100,165	22.13%	1.12%	6.35%	40.31%	12.31%	6.10%	3.37%	3.09%
Alt. 1D (400m zone)	99,218	20.29%	1.03%	5.62%	38.63%	10.07%	4.84%	3.07%	2.81%
Alt. 1E (500m zone)	98,444	19.06%	0.97%	5.14%	37.29%	8.83%	4.07%	2.86%	2.62%
Alt. 1F (Council-preferred zone)	98,934	20.04%	1.04%	5.43%	38.00%	9.09%	4.36%	3.02%	2.78%

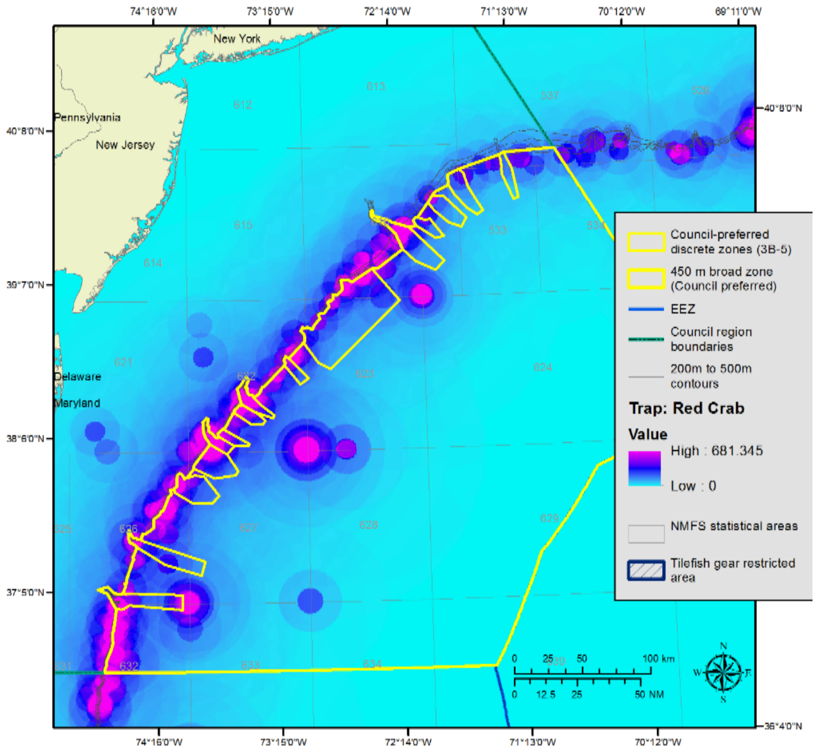


Figure 44: Areas of high cumulative estimated revenue (USD) for red crab caught using pots, 2007-2012, Maine through Virginia.

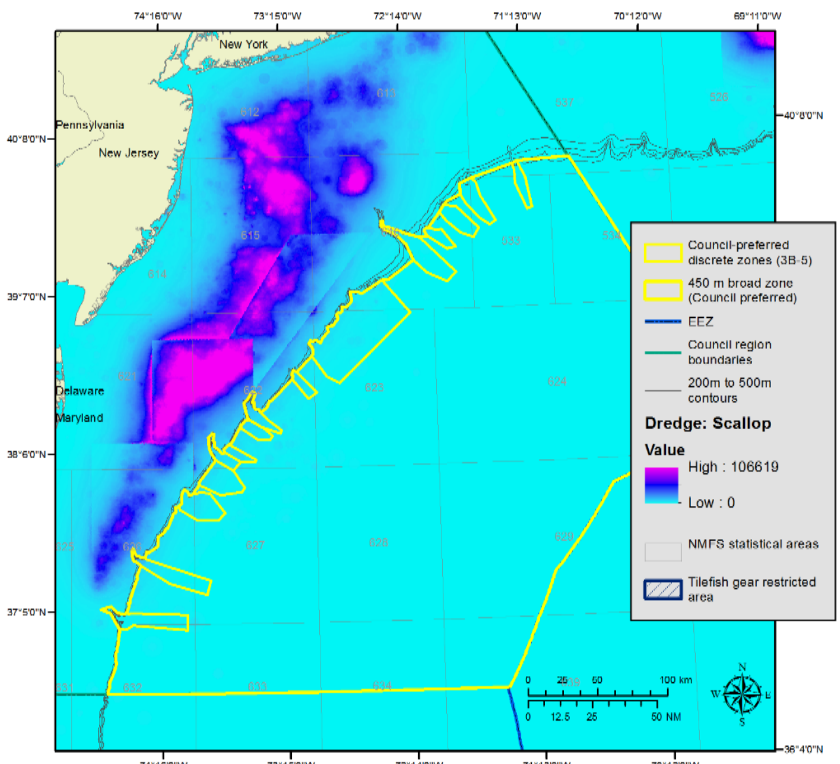


Figure 45: Areas of high cumulative estimated revenue (USD) for scallops caught using dredge gear, 2007-2012, Maine through Virginia.

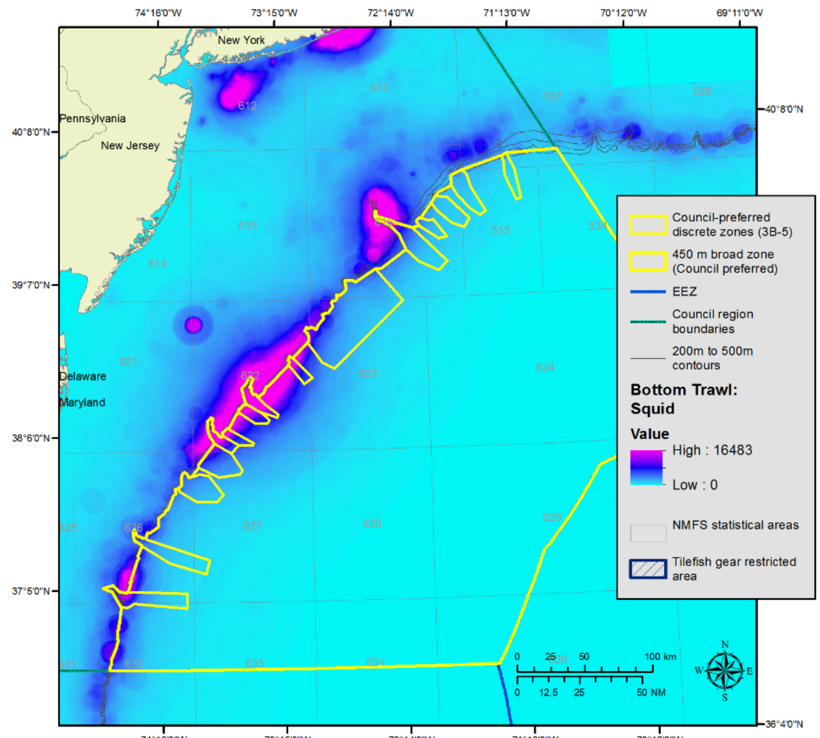


Figure 46: Areas of high cumulative estimated revenue (USD) for *Illex* and longfin squid caught using bottom otter trawls, 2007-2012, Maine through Virginia.

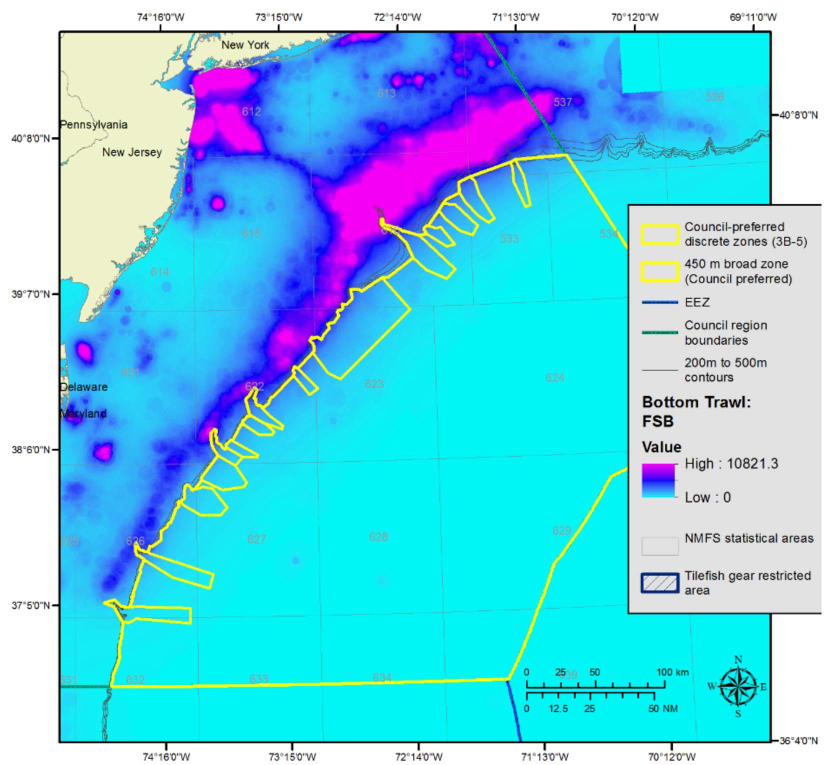


Figure 47: Areas of high cumulative estimated revenue (USD) for summer flounder, scup, and black sea bass caught using bottom otter trawl gear, 2007-2012, Maine through Virginia.

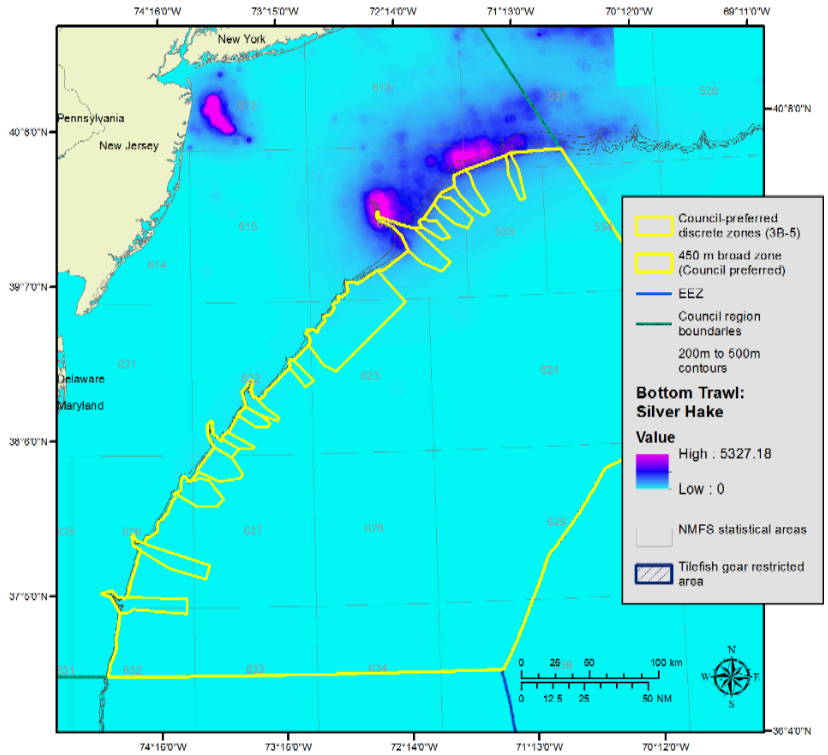


Figure 48: Areas of high cumulative estimated revenue (USD) for silver hake (whiting) caught using bottom otter trawl gear, 2007-2012, Maine through Virginia.

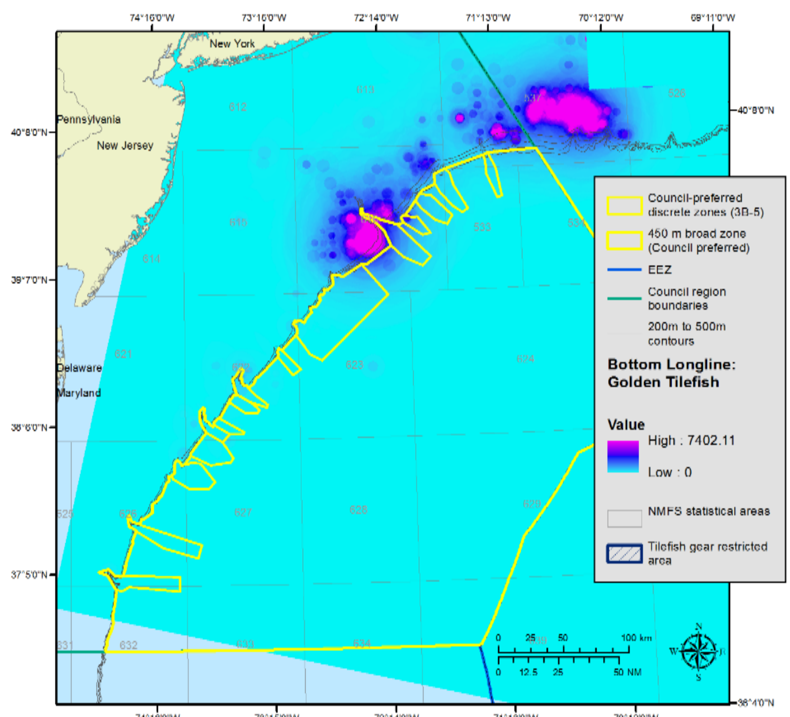


Figure 49: Areas of high cumulative estimated revenue (USD) for golden tilefish caught using bottom longline gear, 2007-2012, Maine through Virginia.

Observer Data

Observer data from NEFOP were analyzed for bottom trawl, bottom longline, and sink/anchored gillnet gear types for years 2000 through 2013 for the Mid-Atlantic region. Records with incomplete geographic coordinates were removed. Observed hauls were analyzed relative to proposed broad zones. While coverage of trips is much lower with the observer data compared to the VTR data, the observer data generally provides very precise location data for gear haul and set locations (though not the exact path fished). Observer coverage also varies by fishery and by year, however, aggregating the data over many years likely reveals relative patterns in fishing effort. Accordingly, NEFOP data was used to consider effort across the potential coral zones.

Bottom Trawl Effort

Within the Mid-Atlantic management region, there were 25,073 total observed hauls (on 3,967 trips) using bottom trawl gear within this time period. Table 82 and Figure 50 show bottom trawl hauls intersecting each of the proposed broad coral zones, with associated number of trips and the average depth taken at the start of each haul. Depth information is meant to provide an approximation of the depth at which these fisheries are prosecuted, but may not provide a complete picture (especially for longer hauls), given that it is based on haul start location.

Hauls were analyzed by selecting those intersecting each broad zone, and many records are duplicated across broad zone portions of the table f they intersect more than one broad zone alternative. In the vicinity of the proposed coral zones, bottom trawl effort is concentrated along the continental shelf and shelf break, and at the heads of canyons (Figure 50). For observed bottom trawl hauls over this time period, 14% intersect the 200 meter broad zone, 6% intersect the 300 meter broad zone, 3% intersect the 400 meter broad zone, and 1% intersect the 500 m broad zone.

Table 82: All NEFOP observed bottom trawl hauls and trips, by gear type, within the Mid-Atlantic Council region from 2000-2013.

Gear Type	Number of trips	Number of hauls	Average Haul Start Depth
TRAWL,OTTER,BOTTOM,FISH	3,959	24,985	86 m (47 ftm)
TRAWL,OTTER,BOTTOM,SCALLOP	2	20	51 m (28 ftm)
TRAWL,OTTER,BOTTOM,SHRIMP	6	68	340 m (186 ftm)
Total	**3,967**	**25,073**	**Average: 87 m (48 ftm)**

Table 83: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by gear type and target species, intersecting each broad zone alternative, 2000-2013. Records removed for species observed on less than 5 hauls.

Alt. 1B: 200 meter broad zone

Gear Type; Target Species	Number of trips	Number of hauls	Average Haul Start Depth
TRAWL,OTTER,BOTTOM,FISH	**637**	**3,414**	**199 m (109 ftm)**
SQUID, ATL LONG-FIN	--	1,257	163 m (89 ftm)
SQUID, SHORT-FIN	--	1,248	199 m (109 ftm)
MONKFISH (GOOSEFISH)	--	449	267 m (146 ftm)
HAKE, SILVER (WHITING)	--	245	279 m (152 ftm)
FLOUNDER, SUMMER (FLUKE)	--	67	109 m (60 ftm)
WHITING, BLACK (HAKE, OFFSHORE)	--	46	362 m (198 ftm)
SCUP	--	32	133 m (73 ftm)
SQUID, NK	--	23	152 m (83 ftm)
SEA BASS, BLACK	--	20	100 m (55 ftm)
GROUNDFISH, NK	--	18	262 m (143 ftm)
TRAWL,OTTER,BOTTOM,SHRIMP	**6**	**67**	**343 m (188 ftm)**
SHRIMP, ROYAL RED	--	31	344 m (188 ftm)
HAKE, SILVER (WHITING)	--	15	338 m (185 ftm)
SHRIMP, PANDALID (NORTHERN)	--	9	353 m (193 ftm)
WHITING, BLACK (HAKE, OFFSHORE)	--	9	350 m (191 ftm)
Grand Total	**643**	**3,481**	**Average: 202 m (110 ftm)**

Alt. 1C: 300 meter broad zone

Gear Type; Target Species	Number of trips	Number of hauls	Average Haul Start Depth
TRAWL,OTTER,BOTTOM,FISH	**432**	**1,486**	**217 m (119 ftm)**
SQUID, SHORT-FIN	--	640	207 m (113 ftm)
SQUID, ATL LONG-FIN	--	441	162 m (88 ftm)
MONKFISH (GOOSEFISH)	--	172	323 m (176 ftm)
HAKE, SILVER (WHITING)	--	121	323 m (177 ftm)
WHITING, BLACK (HAKE, OFFSHORE)	--	42	371 m (203 ftm)
FLOUNDER, SUMMER (FLUKE)	--	31	101 m (55 ftm)
SEA BASS, BLACK	--	13	91 m (50 ftm)
SCUP	--	11	126 m (69 ftm)
GROUNDFISH, NK	--	7	289 m (158 ftm)
SQUID, NK	--	5	147 m (81 ftm)
TRAWL,OTTER,BOTTOM,SHRIMP	**6**	**67**	**343 m (188 ftm)**
SHRIMP, ROYAL RED	--	31	344 m (188 ftm)
HAKE, SILVER (WHITING)	--	15	338 m (185 ftm)
SHRIMP, PANDALID (NORTHERN)	--	9	353 m (193 ftm)
WHITING, BLACK (HAKE, OFFSHORE)	--	9	350 m (191 ftm)
Grand Total	**438**	**1,553**	**Average: 222 m (122 ftm)**

Alt. 1D: 400 meter broad zone

Gear Type; Target Species	Number of trips	Number of hauls	Average Haul Start Depth
TRAWL,OTTER,BOTTOM,FISH	**272**	**627**	**221 m (121 ftm)**
SQUID, SHORT-FIN	--	291	208 m (113 ftm)
SQUID, ATL LONG-FIN	--	166	158 m (86 ftm)
HAKE, SILVER (WHITING)	--	63	348 m (190 ftm)
MONKFISH (GOOSEFISH)	--	56	378 m (207 ftm)
FLOUNDER, SUMMER (FLUKE)	--	19	91 m (50 ftm)
WHITING, BLACK (HAKE, OFFSHORE)	--	14	395 m (216 ftm)
SEA BASS, BLACK	--	10	86 m (47 ftm)
SCUP	--	7	126 m (69 ftm)
TRAWL,OTTER,BOTTOM,SHRIMP	**5**	**13**	**357 m (195 ftm)**
SHRIMP, ROYAL RED	--	5	345 m (189 ftm)
Grand Total	**277**	**640**	**Average: 225 m (123 ftm)**

Alt. 1E: 500 meter broad zone			
Gear Type; Target Species	**Number of trips**	**Number of hauls**	**Average Haul Start Depth**
TRAWL,OTTER,BOTTOM,FISH	**170**	**299**	**192 m (105 ftm)**
FLOUNDER, SUMMER (FLUKE)	--	13	81 m (44 ftm)
HAKE, SILVER (WHITING)	--	12	341 m (186 ftm)
MONKFISH (GOOSEFISH)	--	9	338 m (185 ftm)
SCUP	--	6	123 m (67 ftm)
SEA BASS, BLACK	--	10	86 m (47 ftm)
SQUID, ATL LONG-FIN	--	95	157 m (86 ftm)
SQUID, NK	--	1	106 m (58 ftm)
SQUID, SHORT-FIN	--	153	212 m (116 ftm)
TRAWL,OTTER,BOTTOM,SHRIMP	**1**	**1**	**349 m (191 ftm)**
SHRIMP, ROYAL RED	--	1	349 m (191 ftm)
Grand Total	**171**	**300**	**Average: 192 m (105 ftm)**

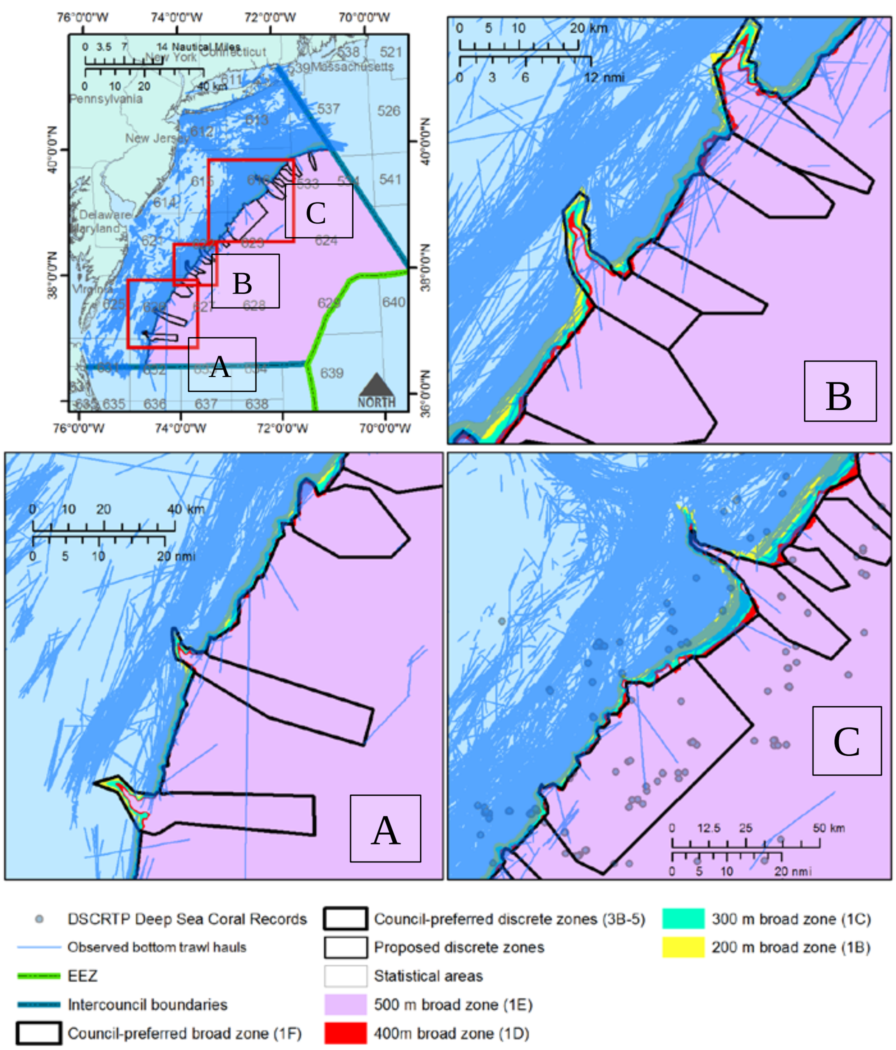


Figure 50: NEFOP observed bottom trawl hauls in the Mid-Atlantic region by gear type, 2000-2013.

Gillnet Effort

Observer data indicate that in the Greater Atlantic Region from 2000-2013, there were 63,494 observed hauls (on 14,160 trips) using gillnet gear. Geographic coordinates for gillnet set location were present for only about 33% of the records in the database; therefore, haul coordinates were analyzed. Records with incomplete geographic location for haul were removed (6% of hauls; 4% of trips).

Within the Mid-Atlantic region, there were 13,928 observed hauls using gillnet gear, on 3,432 trips (Table 84). Of these observed hauls, only six intersected any of the proposed coral zones (a small fraction of one percent). All six of these were hauls targeting monkfish using sink gillnets in 2004. These hauls occurred on two trips northeast of Block Canyon along the 300 meter depth contour (Figure 51). No observed gillnet hauls during this time period intersected any of the proposed discrete zones.

The vast majority of observed gillnet effort since 2000 has occurred in waters much shallower than the depths of any of the proposed coral zones in the Mid-Atlantic (Table 84). Only about 0.6% of observed gillnet trips and 0.5% of observed gillnet hauls occurred deeper than 75 fathoms (137 meters) in the Mid-Atlantic region, according to haul depth information recorded in the observer data.

Table 84: NEFOP Observer records of gillnet gear a) in the MAFMC region and b) intersecting proposed coral zones, 2000-2013.

a) Within MAFMC Region			
Gear Type	**Trips**	**Hauls**	**Average Haul Start Depth**
GILL NET, ANCHORED-FLOATING, FISH	32	135	10 m (5 ftm)
GILL NET, DRIFT-FLOATING, FISH	197	621	20 m (11 ftm)
GILL NET, DRIFT-SINK, FISH	496	2,045	8 m (15 ftm)
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	2,707	11,127	12 m (22 ftm)
Total	**3,432**	**13,928**	**11 m (21 ftm)**
b) Within proposed coral zones			
Gear Type	**Trips**	**Hauls**	**Average Haul Start Depth**
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	2	6	282 m (154 ftm)
Total	**2**	**6**	**282 m (154 ftm)**

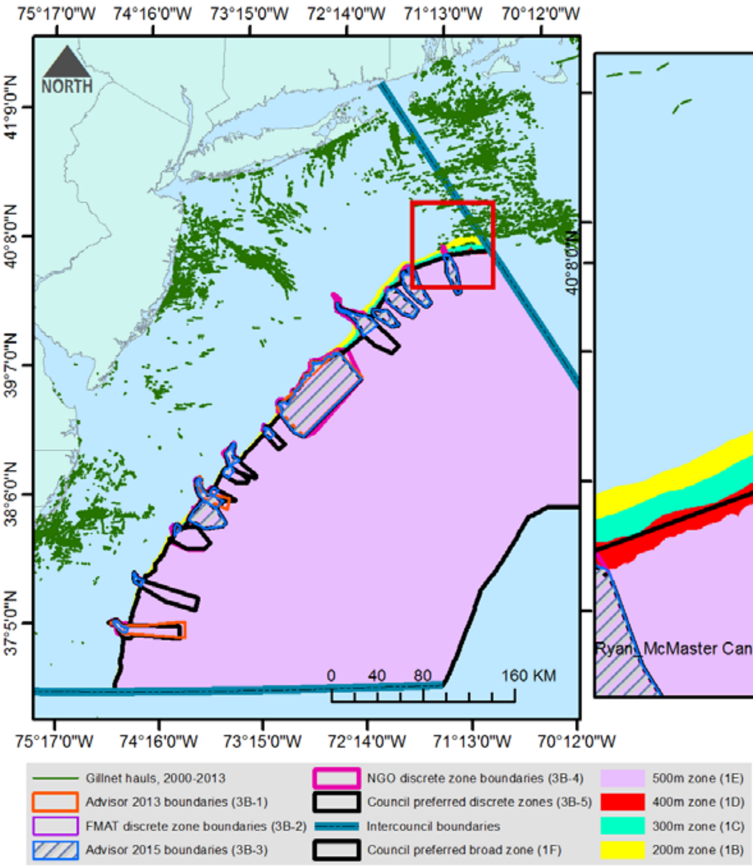


Figure 51: NEFOP observer hauls for gillnet gear in the Mid-Atlantic, 2000-2013, and area of intersection with proposed MAFMC broad coral zones.

Bottom Longline Effort

For years 2000-2013, a total of 885 trips and 4,791 hauls using bottom longline gear were recorded for the Greater Atlantic Region in the NEFOP database. The majority of these records occurred within the management region of the NEFMC, and primarily targeted Atlantic cod, haddock, and other groundfish. Records with missing or incomplete geographic coordinates were unable to be plotted and were removed (about 1% of trips; 8% of hauls).

Within the MAFMC region, a total of 130 hauls using bottom longline gear were recorded in the observer data for 2000-2013. All of these records indicated tilefish as the target species, and occurred in northern areas of the MAFMC management region between 2004 and 2008 (Table 85; Figure 52).

In total, the proposed coral zones are intersected by most of these observed longline trips occurring within the MAFMC region (92%), and only about half of the hauls (53%). At the 300 meter broad zone, the number of observed trips within proposed zones drops to 4. Only one trip extends into the 400 meter and 500 meter broad zones (Figure 52). This would suggest that longline effort in these areas tends to be concentrated around the 200 meter depth contour or shallower at the heads of the canyon.

Table 85: NEFOP Observer data records of hauls using bottom longline gear from 2000-2013 a) in the MAFMC region, and b) within proposed broad coral zones.

a) Within MAFMC Region

Gear Type, Target Species	Trips	Hauls	Average Haul Start Depth
LONGLINE, BOTTOM			
TILEFISH, GOLDEN	10	98	180 m (99 ftm)
TILEFISH, NOT KNOWN	3	32	166 m (91 ftm)
Grand Total	**13**	**130**	**177 m (97 ftm)**

b) Within proposed broad coral zones

Broad Zone, Target Species	Trips	Hauls	Average Haul Start Depth
200 Meter Broad Zone	**12**	**69**	**203 m (111 ftm)**
TILEFISH, GOLDEN		54	205 m (112 ftm)
TILEFISH, NOT KNOWN		15	195 m (106 ftm)
300 Meter Broad Zone		**5**	**229 m (125 ftm)**
TILEFISH, GOLDEN		4	193 m (106 ftm)
TILEFISH, NOT KNOWN		1	375 m (205 ftm)
400 Meter Broad Zone		**2**	**144 m (79 ftm)**
TILEFISH, GOLDEN		2	144 m (79 ftm)
500 Meter Broad Zone		**1**	**146 m (80 ftm)**
TILEFISH, GOLDEN		1	146 m (80 ftm)

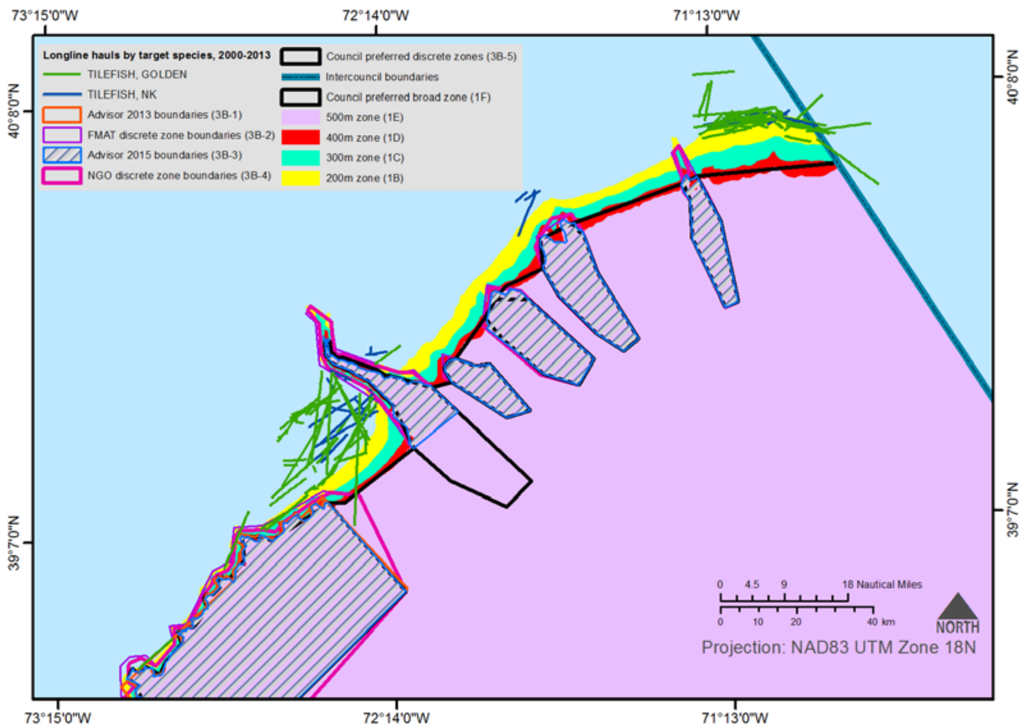


Figure 52: Observed bottom longline hauls in the MAFMC region, 2000-2013.

7.4.2.2 Broad Zone Management Measure Alternatives

Gear Restriction and Exemption Alternatives

In general terms, human communities are expected to experience negative impacts from any alternative that reduces access to productive and currently utilized fishing grounds. The exact nature of potential impacts to human communities are difficult to define, because currently very little fishing effort currently occurs in the vast majority of the broad zone area. This is by design; the broad zone alternatives were developed under the precautionary "freeze the footprint of fishing" principle (see Section 5.0) primarily in order to protect corals from future expansion of fishing effort, including the potential development of new deep sea fisheries. Each of the broad zone designation alternatives was chosen for consideration based on their potential to exclude most current fishing effort.

Analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the exception of the red crab fishery; see "Fishery Exemption Alternatives" below). Thus, the areas within the proposed broad zones where fishing effort is most likely to be impacted includes primarily areas near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas.

Under the no action/*status quo* management measure Alternative 2A, one would expect neutral impacts to fishing communities relative to the baseline conditions. Under gear restriction Alternatives 2B and 2C, direct negative economic impacts to fishing communities would be expected resulting from reduced access to current fishing grounds near the shelf/slope break. Alternative 2B, prohibition on all bottom-tending gear types, would be expected to result in greater negative impacts compared to Alternative 2C (prohibition on mobile bottom-tending gear only). For both alternatives, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort around the heads of the canyons typically takes place in very strategic, specific areas around the bights of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (under the Council preferred broad and discrete zones). These preferred boundary options in combination with the gear restriction alternatives are expected to reduce the negative impacts to fishing communities.

Sub-alternatives under Alternative 2B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 2B-1) and the golden tilefish bottom longline fishery (Alt. 2B-2). These exemptions would not be necessary under Alternative 2C (prohibition on mobile bottom tending gear).

Red Crab Exemption (Alt. 2B-1)

The exemption for red crab was proposed given the small overall scope of the red crab fishery (see Section 6.4) and because all red crab effort takes place at depths entirely within all of the proposed broad zone areas. As described in Section 6.4.7, there are currently five limited access permit issued for red crab, three of which are currently active: two active full-time vessels and one active part-time vessel. Traps are set along the 350 fathom (640 meter) depth contour, which falls entirely within all of the proposed broad zone designations. This depth is targeted because red crabs segregate by sex and depth, and take of female crabs is prohibited, so targeting this depth allows for male-only harvest. Given this targeted depth, the red crab fishery would have no ability to displace effort within the Mid-Atlantic region to avoid broad zone restricted areas. The fishery would still be able to operate in the New England Council region.

When considering the exemption alternative alone, the existing economic baseline conditions for the red crab fishery specifically would remain unchanged under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 2A), the combination of Alternative 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 2C (prohibitions on only mobile bottom-tending gear). In this sense, the impacts resulting specifically from allowing red crab fishing would be functionally equivalent under all of these alternatives. However, when considered in combination with Alternative 2B, overall negative economic impacts resulting from Alternative 2B would be expected to be lessened by the simultaneous implementation of Alternative 2B-1. Thus, overall, the expected economic impacts of this exemption alternative are positive.

Under Alternative 2B (with no exemption), impacts to the red crab fishery would be expected to be high direct negative, as the fishery would be restricted to operating in the New England Council region (unless otherwise allowed to access Mid-Atlantic fishing grounds through an Exempted Fishing Permit). The Council considered the potential impacts to deep sea corals in combination with the practicality of restricting the red crab fishery throughout half of its operating range, and determined that an exemption for this fishery was warranted; thus the Council's preferred alternatives include Alternative 2B-1.

Golden Tilefish Exemption (Alt. 2B-2)

The golden tilefish bottom longline fishery was also considered for an exemption given the relatively small footprint of this fishery within any of the broad zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around two or three of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered in the event that a 200m or 300m broad zone was selected, as tilefish longline effort currently occurs at those depths. Industry members indicated that an exemption would likely be unnecessary if a deeper broad zone was designated, as virtually no tilefish longline effort currently takes place beyond 300m.

As for red crab, when considering the exemption alternative alone, the existing economic baseline conditions for the tilefish fishery specifically would remain unchanged under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 2A), the combination of Alternative 2B and 2B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and Alternative 2C (prohibitions on only mobile bottom-tending gear). In this sense, the impacts resulting specifically from allowing tilefish fishing would be functionally equivalent under all of these alternatives. However, when considered in combination with Alternative 2B, overall negative economic impacts resulting from Alternative 2B would be expected to be lessened by the simultaneous implementation of Alternative 2B-1. Thus, overall, the expected economic impacts of this exemption alternative are positive.

Under Alternative 2B (with no exemption), impacts to the tilefish fishery would be expected to range from neutral to moderate direct negative, depending on the designation boundary selected in combination. In combination with the deeper broad zones (Alternatives 1D and 1E), an exemption would have no economic impact as the fishery does not operate at these depths. For the other broad zone designation options (Alternatives 1B, 1C, or 1F), some tilefish effort would be restricted and displaced unless otherwise allowed through an Exempted Fishing Permit. The tilefish fishery has more ability to displace effort compared to the red crab fishery, and a more limited area of prime fishing grounds that overlaps with the proposed areas, thus the magnitude of negative economic impacts resulting from the lack of an exemption would be less than for red crab.

Section 7.4.2.4 summarizes the expected impacts to human communities of gear restriction alternatives in combination with broad zone designation alternatives.

VMS Requirement Alternative

In addition to the gear specific restrictive measures within the proposed broad coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone.

Under Alternative 2D (Council non-Preferred), vessels would be required to use an approved VMS unit as a condition for operating within the broad coral zone. This alternative (Alternative 2D) could be implemented alone or in combination with any of the gear restriction alternatives above (if gear restriction alternatives are also selected). If implemented in combination with gear restriction alternatives, the requirement for vessels to use VMS units when operating in the broad close zone could enhance the enforceability of coral restrictive gear zones. Potential economic impacts of this measures are mixed with an uncertain net impact. However, as indicated in Section 5.2, most vessels operating in these areas are already required to use VMS as such overall low economic impacts are expected. However, for vessels that may not have a VMS system, the costs to initially equip the vessel are approximately $1,700-$3,300, plus operating costs for the unit of approximately $40-$100 per month.

Transit Alternatives

Under Alternative 2E (Council Preferred), vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). In combination with gear restriction alternatives, this measures would be expected to generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas.

Under Alternative 2F (Council non-Preferred), vessels would be allowed to transit through gear-restricted broad coral areas if they submit a VMS declaration specific to transit prior to crossing into designated deep sea coral zones. The NMFS has a system in place to process VMS declarations from a variety of fisheries, and it is not expected that this alternative would substantially increase operating cost for the agency. However, the NMFS would have to create a "transit" VMS declaration. In combination with gear restriction alternatives (2B or 2C), this alternative could generate slight positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas. In addition, this alternative would enhance the enforceability of coral restrictive gear zones. However, the use of VMS has an associated cost that make the overall economic impacts of this alternative more uncertain, and likely to range from slight negative to slight positive.

Potential economic impacts to fishery participants are mixed with an uncertain net impact. The cost of transmitting a report via VMS is approximately $0.60 per transmission. There is a wide range of fishing activity for the species harvested in the potential area considered for closure, so multiplying average days fished by $0.60 per day would not be illustrative for many vessels. Most vessels impacted by this provision would know how many times they transit through the proposed close areas in a year, so could potentially calculate the cost of their total likely transit declarations to determine an annual impact on their business. For example, if a vessel were to make a transit declaration 100 times in a year, then they would have $60 in additional annual costs associated with this measure. Each VMS report is estimated to take less than 5 minutes to complete.

Overall economic impacts are expected to be neutral to slight negative for Alternative 2F (requiring use of VMS for transit) and slight positive for Alternative 2E (transit with gear stowage) when implemented in combination with gear restriction alternatives.

7.4.2.3 Additional Analysis of Economic Impacts

In addition to the economic analysis presented above, the overall impacts of proposed measures and their impacts on vessels were evaluated in Section 9.9. This analysis is summarized here to provide additional support for the impacts analysis under NEPA. Due to the number of broad/discrete zone designations and management measure within them presented in this document, a subset of these alternatives were further analyzed to assess potential economic impacts. The subset of broad coral zone alternatives selected for analysis here were chosen as they would provide information on the potential economic changes between the most restrictive and least restrictive combined designations. The same approach used in the VTR Revenue Mapping Model was employed in Section 9.9 to derive VTR-point data. However, in this analysis, VTR data for years 2012-2014 were used to assess revenue impacts associated with the evaluated combined designations and measures. In this section, a summary of overall economic impacts and impacts on vessels is presented. For details on impacts of combined designations on specific species and small business entities see section 9.9.

To simplify analysis and comparison of various combinations, two broad zone alternatives were compared in this analysis: Alternative 1B (200m broad zone) and Alternative 1F (Council preferred broad zone). These two zones represent coverage of the largest broad zone area for evaluation of a potential range of impacts. The overall potential economic impacts on vessels, associated with the designation of the broad zone under Alternative 1B (landward boundary approximating 200 meter depth contour) would be larger than the impacts associated with the implementation of the Council preferred Alternative 1F (landward boundary simplified between 400 meter and 500 meter depth contour), if bottom-tending gear restricted management measure measures are also implemented (when compared to current conditions; Appendix Tables D1-D3 and Figures D1-D9). Table 86 shows the average revenues generated under each of the analyzed combined designations. The average revenues in Table 86 show the maximum potential average loss in revenues, by combined designations, if they would had been implemented in 2012-2014 (that is given recent fishing activity).

In general terms, Council preferred combined designations (Area 1F + Alternative 2B and Area 1F + Alternative 2B-1) are associated with two of the four smallest overall potential revenue reductions (amongst the broad zone options), when compared to current conditions (Table 86). When comparing combined designations to existing conditions, Area 1B + Alternative 2C would have the largest average potential revenue reduction per vessel, followed by Area 1B + Alternative 2B, Area 1B + Alternative

2B-2; Area 1B + Alternative 2B-1, Area 1F + Alternative 2C; Area 1F + Alternative 2B (Council preferred), Area 1F + Alternative 2B-2, and Area 1F + Alternative 2B-1 (Council preferred).

The largest overall potential revenue losses, across broad zones, are associated with the combined designations that would prohibit the use of all bottom-tending mobile gear (Area 1B + Alternative 2B and Area 1F+ Alternative 2B). However, on a per vessel level, the largest revenue reductions are associated with the combined designations that would prohibit the use of all mobile-tending gear (Area 1B + Alternative 2C and Area 1F + Alternative 2C), when compared to current conditions (Table 86).

Lastly, on a per vessel level, revenue losses associated with the combined designations (within the proposed closed area and impacted gear only) were larger under Alternative 1B when compared to Alternative 1F, ranging from 4.0% to 5.9% versus 3.4% to 4.8%, when compared to current conditions. However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion; ranging from 1.3% to 1.6% (Alternative 1B) versus 1.0% to 1.2% (Alternative 1F; Appendix Tables D1 and D3).

Table 86 shows the maximum potential average loss in revenues, by combined designations, if they would had been implemented in 2012-2014. These revenue reductions or losses are equivalent to maximum potential impacts. However, as described in the sections above, it would be expected that as fishermen redirect fishing effort and/or modify fishing practices would substantially reduce and potentially eliminate vessel's revenue losses.

Table 86: Summary of average total revenues inside broad deep sea zone coral combined designations, 2012-2014.

Combined designation	Area Size (km^2)	Average revenues generated in the combined designation, 2012-2014	Per vessel average revenues generated in the combined designation, 2012-2014	Average number of vessels that landed in the combined designation, 2012-2014
Area 1B + Alternative 2B	100,372	$18,224,204	$37,498	486
Area 1B + Alternative 2B-1		$17,356,859	$35,936	483
Area 1B + Alternative 2B-2		$17,534,543	$36,378	482
Area 1B + Alternative 2C		$16,464,520	$40,821	403
Area 1F + Alternative 2B	98,831	$14,417,898	$31,275	461
Area 1F + Alternative 2B-1		$13,686,228	$29,883	458
Area 1F + Alternative 2B-2		$14,049,522	$30,765	457
Area 1F + Alternative 2C		$13,196,502	$34,158	386

Note: See Appendix Tables D1 and D3 for information on a yearly basis.

7.4.2.4 Summary of Broad Zone Impacts

A summary of expected social and economic impacts from various combinations of designation alternatives (Alts. 1A through 1F) and gear restriction and exemption alternatives (Alts. 2A through 2C) are shown in Table 87.

Under Alternative 1A (No Action/*Status Quo)* no action would be taken to designate a broad deep sea coral zone. This alternative would not be expected to affect fishing effort or the spatial and/or temporal distribution of current fishing effort. Thus, neutral economic impacts would be expected for this alternative relative to baseline conditions.

If implemented in combination with gear restriction alternatives (Alts. 2B or 2C), all of the action alternatives for broad zone designations would be expected to result in overall neutral to moderate negative economic impacts for fishing businesses, depending on the fishery and the ability to redistribute effort. Higher impacts are expected for the red crab fishery absent an exemption. These impacts may be direct, through the increased costs associated with avoiding closed areas, or indirect, in terms of opportunity costs and/or reductions in efficiency resulting from fishing in different areas that may not be preferred fishing grounds for a given target species. The magnitude of impacts is complicated to assess, given that the vast majority of the proposed broad coral zones are not currently experiencing fishing activity. In addition, the preferred alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity.

In general, the fisheries most likely to be impacted by the alternatives include trawl vessels targeting squid and whiting, and the red crab trap fishery. The areas where trawl vessels are most likely to be impacted include the shallower portions of the broad zones (near the shelf/slope break), where some fishing effort currently occurs. As described previously, the mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons. Industry representatives have indicated that some of the boundary alternatives proposed for broad zones would cut off important areas for fishing and/or setting and deploying gear for trawl fisheries. These conversations led to an April 2015 Council workshop where the Council's Ecosystems and Ocean Planning Advisory Panel and the Mackerel, Squid, Butterfish Advisory Panel, along with other industry participants and coral experts, negotiated and redrew boundary proposals for discrete coral zones. These boundaries were adopted in the Council's final action for both the discrete and the broad coral zones (i.e., both Alternatives 1F and 3B-5 follow these boundaries on the landward side). These boundaries were developed by consensus among these groups and were designed to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. This is expected to lessen the economic impacts of this proposed broad zone.

For the red crab trap fishery, it is worth considering the impacts specifically to this fishery given the limited ability to displace effort as described above. The Council's preferred alternatives include an exemption for this fishery, such that expected economic impacts for this fishery would be neutral under this alternative (2B-1). As previously discussed, under Alternative 2B (prohibition on all bottom-tending gear) and absent an exemption under Alternative 2B-1, the economic impacts specific to the red crab fishery would be expected to be high negative, as a substantial portion of their fishing effort takes places within the broad zones (regardless of designation option). Thus, impacts specifically to the red crab fishery would range from neutral to high negative under various gear restriction and exemption alternative combinations. When considering the overall impacts described below, these higher impacts for red crab raise the overall level of expected negative economic impacts.

For fisheries other than red crab, restrictions within the deeper portions of the various proposed broad zone options (below about 500m) are expected to have very little economic impacts as little or no effort currently occurs here and any restricted effort is expected to be easily displaced. Gear restrictions in these deeper areas are being proposed to cover these deeper areas as a precautionary measure against the future expansion of effort. The likelihood and extent of potential future fishing effort (if unrestricted) in these areas is difficult to predict, but would be expected to be relatively minor if it occurred at all, as high costs associated with developing new deep sea fisheries and operating far from shore would be expected to deter this type of expansion. Thus, the economic impacts to fishing communities associated with gear restrictions in the broad zones are much more limited than would appear by considering the size of the restricted area alone.

In combination across designations and gear alternatives, the overall magnitude of the direct and indirect impacts to fishing operations resulting from the implementation of broad coral zones with bottom fishing restrictions likely ranges from neutral to moderate negative, depending on the range of current operations and ease of redistributing effort for a given fishery. Because more current fishing activity takes place within the 200m and 300m broad zones (Alternatives 1B and 1C, respectively), these designations would be expected to result in slight to moderate direct and indirect negative impacts. Alternatives 1D and 1F, according to the analysis described in the sections above, can be expected to result in similar negative economic impacts, ranging from slight to moderate negative, though to a lesser extent than those resulting from Alternatives 1B and 1C. Because very little fishing activity occurs deeper than 500m, the impacts expected from Alternative E are expected to be neutral to slight negative. Overall, the order of negative impacts to be expected from the designation alternatives is: 1B, 1C, 1D = 1F, 1E, and finally, 1A.

The prohibition on all bottom-tending gear (Alt. 2B) would be expected to have greater negative economic impacts than a prohibition on mobile bottom-tending gear (Alt. 2C). In particular, the red crab fishery would experience high negative impacts from Alternative 2B without a simultaneous adoption of sub-alternative 2B-1 (exemption for the red crab fishery), as a substantial portion of the effort for this fishery occurs entirely within the broad zone. The number of other fisheries and spatial extent of bottom-tending passive gear types in these areas is limited. Any fishing exemption alternatives implemented to a restriction on all bottom-tending gear would likely result in neutral impacts to that specific fishery relative to the *status quo*; however, these exemptions would reduce the negative economic impacts associated with gear restricted areas for these fisheries and overall result in moderate positive economic impacts in combination with alternative 2B.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect positive impacts from the designation of gear-restricted broad coral zones associated with the protection of deep sea coral ecosystems. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

For enforcement and transit alternatives (Alts. 2D through 2F), a summary of expected impacts in combination with the various designation alternatives is shown in Table 88. The impacts of these action alternatives are not expected to vary based on the broad zone designation implemented, and would be as described above in Section 7.4.2.2.

Table 87: Summary of impacts to human communities for broad zone designation alternatives in combination with broad zone gear restriction alternatives. BTG= bottom-tending gear.

<table>
<tr><th>Alt.</th><th>2A (No action/Status quo)</th><th>2B (Prohibit all BTG; Council preferred)</th><th>Sub-Alt 2B-1 (Exempt red crab fishery under 2B; Council preferred)</th><th>Sub-Alt 2B-2 (Exempt tilefish fishery under 2B)</th><th>2C (Prohibit mobile BTG)</th></tr>
<tr><td>1A (No broad zone)</td><td>Neutral impacts relative to baseline conditions, which are complex and variable.</td><td colspan="4">NA: These would not be reasonable combinations of alternatives given that gear restrictions within a broad zone would not be implemented unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">Broad zone would be designated, but no management measures would be applied. Neutral impacts relative to the baseline conditions. Current baseline conditions for human communities are complex and variable. Slight indirect positive impacts for conservation community.</td><td rowspan="3">Slight to moderate direct and indirect negative impacts for most fisheries, depending on ability to redistribute effort. Alternative 1B slightly more negative than 1C, followed by 1D=1F. High direct negative impacts expected for red crab fishery (absent exemption). Indirect positive impacts to conservation community.</td><td rowspan="5">Neutral impacts relative to status quo for red crab fishery; Overall moderate positive impacts in combination with 2B due to lessened impacts associated with Alt. 2B. Impacts would be the same under all designation alternatives 1B-1F, as red crab effort occurs exclusively in deeper waters.</td><td rowspan="2">Neutral impacts relative to status quo for tilefish fishery; Overall moderate positive impacts in combination with 2B due to lessened impacts associated with Alt. 2B.</td><td rowspan="3">Slight to moderate direct and indirect negative impacts depending on ability to redistribute effort. Alternative 1B slightly more negative than 1C, followed by 1D=1F. Indirect positive impacts to conservation community.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td><td rowspan="2">Tilefish fishery does not currently operate at these depths; thus, neutral impacts expected impacts relative to status quo/baseline conditions.</td></tr>
<tr><td>1E (500m broad zone)</td><td>Neutral to slight direct and indirect negative impacts expected for most fisheries, depending on ability to redistribute effort. High direct negative impacts expected for red crab fishery (absent exemption). Indirect positive impacts to conservation community. Less negative impacts than other designation alts.</td><td>Neutral to slight direct and indirect negative impacts depending on ability to redistribute effort. Indirect positive impacts to conservation community.</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td><td>Slight to moderate direct and indirect negative impacts for most fisheries, depending on ability to redistribute effort. Alternative 1B slightly more negative than 1C, followed by 1D=1F. High direct negative impacts expected for red crab fishery (absent exemption). Indirect positive impacts to conservation community.</td><td>Neutral impacts relative to status quo for tilefish fishery; Overall moderate positive impacts in combination with 2B due to lessened impacts associated with Alt. 2B.</td><td>Slight to moderate direct and indirect negative impacts depending on ability to redistribute effort. Alternative 1B slightly more negative than 1C, followed by 1D=1F.Indirect positive impacts to conservation community.</td></tr>
</table>

Table 88: Summary of impacts to human communities of broad zone designation alternatives in combination with broad zone VMS and vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>2D (Require VMS within broad zones)</th><th>2E (Transit with gear stowage; Council preferred)</th><th>2F (Transit with VMS declaration)</th></tr>
<tr><td>1A (No broad zone designation)</td><td colspan="3">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within a broad zone would not be necessary or practical unless a broad zone is designated.</td></tr>
<tr><td>1B (200m broad zone)</td><td rowspan="5">Neutral to slight negative economic impacts to fishing businesses expected from VMS requirements due to cost of obtaining and operating VMS units. Costs of obtaining units are limited as most affected vessels already use VMS. Impacts variable depending on frequency of transit.</td><td rowspan="5">Positive impacts in combination with 2B or 2C, due to allowing transit through closed areas rather than requiring crew time and fuel to transit around closed areas. Alt. 2E more positive in magnitude vs. Alt. 2F.</td><td rowspan="5">Slight negative to slight positive economic impacts to fishing businesses expected from VMS transmission. Slight negative impacts expected due to cost of obtaining and operating VMS units. Costs of obtaining units are limited as most affected vessels already use VMS. Slight positive economic impacts expected from allowing transit through closed areas. Impacts variable depending on frequency of transit.</td></tr>
<tr><td>1C (300m broad zone)</td></tr>
<tr><td>1D (400m broad zone)</td></tr>
<tr><td>1E (500m broad zone)</td></tr>
<tr><td>1F (450 m broad zone; Council preferred)</td></tr>
</table>

7.4.3 Discrete Coral Zones and Management Measures

7.4.3.1 Discrete Zone Designation Alternatives

VTR Revenue Mapping Model

Proposed discrete zones were analyzed first using the VTR revenue mapping model. The data in Table 90 are also illustrated in revenue intensity maps shown in Figure 44 through Figure 49 in Section 7.4.2. Both the values in the tables and the revenue intensity displayed in the figures are a direct product of the model. The tables show cumulative revenue over the time period 2007-2012, in a given area, for a given species-gear combination. The maps reveal spatial concentrations of effort that provide additional context for the estimates in the tables. When interpreting the maps, the appropriate interpretation is that most revenues would be contained by the areas of intense color, but it would not be correct to interpret the model as saying high effort definitely occurred in all areas of intense color (see description of caveats in Section 7.4.1 above). It should also be noted that each map uses different scales based on standard deviations of the data for each species-gear combination; thus, the color intensity of the maps should not be directly compared across species. In other words, the "high" value for each map is relative to that specific fishery.

For proposed discrete zone boundary options, as with the broad zones, the relative impacts of the boundary options are associated with the size of the combined proposed areas and the extent to which these areas overlap with current fishing effort. Alternative 3B-1 would be expected to have the lowest negative economic impacts, as this alternative only includes three canyons for designation. Alternative 3B-3 (GSSA boundaries) would have slightly more negative economic impacts, followed by the Council-preferred Alternative 3B-5. The FMAT and NGO Coalition boundaries (Alternatives 3B-2 and 3B-4 respectively), would have comparable impacts that would be higher than the other boundary proposal alternatives (Table 89).

Table 89: VTR model-estimated cumulative revenue over 2007-2012 (USD) by discrete zone boundary alternative (all discrete zones combined), shown as a percentage of coastwide revenues for each species-gear combination, Maine through North Carolina.

Species-Gear Combination	3B-1 (Advisor 2013)	3B-2 (FMAT)	3B-3 (GSSA)	3B-4 (NGO)	3B-5 (Council preferred)
Scallop Dredge	0.07%	0.60%	0.33%	0.56%	0.48%
Red Crab Trap	1.87%	11.50%	6.78%	11.16%	9.81%
Squid BOT	1.14%	9.11%	4.99%	8.55%	7.18%
Whiting BOT	0.02%	2.52%	1.45%	2.28%	1.60%
FSB BOT	0.22%	3.10%	1.87%	2.88%	2.29%
Tilefish Longline	0.07%	6.52%	3.59%	5.90%	4.27%

Table 90: VTR model-estimated revenue (USD) by proposed discrete zone for Council preferred boundary options (Alt. 3B-5), shown as a percentage of coastwide revenues for each species-gear combination, 2007-2012, Maine through North Carolina. BOT = bottom otter trawl; BLL = bottom longline; DRG = dredge.

DISCRETE ZONE	AREA (km^2)	BOT-SQUID	DRG-SCALL	BOT-FLUKE	POT-RCRAB	LL-TILE	BOT-HAKE	Total	Mobile gears only (trawl/ dredge)
Mey-Lindenkohl Slope	2,495	1.68%	0.15%	0.92%	2.71%	1.06%	0.23%	0.33%	0.31%
Hudson Canyon	607	0.62%	0.02%	0.26%	0.91%	2.07%	0.61%	0.11%	0.09%
Wilmington Canyon	243	1.36%	0.06%	0.13%	0.70%	0.11%	0.01%	0.17%	0.16%
Baltimore Canyon	198	0.61%	0.04%	0.11%	0.70%	0.02%	0.01%	0.09%	0.09%
Warr & Phoenix Canyon Complex	481	0.54%	0.04%	0.09%	0.89%	0.02%	0.01%	0.08%	0.08%
Accomac & Leonard Canyons	486	0.27%	0.04%	0.08%	0.73%	0.01%	0.01%	0.06%	0.06%
North Heyes & South Wilmington Canyon	175	0.48%	0.02%	0.05%	0.39%	0.02%	0.00%	0.06%	0.06%
Washington Canyon	547	0.21%	0.04%	0.10%	0.62%	0.00%	0.00%	0.06%	0.06%
Spencer Canyon	143	0.33%	0.02%	0.06%	0.20%	0.00%	0.00%	0.04%	0.04%
South Vries Canyon	129	0.29%	0.02%	0.03%	0.24%	0.01%	0.00%	0.04%	0.04%
Norfolk Canyon*	549	0.32%	0.01%	0.03%	0.78%	0.00%	0.00%	0.04%	0.03%
Ryan & McMaster Canyons	365	0.11%	0.00%	0.16%	0.28%	0.20%	0.29%	0.03%	0.02%
Emery & Uchupi Canyons	324	0.10%	0.00%	0.12%	0.25%	0.26%	0.18%	0.02%	0.02%
Jones & Babylon Canyons	159	0.07%	0.00%	0.06%	0.17%	0.42%	0.11%	0.02%	0.01%
Block Canyon	201	0.04%	0.00%	0.07%	0.11%	0.09%	0.14%	0.01%	0.01%
All Discrete Zones	**7,099**	7.03%	0.47%	2.28%	9.66%	4.27%	1.60%	1.16%	1.09%
Coastwide		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

*Norfolk Canyon revenue estimates for trawl and dredge fisheries were adjusted to exclude the Norfolk Canyon Tilefish GRA, which is closed to mobile bottom-tending gear.

Observer Data

Observer data from NEFOP were analyzed for bottom trawl, bottom longline, and sink/anchored gillnet gear types for years 2000 through 2013 for the Mid-Atlantic region. Records with incomplete geographic coordinates were removed. Observed hauls were analyzed relative to proposed discrete zones. While coverage of trips is much lower with the observer data compared to the Vessel Trip Report (VTR) data, the observer data generally provides very precise location data for each tow/set. Observer coverage also varies by fishery and by year, however, aggregating the data over many years likely reveals relative patterns in fishing effort. Accordingly, NEFOP data was used to consider effort across the potential coral zones.

Bottom Trawl Effort

Within the Mid-Atlantic management region, there were 25,073 total observed hauls (on 3,967 trips) using bottom trawl gear within this time period. Table 91 and Figure 50 show bottom trawl hauls intersecting each of the proposed discrete coral zones, with associated number of trips and the average depth taken at the start of each haul. Depth information is meant to provide an approximation of the depth at which these fisheries are prosecuted, but may not provide a complete picture (especially for longer hauls), given that it is based on haul start location.

Hauls were analyzed by selecting those intersecting each broad zone, and a few records may be duplicated across discrete zones f they intersect more than one. In the vicinity of the proposed coral zones, bottom trawl effort is concentrated along the continental shelf and shelf break, and at the heads of canyons (Figure 50).

Table 91: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by target species, intersecting the discrete zones under alternative 3B-2 (FMAT boundaries).

Canyon or Complex TARGET SPECIES	**Trips**	**Hauls**	**Avg. Haul Start Depth**	
			meters	**fathoms**
Block Canyon	**26**	**51**	**329.7**	**180.3**
GROUNDFISH, NK	--	3	249.9	136.7
HAKE, SILVER (WHITING)	--	14	360.9	197.4
MONKFISH (GOOSEFISH)	--	33	327.5	179.1
SQUID, ATL LONG-FIN	--	1	206.7	113.0
Ryan-McMaster Canyons	**8**	**13**	**261.9**	**143.2**
HAKE, SILVER (WHITING)	--	4	334.7	183.0
MONKFISH (GOOSEFISH)	--	5	303.6	166.0
SQUID, ATL LONG-FIN	--	4	137.2	75.0
Emery-Uchupi Canyons	**6**	**12**	**365.2**	**199.7**
HAKE, SILVER (WHITING)	--	7	368.1	201.3
MONKFISH (GOOSEFISH)	--	2	299.9	164.0
WHITING, BLACK (HAKE, OFFSHORE)	--	3	401.7	219.7
Jones-Babylon Canyons	**4**	**6**	**390.8**	**213.7**
HAKE, SILVER (WHITING)	--	4	388.6	212.5
WHITING, BLACK (HAKE, OFFSHORE)	--	2	395.0	216.0
Hudson Canyon	**197**	**488**	**154.1**	**84.3**
DORY, BUCKLER (JOHN)	--	1	135.3	74.0
FLOUNDER, SUMMER (FLUKE)	--	15	119.4	65.3
HAKE, RED (LING)	--	1	40.2	22.0
HAKE, SILVER (WHITING)	--	41	214.0	117.0
MONKFISH (GOOSEFISH)	--	2	138.1	75.5
SCUP	--	21	127.8	69.9

Canyon or Complex TARGET SPECIES	Trips	Hauls	Avg. Haul Start Depth	
			meters	fathoms
SEA BASS, BLACK	--	3	134.1	73.3
SHRIMP, ROYAL RED	--	12	356.3	194.8
SQUID, ATL LONG-FIN	--	373	137.0	74.9
SQUID, NK	--	2	139.9	76.5
SQUID, SHORT-FIN	--	5	186.2	101.8
WHITING, BLACK (HAKE, OFFSHORE)	--	12	376.0	205.6
Mey-Lindenkohl Slope	**172**	**571**	**153.2**	**83.8**
FLOUNDER, SUMMER (FLUKE)	--	66	109.8	60.0
HAKE, SILVER (WHITING)	--	14	246.2	134.6
SCUP	--	13	113.8	62.2
SEA BASS, BLACK	--	14	105.9	57.9
SHRIMP, ROYAL RED	--	1	365.8	200.0
SQUID, ATL LONG-FIN	--	349	141.7	77.5
SQUID, NK	--	8	151.1	82.6
SQUID, SHORT-FIN	--	104	212.7	116.3
WHITING, BLACK (HAKE, OFFSHORE)	--	2	343.8	188.0
Spencer Canyon	**91**	**248**	**169.9**	**92.9**
FLOUNDER, SUMMER (FLUKE)	--	1	118.9	65.0
SCUP	--	4	134.9	73.8
SQUID, ATL LONG-FIN	--	119	156.8	85.7
SQUID, NK	--	6	133.8	73.2
SQUID, SHORT-FIN	--	118	186.5	102.0
Wilmington Canyon	**112**	**215**	**156.8**	**85.8**
FLOUNDER, SUMMER (FLUKE)	--	15	86.6	47.3
MACKEREL, ATLANTIC	--	1	76.8	42.0
SCUP	--	4	107.9	59.0
SEA BASS, BLACK	--	5	99.1	54.2
SQUID, ATL LONG-FIN	--	108	154.3	84.4
SQUID, NK	--	1	168.2	92.0
SQUID, SHORT-FIN	--	81	180.1	98.5
North Heyes-South Wilmington Canyons	**33**	**49**	**183.2**	**100.2**
SQUID, ATL LONG-FIN	--	15	173.6	94.9
SQUID, SHORT-FIN	--	34	187.4	102.5
South Vries Canyon	**58**	**121**	**183.4**	**100.3**
SQUID, ATL LONG-FIN	--	41	169.4	92.6
SQUID, SHORT-FIN	--	80	190.5	104.2
Baltimore Canyon	**117**	**267**	**150.3**	**82.2**
FLOUNDER, SUMMER (FLUKE)	--	80	81.3	44.5
SEA BASS, BLACK	--	13	89.0	48.7
SQUID, ATL LONG-FIN	--	89	152.6	83.4
SQUID, SHORT-FIN	--	85	222.4	121.6
Warr-Phoenix Canyon Complex	**30**	**72**	**185.8**	**101.6**
SQUID, ATL LONG-FIN	--	43	176.2	96.3
SQUID, SHORT-FIN	--	29	200.1	109.4
Accomac-Leonard Canyons	**37**	**87**	**168.6**	**92.2**
FLOUNDER, SUMMER (FLUKE)	--	5	66.2	36.2
SQUID, ATL LONG-FIN	--	40	161.7	88.4
SQUID, SHORT-FIN	--	42	187.4	102.5
Washington Canyon	**47**	**93**	**150.3**	**82.2**
FLOUNDER, SUMMER (FLUKE)	--	19	93.1	50.9
SCUP	--	1	107.9	59.0
SEA BASS, BLACK	--	11	104.9	57.4

Canyon or Complex TARGET SPECIES	Trips	Hauls	Avg. Haul Start Depth	
			meters	fathoms
SQUID, ATL LONG-FIN	--	27	143.5	78.5
SQUID, SHORT-FIN	--	35	202.1	110.5
Norfolk Canyon	**50**	**178**	**193.1**	**105.6**
CROAKER, ATLANTIC	--	1	20.1	11.0
FLOUNDER, SUMMER (FLUKE)	--	2	77.7	42.5
SQUID, ATL LONG-FIN	--	49	174.7	95.5
SQUID, SHORT-FIN	--	126	203.5	111.3

Table 92: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by target species, intersecting the advisor-proposed discrete zones under sub-alternative 3B-1.

Canyon or Complex	Trips	Hauls	Avg. Haul Start Depth	
			meters	Fathoms
Baltimore Canyon	**34**	**45**	**192**	**105**
FLOUNDER, SUMMER (FLUKE)	--	8	77	42
SEA BASS, BLACK	--	1	106	58
SQUID, ATL LONG-FIN	--	12	153	83
SQUID, SHORT-FIN	--	24	254	139
Mey-Lindenkohl Slope (Depth-based)*	**24**	**30**	**182**	**99**
FLOUNDER, SUMMER (FLUKE)	--	2	131	72
HAKE, SILVER (WHITING)	--	2	221	121
SCUP	--	1	57	31
SQUID, ATL LONG-FIN	--	16	135	74
SQUID, SHORT-FIN	--	9	281	154
Mey-Lindenkohl Slope Straight*	**69**	**151**	**179**	**98**
FLOUNDER, SUMMER (FLUKE)	--	8	125	69
HAKE, SILVER (WHITING)	--	1	132	72
SCUP	--	4	113	62
SEA BASS, BLACK	--	1	90	49
SQUID, ATL LONG-FIN	--	83	156	85
SQUID, SHORT-FIN	--	54	229	125
Norfolk Canyon	**36**	**86**	**209**	**114**
CROAKER, ATLANTIC	--	1	20	11
FLOUNDER, SUMMER (FLUKE)	--	2	59	32
SQUID, ATL LONG-FIN	--	20	186	102
SQUID, SHORT-FIN	--	63	224	122

*Differences in hauls and trips in the depth-based vs. straight line option for advisor-proposed boundaries of Mey-Lindenkohl are largely due to a very small area in the western corner of the proposed area, where the straight-line boundary extends slightly into an area where the depth-based boundary does not.

Gillnet Effort

As described in Section 7.4.2.1, observed gillnet effort for the Greater Atlantic Region from 2000-2013 has very little overlap with proposed coral zones in this action. Within the Mid-Atlantic region, there were 13,928 observed hauls using gillnet gear, on 3,432 trips (Table 84). Of these observed hauls, only six intersected any of the proposed coral zones (a small fraction of one percent), and all of these intersections were for proposed broad zones (200m or 300m). These hauls occurred on two trips northeast of Block Canyon along the 300 meter depth contour (Figure 51). No observed gillnet hauls during this time period intersected any of the proposed discrete zones.

The vast majority of observed gillnet effort since 2000 has occurred in waters much shallower than the depths of any of the proposed coral zones in the Mid-Atlantic (Table 84 in Section 7.4.2). Only about

0.6% of observed gillnet trips and 0.5% of observed gillnet hauls occurred deeper than 75 fathoms (137 meters) in the Mid-Atlantic region, according to haul depth information recorded in the observer data.

Bottom Longline Effort

As described in Section 7.4.2.1, observed bottom longline effort for the Greater Atlantic Region from 2000-2013 has very little overlap with proposed coral zones in this action. For years 2000-2013, a total of 885 trips and 4,791 hauls using bottom longline gear were recorded for the Greater Atlantic Region in the NEFOP database. The majority of these records occurred within the management region of the NEFMC, and primarily targeted Atlantic cod, haddock, and other groundfish. Within the MAFMC region, a total of 130 hauls using bottom longline gear were recorded in the observer data for 2000-2013. All of these records indicated tilefish as the target species, and occurred in northern areas of the MAFMC management region between 2004 and 2008 (Table 85; Figure 52).A few observed longline hauls over this time periods intersect portions of Hudson Canyon and the Mey-Lindenkohl Slope, but appear to be concentrated mostly outside of these proposed discrete zones (Figure 52).

7.4.3.2 Discrete Zone Management Measure Alternatives

Gear Restriction and Exemption Alternatives

In general terms, human communities are expected to experience negative impacts from any alternative that reduces access to productive and currently utilized fishing grounds. The exact nature of potential impacts to human communities are variable by fishery and somewhat difficult to define, because many portions of the proposed discrete zones are currently unfished. Analysis of fishing effort (Section 7.4) and reports from industry participants indicate that little to no fishing activity currently occurs deeper than 200 fathoms, or about 365 meters (with the exception of the red crab fishery). Thus, the areas within the proposed discrete zones where fishing effort is most likely to be impacted includes primarily areas near the shelf/slope break; i.e., areas near the landward boundary of each proposed coral zone (particularly the shallower broad zone alternatives). More fishing effort takes place in or around the heads of the canyons compared to the shelf/slope break in inter-canyon areas.

Under the no action/*status quo* management measure Alternative 4A, one would expect neutral economic impacts to fishing communities. Under gear restriction Alternatives 4B and 4C, direct negative impacts to fishing communities would be expected resulting from reduced access to current fishing grounds near the shelf/slope break. Alternative 4B, prohibition on all bottom-tending gear types, would be expected to result in greater negative impacts compared to Alternative 4C (prohibition on mobile bottom-tending gear only). For both alternatives, effort for restricted gear types would be expected to shift to areas just outside the coral zone boundaries; i.e., near/around the heads of the canyons just shallower than the coral zone boundary. Input from Council industry advisors indicates that fishing effort around the heads of the canyons typically takes place in very strategic, specific areas around the bights of the canyons, in order to take advantage of the productivity of these areas resulting from the flow of nutrient rich water up from the depths of the canyons. During the April 2015 workshop to refine proposed boundaries for coral zones, advisors assisted in developing boundaries that would allow for continued fishing just outside the proposed gear restricted areas (under the Council-preferred broad and discrete zones). These preferred boundary options in combination with the gear restriction alternatives are expected to reduce the negative impacts to fishing communities.

Sub-alternatives under Alternative 4B (prohibition on all bottom-tending gear) include exemption options for the red crab trap fishery (Alt. 4B-1) and the golden tilefish bottom longline fishery (Alt. 4B-

2). These exemptions would not be necessary under Alternative 4C (prohibition on mobile bottom tending gear).

<u>Red Crab Exemption (Alt. 4B-1)</u>

The exemption for red crab was proposed given the small overall scope of the red crab fishery (see Section 6.4) and because all red crab effort takes place at depths entirely within all of the proposed broad zone areas. As described in Section 6.4.7, there are currently five limited access permit issued for red crab, three of which are currently active: two active full-time vessels and one active part-time vessel. Traps are set along the 350 fathom (640 meter) depth contour, which falls along most of all of the proposed discrete zone designations. This depth is targeted because red crabs segregate by sex and depth, and take of female crabs is prohibited, so targeting this depth allows for male-only harvest. Given this targeted depth, the red crab fishery would need to displace effort within the Mid-Atlantic region in between designation discrete zones to avoid restricted areas.

When considering the exemption alternative alone, the existing economic baseline conditions for the red crab fishery specifically would remain unchanged under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). In this sense, the impacts resulting specifically from allowing red crab fishing would be functionally equivalent under all of these alternatives. However, when considered in combination with Alternative 4B, overall negative economic impacts resulting from Alternative 4B would be expected to be lessened by the simultaneous implementation of Alternative 4B-1. Thus, overall, the expected economic impacts of this exemption alternative are positive.

Under Alternative 4B (with no exemption), impacts to the red crab fishery would be expected to be moderate to high direct negative, depending on the ability of the fishery to shift effort solely to inter-canyon areas between designated discrete zones. Fishing in between discrete zones would be logistically very difficult, as trap lines would need to be entirely hauled up and re-set in between each canyon (the vessels typically move north-south along the targeted depth contour). Thus, the economic impacts could be high even if the fishery was theoretically allowed to operate in between discrete zones. The Council considered the potential impacts to deep sea corals in combination with the practicality of restricting the red crab fishery throughout half of its operating range, and determined that an exemption for this fishery was warranted at least in the near term; thus the Council's preferred alternatives include Alternative 4B-1. The Council intends to review exemption after it has been in place for at least two years.

<u>Golden Tilefish Exemption (Alt. 2B-2)</u>

The golden tilefish bottom longline fishery was also considered for an exemption given the relatively small footprint of this fishery within any of the broad zone boundaries and the likely lower interaction rates for hook gear types with deep sea corals. This fishery is primarily concentrated around two or three of the northernmost canyons in the Mid-Atlantic Council region (primarily Hudson Canyon to Block Canyon), and primarily near the shelf/slope break. The tilefish industry asked that an exemption be considered in the event that a 200m or 300m broad zone was selected, as tilefish longline effort currently occurs at those depths. Industry members indicated that an exemption would likely be unnecessary if a deeper broad zone was designated, as virtually no tilefish longline effort currently takes place beyond 300m.

Similar to the description of red crab impacts above, when considering this exemption alternative alone, the existing economic baseline conditions for the tilefish fishery specifically would remain unchanged under any alternative or combination of alternatives that preserves fishing access for this fishery, including the no action/*status quo* alternative for gear restrictions (Alternative 4A), the combination of Alternative 4B and 4B-2 (prohibition on all bottom-tending gear with an exemption for the tilefish fishery), and Alternative 4C (prohibitions on only mobile bottom-tending gear). In this sense, the impacts resulting specifically from allowing tilefish fishing would be functionally equivalent under all of these alternatives. However, when considered in combination with Alternative 4B, overall negative economic impacts resulting from Alternative 4B would be expected to be lessened by the simultaneous implementation of Alternative 4B-1. Thus, overall, the expected economic impacts of this exemption alternative are positive.

Under Alternative 4B (with no exemption), impacts to the tilefish fishery would be expected to range from neutral to moderate direct negative, depending on the designation boundary selected in combination. As described in the analysis above, tilefish effort within the proposed areas is limited, and concentrated within certain northern canyons and at relatively shallower depths. In combination with discrete zones that do not extend far or at all into major territory fished by the tilefish fishery (Alternatives 3B-1 and 3B-3), an exemption would have small economic impacts as the fishery does not operate in these areas. Industry members have also indicated that the workshop boundaries (3B-5) would have little impact on the tilefish fishery, meaning this alternative is likely equivalent to 3B-1 and 3B-3 for the tilefish fishery. For the other discrete zone designation options (Alternatives 3B-2 and 3B-4), some tilefish effort would be restricted and displaced unless otherwise allowed through an Exempted Fishing Permit. The tilefish fishery has more ability to displace effort compared to the red crab fishery, and a more limited area of prime fishing grounds that overlaps with the proposed areas, thus the magnitude of negative economic impacts resulting from the lack of an exemption would be less than for red crab.

Section 7.4.3.4 summarizes the expected impacts to human communities of gear restriction alternatives in combination with discrete zone designation alternatives.

Transit Alternatives

Under Alternative 4D, (Council Preferred), vessels would be allowed to transit through gear-restricted discrete coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). In combination with gear restriction alternatives, these measures would be expected to generate slight positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas.

Under Alternative 4E, (Council non-Preferred), vessels would be allowed to transit through gear-restricted discrete3 coral areas if they submit a VMS declaration specific to transit prior to crossing into designated deep sea coral zones. The NMFS has a system in place to process VMS declarations from a variety of fisheries, and it is not expected that this alternative would substantially increase operating cost for the agency. However, the NMFS would have to create a "transit" VMS declaration. In combination with gear restriction alternatives, this alternative could generate slight positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas. In addition, this alternative would enhance the enforceability of coral restrictive gear zones. However, the use of VMS has an associated cost that make the overall economic impacts of this alternative more uncertain, and likely to range from slight negative to slight positive.

Potential economic impacts to fishery participants are mixed with an uncertain net impact. The cost of transmitting a report via VMS is approximately $0.60 per transmission. There is a wide range of fishing activity for the species harvested in the potential area considered for closure, so multiplying average days fished by $0.60 per day would not be illustrative for many vessels. Most vessels impacted by this provision would know how many times they transit through the proposed close areas in a year, so could potentially calculate the cost of their total likely transit declarations to determine an annual impact on their business. For example, if a vessel were to make a transit declaration 100 times in a year, then they would have $60 in additional annual costs associated with this measure. Each VMS report is estimated to take less than 5 minutes to complete.

Overall economic impacts are expected to be neutral to slight negative for Alternative 4E (requiring use of VMS for transit) and slight positive for Alternative 4D (transit with gear stowage) when implemented in combination with gear restriction alternatives.

7.4.3.3 Additional Analysis of Economic Impacts

In addition to the economic analysis presented above, the overall impacts of proposed measures and their impacts on vessels were evaluated in Section 9.9. Due to the number of broad/discrete zone designations and management measure within them presented in this document, a subset of these alternatives were further analyzed to assess potential economic impacts. The subset of discrete coral zone boundary alternatives selected for analysis here were chosen as they would provide information on the potential economic changes between the most restrictive and least restrictive combined designations. The same approach used in the VTR Revenue Mapping Model was employed in Section 9.9 to derive VTR-point data. However, in this analysis, VTR data for years 2012-2014 were used to assess revenue impacts associated with the evaluated combined designations and measures. In this section, a summary of overall economic impacts and impacts on vessels is presented. For details on impacts of combined designations on specific species and small business entities see section 9.9.

The potential loss in revenues associated with the designation of the Council preferred discrete zone boundaries (Alternative 3B-5), if bottom-tending gear restricted management measure measures are also implemented, would be larger than impacts associated with the GSSA boundaries (Alternative 3B-3) and the 2013 advisor-proposed boundaries (when compared to current conditions; Appendix Tables D4-D6 and Figures D10-21). Table 93 shows the average revenues generated under each of the analyzed combined designations. The average revenues in Table 93 show the maximum potential average loss in revenues, by combined designations, if they would had been implemented in 2012-2014 (that is given recent fishing activity).

In general terms, Council preferred combined designations (Area 3B-5 + Alternative 4B and Area 3B-5 + Alternative 4B-1) are associated with two of the three largest overall potential revenue reductions (amongst the discrete zone options), when compared to current conditions (Table 93). When comparing combined designations to existing conditions, Area 3B-5 + Alternative 4C would have the largest average potential revenue reduction per vessel, followed by Area 3B-5 + Alternative 4B (Council preferred), Area 3B-5 + Alternative 4B-2, Area 3B-5 + Alternative 4B-1 (Council preferred), Area 3B-3 + Alternative 4C, Area 3B-3 + Alternative 4B, Area 3B-3 + Alternative 4B-2, Area 3B-3 + Alternative 4B-1, Area 3B-1 + Alternative 4C, Area 3B-1 + Alternative 4B, Area 3B-1 + Alternative 4B-2, and Area 3B-1 + Alternative 4B-1 (Table 93).

The overall largest potential revenue losses, across discrete zones, are associated with the combined designations that would prohibit the use of all bottom-tending mobile gear (Area 3B-5 + Alternative 4B, Area 3B-3 + Alternative 4B, and Area 3B-1 + Alternative 4B). However, on a per vessel level, the largest revenue reductions are associated with the combined designations that would prohibit the use of all mobile-tending gear, when compared to current conditions (Area 3B-5 + Alternative 4C, Area 3B-3 + Alternative 4C, and Area 3B-1 + Alternative 4C (Table 93).

Lastly, on a per vessel level, revenue losses associated with the combined designations (within the proposed closed area and impacted gear only) were 2% or less across all combined designations (when compared to current conditions). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion (of 0.4% or less; Appendix Tables D4-D6).

Table 93 shows the maximum potential average loss in revenues, by combined designations, if they would had been implemented in 2012-2014. These revenue reductions or losses are equivalent to maximum potential impacts. However, it would be expected that as fishermen redirect fishing effort and/or modify fishing practices would substantially reduce and potentially eliminate vessel's revenue losses.

Table 93: Average total revenues inside discrete deep sea zone coral combined designations, 2012-2014.

Combined designation	Area Size (Km^2)	Average revenues generated in the combined designation, 2012-2014	Per vessel average revenues generated in the combined designation, 2012-2014	Average number of vessels that landed in the combined designation, 2012-2014
Area 3B-1 Alternative 4B	5,723	$2,180,849	$7,150	305
Area 3B-1 Alternative 4B-1		$2,081,787	$6,901	302
Area 3B-1 Alternative 4B-2		$2,124,101	$7,026	302
Area 3B-1 Alternative 4C		$2,011,400	$7,368	273
Area 3B-3 Alternative 4B	4,838	$3,568,680	$8,173	437
Area 3B-3 Alternative 4B-1		$3,349,561	$7,724	434
Area 3B-3 Alternative 4B-2		$3,421,920	$7,909	433
Area 3B-3 Alternative 4C		$3,182,477	$8,427	378
Area 3B-5 Alternative 4B	7,099	$4,886,755	$11,208	436
Area 3B-5 Alternative 4B-1		$4,600,231	$10,624	433
Area 3B-5 Alternative 4B-2		$4,710,331	$10,904	432
Area 3B-5 Alternative 4C		$4,394,441	$11,667	377

Note: See Appendix Table D4-D6 for information on a yearly basis.

7.4.3.4 Summary of Discrete Zone Impacts

A summary of expected social and economic impacts from various combinations of designation alternatives (Alts. 3A through 3B-5) and gear restriction and exemption alternatives (Alts. 4A through 4C) are shown in Table 94. If implemented in combination with gear restriction alternatives (Alts. 4B or 4C), all of the action alternatives for discrete zone designations may result in negative economic impacts for fishing businesses, depending on the fishery and the ability to redistribute effort and the specific boundaries implemented. These impacts may be direct, through the increased costs associated with avoiding closed areas, or indirect, in terms of opportunity costs and/or reductions in efficiency resulting from fishing in different areas that may not be preferred fishing grounds for a given target species. The magnitude of impacts is complicated to assess, given that the discrete coral zones are not currently experiencing fishing activity, and activity is variable by species across the many canyons proposed for designation. In addition, the discrete zone alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity.

The impacts of the proposed discrete zones are similar overall to those described in Section 7.4.2.5 for broad zones. The deeper portions of the various proposed discrete zone options (below about 500m) are expected to have very little impacts on any fishery other than red crab. Very little fishing effort currently occurs here, and gear restrictions are being proposed to protect known or highly likely concentrations of corals in the canyon environments as a precautionary measure against the future expansion of effort and unintentional bottom contact or gear loss in the canyons. The likelihood and extent of potential future fishing effort in these areas is difficult to predict, but would be expected to be relatively minor if it occurred at all, as high costs associated with developing new deep sea fisheries and operating far from shore would be expected to deter this type of expansion. Thus, the economic impacts to fishing communities associated with gear restrictions in the discrete zones are primarily expected to result from the areas near the heads of the canyons at the shelf/slope break.

In general, the mobile gear fisheries most likely to be impacted by the alternatives include trawl vessels targeting squid and whiting, and the areas where vessels are most likely to be impacted include the shallower portions of the discrete zones (near the shelf/slope break), where some fishing effort currently occurs. As described in Section 7.4.2.5, these fisheries tend to operate in very specific areas near the heads and bights of the canyons. For fixed gear types, the fishery with the most potential impacts is the red crab trap fishery; however, these impacts would be limited under the Council’s preferred alternatives, which include exemptions for this fishery. Industry representatives have indicated that some of the boundary alternatives proposed for discrete zones would cut off important areas for fishing and/or setting and deploying gear for trawl fisheries. These conversations led to the April 2015 Council workshop where the Council’s Ecosystems and Ocean Planning Advisory Panel and the Mackerel, Squid, Butterfish Advisory Panel, along with other industry participants and coral experts, negotiated and redrew boundary proposals for discrete coral zones. These boundaries were adopted in the Council’s final action for both the discrete and the broad coral zones (i.e., both Alternatives 1F and 3B-5 follow these boundaries on the landward side).

These boundaries were developed by consensus among these groups and were designed to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. Thus, the magnitude of negative economic impacts of the Council preferred discrete zone designation alternative is expected to be small, especially in comparison to discrete zone boundary options that cover more area and/or extend into shallower areas (Alternatives 3B-2 and 3B-4, which are expected to be extremely similar in terms of economic impacts). The GSSA boundaries (Alternative 3B-5) are the smallest discrete zone boundaries, and were designed to limit negative impacts to the fishing industry as much as possible. Alternative 3B-1 was also designed by active fishery participants, and only for three canyon areas.

For the red crab trap fishery, it is worth considering the impacts specifically to this fishery given the limited ability to displace effort as described above. The Council’s preferred alternatives include an exemption for this fishery, such that expected economic impacts for this fishery would be neutral under this alternative (4B-1). As previously discussed, under Alternative 4B (prohibition on all bottom-tending gear) and absent an exemption under Alternative 4B-1, the economic impacts specific to the red crab fishery would be expected to be moderate to high negative, depending on the fisheries ability to fish between discrete zones. Thus, impacts specifically to the red crab fishery would range from neutral to high negative under various gear restriction and exemption alternative combinations. When considering the overall impacts described below, these higher impacts for red crab raise the overall level of expected negative economic impacts. For fisheries other than red crab, restrictions within the deeper portions of the various proposed discrete zone options (below about 500m) are expected to have very little economic impacts as little or no effort currently occurs here and any restricted effort is expected to be easily displaced.

In combination across designations and gear alternatives, the overall magnitude of the direct and indirect impacts to fishing operations resulting from the implementation of discrete coral zones with bottom fishing restrictions likely ranges from slight to moderate negative, depending on the footprint of current operations and ease of redistributing effort for a given fishery. Alternative 3B-1 would be expected to have the lowest negative economic impacts, as this alternative only includes three canyons for designation. Alternative 3B-3 (GSSA boundaries) would have slightly more negative economic impacts, followed by the Council-preferred Alternative 3B-5. The FMAT and NGO Coalition boundaries (Alternatives 3B-2 and 3B-4 respectively), would have comparable impacts that would be higher than the other boundary proposal alternatives.

The prohibition on all bottom-tending gear (Alt. 4B) would be expected to have greater negative economic impacts than a prohibition on mobile bottom-tending gear. In particular, the red crab fishery would experience high negative impacts from Alternative 4B without a simultaneous adoption of sub-alternative 4B-1 (exemption for the red crab fishery), as a substantial portion of the effort for this fishery occurs within the proposed discrete zones. The number of other fisheries and spatial extent of other bottom-tending passive gear types in these areas is limited. Any fishing exemption alternatives implemented to a restriction on all bottom-tending gear would likely result in neutral impacts to that specific fishery relative to the *status quo*; however, these exemptions would reduce the negative economic impacts associated with gear restricted areas for these fisheries and overall result in moderate positive economic impacts in combination with alternative 4B.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect positive impacts from the designation of gear-restricted discrete coral zones associated with the protection of deep sea coral ecosystems. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

A summary of expected impacts from various combinations of designation alternatives and transit alternatives (Alts. 4D and 4E) are shown in Table 95. The impacts of these action alternatives are not expected to vary substantially based on the discrete zone designation implemented, and would be as described above in Section 7.4.1.2.

Table 94: Summary of impacts to human communities of discrete zone designation alternatives in combination with discrete zone gear restriction alternatives. BTG= bottom-tending gear.

Alt.	4A (No action/*Status quo*)	4B (Prohibit all BTG; *Council preferred*)	Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)	Sub-Alt 4B-2 (Exempt tilefish fishery)	4C (Prohibit mobile BTG)
3A (No discrete zone designation)	**Neutral impacts relative to the baseline conditions,** which are complex and variable.	NA: These would not be reasonable combinations of alternatives given that gear restrictions within a discrete zone would not be implemented unless discrete zones are designated.			
3B-1 (Advisor 2013 boundaries)	Broad zone designated, but no management measures applied. **Neutral impacts relative to the baseline conditions.** Current baseline conditions for human communities are complex and variable. **Slight indirect positive impacts** expected for conservation community.	**Slight direct and indirect negative impacts** expected for most fisheries. Least negative impacts of all designation Alts. **High direct negative impacts to red crab fishery** (absent an exemption). **Indirect positive impacts** to conservation community.	Neutral impacts relative to *status quo* for red crab fishery; **Overall moderate positive impacts in combination with 4B due to lessened impacts associated with 4B.** Impacts would be similar under all designation alternatives 3B-1 through 3B-5, as red crab effort occurs exclusively in deeper waters.	Neutral impacts relative to *status quo* for tilefish fishery; **Overall moderate positive impacts in combination with 4B due to lessened impacts associated with 4B.**	**Slight direct and indirect negative impacts** expected for most fisheries, depending on ability to redistribute effort. Least negative impacts of all designation Alts. **Indirect positive impacts** to conservation community.
3B-2 (FMAT boundaries)		**Slight to moderate direct and indirect negative impacts** expected for most fisheries, depending on ability to redistribute effort. Impacts similar magnitude under 3B-2 and 3B-4. Slightly lower negative impacts from 3B-5, followed by 3B-3. **High direct negative impacts to red crab fishery** (absent an exemption). **Indirect positive impacts** to conservation community.			**Slight to moderate direct and indirect negative impacts** expected for most fisheries, depending on ability to redistribute effort. Impacts similar magnitude under 3B-2 and 3B-4. Slightly lower negative impacts from 3B-5, followed by 3B-3. Impacts lower from 4C vs. 2B. **High direct negative impacts to red crab fishery** (absent an exemption). **Indirect positive impacts** to conservation community.

Alt.	**4A (No action/*Status quo*)**	**4B (Prohibit all BTG; *Council preferred*)**	**Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)**	**Sub-Alt 4B-2 (Exempt tilefish fishery)**	**4C (Prohibit mobile BTG)**
3B-3 (GSSA boundaries)	See above		See above	See above	**Slight to moderate direct and indirect negative impacts** expected for most fisheries, depending on ability to redistribute effort. Impacts similar magnitude under 3B-2 and 3B-4. Slightly lower negative impacts from 3B-5, followed by 3B-3. Impacts lower from 4C vs. 2B. **High direct negative impacts to red crab fishery** (absent an exemption). **Indirect positive impacts** to conservation community.
3B-4 (NGO coalition boundaries)					
3B-5 (Workshop boundaries; *Council preferred*)					

Table 95: Summary of impacts to human communities of discrete zone designation alternatives in combination with discrete zone vessel transit alternatives.

<table>
<tr><th>Alternative</th><th>4D (Transit with gear stowage; Council preferred)</th><th>4E (Transit with VMS declaration)</th></tr>
<tr><td>3A (No discrete zone designation)</td><td colspan="2">NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within discrete zones would not be necessary or practical unless discrete zones are designated.</td></tr>
<tr><td>3B-1 (Advisor 2013 boundaries)</td><td rowspan="5">Positive impacts in combination with 4B or 4C, due to allowing transit through closed areas rather than requiring crew time and fuel to transit around closed areas. Alt. 4D more positive in magnitude vs. Alt. 4E.</td><td rowspan="5">Slight negative to slight positive economic impacts to fishing businesses expected from VMS transmission. Slight negative impacts expected due to cost of obtaining and operating VMS units. Costs of obtaining units are limited as most affected vessels already use VMS. Slight positive economic impacts expected from allowing transit through closed areas. Overall impacts variable depending on frequency of transit.</td></tr>
<tr><td>3B-2 (FMAT boundaries)</td></tr>
<tr><td>3B-3 (GSSA boundaries)</td></tr>
<tr><td>3B-4 (NGO coalition boundaries)</td></tr>
<tr><td>3B-5 (Workshop boundaries; Council preferred)</td></tr>
</table>

7.4.4 Framework Provision Alternatives

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. This action proposes to modify the list of items in the FMP that could be modified through a framework, to allow for future consideration of deep sea coral measures through a framework action.

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. The purpose of modifying the list of "frameworkable items" in the FMP is to demonstrate that the concepts included on the list has previously been considered in an amendment (i.e., they are not novel). Any proposed action or future change will be analyzed through a separate NEPA process.

Because the framework provision alternatives are administrative, they are not expected to result in any direct impacts to the human environment, though indirect impacts are possible from some of the alternatives if they allow for more efficient responses to pressing concerns for human communities. Specifically, because the administrative process for an amendment is longer, it is possible that any immediate conservation concerns arising in the future could be addressed in a more timely manner through a framework action rather than an amendment. In addition, because amendments typically uses up more Council and NMFS time and resources, it is possible that the Council may decide not to prioritize future adjustments to the coral measures if such actions would require an amendment rather than a framework. To the extent that framework provisions may allow more efficient responses to social or economic issues resulting from coral measures, or to the priorities of the conservation community, the framework provision action alternatives 5B, 5C, and 5E would be expected to result in indirect slight positive impacts to human communities (Table 96). Alternative 5D would not be expected to address an immediate social or economic need. The impacts of any future special access program developed under this framework provision would be described in a future NEPA analysis.

Table 96: Expected impacts to the human environment from framework provision alternatives (alternative set 5).

Alternative	Expected Impacts
Alt. 5A: No action/*status quo*	**Neutral to indirect slight negative.** Administrative in nature; no direct impacts on human communities. Due to time/resource requirements for amendments, adjustments to coral measures to address social or economic issues may be delayed or de-prioritized.
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on human communities. Indirect slight positive impacts expected if framework process allows for more efficiently addressing economic concerns associated with coral measures.
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on human communities. Indirect slight positive impacts expected if framework process allows for more efficiently addressing economic concerns associated with coral measures.
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	**Neutral.** Administrative in nature; no direct impacts on human communities.
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	**Neutral to indirect slight positive.** Administrative in nature; no direct impacts on human communities. Indirect slight positive impacts expected if framework process allows for more efficiently addressing social or economic concerns.

7.4.5 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. *Illex* vessels are not currently required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). Alternative 6B could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. This alternative set focuses exclusively on the *Illex* fishery because most other fisheries that operate in these deep water, offshore environments considered in this action are already required to use VMS. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

Relative to the baseline environmental conditions, Alternative 6A would be expected to result in neutral impacts. Alternative 6B would require use of VMS for all *Illex* squid moratorium vessels (regardless of whether fishing activity is occurring within or outside of any designated deep sea coral zones). Few *Illex* moratorium vessels are not already required to use VMS related to other permits they possess (Section 6.4). Potential economic impacts are mixed with an uncertain net impact. However, since most *Illex* moratorium vessels are already required to use VMS due to their participation in other fisheries, overall low economic impacts are expected. However, for vessels that may not have a VMS system, the costs to equip the vessel are approximately $1,700-$3,300 with operating costs for the unit of approximately $40-$100 per month.

Table 97: Expected impacts to the human environment from *Illex* VMS alternatives (alternative set 6).

Alternative	Expected Impacts
Alt. 6A: No action/*status quo*	**Neutral to indirect slight negative.** No direct impacts on deep sea corals. Indirect slight negative impacts expected if coral gear-restricted areas are implemented due to reduced ability to enforce and monitor.
Alt. 6B Require VMS for federally-permitted *Illex* squid vessels *(Council preferred)*	**Indirect slight positive**. No direct impacts on deep sea corals. Indirect slight positive impacts expected from increased ability to monitor, enforce, and evaluate gear-restricted areas.

7.5 IMPACTS TO PROTECTED RESOURCES

7.5.1 Broad Coral Zones and Management Measures

The coral zone management alternatives proposed in this amendment have the potential to change fishing behavior and patterns of gear use in the affected waters, which may influence the magnitude of protected resources impacts in the affected region (see Section 6.5 for description of risks to protected resources form relevant gear types). The management measures currently in place for the MSB, summer founder, scup, black sea bass, whiting, golden tilefish, red crab, and scallop fisheries (i.e., the fisheries that utilize bottom-tending gear in or near the proposed areas) all limit the overall amount of fishing effort, mainly through annual catch limits on target stocks. As a result, the changes proposed in this amendment are not expected to result in an increase in fishing effort overall, just shifts in the location of that effort.

Predicting precisely how fishing effort may shift is complicated. A number of the fisheries operate in specific areas where availability of certain species is high, due in part to local oceanographic features and associated physical and ecological processes. For example, the *Illex* squid fishery tends to operate very near the shelf/slope break at the heads of the canyons. Thus, it is expected that for the majority of the fisheries affected by this action, effort that would typically occur within the broad or discrete zones will shift to just outside the zone boundaries (i.e., just shallower than the zone boundaries). Large-scale shifts in effort, i.e., from the proposed broad or discrete zones to nearshore waters, are not expected. There are limited data to provide additional insight as to how exactly fishing effort may potentially shift and what kind of impacts potential shifts may have on protected species. As a result, it is not possible to forecast precisely what entanglement or interaction risks would exist if the closures are implemented; however, we can assess the range of possible impacts to protected species that could result from shifts in effort and the risks associated with these possible impacts.

When looking at protected species interaction risks, the concern is the total amount of gear in the water, soak or tow time, and co-occurrence with protected species. Generally speaking, if shifts in effort result in more gear being present for a longer period of time and in areas of high protected species co-occurrence, this is likely to result in increased interaction risks. However, relative to current operating conditions in and around the proposed coral zones, we do not expect the outcome of introducing new gear restricted areas to result in significant changes in overall fishing effort or behavior (e.g., gear type, gear quantity, area fished) in the affected area. Regardless of the area restricted for coral protections, the number of vessels and amount of gear in the water are not expected to be substantially different from current conditions.

What would differ is that some of these vessels would be restricted from fishing and setting gear in any designated coral areas, meaning their effort would be expected to shift to and perhaps become more concentrated in non-restricted areas just shallower than the proposed coral zones. It is difficult to predict precisely how or where effort shifts would occur and to what extent that would impact the concentration of gear and the total time gear is deployed in the water. As described in Section 7.4, current fishing effort within the coral zone designation alternatives is limited both in terms of the spatial extent and the fisheries that operate in the areas in question. The vast majority of area within each of the broad zone area alternatives consists of waters far deeper than existing fisheries operate; therefore, the extent of displaced effort is expected to be much smaller than one would assume based on size of the protected area alone. Based on what is known about the fishing effort currently occurring in and around the proposed coral zones, effort shifts are expected to be relatively concentrated near the shelf/slope break, shifting from areas just deeper than the proposed broad zone boundaries to areas just shallower than the proposed broad zone boundaries. The deeper portions of the various proposed broad zone options (below about 500m) are expected to have very little impacts on protected resources as little or no effort currently occurs here and therefore interaction rates in these areas are unlikely to change.

In general, the fisheries most likely to be impacted by the gear restriction alternatives, and therefore the fisheries that are most likely to experience shifts in fishing effort, include trawl vessels targeting squid and whiting. Because the red crab trap fishery would be exempt from gear restrictions under the Council's preferred alternative, red crab effort is not expected to shift and therefore interactions with this gear type would not be expected to change. The areas where trawl vessels are most likely to be impacted include the shallower portions of the broad zones (near the shelf/slope break), where some fishing effort currently occurs. As described previously, the mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons.

Based on the information described in Section 7.4 regarding the amount of fishing effort that occurs within or near the proposed areas, as well as the depths where observed hauls were recorded, fisheries using gilllnet, scallop dredge, and bottom longline gear types are very limited in the proposed areas, as these gear types are generally used closer to shore and take few trips within the proposed areas. Thus, any effort shifts resulting from the proposed coral zones is likely to be insignificant for those vessels prosecuting their fishery with these gear types. As a result, increased concentration of gear associated with these vessels around the coral zones is unlikely.

Changes in the spatial distribution of fishing effort; however, do not necessarily equate to increased protected species interactions. Taking into consideration the above, effects on protected species could, in theory, range from negative to positive. Using information on species distribution and abundance, available bycatch/entanglement data, as well as information on gear types that pose the greatest risk to a particular species, the following are some possible effort shift scenarios and the interaction risks that could present themselves:

- If the waters within and surrounding areas proposed for coral zones have had few observed cases of bycatch/entanglement of protected species, there is no information to suggest that bycatch/entanglement rates will change once a coral zone is designated. As a result, if effort is simply redistributed to outside the coral zone, impacts to protected species are not expected to increase. Relative to conditions prior to implementation of the coral zone, impacts to protected species are expected to be neutral.
- If observed protected species interactions are high in the waters within and surrounding the areas proposed for coral zones, interactions with protected species may increase once the coral zone is implemented as vessels would need to shift out of the now protected area and into waters with existing high interaction rates. With more vessels and gear now concentrated in the waters surrounding the coral zone, and in waters that had pre-exiting high protected species interactions rates, interactions with protected species have the potential to increase. Relative to conditions prior to implementation of the coral zone, impacts to protected species are expected to increase or remain neutral.
- If the waters around the proposed coral zone have had few observed cases of bycatch/entanglement of protected species, but the areas proposed for protection have higher observed interaction rates, an effort shift could result in vessels shifting from an area where bycatch/entanglement of protected species is high to an area where interactions are low. This could generate positive impacts.
- If a coral zone is implemented, gear may be set in higher concentrations along the border of the closed areas. This creates an elevated risk of entanglement as species cannot move through the area without the risk of an interaction; this has been seen in observer data where interactions with particular protected species are observed concentrated around the border of the closed area. This could generate negative impacts to protected resources.
- If a coral zone gear-restricted area results in more effort concentrated near the borders of the implemented area, fishing efficiency may be reduced if more vessels are operating within the same area. This could lead to slower catch rates and gear being present in the water for more time. With an increase in overall soak time, potential interactions with protected species would likely increase as well. This could generate negative impacts. However, as described above, additional concentration of effort is expected to be minimal for most gear types, in particular longlines, dredges, traps, and gillnets. Some additional concentration of trawl vessels targeting squid and whiting is possible.
- Coral zone gear restricted areas implemented for habitat protections may have indirect positive impacts on protected resources that utilize the deep sea environment, including enhanced habitat quality for the protected resources themselves, or for their forage base.

Without knowing exactly how fishing behavior will change, and without very fine-scale information on bycatch within or outside the proposed gear restricted area boundaries, we cannot definitively state that interactions will increase as a result of implementing restricted areas. As a result, tables below summarize the range of possible impacts of each alternative on protected species, taking into consideration the above scenarios and focusing primarily on the impacts of shifting and/or concentrating gears outside of proposed gear restricted areas.

Table 98: Summary of impacts to protected resources of broad zone designation alternatives in combination with broad zone gear restriction alternatives. BTG= bottom-tending gear.

Alt.	**2A (No action/*Status quo*)**	**2B (Prohibit all BTG; *Council preferred*)**	**Sub-Alt 2B-1 (Exempt red crab fishery under 2B; *Council preferred*)**	**Sub-Alt 2B-2 (Exempt tilefish fishery under 2B)**	**2C (Prohibit mobile BTG)**
1A (No broad zone designation)	No broad zone designated and no management measures implemented. No increases or decreases in interactions expected. **Neutral impacts relative to the baseline conditions.** Baseline conditions for protected resources vary, ranging from negative to positive.	NA: These would not be reasonable combinations of alternatives given that gear restrictions within a broad zone would not be implemented unless a broad zone is designated.			
1B (200m broad zone)	Broad zone would be designated, but no management measures would be applied. No increases or decreases in interactions expected. **Neutral impacts to protected resources expected** relative to *status quo* and baseline environmental conditions.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.
1C (300m broad zone)					
1D (400m broad zone)					
1E (500m broad zone)					
1F (450 m broad zone; *Council preferred*)					

Table 99: Summary of impacts to protected resources of broad zone designation alternatives in combination with broad zone VMS and vessel transit alternatives.

Alternative	2D (Require VMS within broad zones)	2E (Transit with gear stowage; *Council preferred*)	2F (Transit with VMS declaration)
1A (No broad zone designation)	NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within a broad zone would not be necessary or practical unless a broad zone is designated.		
1B (200m broad zone)	No direct impacts expected on protected resources from VMS requirements. In combination with any broad zone designation, **neutral to indirect slight positive impacts to protected resources are possible** given increased ability to monitor and enforce gear restriction and other spatial management measures; may enhance ability to analyze future protected resources measures.	Alt. 2E in combination with any broad zone designation alternative is expected to have **neutral impacts to protected resources.**	Alt. 2F in combination with any broad zone designation alternative is expected to have **neutral impacts to protected resources.**

7.5.2 Discrete Coral Zones and Management Measures

Considerations for impacts of discrete zones on protected resources are the same as described above in Section 7.5.1. Table 100 summarizes the potential impacts of designation and gear restriction measures, and Table 101 summarizes the potential impacts of transit alternatives.

Table 100: Summary of impacts to the deep sea corals of discrete zone designation alternatives in combination with discrete zone gear restriction alternatives. BTG= bottom-tending gear.

Alt.	4A (No action/*Status quo*)	4B (Prohibit all BTG; *Council preferred*)	Sub-Alt 4B-1 (Exempt red crab fishery; *Council preferred*)	Sub-Alt 4B-2 (Exempt tilefish fishery)	4C (Prohibit mobile BTG)
3A (No discrete zone designation)	No discrete zones designated; no management measures. **Neutral impacts to protected resources expected** relative to *status quo* and baseline environmental conditions.	NA: These would not be reasonable combinations of alternatives given that gear restrictions within a discrete zone would not be implemented unless a discrete zone is designated.			
3B-1 (Advisor 2013 boundaries) **3B-2 (FMAT boundaries)** **3B-3 (GSSA boundaries)** **3B-4 (NGO coalition boundaries)** **3B-5 (Workshop boundaries; *Council preferred*)**	Discrete zones designated, but no measures applied. **Neutral impacts to protected resources expected** relative to *status quo* and baseline environmental conditions.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.	**Uncertain impacts ranging from negative to positive,** depending on factors described in text above.

Table 101: Summary of impacts to protected resources of discrete zone designation alternatives in combination with discrete zone vessel transit alternatives.

Alternative	**4D (Transit with gear stowage; *Council preferred*)**	**4E (Transit with VMS declaration)**
3A (No discrete zone designation)	NA: These would not be reasonable combinations of alternatives given that transit and VMS measures within discrete zones would not be necessary or practical unless discrete zones are designated.	
3B-1 (Advisor 2013 boundaries)	Alt. 4D in combination with any discrete zone designations alternative is expected to have **neutral to indirect slight negative impacts to protected resources,** as allowing transit complicates enforcement and monitoring of gear-restricted areas.	Alt. 4E in combination with any discrete zone designations alternative is expected to have **neutral to indirect slight negative impacts to protected resources,** as allowing transit complicates enforcement and monitoring of gear-restricted areas.
3B-2 (FMAT boundaries)		
3B-3 (GSSA boundaries)		
3B-4 (NGO coalition boundaries)		
3B-5 (Workshop boundaries; *Council preferred*)		

7.5.3 Framework Provisions

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment. While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. This action proposes to modify the list of items in the FMP that could be modified through a framework, to allow for future consideration of deep sea coral measures through a framework action.

In general, the framework alternatives proposed are primarily administrative and intended to simplify and improve the efficiency of future actions related to deep sea coral protections. The purpose of modifying the list of "frameworkable items" in the FMP is to demonstrate that the concepts included on the list has previously been considered in an amendment (i.e., they are not novel). Any proposed action or future change will be analyzed through a separate NEPA process.

Because the framework provision alternatives are administrative, they are not expected to result in any direct impacts to protected resources. The framework provision alternatives are also unlikely to have indirect impacts on protected resources, as the process and timeline for any future coral action is unlikely to impact protected resources interactions. Any immediate protected resources need to would be addressed by NMFS, or through a separate Council action not related to deep sea corals. Thus, the no action alternative 5A as well as the framework provision action alternatives 5B through 5E would be expected to result in neutral impacts to protected resources relative to the *status quo* and baseline environmental conditions. The impacts of any future special access program developed under this framework provision would be described in a future NEPA analysis.

Table 102: Expected impacts to protected resources from framework provision alternatives (alternative set 5).

Alternative	Expected Impacts
Alt. 5A: No action/*status quo*	**Neutral.** Alternatives are administrative in nature and would primarily affect the process and timeline to complete future coral related actions. Any future action would undergo a separate NEPA process. No direct or indirect impacts on protected resources are expected.
Alt. 5B: Option to modify coral zone boundaries via framework action *(Council preferred)*	
Alt. 5C: Option to modify management measures within zones via framework action *(Council preferred)*	
Alt. 5D: Option to add additional discrete coral zones via framework action *(Council preferred)*	
Alt. 5E: Option to implement special access program via framework action *(Council preferred)*	

7.5.4 *Illex* VMS Requirement Alternatives

Alternative set 6 consists of Alt. 6A (no action/*status quo*) and Alt. 6B, which would require federally-permitted *Illex* squid vessels to have and use VMS. This alternative could be implemented either alone or in combination with any of the other alternatives described in the document, and is intended to improve VMS coverage for fisheries operating in offshore environments that overlap with corals. This alternative set focuses exclusively on the *Illex* fishery because most other fisheries that operate in these deep water, offshore environments considered in this action are already required to use VMS. Alternative 6B would make this requirement consistent across the MSB fisheries and enhance the ability to enforce coral and other management measures, as well as to improve future evaluations of fishing effort for area-based management.

Because these alternatives are focused on monitoring *Illex* vessel activity and do not include any monitoring or reporting requirements related directly to protected resources, and include no provisions that would be expected to reduce interactions, there would be no direct impacts to protected resources resulting from a VMS requirement. However, a VMS requirement for the *Illex* squid fishery, if implemented in combination with coral protection measures, may increase effective enforcement of measures that are relevant to protected resources, potentially resulting in indirect positive impacts. In addition, improved VMS coverage for offshore fisheries may allow for more refined analysis of fishing activity, and thus potentially more effective future protected resources protection measures. Thus, Alternative 6B could have indirect positive impacts on protected resources stemming from improved ability to enforce spatial management measures, and improved ability to evaluate fishing patterns. Because most *Illex* vessels currently already use VMS, the magnitude of this positive impact is expected to be small. Alternative 6A (no action/*status quo*) would have no direct impacts on protected resources, and would also be unlikely to result in either positive or negative indirect impacts, relative to baseline environmental conditions. A lack of a VMS requirement for the *Illex* fishery is unlikely to have an impact on the interactions with or recovery of any protected resources or habitat (Table 103).

Table 103: Expected impacts to protected resources from *Illex* VMS alternatives (alternative set 6).

Alternative	Expected Impacts
Alt. 6A: No action/*status quo*	**Neutral.** No direct impacts on protected resources. Relative to baseline conditions, no indirect impacts are expected as lack of VMS for *Illex* vessels is unlikely to affect protected resources interactions.
Alt. 6B: Require VMS for federally-permitted *Illex* squid vessels *(Council preferred)*	**Indirect slight positive.** No direct impacts on protected resources. Indirect slight positive impacts possible from increased ability to monitor, enforce, and evaluate other management measures and fishing activity.

7.6 CUMULATIVE EFFECTS ANALYSIS

A cumulative effects analysis (CEA) is required by the Council on Environmental Quality (CEQ) (40 CFR part 1508.7). The purpose of CEA is to consider the combined effects of many actions on the human environment over time that would be missed if each action were evaluated separately. CEQ guidelines recognize that it is not practical to analyze the cumulative effects of an action from every conceivable perspective, but rather, the intent is to focus on those effects that are truly meaningful. A formal cumulative impact assessment is not necessarily required as part of an EA under NEPA as long as the significance of cumulative impacts have been considered (U.S. EPA 1999). The following sections address the significance of the expected cumulative impacts as they relate to the VECs considered in this document.

7.6.1 Consideration of the VECs

In Section 6.0 (Description of the Affected Environment), the VECs relevant to this action are identified. Therefore, the significance of the cumulative effects will be discussed in relation to the VECs listed below.

1. The **physical environment**, including Essential Fish Habitat (EFH);
2. The **managed resources,** including the managed species potentially affected by the measures under consideration;
3. The **deep sea corals** and associated ecosystems proposed for protection;
4. The **human environment**, including socioeconomic aspects of the fisheries targeting the above managed species, and the communities associated with those fisheries;
5. **Protected resources**, including ESA-listed and MMPA-protected large and small cetaceans, pinnipeds, sea turtles, fish, and critical habitat occurring in the Mid-Atlantic Council Region in offshore waters where proposed management measures are under consideration.

7.6.2 Geographic Boundaries

The geographic scope of the measures proposed in this action, and the scope of analysis of impacts to deep sea corals, includes the Mid-Atlantic Council region, as delimited by the Mid-Atlantic/New England inter-council boundary and extending out to the edge of the U.S. EEZ. The geographic scope of the analysis of impacts to managed resources and habitat for this action is the range of the fisheries in the Western Atlantic Ocean, as described in the Affected Environment (Section 6.0) and Environmental Impacts (Section 7.0) sections of the document. For endangered and protected species the geographic range is the total range of each species. The geographic range for socioeconomic impacts is defined as those fishing communities bordering the range of the fisheries for mackerel, longfin squid and *Illex* squid and butterfish which occur primarily from the U.S.- Canada border to Cape Hatteras, although the management unit includes all the coastal states from Maine to Florida.

7.6.3 Temporal Boundaries

The temporal scope of this analysis is primarily focused on actions that have taken place since 1976, when these fisheries began to be managed under the MSA. For endangered and other protected resources, the scope of past and present actions is on a species-by-species basis (Section 6.5) and is largely focused on the 1980s and 1990s through the present, when NOAA Fisheries began generating stock assessments for marine mammals and sea turtles that inhabit waters of the U.S. EEZ. The temporal scope of future actions for all five VECs extends about three years into the future (through 2018). This period was chosen because the dynamic nature of resource management and lack of information on projects that may occur in the future make it very difficult to predict impacts beyond this timeframe with any certainty.

7.6.4 Actions Other Than Those Proposed in this Amendment

The impacts of each of the alternatives considered in this amendment document are given in Sections 7.1 through 7.5. The text below describes the meaningful past (P), present (Pr), or reasonably foreseeable future (RFF) actions to be considered other than those actions being considered in this amendment document. Table 109 summarizes the possible impacts of these actions on each VEC. These impacts are described in chronological order and qualitatively, as the actual impacts of these actions are too complex to be quantified in a meaningful way. When any of these abbreviations occur together (i.e., P, Pr, RFF), it indicates that some past actions are still relevant to the present and/or future actions.

7.6.4.1 Past, Present, and Reasonably Foreseeable Future Actions

The historical management practices of the Mid-Atlantic and New England Council have resulted in overall positive impacts on the health of the managed stocks (Section 6.2). Numerous actions have been taken to manage these fisheries through amendments and framework adjustment actions.

The specifications process for annual catch limits, as required by the MSA, provides the opportunity for the Councils and NOAA Fisheries to regularly assess the status of the fishery and to make necessary adjustments to ensure that there is a reasonable expectation of meeting the objectives of the FMPs. The statutory basis for federal fisheries management is the MSA. To the degree that this regulatory regime and National Standards are complied with, the cumulative impacts of past, present, and reasonably foreseeable future federal fishery management actions on the VECs should generally be associated with positive long-term outcomes, which should bring about long-term sustainability of a given resource, and as such, should, in the long-term, promote positive effects on human communities, especially those that are economically dependent upon the managed stocks.

Overall, past fishery actions have served to reduce effort or the impacts of effort through access limitations, upgrade restrictions, area and gear restrictions, EFH designations, monitoring, and accountability. These reductions have likely overall benefitted the managed species, habitat, protected resources, and non-target species (including deep sea corals). By ensuring the continued productivity of the managed resources, the human communities that benefit from catching the managed resources have also benefited in the long term, though at times quota reductions or other restrictions may have caused short-term economic dislocations.

In the reasonably foreseeable future, annual or multi-year specifications for all managed species in future years should maintain the benefits as described above.

In some cases, fishery management plan actions are developed in an omnibus fashion to update many plans at once. These amendments are considered amendments to the individual fishery management plans, and the actions associated with these amendments are described in the table below as needed, by FMP. One special case set of omnibus actions are the Standardized Bycatch Reporting Methodology (SBRM) amendments, which cover Federal waters fisheries managed by the New England and/or the Mid-Atlantic Councils. The first SBRM amendment became effective in 2008, and an update to these measures was finalized in June 2015 (80 FR 37182). The updated regulations modify the following elements of the monitoring program: new prioritization process for allocation of observers if agency funding is insufficient to achieve target observer coverage levels; bycatch reporting and monitoring mechanisms; analytical techniques and allocation of at sea fisheries observers; a precision-based performance standard for discard estimates; a review and reporting process; framework adjustment and annual specifications provisions; and provisions for industry-funded observers and observer set-aside programs. Separate from the SBRM amendment, NMFS, in collaboration with the MAFMC and NEFMC, is currently developing an industry-funded monitoring amendment. The Omnibus Observer Coverage Amendment will not necessarily result in immediately increased observer coverage because sufficient funds (from both industry for at-sea costs and NOAA for shoreside costs) may not be available. Rather, this amendment will set up a mechanism for increasing observer coverage should sufficient funding become available.

The NEFMC has also developed a comprehensive Omnibus Habitat Amendment (submitted January 2016) which includes the closure of some New England fishing grounds to certain gear types. The NEFMC is also developing a Deep Sea Corals Amendment for coral protections within their management region, which is expected to contain similar measures to those proposed in this document. This action may or may not be completed prior to 2018.

The MAFMC is also developing an Omnibus Unmanaged Forage Amendment, to prohibit the development of new, or expansion of existing, directed fisheries on unmanaged forage species until adequate scientific information is available to promote ecosystem sustainability.

In terms of FMP-specific actions expected to be implemented before 2018, the Council is beginning development of an amendment to reduce the capacities of the longfin squid and *Illex* squid fleets; however, this amendment is in the early stages of development and it is not clear if any proposed measures would be implemented prior to 2018.

For the summer flounder, scup, and black sea bass FMP, the MAFMC is currently in the process of modifying the scup gear-restricted areas, which impact vessels fishing for longfin squid, black sea bass, and whiting. The Council has proposed reconciling any boundary adjustments with the preferred coral zone boundaries proposed in this action given the spatial overlap of these areas. The MAFMC is also developing a Comprehensive Summer Flounder Amendment to re-evaluate summer flounder management, and also planning development of a Black Sea Bass Amendment to address a variety of recreational and commercial management issues, potentially including allocations.

The MAFMC is also considering adopting management measures for blueline tilefish, which is a south Atlantic species that is also caught north of Cape Hatteras.

For Atlantic sea scallops, the NEFMC is considering adjustments to Northern Gulf of Maine LAGC management programs, as well as fishing year changes. Future adjustments may be made to the rotational management program if addition resources are made available to the fishery through lifting of habitat closures.

For deep sea red crab, limited access permits have been managed under a limited entry system since the FMP was established in 2002; no new limited access permits are being issued. No major actions are expected except for the continuation of annual specifications.

Regarding protected resources, a take reduction strategy for long-finned pilot whales (*Globicephala melas*), short-finned pilot whales (*Globicephala macrorhynchus*), white-sided dolphins (*Lagenorhynchus acutus*), and common dolphins (*Delphinus delphis*) has been developed and is described in Section 6.

In addition to the direct effects on the environment from fishing, the cumulative effects to the physical and biological dimensions of the environment may also come from non-fishing activities (e.g., climate change, point source and non-point source pollution, shipping, dredging, storm events, etc.). Impacts from non-fishing activities generally relate to habitat loss from human interaction and alteration or natural disturbances. These activities are widespread and can have localized impacts to habitat such as accretion of sediments from at-sea disposal areas, oil and mineral resource exploration, aquaculture, construction of at-sea wind farms, bulk transportation of petrochemicals and significant storm events. In addition to guidelines mandated by the MSA, NMFS reviews some of these types of effects during the review process required by Section 404 of the Clean water Act and Section 10 of the Rivers and Harbors Act for certain activities that are regulated by Federal, state, and local authority. The jurisdiction of these activities is in "waters of the United States" and includes both riverine and marine habitats.

Non-fishing activities that introduce chemical pollutants, sewage, changes in water temperature, salinity, dissolved oxygen, and suspended sediment into the marine environment pose a risk to all of the identified VECs. Human-induced non-fishing activities tend to be localized in nearshore areas and marine project areas where they occur. Examples of these activities include, but are not limited to agriculture, port maintenance, beach nourishment, coastal development, marine transportation, marine mining, dredging and the disposal of dredged material. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease habitat quality and, as such, may indirectly constrain the sustainability of the managed resources, non-target species (including deep sea corals), and protected resources. Decreased habitat suitability would tend to reduce the tolerance of these VECs to the impacts of fishing effort. Mitigation of this outcome through regulations that would reduce fishing effort could then negatively impact human communities. The overall impact to the affected species and their habitats on a population level is likely neutral to low negative, since a large portion of these species have a limited or minor exposure to these local non-fishing perturbations.

For many of the proposed non-fishing activities to be permitted under other federal agencies (such as beach nourishment, offshore wind facilities, etc.), those agencies would conduct examinations of potential impacts on the VECs. The MSA (50 CFR 600.930) imposes an obligation on other federal agencies to consult with the Secretary of Commerce on actions that may adversely affect EFH. The eight Fishery Management Councils are engaged in this review process by making comments and recommendations on any federal or state action that may affect habitat, including EFH, for their managed species and by commenting on actions likely to substantially affect habitat, including EFH.

In addition, under the Fish and Wildlife Coordination Act (Section 662), "whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the U.S., or by any public or private agency under federal permit or license, such department or agency first shall consult with the U.S. Fish and Wildlife Service (USFWS), Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular state wherein the" activity is taking place. This act provides another avenue for review of actions by other federal and state agencies that may impact resources that NOAA Fisheries manages in the reasonably foreseeable future.

In addition, NOAA Fisheries and the USFWS share responsibility for implementing the ESA. ESA requires NOAA Fisheries to designate "critical habitat" for any species it lists under the ESA (i.e., areas that contain physical or biological features essential to conservation, which may require special management considerations or protection) and to develop and implement recovery plans for threatened and endangered species. The ESA provides another avenue for NOAA Fisheries to review actions by other entities that may impact endangered and protected resources whose management units are under NOAA Fisheries jurisdiction.

Regarding climate change, all of the managed species considered in this document are potentially vulnerable to changing climate conditions. NOAA scientists have recently developed an assessment of the climate vulnerability of 82 fish and invertebrate species in the Northeast region, including exploited, forage, and protected species. The results of the assessment were published in Hare et al. (2016).[52] The authors found that "the overall climate vulnerability is high to very high for approximately half the species assessed; diadromous and benthic invertebrate species exhibit the greatest vulnerability. In addition, the majority of species included in the assessment have a high potential for a change in distribution in response to projected changes in climate. Negative effects of climate change are expected for approximately half of the species

[52] See also, the associated press release at: http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1603/.

assessed, but some species are expected to be positively affected (e.g., increase in productivity or move into the region)."

The potential impacts of climate change on deep sea coral ecosystems vary based on several factors, (e.g., degree of overall warming, interactions with weather patterns, etc.), but there are several climate change scenarios or theories that can be considered to describe possible effects on deep sea corals. One scenario is the weakening of the Northern Hemisphere thermohaline circulation by 2100 (Joos et al. 1999). Thermohaline circulation is the major driving force behind currents in the deep ocean. A weakening of this process could reduce transport of food and oxygen to deep coral communities and eventually alter the structure of deep sea ecosystems. Another could be the increase in intensity of El Nino-Southern Oscillation (ENSO) events in the Pacific. Global circulation patterns would be affected by an increase in ENSO events that would cause major shifts in food and oxygen distribution in many areas of the Pacific and Atlantic basins.

Another major scenario involves ocean acidification. Deep coral communities may be uniquely vulnerable to changes in ocean chemistry associated with ocean acidification due to increased atmospheric CO_2 from the combustion of fossil fuels (Guinotte et al. 2006). The ocean acts as the largest net sink for CO_2, absorbing this gas from the atmosphere and then storing carbon in the deep ocean. Oceanic uptake of CO_2 drives the carbonate system to lower pH and lower saturation states of the carbonate minerals calcite and aragonite, the materials used to form supporting skeletal structures in many major groups of marine organisms, including corals (Kleypas et al. 2006). This change in ocean chemistry will reduce the ability of corals to lay down calcium carbonate skeletons (calcification) and build reefs.

There is evidence that the rate of CO_2 increase in the deep ocean has been occurring at a pace double that of shallow waters and therefore the effect of ocean acidification on deep corals could be significant (Bates 2002; Guinotte et al. 2006). The ability for organisms to calcify decreases in the deep ocean naturally with latitude, temperature, and pressure, causing an increased concern for deep corals in the near future. There are also areas in the ocean where a natural boundary known as the 'saturation horizon' exists below which organisms cannot form calcium carbonate. This is due to the physical factors already mentioned that decrease calcification in the deep ocean but as CO_2 levels increase the saturation horizon will become shallower. This would severely limit the distribution of deep corals in certain parts of the ocean. Other indirect effects of ocean acidification on deep corals may involve changes in the availability of nutrients and the effects of toxins. Relative nutrient concentrations could become altered as a result of changes in ocean chemistry. Changes in pH could also cause a release of previously bound metals from sediments, increasing the amount of metal toxins in the water column (The Royal Society 2005).

The effects of warming ocean temperatures and ocean acidification due to climate change on deep coral communities are still unknown at this time. If ocean temperatures become warmer especially in the deep sea it will be important to understand if deep corals are able to adapt to this change. There have been no studies on the sensitivity of deep corals to CO_2-associated ocean acidification, but it is expected that calcification rates, especially of stony corals, will decrease and conditions in vast areas of the ocean may become unsuitable for deep reef accretion (The Royal Society 2005). Climate change and ocean acidification may be secondary stressors on corals when they are already impacted by other threats or disturbances; i.e., anthropogenic impacts. Currently, there is no quantitative information on the extent of anthropogenic impacts to deep corals in this region; therefore, another research goal should be the quantification on the susceptibility of deep corals to anthropogenic influences, particularly fishing.

7.6.4.2 Impacts of Past, Present, and Reasonably Foreseeable Future Actions on All VECs

The impacts of the previously described past, present, and reasonably foreseeable future actions on all VECs is presented in the text below, followed by a summary of the impacts on each VEC in Table 109.

Physical Environment and EFH

Those past, present, and reasonably foreseeable future actions, whose effects may impact habitat (including EFH) and the direction of those potential impacts, are summarized in Table 109. The direct and indirect negative actions described in Table 109 are localized in nearshore areas and marine project areas where they occur. Therefore, the magnitude of those impacts on habitat is expected to be limited due to a lack of exposure to habitat at large. Agricultural runoff may be much broader in scope, and the impacts of nutrient inputs to the coastal system may be of a larger magnitude, although the impact on habitat and EFH is unquantifiable. As described above (Section 7.6.4), NOAA Fisheries has several means under which it can review non-fishing actions of other federal or state agencies that may impact NOAA Fisheries managed resources and the habitat on which they rely prior to permitting or implementation of those projects. This serves to minimize the extent and magnitude of direct and indirect negative impacts those actions could have on habitat utilized by resources under NOAA Fisheries jurisdiction.

Past fishery management actions taken through the various FMPs and annual specification processes have had a positive cumulative effect on habitat and EFH. The actions have constrained fishing effort at a large scale and locally, which may reduce habitat impacts. As required under these FMP actions, EFH was designated for the managed resources. It is anticipated that the future management actions, described in Table 104, will result in additional direct or indirect positive effects on habitat through actions which protect EFH for federally-managed species and protect ecosystem services on which these species' productivity depends. These impacts could be broad in scope. All of the VECs are interrelated; therefore, the linkages among habitat quality and EFH, managed resources and deep sea coral productivity, and associated fishery yields should be considered. For habitat and EFH, there are direct and indirect negative effects from actions which may be localized or broad in scope; however, positive actions that have broad implications have been, and are expected to continue to be, taken to improve the condition of habitat. There are some actions, which are beyond the scope of NOAA Fisheries and Council management such as coastal population growth and climate change, which may indirectly impact habitat and ecosystem productivity. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful to habitat have had a slight negative to positive cumulative effect (Table 104).

Table 104. Summary of the effects of past, present, and reasonably foreseeable future actions on the physical environment and habitat.

Action	Past to the Present	Reasonably Foreseeable Future
Original FMP and subsequent Amendments and Frameworks to the FMPs	**Indirect Positive**	
Managed Resource Specifications	**Indirect Positive**	
Development, Application, and Redo of Standardized Bycatch Reporting Methodology	**Neutral**	
Agricultural runoff	**Direct Negative**	
Port maintenance	**Uncertain – Likely Direct Negative**	
Offshore disposal of dredged materials	**Direct Negative**	
Beach nourishment – Offshore mining	**Direct Negative**	
Beach nourishment – Sand placement	**Direct Negative**	
Marine transportation	**Direct Negative**	
Renewable and Non-renewable Offshore and Nearshore Energy Development	**Uncertain – Likely Direct Negative**	
NEFMC Omnibus Habitat and Coral Actions		**Positive**
Convening Take Reduction Teams	**Indirect Positive**	
Summer Flounder, Black Sea Bass, and Squid Amendments		**Neutral to Positive**

Managed Resources

Those past, present, and reasonably foreseeable future actions, whose effects may impact the managed resources and the direction of those potential impacts, are summarized in Table 109. The indirectly negative actions described in Table 109 are mainly localized in nearshore areas and marine project areas where they occur. Therefore, the magnitude of those impacts on the managed resources is expected to be limited due to a lack of exposure to the population at large. Agricultural runoff may be much broader in scope, and the impacts of nutrient inputs to the coastal system may be of a larger magnitude, although the impact on productivity of the managed resources is unquantifiable. As described above (Section 7.6.4), NOAA Fisheries has several means under which it can review non-fishing actions of other federal or state agencies that may impact NOAA Fisheries managed resources prior to permitting or implementation of those projects. This serves to minimize the extent and magnitude of indirect negative impacts those actions could have on resources under NOAA Fisheries jurisdiction.

Past fishery management actions taken through the FMP and specification process have had a positive cumulative effect on the managed resources. It is anticipated that the future management actions, described in Table 104, will result in additional indirect positive effects on the managed resources through actions which reduce and monitor bycatch, protect habitat, and protect ecosystem services on which MSB productivity depends. The 2012 fishing year was the first year of implementation for an Amendment which requires specification of ACLs and ACTs, and this process has been carried forward into the 2014-2016 measures. This represents a major change to the current management program and is expected to lead to improvements in resource sustainability over the long-term. These impacts could be broad in scope. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful to the MSB FMP have had a positive cumulative effect.

Catch limits, and commercial quotas for each of the managed resources have been specified to ensure these rebuilt stocks are managed in a sustainable manner, and measures are consistent with the objectives of the FMP under the guidance of the MSA. The impacts from specification of management measures established in previous years on the managed resources are largely dependent on how effective those measures were in meeting their intended objectives (i.e., preventing overfishing, achieving OY) and the extent to which mitigating measures were effective (Table 105).

Table 105: Summary of the effects of past, present, and reasonably foreseeable future actions on the managed resource.

<table>
<tr><th>Action</th><th>Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMP and subsequent Amendments and Frameworks to the FMPs</td><td>Indirect Positive</td><td></td></tr>
<tr><td>Managed Resource Specifications</td><td>Indirect Positive</td><td></td></tr>
<tr><td>Development, Application, and Redo of Standardized Bycatch Reporting Methodology</td><td colspan="2">Neutral</td></tr>
<tr><td>Agricultural runoff</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Port maintenance</td><td colspan="2">Uncertain – Likely Indirect Negative</td></tr>
<tr><td>Offshore disposal of dredged materials</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Beach nourishment – Offshore mining</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Beach nourishment – Sand placement</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Marine transportation</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Renewable and Non-renewable Offshore and Nearshore Energy Development</td><td colspan="2">Uncertain – Likely Indirect Negative</td></tr>
<tr><td>NEFMC Omnibus Habitat and Coral Actions</td><td colspan="2">Indirect Positive</td></tr>
<tr><td>Convening Take Reduction Teams</td><td></td><td>Neutral to Indirect Positive</td></tr>
<tr><td>Summer Flounder, Black Sea Bass, and Squid Amendments</td><td></td><td>Positive</td></tr>
</table>

Deep Sea Corals

Those past, present, and reasonably foreseeable future actions, whose effects may impact deep sea corals species and the direction of those potential impacts, are summarized in Table 109. The effects of many of the indirectly negative actions described in Table 109 are localized, many in nearshore areas and marine project areas where they occur. Therefore, the magnitude of those impacts on coral species is expected to be limited due to a lack of exposure to the population at large. Agricultural runoff may be much broader in scope, and the impacts of nutrient inputs to the coastal system may be of a larger magnitude, although the impact on productivity of deep sea coral resources and the oceanic ecosystem is unquantifiable. As described above (section 7.6.4), NOAA Fisheries has several means under which it can review non-fishing actions of other federal or state agencies that may impact NOAA Fisheries managed resources prior to permitting or implementation of those projects. At this time, NOAA Fisheries can consider impacts to non-target species (federally-managed or otherwise) and comment on potential impacts. This serves to minimize the extent and magnitude of indirect negative impacts those actions could have on resources within NOAA Fisheries jurisdiction.

Past fishery management actions taken through the FMP and annual specifications process have had overall mixed impacts on deep sea corals. Specifically, limited access management, catch limits, monitoring requirements, spatial restrictions, and other management measures have contributed to changes in the spatial concentration of fishing effort, the overall level of fishing effort, gear configuration, and other elements of fishing behavior. Many of these measures are likely to have reduced effort in deep sea coral habitats or reduced gear interactions with corals, while others may have had the opposite effect. It is anticipated that future management actions, described in Table 106, will result in additional indirect positive effects on deep sea coral communities through actions which protect habitat and protect ecosystem services on which the productivity of deep sea coral resources depend. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful have had a positive cumulative effect on deep sea coral species (Table 106).

Table 106. Summary of the effects of past, present, and reasonably foreseeable future actions on deep sea corals.

<table>
<tr><th>Action</th><th colspan="2">Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMP and subsequent Amendments and Frameworks to the FMPs</td><td colspan="2">Indirect Positive</td><td></td></tr>
<tr><td>Managed Resource Specifications</td><td colspan="2">Indirect Positive</td><td></td></tr>
<tr><td>Development, Application, and Redo of Standardized Bycatch Reporting Methodology</td><td colspan="3">Neutral</td></tr>
<tr><td>Agricultural runoff</td><td colspan="3">Neutral to Indirect Negative</td></tr>
<tr><td>Port maintenance</td><td colspan="3">Uncertain – Likely Indirect Negative</td></tr>
<tr><td>Offshore disposal of dredged materials</td><td colspan="3">Indirect or Direct Negative</td></tr>
<tr><td>Beach nourishment – Offshore mining</td><td colspan="3">Indirect or Direct Negative</td></tr>
<tr><td>Beach nourishment – Sand placement</td><td colspan="3">Indirect Negative</td></tr>
<tr><td>Marine transportation</td><td colspan="3">Indirect Negative</td></tr>
<tr><td>Renewable and Non-renewable Offshore and Nearshore Energy Development</td><td colspan="3">Uncertain – Likely Indirect or Direct Negative</td></tr>
<tr><td>NEFMC Omnibus Habitat and Coral Actions</td><td></td><td colspan="2">Positive</td></tr>
<tr><td>Convening Take Reduction Teams</td><td></td><td></td><td>Neutral</td></tr>
<tr><td>Summer Flounder, Black Sea Bass, and Squid Amendments</td><td></td><td></td><td>Neutral to Indirect Positive</td></tr>
</table>

Human Communities

Those past, present, and reasonably foreseeable future actions, whose effects may impact human communities and the direction of those potential impacts, are summarized in Table 109. The indirectly negative actions described are localized in nearshore areas and marine project areas where they occur. Therefore, the magnitude of those impacts on human communities is expected to be limited in scope. It may, however, displace fishermen from project areas. Agricultural runoff may be much broader in scope, and the impacts of nutrient inputs to the coastal system may be of a larger magnitude. This may result in indirect negative impacts on human communities by reducing resource availability; however, this effect is unquantifiable. As described above (Section 7.6.4), NOAA Fisheries has several means under which it can review non-fishing actions of other federal or state agencies prior to permitting or implementation of those projects. This serves to minimize the extent and magnitude of indirect negative impacts those actions could have on human communities.

Past fishery management actions taken through the FMP and annual specification process have had both positive and negative cumulative effects by benefiting domestic fisheries through sustainable fishery management practices, while at the same time potentially reducing the availability of the resource to all participants. Sustainable management practices are, however, expected to yield broad positive impacts to fishermen, their communities, businesses, and the nation as a whole. It is anticipated that the future management actions, described in Table 107, will result in positive effects for human communities due to sustainable management practices, although additional indirect negative effects on the human communities could occur through management actions that may result in area closures and thus, reduce revenues. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful to human communities have had an overall positive cumulative effect (Table 107).

Table 107. Summary of the effects of past, present, and reasonably foreseeable future actions on human communities.

<table>
<tr><th>Action</th><th colspan="2">Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMP and subsequent Amendments and Frameworks to the FMPs</td><td colspan="2">Indirect Positive</td><td></td></tr>
<tr><td>Managed Resource Specifications</td><td colspan="2">Indirect Positive</td><td></td></tr>
<tr><td>Development, Application, and Redo of Standardized Bycatch Reporting Methodology</td><td colspan="3">Potentially Indirect Negative</td></tr>
<tr><td>Agricultural runoff</td><td colspan="3">Indirect Negative</td></tr>
<tr><td>Port maintenance</td><td colspan="3">Uncertain – Likely Mixed</td></tr>
<tr><td>Offshore disposal of dredged materials</td><td colspan="3">Indirect Negative</td></tr>
<tr><td>Beach nourishment – Offshore mining</td><td colspan="3">Mixed</td></tr>
<tr><td>Beach nourishment – Sand placement</td><td colspan="3">Positive</td></tr>
<tr><td>Marine transportation</td><td colspan="3">Mixed</td></tr>
<tr><td>Renewable and Non-renewable Offshore and Nearshore Energy Development</td><td colspan="3">Uncertain – Likely Mixed</td></tr>
<tr><td>NEFMC Omnibus Habitat and Coral Actions</td><td></td><td colspan="2">Uncertain – Likely Mixed</td></tr>
<tr><td>Convening Take Reduction Teams</td><td></td><td></td><td>Mixed</td></tr>
<tr><td>Summer Flounder, Black Sea Bass, and Squid Amendments</td><td></td><td></td><td>Indirect Positive</td></tr>
</table>

Protected Resources

Those past, present, and reasonably foreseeable future actions, whose effects may impact the protected resources and the direction of those potential impacts, are summarized in Table 109. As described above (Section 7.6.4), NOAA Fisheries has several means, including ESA, under which it can review non-fishing actions of other federal or state agencies that may impact NOAA Fisheries protected resources prior to permitting or implementation of those projects. This serves to minimize the extent and magnitude of indirect negative impacts those actions could have on protected resources under NOAA Fisheries jurisdiction.

Past fishery management actions taken through the FMP and annual specification process have had a mixed to overall positive effect on ESA-listed and MMPA protected species through the reduction of fishing effort (potential interactions). It is anticipated that the future management actions, specifically those recommended by the ALWTRT and the development of strategies for sea turtle conservation described in Section 6.0, will result in additional direct positive effects on the protected resources. These impacts could be broad in scope. However, many non-fishing negative impacts to protected resources are ongoing. Overall, the past, present, and reasonably foreseeable future actions have had an overall mixed cumulative effect on protected resources (Table 108).

Table 108. Summary of the effects of past, present, and reasonably foreseeable future actions on the protected resources.

<table>
<tr><th>Action</th><th>Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMP and subsequent Amendments and Frameworks to the FMPs</td><td>Indirect Positive</td><td></td></tr>
<tr><td>Managed Resource Specifications</td><td>Indirect Positive</td><td></td></tr>
<tr><td>Development, Application, and Redo of Standardized Bycatch Reporting Methodology</td><td colspan="2">Neutral to Indirect Positive</td></tr>
<tr><td>Agricultural runoff</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Port maintenance</td><td colspan="2">Direct and Indirect Negative</td></tr>
<tr><td>Offshore disposal of dredged materials</td><td colspan="2">Direct and Indirect Negative</td></tr>
<tr><td>Beach nourishment – Offshore mining</td><td colspan="2">Direct and Indirect Negative</td></tr>
<tr><td>Beach nourishment – Sand placement</td><td colspan="2">Indirect Negative</td></tr>
<tr><td>Marine transportation</td><td colspan="2">Direct and Indirect Negative</td></tr>
<tr><td>Renewable and Non-renewable Offshore and Nearshore Energy Development</td><td colspan="2">Direct and Indirect Negative</td></tr>
<tr><td>NEFMC Omnibus Habitat and Coral Actions</td><td></td><td>Uncertain – Likely Mixed</td></tr>
<tr><td>Convening Take Reduction Teams</td><td></td><td>Positive</td></tr>
<tr><td>Summer Flounder, Black Sea Bass, and Squid Amendments</td><td></td><td>Neutral to Positive</td></tr>
</table>

Table 109: Impacts of Past (P), Present (Pr), and Reasonably Foreseeable Future (RFF) Actions on the five VECs (not including those actions considered in this Amendment document).

Action	Description	Impacts on Habitat and EFH	Impacts on Managed Resource	Impacts on Deep Sea Corals	Impacts on Human Communities	Impacts on Protected Species
[P, Pr] Original FMPs, and Amendments and Frameworks to the FMP	Established management measures	**Indirect Positive** Reduced fishing effort	**Indirect Positive** Regulatory tool available to rebuild and manage stocks	**Indirect Positive** Reduced fishing effort	**Indirect Positive** Benefited domestic businesses	**Indirect Positive** Reduced fishing effort
[P, Pr, RFF] Specifications	Establish quotas, other fishery regulations	**Indirect Positive** Reduced effort levels; gear requirements	**Indirect Positive** Regulatory tool to specify catch limits, and other regulation; allows response to annual stock updates	**Indirect Positive** Reduced effort levels; gear requirements	**Indirect Positive** Benefited domestic businesses	**Indirect Positive** Reduced effort levels; gear requirements
[P, Pr, RFF] Development, Application, and Redo of Standardized Bycatch Reporting Methodology	Established acceptable level of precision and accuracy for monitoring of bycatch in fisheries	**Neutral** Will not affect distribution of effort	**Neutral** May improve data quality for monitoring total removals of managed resource	**Neutral** Unlikely to impact data quality for interactions with deep sea corals	**Potentially Indirect Negative** May impose an inconvenience on vessel operations	**Neutral** May increase observer coverage and will not affect distribution of effort
[P, Pr, RFF] Agricultural runoff	Nutrients applied to agricultural land are introduced into aquatic systems	**Direct Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality negatively affects resource health	**Indirect Negative** Reduced habitat quality
[P, Pr, RFF] Port maintenance	Dredging of coastal, port and harbor areas for port maintenance	**Uncertain – Likely Direct Negative** Dependent on mitigation effects	**Uncertain – Likely Indirect Negative** Dependent on mitigation effects	**Uncertain – Likely Neutral** Unlikely to impact corals in offshore environments	**Uncertain – Likely Mixed** Dependent on mitigation effects	**Direct and Indirect Negative** Dependent on mitigation effects

Action	Description	Impacts on Habitat and EFH	Impacts on Managed Resource	Impacts on Deep Sea Corals	Impacts on Human Communities	Impacts on Protected Species
[P, Pr, RFF] Offshore disposal of dredged materials	Disposal of dredged materials	**Direct Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality	**Indirect Negative** Reduced habitat quality negatively affects resource health	**Indirect Negative** Reduced habitat quality
[P, Pr, RFF] Beach nourishment	Offshore mining of sand for beaches	**Direct Negative** Reduced habitat quality	**Indirect Negative** Localized decreases in habitat quality	**Uncertain – Likely Neutral** Corals unlikely to be present in areas mined for sand; may impact sediment redistribution	**Mixed** Positive for mining companies, possibly negative for fishing industry	**Direct and Indirect Negative** Localized decreases in habitat quality; dredge interactions
	Placement of sand to nourish beach shorelines	**Direct Negative** Reduced habitat quality	**Indirect Negative** Localized decreases in habitat quality	**Neutral** Does not impact corals in offshore environments	**Positive** Beachgoers like sand; positive for tourism	**Indirect Negative** Localized decreases in habitat quality
[P, Pr, RFF] Marine transportation	Expansion of port facilities, vessel operations and recreational marinas	**Direct Negative** Reduced habitat quality	**Indirect Negative** Localized decreases in habitat quality	**Uncertain – Possible Indirect Negative** Localized decreases in habitat quality	**Mixed** Positive for some interests, potential displacement for others	**Direct and Indirect Negative** Localized decreases in habitat quality; ship strikes
[P, Pr, RFF] Renewable and Non-renewable Offshore and Nearshore Energy Development	Transportation of oil, gas, and electric through pipelines and cables; Construction of oil platforms, wind facilities, liquefied natural gas facilities; Additional port development infrastructure	**Uncertain – Likely Direct Negative** Reduced habitat quality; offshore platforms may benefit structure oriented fish species habitat	**Uncertain – Likely Indirect Negative** Dependent on mitigation effects	**Potentially Direct Negative** Reduced habitat quality; offshore platforms may displace corals	**Mixed** Positive for some interests, potential displacement for others	**Direct and Indirect Negative** Reduced habitat quality ; Sound Exposure (physical injury or behavioral harassment);Dependent on mitigation effects

Action	Description	Impacts on Habitat and EFH	Impacts on Managed Resource	Impacts on Deep Sea Corals	Impacts on Human Communities	Impacts on Protected Species
RFF Deep sea mining	Potential mining activity for deep sea minerals	**Direct Negative** Reduced habitat quality	**Uncertain – Likely Indirect Negative** Dependent on mitigation effects	**Direct Negative** Reduced habitat quality; potential for direct disturbance	**Mixed** Positive for some interests, potential displacement for others	**Potentially Indirect Negative** Reduced habitat quality; Dependent on mitigation effects
RFF Convening of Take Reduction Teams (periodically)	Recommend measures to reduce mortality and injury to marine mammals	**Indirect Positive** Reducing availability of gear could reduce gear impacts	**Indirect Positive** Will improve data quality for monitoring total removals	**Indirect Positive** Reducing availability of gear could reduce bycatch	**Indirect Negative** Reducing availability of gear could reduce revenues	**Direct Positive** Reducing availability of gear could reduce encounters
RFF NEFMC Omnibus Habitat Amendment 2	Review/revision of EFH designations; actions to minimize adverse effects of fishing on EFH	**Direct Positive** Updates designations and protections for habitat and EFH	**Neutral to Positive** Indirect positive impacts associated with updated EFH designations; mixed impacts from spatial management options depending on measures adopted and spatial extent of fishery	**Uncertain – Likely Mixed** Measures include restricting gear use in some areas and opening some previously restricted areas; depending on coral distribution, could increase or decrease potential for interactions	**Mixed** Socioeconomic impacts of spatial measures vary by fishery; Fisheries will benefit long-term from improved habitat protections	**Neutral** Measures are not expected to influence the trajectory of recovery of protected species of turtles, marine mammals, or fish.
RFF NEFMC Omnibus Deep Sea Coral Amendment	Amendment to protect deep sea corals from the impacts of fishing gear in the NEFMC region	**Direct and Indirect Positive** Protected areas for deep sea corals likely to benefit habitat	**Uncertain – Likely Indirect Positive** Protected areas may provide refuge for managed resources	**Direct Positive** Reduced interactions between fishing gear and deep sea corals	**Likely Direct Negative** Restricted access/redistribution of effort may have negative socioeconomic impacts	**Uncertain - Likely Indirect Positive** Protected areas may reduce interactions with protected resources

Action	Description	Impacts on Habitat and EFH	Impacts on Managed Resource	Impacts on Deep Sea Corals	Impacts on Human Communities	Impacts on Protected Species
[RFF] MAFMC Omnibus Unmanaged Forage Amendment	Amendment to prohibit development of new/ expansion of existing fisheries for unmanaged forage species	**Uncertain – Likely Neutral** Depending on measures adopted, not likely to impact habitat	**Indirect Positive** Will likely provide protections for forage prey base for many managed resources	**Uncertain – Likely Neutral** Depending on species included and measures adopted, not likely to impact fishing behavior in deep sea coral areas	**Uncertain – Likely Indirect Negative** Depending on measures adopted, likely to prevent expansion of some fishing operations	**Indirect Positive** Will likely provide protections for forage prey base for many protected species
[RFF] Comprehensive Summer Flounder and Black Sea Bass Amendments	Updates to several aspects of the FMP for summer flounder and black sea bass, including FMP goals and objectives and allocation schemes	**Uncertain – Likely Neutral** Depending on actions implemented, will not likely result in significant changes to fishing behavior	**Direct Positive** Will improve management of summer flounder and black sea bass fisheries	**Uncertain – Likely Neutral** Depending on actions implemented, will not likely result in significant changes to fishing behavior in coral areas	**Uncertain - Likely Mixed** Positive for some interests, potential negative socioeconomic impacts for others	**Uncertain – Likely Neutral or Indirect Positive** Depending on actions implemented, may reduce likelihood of interactions
[RFF] Omnibus Observer Coverage Amendment	Measures to implement industry-funded monitoring coverage in some FMPs above levels required by SBRM	**Uncertain – Likely Neutral** Depending on actions implemented, will not likely result in significant changes to fishing behavior	**Likely Indirect Positive** May improve monitoring and reporting for managed resources	**Likely Indirect Positive** May improve monitoring and reporting for deep sea coral interactions	**Likely Direct Negative** Likely to impose additional costs on fishing operations	**Likely Indirect Positive** May improve monitoring and reporting for protected resources interactions
[RFF] Squid Capacity Amendment	Measures to reduce the capacities of the longfin squid and *Illex* squid fleets	**Uncertain - Likely Neutral** Unlikely to result in changes in fishing behavior	**Uncertain – Likely Indirect Positive** May improve management of squid fisheries	**Uncertain - Likely Neutral** Unlikely to result in changes in fishing behavior	**Uncertain - Likely Mixed** Positive for some interests, potential negative socioeconomic impacts for others	**Uncertain - Likely Neutral** Unlikely to result in changes in fishing behavior

Action	Description	Impacts on Habitat and EFH	Impacts on Managed Resource	Impacts on Deep Sea Corals	Impacts on Human Communities	Impacts on Protected Species
[RFF] Scup Gear Restricted Areas Framework	Consider modifications to the scup Gear Restricted Areas (GRAs)	**Uncertain – Likely Neutral or Indirect Positive** Depending on changes made, could reduce gear impacts	**Direct Positive** Will ensure that GRAs remain effective tools for minimizing scup bycatch	**Uncertain – Likely Indirect Negative to Indirect Positive** Depending on changes made, could reduce or increase potential for coral interactions	**Uncertain - Likely Indirect Mixed** Depending on changes made, could benefit scup fishery and could negatively or positively impact small mesh fisheries	**Uncertain – Likely Neutral to Indirect Positive** Depending on changes made, could reduce encounters
[P, RFF] Development of management measures for Blueline Tilefish (via Golden Tilefish FMP)	Development of management measures for blueline tilefish off the Mid-Atlantic	**Uncertain – Likely Neutral to Indirect Positive** Depending on measures implemented, could result in changes in fishing behavior. No explicit habitat measures under consideration at this time.	**Uncertain – Likely Neutral to Positive** Positive for blueline tilefish due to improved management; likely neutral impacts to other managed resources	**Uncertain – Likely Neutral to Indirect Positive** Depending on measures implemented, could result in changes in fishing behavior. No explicit habitat measures under consideration at this time.	**Uncertain - Likely Indirect Mixed** Depending on changes made, could negatively impact entities targeting blueline tilefish, but likely to improve management and stock condition in the long term	**Uncertain – Likely Neutral to Indirect Positive** Depending on changes made, could reduce encounters

7.6.5 Magnitude and Significance of Cumulative Effects

In determining the magnitude and significance of the cumulative effects, the additive and synergistic effects of the proposed action, as well as past, present, and future actions, must be taken into account. The following Sections discuss the effects of past, present, and future actions on each of the VECs, the effects of all preferred alternatives in combination, and the synergistic effects of the proposed action in combination with the effects of the combined proposed alternatives.

All VECs are influenced to some degree by changes in global climate. These climate shifts may alter the pattern and strength of ocean currents; change the rate of freshwater inflows; influence water temperature, acidity, and salinity; etc. These changes affect the physical environment directly, which in turn may shape the suitability of local habitats for non-target biological features, managed fish and shellfish species, and protected resources. Changes in the abundance and distribution of these biological resources affect the communities that prosecute fisheries for these resources. For example, if the target species important to a particular port community declines in abundance or its distribution shifts north or south due to environmental factors, there may be negative economic impacts locally, although there could be positive impacts due to increases in abundance of other species. Although the direct impacts to the baseline status of the VECs in this action will vary and are typically associated with some uncertainty, trends are summarized in the sections below where information is available.

7.6.5.1 Preferred Action on all VECs

As described in Section 5.1, the broad zone designation and gear restriction alternatives are precautionary in nature and are primarily intended to “freeze the footprint of fishing” to protect corals from future expansion of fishing effort into deeper waters. The discrete coral zone designations and gear restrictions are primarily intended to protect areas with concentrations of known or highly likely deep sea coral communities or habitat. The Council-preferred designation alternatives include a broad zone and a set of discrete zones that follow the same landward boundary, resulting in discrete zones that entirely overlap the proposed broad zones. Separate designations are maintained in order to allow the Council to consider different management measures and strategies for each type of area. However, the overlapping designations, in combination with the same gear restrictions and exemptions implemented within, mean that essentially the combined impact of the proposed coral zones is similar to those of the broad zone alone. Additional benefits are possible from the combination of discrete and broad zones that would not be available from the broad zone alone, specifically, the ability to tailor management measures specifically to areas where high concentrations of corals are present while maintaining precautionary measures in areas where less is known about coral presence. The combined impact of the Council preferred alternatives are described for each VEC below.

Physical Environment and EFH

As described in Section 7.1, for habitat and EFH, the combined expected impacts from the Council-preferred alternatives, including a broad and discrete coral zone designation with a restriction on bottom-tending gear and an exemption for red crab, is expected to be moderate positive. Within the preferred coral zones, there is substantial overlap with red crab EFH, some overlap with tilefish EFH, and slight overlap with EFH for other managed species. The combined area proposed for protection covers approximately 99,000 km^2. In combination, the proposed broad and discrete zones would cover over 20,000 km^2 of designated EFH, as well as additional non-designated habitat for many managed and unmanaged species. Although much of the proposed gear-restricted area covers deep sea areas beyond the location of most fishing effort, the measures would protect these areas from expansion of current bottom trawling effort and reduce habitat interactions near the landward boundary of the proposed coral zones near the shelf/slope break.

Managed Resources

As discussed in Section 7.2, the expected impacts to the managed resources from the combined Council-preferred alternatives, including a broad and discrete coral zone designation with a restriction on bottom-tending gear and an exemption for red crab, is expected to be slight indirect positive. Direct impacts to the managed resources are unlikely. The measures proposed in this action are not expected to change the overall levels of fishing for any species, nor the methods used to capture the fish (with the exception of the spatial areas of operation and some increased monitoring). However, indirect positive impacts may be realized through increased habitat quality and possible refugia from fishing effort, particularly for species with strong habitat associations in the canyon environments. Because the managed resources are generally highly mobile, widely distributed, and vary in their reproductive strategies, it is difficult to evaluate the extent to which gear-restricted areas may indirectly benefit the stocks as a whole. The expected magnitude of any positive impacts to managed resources from gear restrictions within the combined Council-preferred broad and discrete coral zones would be small for most species. Indirect positive impacts would be expected to be relatively greater for some species, particularly for red crab and golden tilefish which have specific habitat and distributional considerations in the areas considered.

Deep Sea Corals

As discussed in Section 7.3, the expected impacts to deep sea corals from the combined Council-preferred alternatives, including a broad and discrete coral zone designation with a restriction on bottom-tending gear and an exemption for red crab, is expected to be high positive. Corals thrive in specific habitat conditions, are highly vulnerable to fishing gear, and have very long recovery times when disturbed, such that they would be expected to benefit from reductions in interactions with fishing gear. However, benefits to corals are somewhat lessened by the fact that many deep sea corals exist in areas with some degree of natural protection from fishing gear, i.e., they inhabit areas where little or no fishing effort is currently taking place due to extreme depths, areas of very high seafloor slope, or areas with complex structure that fishermen tend to avoid due to the potential for lost or damaged fishing gear. The combined Council-preferred coral protection broad and discrete zone alternatives proposed in this document would expand on this natural protection, reduce gear interactions in places where fishing effort does occur, and prevent expansion of fishing effort into deeper water or areas of steeper slopes where corals are prevalent. In addition, the designation of gear-restricted coral zones is expected to have indirect benefits to deep sea corals

Human Communities

As discussed in Section 7.4, the expected impacts to human communities from the combined Council-preferred alternatives, including a broad and discrete coral zone designation with a restriction on bottom-tending gear and an exemption for red crab, is expected to be moderate negative, depending on the ability to redistribute effort. The preferred alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity. In general, the fisheries most likely to be impacted by the Council-preferred alternatives include trawl vessels targeting squid and whiting. The mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons. The Council-preferred boundaries for both broad and discrete zones follow boundaries developed at the April 2015 collaborative workshop previously discussed in this document. These boundaries were developed by consensus among these groups and were designed to protect corals while limiting impacts to the fishing industry, by allowing for sufficient effort redistribution in productive areas around the boundaries of gear-restricted areas. This is expected to lessen the economic impacts of this Council-preferred broad zone.

Impacts to other human communities beyond fishing communities should be considered in terms of impacts to this VEC. Specifically, the conservation community (e.g., environmental NGOs, agencies, or individuals focused on marine conservation) are expected to experience indirect moderate positive impacts from the designation of gear-restricted broad coral zones associated with the protection of deep sea coral ecosystems. These stakeholders are interested in preserving the integrity of marine ecosystems and the ecosystem services they provide, as well as the non-use or existence value of deep sea corals. Additional indirect benefits to human communities interested in deep sea corals may include increased public and conservation interest, academic interest, and funding for monitoring and research on these ecosystems.

Protected Resources

As discussed in Section 7.5, impacts to protected resources for broad zone gear restricted areas are uncertain, and depend on a number of factors including current species distribution, patterns of effort shifts resulting from gear restricted areas, and whether the concentration of gear deployed changes in areas that experience high interaction rates. The changes proposed in this amendment are not expected to result in an increase in fishing effort overall, just shifts in the location of that effort.

It is expected that for the majority of the fisheries affected by this action, effort that would typically occur within the broad or discrete zones will shift to just outside the zone boundaries (i.e., just shallower than the zone boundaries). In general, the fisheries most likely to be impacted by the gear restriction alternatives, and therefore the fisheries that are most likely to experience shifts in fishing effort, include trawl vessels targeting squid and whiting. Because the red crab trap fishery would be exempt from gear restrictions under the Council’s preferred alternative, red crab effort is not expected to shift and therefore interactions with this gear type would not be expected to change. As described previously, the mobile gear fisheries in question (particularly for *Illex* squid) tend to operate in very specific areas near the heads and bights of the canyons. Thus, for trawl vessels, effort shifts are expected to be relatively concentrated near the shelf/slope break, shifting from areas just deeper than the proposed broad zone boundaries to areas just shallower than the proposed broad zone boundaries. Gilllnet, scallop dredge, and bottom longline gear effort shifts resulting from the proposed coral zones are likely to be insignificant. As a result, increased concentration of gear associated with these vessels around the coral zones is unlikely.

Regardless of the area restricted for coral protections, the number of vessels and amount of gear in the water are not expected to be substantially different from current conditions. Without more fine-scale fishing effort and protected resources interaction data, it is not possible to forecast precisely what entanglement or interaction risks would exist if the closures are implemented; however, we can assess the range of possible impacts to protected species that could result from shifts in effort and the risks associated with these possible impacts. Impacts for protected resources may range from negative to positive for discrete or broad zone designation and gear restriction alternatives.

7.6.5.2 Cumulative Effects of Preferred Action in Combination with Past, Present, and Reasonably Foreseeable Future Actions

The Council has identified its preferred action alternatives in Section 5.0. The cumulative effects of the range of actions considered in this document can be considered to make a determination if significant cumulative effects are anticipated from the preferred action. The direct and indirect impacts of the proposed action on the VECs are described in detail in Sections 7.1 through 7.5, and summarized in Section 7.6.5.1. The magnitude and significance of the cumulative effects, which include the additive and synergistic effects of the proposed action, as well as past, present, and future actions, are summarized here.

The proposed actions in this document are expected to have moderate positive impacts on habitat, which in conjunction with other anthropogenic activities, would be expected to increase the overall positive cumulative effects on this VEC. This action would not have any significant effect on habitat individually or in conjunction with other anthropogenic activities

For managed resources, the proposed actions in this document are likely to positively reinforce the past and anticipated positive cumulative effects on the managed resources, by enhancing habitat quality. Therefore, the proposed action would not have any significant effect on the managed resources individually or in conjunction with other anthropogenic activities

The proposed action in this document are likely to positively reinforce the past and anticipated positive cumulative effects on deep sea corals, by reducing interactions with fishing gear and enhancing habitat quality. However, as described in Section 7.3, the proposed actions to corals are largely precautionary, and enhance the natural protections afforded to deep sea corals by their deep and rugged habitat that is difficult to access with fishing gear. Therefore, the proposed action would not have any significant effect on deep sea coral ecosystems individually or in conjunction with other anthropogenic activities.

For human communities, this action proposes measures that may result in short-term negative effects on human communities, in particular to vessels that must adapt to new gear-restricted areas. However, the expectation is that effort will be displaced to areas just beyond the closed areas, resulting in long-term neutral to slight positive impacts resulting from improved habitat quality for the managed resources. Indirect positive impacts are also expected for human communities other than fishing communities, including the conservation community and individuals in the general population with an interest in protection of deep sea ecosystems. Overall, the proposed actions in this document would not change the past and anticipated cumulative effects on human communities and thus, would not have any significant effect on human communities individually, or in conjunction with other anthropogenic activities.

The proposed actions in this document are not expected to change the past and anticipated cumulative effects on ESA-listed and MMPA protected species and thus, would not have any significant effect on protected resources individually or in conjunction with other anthropogenic activities.

When the proposed actions in this document are considered in conjunction with all the other pressures placed on fisheries by past, present, and reasonably foreseeable future actions, it is not expected to result in any significant impacts, positive or negative. Based on the information and analyses presented in these past FMP documents and this document, there are no significant cumulative effects associated with the action proposed in this document (Table 110).

Table 110. Magnitude and significance of the cumulative effects; the additive and synergistic effects of the preferred action, as well as past, present, and future actions.

VEC	Status in 2016	Net Impact of P, Pr, and RFF Actions	Impact of the Preferred Action	Significant Cumulative Effects
Physical Environment and EFH	Complex and variable (Section 6.1)	Positive (Sections 7.6.4 and 7.6.5.1)	Broad Zone Designation Alt. 1F, Indirect slight positive (w/ out gear restrictions) to moderate direct positive (w/ gear restrictions) (Section 7.1.1)	**None**
			Broad Zone Measures Alt. 2B, Slight to moderate direct positive (Section 7.1.1)	
			Broad Zone Measures Alt. 2B-1, Overall slight to moderate positive in combination with 2B (Section 7.1.2)	
			Broad Zone Measures Alt. 2E, Neutral to indirect slight negative (Section 7.1.2)	
			Discrete Zone Designation Alt. 3B-5, Indirect slight positive (w/out gear restricitons) to moderate direct positive (w/ gear restrictions, Section 7.1.2)	
			Discrete Zone Measures Alt. 4B, Slight to moderate direct positive (Section 7.1.2)	
			Discrete Zone Measures Alt. 4B-1, Overall slight to moderate positive in combination with 4B (Section 7.1.2)	
			Discrete Zone Measures Alt. 4D, Neutral to indirect slight negative (Section 7.1.2)	
			Framework Provision Alts. 5B, 5C, 5B, and 5E, Neutral to indirect slight positive (Section 7.1.3)	
			VMS Alt. 6B, Neutral to indirect slight positive (Section 7.1.4)	
Managed Resources	Complex and variable (Section 6.2)	Positive (Sections 7.6.4 and 7.6.5.2)	Broad Zone Designation Alt. 1F, Neutral (Section 7.2.1)	**None**
			Broad Zone Measures Alt. 2B, Neutral to slight indirect positive (Section 7.2.1)	
			Broad Zone Measures Alt. 2B-1, Neutral to slight indirect positive (Section 7.2.1)	
			Broad Zone Measures Alt. 2E, Neutral (Section 7.1.1)	
			Discrete Zone Designation Alt. 3B-5, Neutral to slight indirect positive (Section 7.2.2)	
			Discrete Zone Measures Alt. 4B, Neutral to slight indirect positive (Section 7.2.2)	
			Discrete Zone Measures Alt. 4B-1, Neutral to slight indirect positive (Section 7.2.2)	
			Discrete Zone Measures Alt. 4D, Neutral (Section 7.2.2)	
			Framework Provision Alts. 5B, 5C, 5B, and 5E, Neutral (Section 7.2.3)	
			VMS Alt. 6B, Neutral to indirect slight positive (Section 7.2.4)	
Deep Sea Corals	Complex and variable (Section 6.3)	Neutral to positive (Sections 7.6.4 and 7.6.5.3)	Broad Zone Designation Alt. 1F, Indirect slight positive (w/ no gear restrictions) to high direct positive (w/ gear restrictions) (Section 7.3.1)	**None**
			Broad Zone Measures Alt. 2B, Slight to high direct positive (Section 7.3.1)	
			Broad Zone Measures Alt. 2B-1, Moderate positive in combination with 2B (Section 7.3.1)	
			Broad Zone Measures Alt. 2E, Indirect slight negative (Section 7.3.1)	
			Discrete Zone Designation Alt. 3B-5, Indirect slight positive (w/out gear restrictions) to high direct positive (w/ gear restrictions; Section 7.3.2)	

			Discrete Zone Measures Alt. 4B, Slight to high direct positive (Section 7.3.2) Discrete Zone Measures Alt. 4B-1, Moderate positive in combination with 2B (Section 7.3.2) Discrete Zone Measures Alt. 4D, Neutral to indirect slight negative (Section 7.3.2) Framework Provision Alts. 5B, 5C, 5B, and 5E, Indirect slight positive (Section 7.3.3) VMS Alt. 6B, Neutral to indirect slight positive (Section 7.3.4)	
Human Communities	Complex and variable (Section 6.4)	Positive (Sections 7.6.4 and 7.6.5.4)	Broad Zone Designation Alt. 1F, Slight to moderate direct and indirect negative (Section 7.4.1) Broad Zone Measures Alt. 2B, Neutral to moderate direct and indirect negative (Section 7.4.1) Broad Zone Measures Alt. 2B-1, Overall moderate positive in combination with 2B (Section 7.4.1) Broad Zone Measures Alt. 2E, Slight positive (Section 7.4.1) Discrete Zone Designation Alt. 3B-5, Slight to moderate negative (Section 7.4.2) Discrete Zone Measures Alt. 4B, Slight to moderate negative (Section 7.4.2) Discrete Zone Measures Alt. 4B-1, Overall moderate positive in combination with 2B (Section 7.4.2) Discrete Zone Measures Alt. 4D, Neutral to slight positive (Section 7.4.2) Framework Provision Alts. 5B, 5C, 5B, and 5E, Neutral (Section 7.4.4) VMS Alt. 6B, Neutral to direct slight negative (Section 7.4.5)	**None**
Protected Resources	Complex and variable (Section 6.5)	Positive (Sections 7.6.4 and 7.6.5.5)	Broad Zone Designation Alt. 1F, Uncertain, Negative to positive (Section 7.5.1) Broad Zone Measures Alt. 2B, Uncertain, Negative to positive (Section 7.5.1) Broad Zone Measures Alt. 2B-1, Uncertain, Negative to positive (Section 7.5.1) Broad Zone Measures Alt. 2E, Neutral (Section 7.5.2) Discrete Zone Designation Alt. 3B-5, Uncertain, Negative to positive (Section 7.5.2) Discrete Zone Measures Alt. 4B, Negative to positive (Section 7.5.2) Discrete Zone Measures Alt. 4B-1, Uncertain, Negative to positive (Section 7.5.2) Discrete Zone Measures Alt. 4D, Neutral (Section 7.5.2) Framework Provision Alts. 5B, 5C, 5B, and 5E, Neutral (Section 7.5.3) VMS Alt. 6B, Neutral to indirect slight positive (Section 7.5.4)	**None**

8.0 CONSISTENCY WITH MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

8.1 NATIONAL STANDARDS

Section 301 of the MSA requires that fishery management plans contain conservation and management measures that are consistent with the ten National Standards:

(1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The Council continues to meet the obligations of National Standard 1 by adopting and implementing conservation and management measures that will continue to prevent overfishing, while achieving, on a continuing basis, the optimum yield (OY) for Atlantic mackerel, squid, and butterfish fisheries and other Council managed fisheries. To achieve OY, scientific and management uncertainty are considered when establishing catch limits. The Council develops recommendations that do not exceed the Acceptable Biological Catch (ABC) recommendations of the SSC which have been developed to explicitly address scientific uncertainty. In addition, the Council considers relevant sources of management uncertainty and other social, economic, and ecological factors, which may result in recommendations for annual catch targets for a given fishing year. This action proposes to restrict the use of bottom-tending gear in some areas, but will not impact the process of setting catch limits to prevent overfishing, nor is it expected to prevent the fisheries from achieving their catch targets for these three species.

(2) Conservation and management measures shall be based upon the best scientific information available.

The data sources considered and evaluated during the development of this action include, but are not limited to: permit data, landings data from vessel trip reports, information from resource trawl surveys, sea sampling (observer) data, data from the dealer weighout purchase reports, peer-reviewed assessments and original literature, internally reviewed NOAA literature, databases, and models, direct communication with principal investigators from recent research projects, and descriptive information provided by fishery participants and the public. To the best of the Council's knowledge these data sources constitute the best scientific information available. All analyses based on these data have been reviewed by the National Marine Fisheries Service and the public.

As described in Sections 5.0 and 6.0, spatial alternatives for coral protections in this amendment were developed based on several quality datasets for coral distribution, abundance, and habitat. Coral zone boundaries were developed primarily based on a habitat suitability model for deep sea corals developed by NOAA (Kinlan et al. 2013) and high resolution bathymetry data to identify areas of very high seafloor slope (>30 degrees), which has been shown to be highly correlated with coral presence. The habitat suitability model has performed well in groudtruthing and represents the best relevant scientific information available to the Council at this time since it incorporates established factors supporting coral presence. The model has been internally reviewed by NCCOS and NEFSC to meet technical standards for data quality, and detailed metadata have been produced and made publicly available as part of the full data package. The model output package was subsequently provided to the NOAA Coastal Services Center/Bureau of Ocean Energy Management's Multipurpose Marine Cadastre, where it underwent another review process with internal and external reviewers.

In addition, the Council considered data and findings from several recent deep sea research cruises, funded by NOAA's Deep Sea Coral Research and Technology Program, NOAA's Office of Ocean Exploration and Research (OER), and BOEM. The Council coordinated with lead scientists on these expeditions to ensure proposed management measures and analysis incorporated the most accurate and up to date information regarding coral presence and distribution in the Mid-Atlantic Council region.

(3) To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The fishery management plan addresses management of the mackerel, squid, and butterfish stocks throughout the range of the species in U.S. waters, in accordance with the jurisdiction of U.S. law.

(4) Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The proposed management measures are not expected to discriminate between residents of different States. This action does not allocate or assign fishing privileges among various fishermen.

(5) Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The Council considered the practicability of measures, including efficient utilization of fishery resources, when identifying preferred alternatives for this amendment, i.e., balancing the needs of the fisheries in addition to the benefits of deep sea coral protections. Impacts to the human community including economic information were provided to the Council in the Public Information Document prior to final action, and voting members considered oral and written input from its committees, advisory panels, and fishing industry members attending its meetings. While the proposed measures are expected to result in small changes to fishing patterns (mainly the spatial distribution of effort), the measures are not expected to substantially impact the overall efficiency of utilization of fishery resources. In addition, the proposed measures include provisions for allowing transit through closed areas to avoid inefficient transit around closed areas in the heads of canyons. No measures are proposed regarding economic allocation.

(6) Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

In order to provide the greatest flexibility possible for future management decisions, the fishery management plan includes a Framework adjustment mechanism with an extensive list of possible Framework adjustment measures that can be used to quickly adjust the plan as conditions in the fishery change. This action proposes modifications to the list of possible Framework adjustment measures in order to provide maximum flexibility for future adjustments to deep sea coral-related measures.

(7) Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

As always, the Council considered the costs and benefits associated with the management measures proposed when developing this action. This action should not create any duplications related to managing the mackerel, squid, and butterfish resources.

(8) Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The human community impacts of the action are described above in Section 7.0 and predicted to range from high negative to positive. While the proposed coral zones in combination make up a very large area, the vast majority of the area within the proposed zones currently experiences no fishing effort, due to waters that are too deep and/or seafloor terrain that is too steep or rugged. Thus, the actual area of fishing grounds expected to be impacted is small relative to the total footprint of effort for an affected fishery. The boundaries of the both the preferred discrete and broad coral zone alternatives were refined at a very fine spatial scale during a collaborative workshop in April 2015. During this workshop, Council Advisory Panels, including stakeholders likely to be directly affected by the proposed measures, worked to identify boundaries that would achieve an acceptable balance of both coral conservation and minimizing economic impacts to the fishing industry. All of these boundaries, which represent the areas where most of the impacts to fishing effort will occur, were developed by consensus among workshop participants. While some redistribution of fishing effort is expected if the Council preferred boundaries were to be implemented, it is anticipated that effort will shift to areas just outside the coral zone boundaries, and the impacts on overall harvest in the affected fisheries will be minimal. Therefore, the measures contained in this action are not expected to be highly controversial.

(9) Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The MSA defines “bycatch” as fish that are harvested in a fishery, but are not retained (sold, transferred, or kept for personal use), including economic discards and regulatory discards. Deep sea corals fall under the statutory definition of “fish,”[53] thus, the MSA bycatch provisions are applicable to corals. The measures proposed under this action are designed to reduce interactions between commercial fishing gear and deep sea corals, and consistent with the intent of National Standard 9 to minimize bycatch to the extent practicable. The proposed measures are not expected to substantially alter the catch composition or increase the bycatch rates of other species.

[53] *See* 16 U.S.C. § 1802(12) (defining “fish” as “finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds”).

(10) Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Fishing is a dangerous occupation; participants must constantly balance the risks imposed by weather against the economic benefits. According to the National Standard guidelines, the safety of the fishing vessel and the protection from injury of persons aboard the vessel are considered the same as "safety of human life at sea." The safety of a vessel and the people aboard is ultimately the responsibility of the master of that vessel. Each master makes many decisions about vessel maintenance and loading and about the capabilities of the vessel and crew to operate safely in a variety of weather and sea conditions. This national standard does not replace the judgment or relieve the responsibility of the vessel master related to vessel safety. The proposed alternatives contain options to allow for transit over closed areas, which may allow vessels more flexibility to prevent dangerous activity meant to avoid going into a closed area. Given these provisions, the Council determined that safety at sea had been considered to the extent practicable and should not be materially affected by the proposed measures.

8.2 OTHER REQUIRED PROVISIONS OF THE MSA

Section 303 of the MSA contains 15 additional required provisions for FMPs, which are listed and discussed below. Nothing in this action is expected to contravene any of these required provisions.

(1) contain the conservation and management measures, applicable to foreign fishing and fishing by vessels of the United States, which are-- (A) necessary and appropriate for the conservation and management of the fishery to prevent overfishing and rebuild overfished stocks, and to protect, restore, and promote the long-term health and stability of the fishery; (B) described in this subsection or subsection (b), or both; and (C) consistent with the National Standards, the other provisions of this Act, regulations implementing recommendations by international organizations in which the United States participates (including but not limited to closed areas, quotas, and size limits), and any other applicable law

The MSB FMP has evolved over time through 14 Amendments and currently uses ABC recommendations from the Council's SSC to sustainably manage the Mackerel, Squid, and Butterfish fisheries. Under the umbrella of limiting catch to the ABC, a variety of other management and conservation measures have been developed to meet the goals of the fishery management plan and remain consistent with the National Standards. The current measures are codified in the Code of Federal Regulations (50 C.F.R. § 648 Subpart B, available at: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=1e9802ffddb05d0243d9c657fade956c&rgn=div5&view=text&node=50:12.0.1.1.5&idno=50) and summarized at: http://www.greateratlantic.fisheries.noaa.gov/regs/infodocs/msbinfosheet.pdf. This action proposes gear restricted areas for deep sea coral protections, modifications to the framework provisions of the FMP, and a VMS requirement for the *Illex* squid fishery. The existing and proposed management measures should continue to promote the long-term health and stability of the fisheries consistent with the MSA.

(2) contain a description of the fishery, including, but not limited to, the number of vessels involved, the type and quantity of fishing gear used, the species of fish involved and their location, the cost likely to be incurred in management, actual and potential revenues from the

fishery, any recreational interest in the fishery, and the nature and extent of foreign fishing and Indian treaty fishing rights, if any

Every amendment to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan provides this information. This document also updates this information as appropriate in Section 6. The original FMP and all subsequent amendments and frameworks are available at: http://www.mafmc.org/msb/.

(3) assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery, and include a summary of the information utilized in making such specification

This provision is addressed via assessments that are conducted through a peer-reviewed process at the NMFS Northeast Fisheries Science Center. The available information is summarized in every FMP amendment and Specifications document (see Section 6). Full assessment reports are available at: http://www.nefsc.noaa.gov/saw/.

(4) assess and specify-- (A) the capacity and the extent to which fishing vessels of the United States, on an annual basis, will harvest the optimum yield specified under paragraph (3); (B) the portion of such optimum yield which, on an annual basis, will not be harvested by fishing vessels of the United States and can be made available for foreign fishing; and (C) the capacity and extent to which United States fish processors, on an annual basis, will process that portion of such optimum yield that will be harvested by fishing vessels of the United States

Based on past performance and capacity analyses (Amendment 11), if Atlantic mackerel, squid, and butterfish are sufficiently abundant and available, the domestic fishery has the desire and ability to fully harvest the available quotas, and domestic processors can process the fish/squid.

(5) specify the pertinent data which shall be submitted to the Secretary with respect to commercial, recreational, and charter fishing in the fishery, including, but not limited to, information regarding the type and quantity of fishing gear used, catch by species in numbers of fish or weight thereof, areas in which fishing was engaged in, time of fishing, number of hauls, and the estimated processing capacity of, and the actual processing capacity utilized by, United States fish processors

Previous amendments have specified the data that must be submitted to NMFS in the form of vessel monitoring systems (VMS), vessel trip reports, vessel monitoring, and dealer transactions. The action proposes requiring that that federally-permitted *Illex* squid vessels use VMS.

(6) consider and provide for temporary adjustments, after consultation with the Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safe conduct of the fishery; except that the adjustment shall not adversely affect conservation efforts in other fisheries or discriminate among participants in the affected fishery

There are no such requests pending, but the plan contains provisions for framework actions to make modifications regarding access/permitting if necessary.

(7) describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat

Section 6.1 of this document summarizes essential fish habitat (EFH). Amendments 9 and 11 evaluated habitat impacts, updated essential fish habitat designations, and implemented measures to reduce habitat impacts (primarily related to tilefish essential fish habitat).

(8) in the case of a fishery management plan that, after January 1, 1991, is submitted to the Secretary for review under section 304(a) (including any plan for which an amendment is submitted to the Secretary for such review) or is prepared by the Secretary, assess and specify the nature and extent of scientific data which is needed for effective implementation of the plan

The preparation of this action included a review of the scientific data available to assess the impacts of all alternatives considered. No additional data was deemed needed for effective implementation of the plan other than the VMS reporting described above.

(9) include a fishery impact statement for the plan or amendment (in the case of a plan or amendment thereto submitted to or prepared by the Secretary after October 1, 1990) which shall assess, specify, and describe the likely effects, if any, of the conservation and management measures on-- (A) participants in the fisheries and fishing communities affected by the plan or amendment; and (B) participants in the fisheries conducted in adjacent areas under the authority of another Council, after consultation with such Council and representatives of those participants;

Section 7.0 of this document provides an assessment of the likely effects on fishery participants and communities from the considered actions.

(10) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery

Amendments 8 and 9 to the fishery management plan established biological reference points for the species in the plan, and Amendment 10 contained measures for butterfish rebuilding. If a fishery is declared overfished or if overfishing is occurring, another Amendment would be undertaken to implement effective corrective measures. A pending framework will also facilitate rapid incorporation of new overfished/overfishing reference points.

(11) establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority-- (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided

In June 2015, NMFS published a final rule implementing measures contained within an Omnibus Standardized Bycatch Reporting Methodology (SBRM) Amendment (80 FR 37182, June 30, 2015), which revised an older SBRM system that was invalidated by court order. This final rule established an SBRM for all FMPs administered by the Greater Atlantic Regional Fisheries Office. Additional details, including the final rule and supporting Environmental Assessment, are available at: https://www.greateratlantic.fisheries.noaa.gov/regs/2015/June/15SBRMOmnibusAmend.html.

(12) assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish, and include conservation and management measures that, to the extent practicable, minimize mortality and ensure the extended survival of such fish

The Atlantic mackerel, squid, and butterfish fisheries are primarily commercial. There are some discards in the recreational mackerel fishery, but these are minimal related to the overall scale of the mackerel fishery. There are no size limits that would lead to regulatory recreational discarding of mackerel. There are no catch and release fishery management programs. There is some recreational longfin squid fishing, but it is thought to be relatively minor and the Council is considering if a survey is appropriate to further investigate longfin squid recreational fishing.

(13) include a description of the commercial, recreational, and charter fishing sectors which participate in the fishery and, to the extent practicable, quantify trends in landings of the managed fishery resource by the commercial, recreational, and charter fishing sectors

Every amendment to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan provides this information. This document also updates this information as appropriate in Section 6.

(14) to the extent that rebuilding plans or other conservation and management measures which reduce the overall harvest in a fishery are necessary, allocate any harvest restrictions or recovery benefits fairly and equitably among the commercial, recreational, and charter fishing sectors in the fishery.

No rebuilding plans are active (or necessary).

(15) establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.

The annual specifications process addresses this requirement. ABC recommendations from the Council's SSC are designed to avoid overfishing and form the upper bounds on catches. There are a variety of proactive and reactive accountability measures for these fisheries, fully described at: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=1e9802ffddb05d0243d9c657fade956c&rgn=div5&view=text&node=50:12.0.1.1.5&idno=50#50:12.0.1.1.5.2.

8.3 DISCRETIONARY PROVISIONS

The alternatives for coral zones and corresponding management measures described in this document were developed under the discretionary authority for deep sea coral protections described in section 303(b)(2)(B) of the MSA. Section 303(b)(2) provides that any fishery management plan (FMP) which is prepared by any Council or the Secretary, with respect to any fishery, may:

(A) Designate zones where, and periods when, fishing shall be limited, or shall not be permitted, or shall be permitted only by specified types of fishing vessels or with specified types and quantities of fishing gear;

(B) Designate such zones in areas where deep sea corals are identified under section 408 [the Deep Sea Coral Research and Technology Program], to protect deep sea corals from physical damage from fishing gear or to prevent loss or damage to such fishing gear from interactions with deep sea corals, after considering long-term sustainable uses of fishery resources in such areas. 16 U.S.C. § 1853(b)(2)(A)-(B).

The most recent guidance on these provisions was distributed by NMFS in June 2014. Below, compliance with the deep sea coral discretionary provisions is described based on this guidance.

For the purposes of the implementation of the MSA, NOAA has defined the term "deep-sea corals" as azooxanthellate corals (i.e., corals that do not depend upon symbiotic algae and light for energy) generally occurring at depths below 50 meters. The coral ecosystems described in this document are consistent with this definition. In NOAA's Strategic Plan for Deep Sea Corals and Sponges (NOAA 2010), it is noted that of particular ecological importance and conservation concern are "structure-forming deep-sea corals," those colonial deep-sea coral species that provide vertical structure above the seafloor that can be utilized by other species and are most likely to be damaged by interactions with fishing gear. Structure-forming deep-sea corals include both branching stony corals that form a structural framework (e.g., *Lophelia pertusa*) as well as individual colonies of corals, such as gorgonians and other octocorals, black corals, gold corals, and lace corals (see Section 6.3). As described in Section 5.0, the measures proposed in this amendment focus on protection of these structure-forming corals, many of which require hard substrate to attach, which is relatively rare in the Mid-Atlantic region. Although other types of corals would also receive protection from the proposed measures, protections for structure-forming corals were prioritized in the design of the deep sea coral zones and measures.

Consistent with the discretionary provision guidance, the proposed deep-sea coral zones were designed with the following parameters and considerations:

- This amendment document clearly states the purpose, need and rationale for the action, and the citation of the regulatory authority (Section 4.0), and is supported by the factual record, including environmental, economic and social impact analyses (see Section 6.0 and Section 7.0).
- The discretionary authority is applied only to deep-sea coral areas identified by the DSCRTP or using DSCRTP products.
- Deep-sea coral zones are proposed only within the U.S. EEZ and within the geographical range of the fisheries managed under the MSB FMP. Consistent with the guidance, the protective measures proposed in this action apply to general categories of fishing gear, not just the species managed under the MSB FMP. Thus, measures would apply to fishing activities managed under different federal FMPs.

- The MAFMC coordinated with NEFMC as a potentially affected Council in order to acquire sufficient information to support the need for the action and to analyze impacts of the action on other fisheries.
- Long-term sustainable uses of fishery resources in the deep-sea coral areas were considered throughout the process of amendment development, by attempting to achieve conservation goals while minimizing economic impacts to potentially affected fisheries. These impacts were considered through multiple methods of socioeconomic impacts analysis (see Section 7.0) and consulting with potentially affected stakeholders throughout the amendment process, including developing consensus coral zone boundaries at a collaborative stakeholder workshop. This consideration informs but does not limit the scope of protective measures that a Council may adopt.
- Portions of deep-sea coral zones are proposed in areas where there are no vessels currently fishing at or near the areas or there is no indication that current fishing activities are causing physical damage to deep-sea corals.
- To ensure the effectiveness of protective measures, proposed deep-sea coral zones include additional areas beyond the exact locations of the deep-sea corals.
- Areas considered as priorities for protective measures were identified after consideration of the best available information on several factors identified in the NOAA guidance, including: 1) available abundance and density information for deep sea corals,[54] 2) the occurrence of rare species (including corals requiring hard substrate and specific rare mid-Atlantic species, such as *Lophelia pertusa*), 3) the ecological function provided by the deep-sea corals as habitat (see Section 6.3), the extent to which the area is sensitive to human-induced environmental degradation (see the description of coral vulnerability and recovery in Sections 6.3 and the impacts analysis in Section 7.0); and 4) the likelihood of occurrence of deep-sea corals in un-surveyed areas based on the results of a NOAA-developed and reviewed coral habitat suitability model (see Section 6.3).

Within the designated deep-sea coral zones, there are various options available for protecting the corals from physical damage from fishing gear. Consistent with the guidance on applying these discretionary provisions, measures proposed include:

- Restrictions on the location where fishing may occur. There are no coral zones proposed to be closed to all fishing. Therefore, compliance with requirements at MSA section 303(b)(2)(C)[55] is not necessary. The Council instead concluded that targeted gear restrictions for certain gear types, as opposed to a full fishing closure, would provide sufficient protection.
- Restrictions on fishing by specified types of vessels or vessels with specified types and quantities of gear. These include limits on the use of bottom-tending fishing gear.

[54] Note: Density and abundance information for deep sea corals is often lacking, but was considered where available. Otherwise, presence information or modeled habitat suitability was evaluated.

[55] With respect to any closure of an area to all fishing, an FMP/amendment must ensure the closure:
"(i) is based on the best scientific information available; (ii) includes criteria to assess the conservation benefit of the closed area; (iii) establishes a timetable for review of the closed area's performance that is consistent with the purposes of the closed area; and (iv) is based on an assessment of the benefits and impacts of the closure, including its size, in relation to other management measures (either alone or in combination with such measures), including the benefits and impacts of limiting access to: users of the area, overall fishing activity, fishery science, and fishery and marine conservation." 16 U.S.C. § 1853(b)(2)(C).

- Proactive protection by freezing the footprint of current fishing activities of specified types of vessels or vessels with specified types and quantities of gear to protect known or expected locations of deep-sea corals. The proposed broad zone was intended to be designated beginning at depths beyond which there is very limited fishing effort, consistent with the freeze the footprint approach, in order to prevent expansion of current fishing effort into deeper waters. The Council preferred exemption for deep sea red crab in the broad and discrete zones is also consistent with this freeze the footprint approach, since all red crab effort takes place within the proposed zones.

This action does not propose limits on the harvest or bycatch of species of deep sea coral.

Unlike EFH requirements, the discretionary authority does not require demonstration that corals are habitat for federally-managed fish or that current fishing activities are causing physical damage. The discretionary authority has no required consultation process for non-fishing activities that may affect deep sea corals. However, there may be avenues for providing non-binding recommendations to conserve or protect corals through other processes under the MSA (see, e.g., section 305(b)(3)(A)), National Environmental Policy Act, Fish and Wildlife Coordination Act, and other authorities.

9.0 OTHER APPLICABLE LAWS

9.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (NEPA) FINDING OF NO SIGNIFICANT IMPACT (FONSI)

National Oceanic and Atmospheric Administration Administrative Order 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the CEQ regulations at 40 C.F.R. §1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1) Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?

The proposed measures described in this document are not expected to jeopardize the sustainability of any target species affected by the action (see Section 7.0 of this document). The proposed measures are likely to slightly shift the physical footprint of fishing effort, but are not expected to impact levels of harvest for the MSB target stocks.

2) Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?

None of the proposed measures presented in this document are expected to jeopardize the sustainability of any non-target species, including ESA-listed and MMPA protected species. The proposed measures are not expected to alter fishing methods or activities in a manner that would substantially affect interactions with ESA-listed and MMPA protected species (see Section 7.0).

3) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?

The proposed action is not expected to cause damage to the ocean, coastal habitats, and/or EFH as defined under the Magnuson-Stevens Act and identified in the FMP (see section 7.0). In general, the bottom-tending gear types (primarily otter trawls) used to harvest mackerel, squid, butterfish, and the other fisheries that may be impacted by the proposed measures, have the potential to adversely affect EFH for the benthic life stages of a number of species in the Greater Atlantic region that are managed by other FMPs. However, because none of the management measures proposed in this action should cause any increase in overall fishing effort relative to the *status quo*, nor cause substantial shifts in the physical footprint of fishing, they are not expected to have any substantial negative impact on EFH or on coastal and ocean habitats (see section 7.0).

4) Can the proposed action be reasonably expected to have a substantial adverse impact on public health or safety?

None of the proposed measures are expected to substantially alter the manner in which the industry conducts fishing activities for the target species. The measures are expected to slightly alter the physical footprint of fishing, but are not expected to shift fishing effort into areas where it does not already occur. Therefore, no changes in fishing behavior that would affect safety are anticipated. The overall effect of the proposed actions on these fisheries, including the communities in which they operate, will not impact adversely public health or safety.

5) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, marine mammals, or critical habitat of these species?

None of the proposed measures are expected to increase the magnitude of fishing effort or substantially alter fishing methods and activities. While several of the proposed measures are likely to effect the spatial distribution of fishing effort, effort is likely to be redistributed in a manner which is not expected to result in adverse effects on endangered or threatened species, marine mammals, or the critical habitat of these species (see Section 7.0). Therefore, this action is not expected to affect ESA-listed or MMPA protected species or critical habitat in any manner not considered in previous consultations on the fisheries.

6) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

The MSB fisheries are prosecuted using bottom otter trawls, which have the potential to impact bottom habitats. In addition, a number of non-target species are taken incidentally to the prosecution of these fisheries. However, fishing effort is not expected to increase in magnitude under the proposed measures. In addition, none of the proposed measures are expected to substantially alter fishing methods or activities. Therefore, this action is not expected to result in increased negative effects on ecosystem functions. The proposed measures may have a slight positive impact on biodiversity of deep sea corals and their surrounding ecosystems, however, many of the measures proposed in this document are primarily precautionary and the effect is not expected to be substantial.

7) Are significant social or economic impacts interrelated with natural or physical environmental effects?

A complete discussion of the potential impacts of the proposed management measures is provided in Section 7.0 of this document. NMFS has determined that despite the potential socio-economic impacts resulting from this action, there is no need to prepare an EIS. The purpose of NEPA is to protect the environment by requiring Federal agencies to consider the impacts of their proposed actions on the human environment, defined as "the natural and physical environment and the relationship of the people with that environment." The EA for this action describes and analyzes the preferred alternatives and concludes that there will be no significant impacts to the natural and physical environment. While some fishermen, shore-side businesses, and others may experience impacts to their livelihood, these impacts, in and of themselves, do not require the preparation of an EIS, as supported by NEPA's implementing regulations at 40 C.F.R. 1508.14. Consequently, because the EA demonstrates that the action's potential natural and physical impacts are not significant, the execution of a FONSI remains appropriate under these criteria.

8) Are the effects on the quality of the human environment likely to be highly controversial?

The impacts of the proposed measures on the human environment are described in Section 7.0 of the EA. This action proposes to restrict the use of bottom-tending fishing gear in proposed "coral zones," with associated transit, framework provision, and monitoring alternatives. In developing and analyzing the impacts of these proposed measures, the Council used the best scientific information available to characterize the direction and magnitude of the impacts, including the impacts of fishing gear on corals, the impacts of proposed restrictions on the fisheries, and other impacts discussed in this document. Although some of the relied upon information is associated with uncertainties (for example, the predictive habitat suitability model for deep sea corals or the VTR revenue mapping model to analyze fishery effort and revenues), these tools represent the current best available information to complete this analysis. We do not consider this action to be controversial because no information exists that conflicts with the information provided by these models.

9) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas?

A variety of types of commercial fishing already occur in the management area, and although it is possible that historic or cultural resources such as shipwrecks could be present in the affected environment, it is unlikely given the depths at which the gear-restricted areas are proposed. If they did occur in the affected environment, vessels try to avoid fishing too close to wrecks due to the possible loss or entanglement of fishing gear. Therefore, it is not likely that the preferred alternative would result in substantial impacts to unique areas.

10) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

While there is always a degree of variability in the year to year performance of the relevant fisheries, the proposed actions are not expected to substantially increase overall effort or to substantially alter fishing methods and activities. As a result, the effects on the human environment of the proposed measures are not highly uncertain nor do they involve unique or uncertain risks (see section 7.0 of this document).

11) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

As discussed in Section 7.6, the proposed action is not expected to have individually insignificant, but cumulatively significant impacts. The proposed actions, together with past, present, and reasonably foreseeable future actions, are not expected to result in significant cumulative impacts on the biological, physical, and human components of the environment.

12) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

The impacts of the proposed measures on the human environment are described in section 7.0 of the EA. Although there may be shipwrecks present in the affected area where fishing occurs, including some registered on the National Register of Historic Places, vessels typically avoid fishing too close to wrecks due to the possible loss or entanglement of fishing gear. Therefore, it is not likely that the proposed action would adversely affect the historic resources listed above.

13) Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

There is no evidence or indication that these fisheries have ever resulted or would ever result in the introduction or spread of nonindigenous species.

14) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?

This action will establish gear-restricted areas for bottom-tending gear types in offshore waters, allow for transit through gear-restricted areas, and modify the framework provisions of the MSB FMP. None of the proposed measures are expected to change the total amount of current fishing effort or substantially alter the spatial and/or temporal distribution of current fishing effort. All of these types of measures have been implemented in other federal marine fisheries; they are not novel or unique except in the direct focus of protection (deep sea corals, as opposed to habitat more broadly). When new information about deep sea coral distribution or the affected fisheries becomes available in the future, these measures may be adjusted consistent with the FMP and MSA. None of these measures is expected to result in significant effects, nor do they represent a decision in principle about a future consideration. The impact of any future changes will be analyzed as to their significance in the process of developing and implementing them.

15) Can the proposed action reasonably be expected to threaten a violation of federal, State, or local law or requirements imposed for the protection of the environment?

None of the proposed measures are expected to alter fishing methods or activities such that they threaten a violation of federal, state, or local law or requirements imposed for the protection of the environment. The proposed measures have been found to be consistent with other applicable laws as described in this section.

16) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

The impacts of the proposed alternatives on the biological, physical, and human environment are described in Section 7.0. Overall fishing effort is not expected to increase in magnitude under the proposed action. In addition, none of the proposed measures are expected to substantially alter fishing methods. Therefore the proposed action is unlikely to result in cumulative adverse effects (including any that could have a substantial effect on the target species or non-target species). There should be some positive (but not significant) impacts for some non-target species, including deep sea corals and associated species, as the result of this action.

DETERMINATION

In view of the information presented in this document and the analysis contained in the supporting EA prepared for the Deep Sea Corals Amendment to the MSB FMP, it is hereby determined that the proposed measures will not significantly impact the quality of the human environment as described above and in the EA. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an EIS for this action is not necessary.

for John Bullard ______ 11/23/16 ______

Regional Administrator for GARFO, NMFS, NOAA *Date*

9.2 MARINE MAMMAL PROTECTION ACT (MMPA)

The various species which inhabit the management unit of this FMP that are afforded protection under the Marine Mammal Protection Act of 1972 (MMPA) are described in Section 6.5. None of the measures are expected to significantly alter fishing methods or activities or result in substantially increased effort. The Council has reviewed the impacts of the proposed measures on marine mammals and concluded that the management actions proposed are consistent with the provisions of the MMPA and would not alter existing measures to protect the species likely to inhabit the management units of the subject fisheries. For further information on the potential impacts of the fishery and the proposed management action, see Section 7.0 of this EA.

9.3 ENDANGERED SPECIES ACT (ESA)

Section 7(a)(2) of the ESA requires that each Federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a Federal agency may affect species listed as threatened or endangered, that agency is required to consult with either the NOAA Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (FWS), depending upon the species that may be affected.

The National Marine Fisheries Service (NMFS), Greater Atlantic Regional Fisheries Office completed formal consultation on the MSB FMP and six other FMPs on December 16, 2013. NMFS determined that:

> "After reviewing the current status of the species, the environmental baseline, climate change, cumulative effects in the action area, and the effects of the continued operation of the seven fisheries under their respective FMPs over the next ten years, it is our biological opinion that the proposed action may adversely affect, but is not likely to jeopardize, the continued existence of North Atlantic right whales, humpback whales, fin whales, and sei whales, or loggerhead (specifically, the NWA DPS), leatherback, Kemp's ridley, and green sea turtles, any of the five DPSs of Atlantic sturgeon, or GOM DPS Atlantic salmon. It is also our biological opinion that the proposed action is not likely to adversely affect hawksbill sea turtles, shortnose sturgeon, smalltooth sawfish DPS, Acroporid corals, Johnson's seagrass, sperm whales, blue whales, designated critical habitat for right whales in the Northwest Atlantic, or designated critical habitat for GOM DPS Atlantic salmon."

The Council has concluded that the proposed measures and the prosecution of the associated fisheries will not cause effects to ESA-listed species that were not already considered in the 2013 Opinion and therefore, will not change any of the conclusions and determinations reached in the 2013 Opinion (i.e., no jeopardy to any ESA listed species; no destruction or adverse modification to critical habitat). For further information on the potential impacts of the fisheries and the proposed management action, see Section 7.0 of this document.

9.4 COASTAL ZONE MANAGEMENT ACT (CZMA)

The Coastal Zone Management Act (CZMA) of 1972, as amended, provides measures for ensuring stability of productive fishery habitat while striving to balance development pressures with social, economic, cultural, and other impacts on the coastal zone. It is recognized that responsible management of both coastal zones and fish stocks must involve mutually supportive goals. The Council has developed this document and will submit it to NMFS; NMFS must determine whether this action is consistent to the maximum extent practicable with the CZM programs for each state (Maine through North Carolina).

9.5 ADMINISTRATIVE PROCEDURES ACT (APA)

Sections 553 of the Administrative Procedure Act 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. At this time, the Council is not requesting any abridgement of the rulemaking process for this action.

9.6 DATA QUALITY ACT (SECTION 515)

Pursuant to NOAA guidelines implementing section 515 of Public Law 106-554 (the Data Quality Act), all information products released to the public must first undergo a Pre-Dissemination Review to ensure and maximize the quality, objectivity, utility, and integrity of the information (including statistical information) disseminated by or for Federal agencies. The following section addresses these requirements.

Utility

The information presented in this document should be helpful to the intended users (the affected public) by presenting a clear description of the purpose and need of the proposed action, the measures proposed, and the impacts of those measures. A discussion of the reasons for selecting the proposed action is included so that intended users may have a full understanding of the proposed action and its implications, as well as the Council's rationale.

Until a proposed rule is prepared and published, this document is the principal means by which the information contained herein is available to the public. The information provided in this document is based on the most recent available information from the relevant data sources. The development of this document and the decisions made by the Council to propose this action are the result of a multi-stage public process. Thus, the information pertaining to management measures contained in this document has been improved based on comments from the public, the fishing industry, members of the Council, and NMFS.

This document is available in several formats, including printed publication and online through the Council's web page. The *Federal Register* notice that announces the proposed rule and the final rule and implementing regulations will be made available in printed publication, on the website for the Greater Atlantic Regional Office, and through the Regulations.gov website. The *Federal Register* documents will provide metric conversions for all measurements.

Integrity

Prior to dissemination, information associated with this action, independent of the specific intended distribution mechanism, is safeguarded from improper access, modification, or destruction, to a degree commensurate with the risk and magnitude of harm that could result from the loss, misuse, or unauthorized access to or modification of such information. All electronic information disseminated by NMFS adheres to the standards set out in Appendix III, "Security of Automated Information Resources," of OMB Circular A-130; the Computer Security Act; and the Government Information Security Act. All confidential information (e.g., dealer purchase reports) is safeguarded pursuant to the Privacy Act; Titles 13, 15, and 22 of the U.S. Code (confidentiality of census, business, and financial information); the Confidentiality of Statistics provisions of the Magnuson-Stevens Act; and NOAA Administrative Order 216-100, Protection of Confidential Fisheries Statistics.

Objectivity

For purposes of the Pre-Dissemination Review, this document is considered to be a Natural Resource Plan. Accordingly, the document adheres to the published standards of the Magnuson-Stevens Act; the Operational Guidelines, FMP Process; the EFH Guidelines; the National Standard Guidelines; and NOAA Administrative Order 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act.

This information product uses information of known quality from sources acceptable to the relevant scientific and technical communities. Stock status (including estimates of biomass and fishing mortality) reported in this product are based on either assessments subject to peer-review through the Stock Assessment Review Committee or on updates of those assessments prepared by scientists of the Northeast Fisheries Science Center. Landing and revenue information is based on information collected through the Vessel Trip Report and Commercial Dealer databases. Information on catch composition, by tow, is based on reports collected by the NOAA Fisheries Service observer program and incorporated into the sea sampling or observer database systems. These reports are developed using an approved, scientifically valid sampling process. In addition to these sources, additional information is presented that has been accepted and published in peer-reviewed journals or by scientific organizations. Original analyses in this document were prepared using data from accepted sources, and the analyses have been reviewed by members of the Deep Sea Corals Fishery Management Action Team (FMAT).

Despite current data limitations, the conservation and management measures proposed for this action were selected based upon the best scientific information available. The analyses conducted in support of the proposed action were conducted using information from the most recent complete calendar years, generally through 2014 except as noted. The data used in the analyses provide the best available information on the number of seafood dealers operating in the northeast, the number, amount, and value of fish purchases made by these dealers, catch information by area, and deep sea coral distribution and abundance in the Greater Atlantic region. Specialists (including professional members of the FMAT, technical teams, committees, and Council staff) who worked with these data are familiar with the most current analytical techniques and with the available data and information relevant to the affected fisheries.

The policy choices are clearly articulated in Section 4.0 of this document as are the management alternatives considered in this action (see Section 5.0). The supporting science and analyses, upon which the policy choices are based, are described in Sections 6.0 and 7.0 of this document. All supporting materials, information, data, and analyses within this document have been, to the maximum extent practicable, properly referenced according to commonly accepted standards for scientific literature to ensure transparency.

The review process used in preparation of this document involves the responsible Council, the Northeast Fisheries Science Center (Center), the Greater Atlantic Regional Office, and NOAA Fisheries Service Headquarters. The Center's technical review is conducted by senior level scientists with specialties in population dynamics, stock assessment methods, demersal resources, population biology, and the social sciences. The Council review process involves public meetings at which affected stakeholders have opportunity to provide comments on the document. Review by staff at the Regional Office is conducted by those with expertise in fisheries management and policy, habitat conservation, protected species, and compliance with the applicable law. Final approval of the action proposed in this document and clearance of any rules prepared to implement resulting regulations is conducted by staff at NOAA Fisheries Service Headquarters, the Department of Commerce, and the U.S. Office of Management and Budget.

9.7 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 (OMB). This authority encompasses establishment of guidelines and policies, approval of information collection requests, and reduction of paperwork burdens and duplications.

This action proposes a minor change to VMS reporting requirements. If appropriate, a Paperwork Reduction Act package prepared in support of this action and the information collection required by the proposed action, including forms and supporting statements, will be submitted when implementation action is taken.

9.8 IMPACTS RELATIVE TO FEDERALISM/E.O. 13132

This E.O. established nine fundamental federalism principles for Federal agencies to follow when developing and implementing actions with federalism implications. The E.O. also lists a series of policy making criteria to which Federal agencies must adhere when formulating and implementing policies that have federalism implications. However, no federalism issues or implications have been identified relative to the measures proposed measures. This action does not contain policies with federalism implications sufficient to warrant preparation of an assessment under E.O. 13132. The affected states have been closely involved in the development of the proposed management measures through their representation on the Council (all affected states are represented as voting members of at least one Regional Fishery Management Council). No comments were received from any state officials relative to any federalism implications that may be associated with this action.

9.9 REGULATORY IMPACT REVIEW/INITIAL REGULATORY FLEXIBILITY ANALYSIS (RIR/IRFA)

9.9.1 Introduction

This section provides the analysis and conclusions to address the requirements of Executive Order 12866 and the Regulatory Flexibility Act (RFA). Since many of the requirements of these mandates duplicate those required under the Magnuson-Stevens Act and NEPA, this section contains references to other sections of this document.

NMFS requires the preparation of a Regulatory Impact Review (RIR) for all regulatory actions that either implement or significantly amend an FMP. The RIR in Section 9.9.2 provides a comprehensive review of the changes in net economic benefits to society associated with proposed regulatory actions. This analysis reviews the problems and policy objectives prompting the regulatory proposals and evaluates the alternatives presented as a solution. This analysis ensures that the regulatory agency systematically and comprehensively considers all available alternatives so public welfare can be enhanced in the most efficient and cost-effective way. This RIR addresses multiple items in the regulatory philosophy and principles of Executive Order (EO) 12866. An Initial Regulatory Flexibility Analysis (IRFA; Section 9.9.3) was prepared to further evaluate the economic impacts of the various alternatives presented in this document on small business entities. This analysis is undertaken in support of a more thorough analysis for the potential impacts of various deep sea coral zone designations and management measures within those coral zone designations.

9.9.2 Evaluation of EO 12866 Significance

9.9.2.1 Description of the Management Objectives

Complete descriptions of the purpose and need of this action and the management objectives for the MSB fisheries are found under Sections 4.1 and 4.3 of this document, respectively. The proposed actions are consistent with, and do not modify those goals and objectives. This action is taken under the authority of the MSA and regulations at 50 C.F.R. part 648.

9.9.2.2 *Description of the Fishery*

Section 6.0 of this document contains a detailed description of the fisheries managed under this FMP.

9.9.2.3 *A Statement of the Problem*

A statement of the problem for resolution is presented under Section 4.0 of this document. The purpose of this amendment is to identify and implement measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic Council region. The proposed measures in this amendment are necessary to protect valued deep sea corals and their dependent ecosystem components while also considering the operational needs and long term sustainability of commercial fisheries.

9.9.2.4 *A Description of the Proposed Action*

All alternatives considered in this amendment are described in Section 5.0 of this document. The Council has identified a set of preferred alternatives for this action that include:

- **Alternative 1F**: Designation of a broad coral zone with a landward boundary approximating the 450-meter depth contour, and also incorporating a set of discrete coral zone boundaries developed at a 2015 collaborative workshop (discrete zone boundaries of Council-preferred Alternative 3B-5). The remaining boundaries fall along the MAFMC-NEFMC boundary to the north, the U.S. EEZ to the east, and the SAFMC-MAFMC boundary to the south.
- **Alternative 2B**: Restriction on use of all bottom-tending fishing gear within the designated broad zone, with the exception of lobster gear (which is not covered by this action) and the red crab trap gear as per the exemption alternative below.
- **Alternative 2B-1**: An exemption to broad zone gear restrictions for the red crab trap fishery.
- **Alternative 2E**: Allowance for vessels using bottom-tending gear to transit through the designated gear-restricted broad coral zone, provided that the vessel's gear is on deck (the net is on the reel for trawl vessels, or gear is otherwise on deck for other gear types).
- **Alternative 3B-5**: Designation of a set of fifteen discrete coral zones in distinct canyon or canyon-slope areas with known deep sea coral presence. This boundary sub-alternative was developed at a Council-sponsored collaborative workshop in April 2015. The discrete zones are entirely contained within the Council-preferred broad zone, but separate designations are proposed to allow for future separate management measures and strategies to be applied to each zone.
- **Alternative 4B**: Restriction on use of all bottom-tending fishing gear within the designated discrete zones, with the exception of lobster gear (which is not covered by this action) and the red crab trap gear as per the exemption alternative below.
- **Alternative 4B-1**: An exemption to discrete zone gear restrictions for the red crab trap fishery.

- **Alternative 4D**: Allowance for vessels using bottom-tending gear to transit through a designated gear-restricted discrete coral zone, provided that the vessel's gear is on deck (the net is on the reel for trawl vessels, or gear is otherwise on deck for other gear types).
- **Alternative 5B**: Modify the FMP's Framework Provisions to allow coral zone boundaries to be modified in the future through a framework action.
- **Alternative 5C**: Modify the FMP's Framework Provisions to allow coral zone management measures to be modified in the future through a framework action.
- **Alternative 5D**: Modify the FMP's Framework Provisions to allow additional coral zones to be designated in the future through a framework action.
- **Alternative 5E**: Modify the FMP's Framework Provisions to allow special access programs for fisheries to be implemented in the future through a framework action.
- **Alternative 6B**: A requirement for all *Illex* squid federal permit holders to install and use VMS on board the vessel.

In combination, the preferred alternatives result in a large offshore area that is restricted to all bottom-tending gear, except for lobster and red crab effort. The preferred discrete zones entirely overlap the proposed broad zone, and at this time the same management measures are proposed to be implemented within each type. In the future, the Council may wish to tailor management measures to specific coral zone types.

9.9.2.5 Analysis of the Proposed Action

This section evaluates the economic impacts of the preferred suite of management measures considered in this amendment. For each alternative, potential impacts on several areas of interest are discussed such that the economic effects of the various alternatives are comprehensively evaluated. The types of effects that are considered include the following: changes in landings, prices, consumer and producer benefits, harvesting costs, enforcement costs, and distributional effects. Due to the lack of an empirical model for these fisheries and knowledge of elasticities of supply and demand, a qualitative approach to the economic assessment was adopted. Nevertheless, quantitative measures are provided whenever possible. A more detailed description of the economic concepts involved can be found in "Guidelines for Economic Review of National Marine Fisheries Service Regulatory Actions" (NMFS 2007), as only a brief summary of key concepts will be presented here.

Benefit-cost analysis is conducted to evaluate the net social benefit from changes in consumer and producer surpluses that are expected to occur upon implementation of a regulatory action. Total Consumer Surplus (CS) is the difference between the amounts consumers are willing to pay for products or services and the amounts they actually pay. Thus CS represents net benefit to consumers. When the information necessary to plot the supply and demand curves for a particular commodity is available, CS is represented by the area that is below the demand curve and above the market clearing price where the two curves intersect. Since an empirical model describing the elasticities of supply and demand for these species is not available, it was assumed that the price for these species (species for which landings could be impacted due to area closure/gear requirements) was determined by the market clearing price or the intersection of the supply and demand curves. These prices were the base prices used to determine potential changes in prices due to changes in landings.

Net benefit to producers is producer surplus (PS). Total PS is the difference between the amounts producers actually receive for providing goods and services and the economic cost producers bear to do so. Graphically, it is the area above the supply curve and below the market clearing price where supply and demand intersect. Economic costs are measured by the opportunity cost of all resources including the raw materials, physical and human capital used in the process of supplying these goods and services to consumers.

One of the more visible societal costs of fisheries regulation is that of enforcement. From a budgetary perspective, the cost of enforcement is equivalent to the total public expenditure devoted to enforcement. However, the economic cost of enforcement is measured by the opportunity cost of devoting resources to enforcement vis à vis some other public or private use, and/or by the opportunity cost of diverting enforcement resources from one fishery to another.

9.9.2.5.1 Analysis of Preferred Broad and Discrete Deep Sea Coral Zone Measures

Broad zone measures are intended to encompass large, mostly unfished and unexplored areas, where measures would limit and prevent expansion of commercial gear use where little or no fishing has historically occurred. The concept of these broad coral zones is in line with the "freeze the footprint" approach outlined in NOAA's Strategic Plan for Deep Sea Corals (Section 5.0).

Discrete zone measures are proposed as smaller areas encompassing known coral presence locations or areas of highly likely coral habitat. These areas primarily consist of offshore submarine canyons or slope areas along the continental shelf edge. Fishing activity occurs nearby these areas, and to some extent within them. Therefore, restrictions applied to these areas would mainly reduce or eliminate current fishing activities rather than just prevent their expansion (Section 5.0).

As indicated above, the broad and discrete zone sea coral alternatives and associated management measures within the broad zone coral zones are fully described in Section 5.0. This section analyzes the impacts of the Council-preferred broad zone 1F and Council-preferred discrete zone set 3B-5 in combination with the management measures to be implemented within, and associated transit and monitoring alternatives (Table 111).

Table 111: Brief description of the Council-preferred broad and discrete deep sea coral zone alternatives and associated management measures analyzed in this section.

Broad or discrete deep sea coral zone designation [a]	**Management measures within the broad zone** [a] **(broad coral zone restrictions)**	**Combined Designation description** [b]
Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred)	Alternative 2B: Prohibit all bottom-tending gear (Council preferred)	Area 1F Alternative 2B
	Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions (Council preferred)	Area 1F Alternative 2B-1
	Alternative 2E: Allow for transit with gear stowage requirements (Council preferred)	Area 1F Alternative 2E
Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred)	Alternative 4B: Prohibit all bottom-tending gear (Council preferred)	Area 3B-5 Alternative 4B
	Sub-alternative 4B-1: Exempt red crab fishery from discrete zone restrictions (Council preferred)	Area 3B-5 Alternative 4B-1
	Alternative 4D: Allow for transit with gear stowage requirements (Council preferred)	Area 3B-5 Alternative 4D

[a] See section 5.0 for detailed description of coral zones and associated management measures.

[b] Combined broad/discrete deep sea coral zone and management measure designation used in this section to facilitate description of analysis results.

In order to assess potential economic impacts of the proposed deep sea coral measures, NMFS VTR data for years 2012-2014 were employed to determine vessel activity for various deep sea coral zones (broad and discrete) and specific management measures within zone combinations.[56] Appendix Tables D1-D6 show the number of vessel and associated revenues within each of the evaluated deep sea coral zones/management measures.

Tables 86 and 93 in section 7.4 show the maximum potential loss in revenues, by combined designations (specific coral zone designation combined with other selected management measure within the coral zone designations) for all broad and discrete combined designations analyzed in this document, respectively. Since the Council preferred discrete zone combined designation Area 3B-5 Alternative 4B-1[57] is a sub-set of the Council preferred broad zone combined designation Area 1F Alternative 2B-1,[58] the potential impacts associated with its implementation are not further described in this section.

Council preferred Broad Zone: Landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone management combinations

Under Alternative 1A (No Action/*Status Quo)* no action would be taken to designate a broad deep sea coral zone. This alternative would not be expected to affect fishing effort or the spatial and/or temporal distribution of current fishing effort. This alternative is not expected to affect current fishing activity and no economic impacts would occur. Therefore, there are no social or economic fishing impacts associated with it. However, under this alternative, protection to deep sea corals would not be established.

Under combined designation Area 1F Alternative 2A, a landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone would be designated but no action would be taken to implement management measures in the designated broad deep sea coral zone. As such, while a broad deep sea coral zone would be designated, no measures that could affect fishing effort or the spatial and/or temporal distribution of current fishing effort would be implemented. Therefore, there are no social or economic fishing impacts associated with it.

Under combined designation Area 1F Alternative 2B-1, a landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone would be implemented where the use of all bottom-tending gear would be prohibited exempting the red crab fishery from the broad zone restrictions. Combined designation Area 1F Alternative 2B-1 would have the second smallest impacts compared to other evaluated combined broad designations (Table 86). (The alternative with the smallest impact is combined designation Area 1F Alternative 2C but since the difference is minor, this combined designation is not further analyzed).

Since combined designation Area 1F Alternative 2B-1 would exempt the red crab fishery from the broad zone restrictions, it reduces impacts when compared to combined designations Area 1F Alternative 2B

[56] The same approach used in the VTR Revenue Mapping Model was employed here to derive VTR-point data. See Section 7.1 for additional details on methodology used to derive VTR-point data and data limitations. Excel data files used to produce tables in this section provided by Geret De Piper and Andrew Kitts, SSB/NEFSC.

[57] Combined designation "Area 3B-5 Alternative 4B-1" is the combination of discrete deep sea coral sub-alternative 3B-5 (Corals Workshop boundaries) and management alternatives 4B and4B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery).

[58] Combined designation "Area 1F Alternative 2B-1" is the combination of broad deep sea coral alternative 1F (Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries) and management alternatives 2B and 2B-1 (prohibition on all bottom-tending gear with an exemption for the red crab fishery).

(which would prohibit the use of all bottom-tending gear without any exemptions). Combined designation Area 1F Alternative 2B-1 would have the smallest area amongst all the broad deep zone coal zones considered in this amendment.

NMFS VTR data indicates that for the 2012-2014 period the number of vessels that fished with bottom-tending gear under combined designation Area 1F Alternative 2B-1 ranged from 424 (in 2013) to 488 (in 2012; Appendix Table D3). These vessels generated average revenues in the proposed gear restricted area that ranged from $25,215 (in 2014) to $36,294 (in 2012). These revenues represented from 3.6% (in 2012) to 4.3% (in 2013) of the inside revenue (within the proposed closed area and impacted gear only). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 1.0% (in each 2012 and 2013) to 1.1% (in 2014; Appendix Table D3). The total revenue generated in combined designation Area 1F Alternative 2B-1 in 2012-2014 ranged from $11.6 million in 2013 to $17.8 million in 2014 (Appendix Table D3). This indicates that potential impacts are reduced by the exemption of the red crab fishery alternative (when compared to the combined designation Area 1F Alternative 2B). Vessel participation and overall revenue trends described under Area 1F Alternative 2B-1 is relatively similar to those of all the other analyzed combined broad designations (Appendix Table D3). Of the eight broad zone combined designations presented in Table 86 and Appendix Tables D1 and D3, the implementation of combined designation Area 1F Alternative 2B-1 in the 2012-2014 period would have resulted in the second lowest potential overall average revenues reductions. Combined designation Area 1F Alternative 2C would had potentially resulted in marginally lower overall average revenue reduction when compared to Area 1F Alternative 2B-1 due to the fact that this combined designation would prohibit all mobile bottom-tending gear if it would had been implemented during the 2012-2014 period (Table 86 and Appendix Table D3). However, as indicated above, the difference in revenues generated between these two combined designations is minimal.

It is possible that revenue losses due to the implementation of combined designation Area 1F Alternative 2B-1 could be recuperated by redirecting fishing effort to other areas outside the broad coral zone closure or by using other non-bottom tending gear within the broad coral zone. However, it is difficult to estimate how much revenue could be recuperated by shifting fishing effort to other areas or modifying existing fishing practices. However, since the simplified between 400 meter and 500 meter depth contour broad deep sea coral zone (regardless of gear restricted management measure) is smaller in size designation than the landward boundary approximating 200 meter depth contour broad deep sea coral zone, the adverse economic impacts are likely to be smaller given recent fishing activity (Appendix Tables D1-D3 and Figures D1-D9). In addition, as indicated in section 7.4, it is also possible that harvest costs may also increase as fishermen may have to redirect effort to other fishing grounds increasing fishing traveling time and/or have to fish with alternative gear types allowed in the deep broad coral zone. The magnitude of impacts is complicated to assess, given that the vast majority of the proposed broad coral zones are not currently experiencing fishing activity. In addition, the preferred alternatives would be expected to cause redistribution of fishing effort, but it is difficult to predict precisely how or where the effort would shift and to what extent that would impact the costs and revenues associated with fishing activity.

Potential revenue losses would vary by species. For example, the average per vessel ratio of inside revenue (assuming Area 1F Alternative 2B-1 combined designation) to total revenue (of impacted gear only) for the tilefish fishery for the 2012-2014 period was 10%, 16%, and 16%, respectively; and for the squid fishery it was approximately 10% for each year (Appendix Figure D7). For all other species it was approximately 7% or less. As such, it may be more difficult for some fisheries than others to recuperate potential revenue losses due to the implementation of combined designation Area 1F Alternative 2B-1 due to the fact that a large proportion of their total revenue (impacted gear only) comes from the proposed close area under this combined designation.

As indicated before, it is possible that revenue losses due to the implementation of any of the evaluated landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone management measures combinations could be recuperated by redirecting fishing effort to other areas outside the broad coral zone closure or by using other gear not restricted within the broad coral zone. However, if fishermen are not able to maintain the same level of landings, it is possible that the price for the species experiencing decrease in landings may increase holding all other factors constant.

In addition, if there is a change in the price of some of these species, there will be associated changes in producer surplus (PS). The magnitude of the PS change will be associated with the price elasticity of demand for the species in question. The law of demand states that price and quantity demanded is inversely related. Given a demand curve for a commodity (good or service), the elasticity of demand is a measure of the responsiveness of the quantity that will be taken by consumers giving changes in the price of that commodity (while holding other variables constant). There are several major factors that influence the elasticity for a specific commodity. These factors largely determine whether demand for a commodity is price elastic or inelastic[59]: 1) the number and closeness of substitutes for the commodity under consideration, 2) the number of uses to which the commodity can be put; and 3) the price of the commodity relative to the consumer's purchasing power (income). There are other factors that may also determine the elasticity of demand but are not mention here because they are beyond the scope of this discussion. As the number and closeness of substitutes and/or the number of uses for a specific commodity increase, the demand for the specific commodity will tend to be more elastic. Demand for commodities that take a large amount of the consumer’s income is likely to be elastic compared to services with low prices relative to the consumer’s income. It is argued that the availability of substitutes is the most important of the factors listed in determining the elasticity of demand for a specific commodity (Leftwich 1973; Awk 1988). Seafood demand in general appears to be elastic. In fact, for most species, product groups, and product forms, demand is elastic (Asche and Bjørndal 2003).

For example, an increase in the ex-vessel price of tilefish may increase PS. A decrease in the ex-vessel price of tilefish may also increase PS if we assumed that the demand for this species is moderate to highly elastic. However, the magnitude of these changes cannot be entirely assessed without knowing the exact shape of the market demand curve for this species. In all, a decrease in the ex-vessel price of tilefish may increase PS if we assumed that the demand for this species is moderate to highly elastic.

<u>Other Preferred Broad Zone Management Measures for Consideration</u>

In addition to the gear specific restrictive measures within the proposed broad coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone. The Council preferred option includes an allowance for transit through gear restricted broad coral zones.

[59] Price elasticity of demand is elastic when a change in quantity demanded is large relative to the change in price. Price elasticity of demand is inelastic when a change in quantity demanded is small relative to the change in price. Price elasticity of demand is unitary when a change in quantity demanded and price are the same.

Alternative 2E: Allow for transit with gear stowage requirements (combined designation Area 1F Alternative 2E)

Under this alternative (Council preferred), vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). This alternative could generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas.

Council-preferred Discrete Zones: Corals Workshop boundaries for discrete zones[60] management combinations[61]

Under Alternative 3A (No Action/*Status Quo)* no action would be taken to designate a discrete deep sea coral zone. This alternative would not be expected to affect fishing effort or the spatial and/or temporal distribution of current fishing effort. This alternative is not expected to affect current fishing activity and no economic impacts would occur. Therefore, there are no social or economic fishing impacts associated with it. However, under this alternative, protection to deep sea corals would not be established.

Under combined designation Area 3B-5 Alternative 4A, the Coral Workshop boundaries for discrete zones would be designated but no action would be taken to implement management measures in the designated discrete deep sea coral zone. As such, while a discrete deep sea coral zone would be designated, no measures that could affect fishing effort or the spatial and/or temporal distribution of current fishing effort would be implemented. Therefore, there are no social or economic fishing impacts associated with it.

As indicated above, since the Council preferred discrete zone combined designation Area 3B-5 Alternative 4B-1 is a sub-set of the Council preferred broad zone combined designation Area 1F Alternative 2B-1, the potential impacts associated with its implementation are not further described in this section.

9.9.2.5.2 Analysis of Preferred Framework and *Illex* VMS Alternatives

In addition to the gear specific restrictive measures within the proposed broad and discrete coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone. The Council-preferred alternatives in this amendment also include framework adjustment provisions to allow future modification to management measures (framework provisions) and a VMS requirement for the *Illex* squid fishery, which are discussed below.

[60] These boundaries, shown in Figure 4, were developed collaboratively by participants at the Council's April 29-30, 2015 Deep Sea Corals Workshop in Linthicum, MD. Participants included the Council's Squid, Mackerel, and Butterfish Advisory Panel, the Ecosystems and Ocean Planning Advisory Panel, members of the Deep Sea Corals FMAT, invited deep sea coral experts, additional fishing industry representatives, and other interested stakeholders (section 5.3).

[61] "The preferred management measures to be applied within the preferred discrete zones are the same as those for the broad zones, including a prohibition on all bottom-tending gear with an exemption for the red crab trap fishery and allowance for transit provided that fishing gear is on deck and not deployed."

Framework Provision Alternatives (Alternative Set 5)

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment.

While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. The MSB FMP contains a list of actions that are able to be taken via framework action. The alternatives under alternative set 5 would modify that list to allow framework actions related to the proposed deep sea coral measures in this amendment.

Recently completed research surveys have observed deep sea corals in several submarine canyons within the Mid-Atlantic Council management area. Additional research is planned or ongoing and many data products will not be available within the planned timeline for this amendment. Modifying the framework provisions of the FMP would allow the Council to modify deep sea coral zones or management measures in response to new information or issues arising after implementation of the amendment.

Table 112 describes the impacts of the proposed framework provision alternatives relative to the no action alternative.

Table 112: Expected impacts from framework provision alternatives.

Alternative	Expected Impacts
Alternative 5A: No Action	Under this alternative, no changes would be made to the framework provisions of the MSB FMP. Any future modifications to the deep sea coral zones or associated management measures would likely have to be accomplished through an amendment to the FMP. This no action alternative would result in neutral impacts.
Alternative 5B: Option to modify coral zone boundaries via framework action (Council preferred)	This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.
Alternative 5C: Option to modify management measures within zones via framework action (Council preferred)	This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.
Alternative 5D: Option to add additional discrete coral zones via framework action (Council preferred)	This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.
Alternative 5E: Option to implement special access program via framework action (Council preferred)	This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.

VMS Alternatives for the *Illex* Squid Fishery (Alternative Set 6)

Under this alternative, all federally-permitted *Illex* squid vessels, regardless of areas of operation, would be required to obtain and use VMS on board during fishing operations.[62] Table 113 describes the impacts of the proposed *Illex* VMS alternatives relative to the no action alternative.

[62] NMFS permit file data indicates that 90 *Illex* moratorium permits active vessels in at least one year during the 2011-2015 period. All of these vessels had VMS.

Table 113: Expected impacts from *Illex* fishery VMS requirement alternatives.

Alternative	Expected Impacts
Alternative 6A: No Action	Under this alternative, no changes would be made to the VMS requirements for *Illex* squid moratorium vessels. *Illex* vessels are not required to use VMS as a condition of the *Illex* permit, however, many vessels do so to comply with requirements for other permits they hold (e.g., longfin squid). This no action alternative would result in neutral impacts.
Alternative 6B: Vessel Monitoring Systems (VMS) requirement for Illex squid moratorium vessels (Council preferred)	This option would require use of VMS for all *Illex* squid moratorium vessels (regardless of whether fishing activity is occurring within or outside of any designated deep sea coral zones). Current *Illex* moratorium permit holders are already required to use VMS related to other permits they possess. As such, no economic impacts are expected.

9.9.2.5.3 Summary of EO 12866 Impacts for Preferred Alternatives

The proposed action does not constitute a significant regulatory action under EO 12866 for the following reasons. First, it will not have an annual effect on the economy of more than $100 million. Based on the NMFS VTR data, the implementation of the Council preferred broad zone combined designation "Area 1F Alternative 2B-1" would have impacted average revenues by $13.7 million if it would have been implemented during the 2012-2014 period. This value is the maximum estimated revenue loss associated with the preferred alternative. However, it is expected that lost revenue could be recovered by redirecting effort to other areas. Second, the action will not create a serious inconsistency or otherwise interfere with an action taken or planned by another agency. No other agency has indicated that it plans an action that will affect the tilefish fisheries in the EEZ. Third, the actions will not materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of their participants. And, fourth, the actions do not raise novel, legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in EO 12866.

9.9.3 Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) requires the Federal rulemaker to examine the impacts of proposed and existing rules on small businesses, small organizations, and small governmental jurisdictions. In reviewing the potential impacts of proposed regulations, the agency must either certify that the rule "will not, if promulgated, have a significant economic impact on a substantial number of small entities." This determination depends on the context of the proposed action, the problem to be addressed, and the structure of the regulated industry. Standards for determining significance are discussed below. As indicated in Section 4.0, the proposed actions in this amendment is to identify and implement measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic region. A full description of each alternative is given in Section 5.0, and evaluated alternatives in this RFA are summarized in Section 9.9.2.5.

An Initial Regulatory Flexibility Analysis (IRFA) was prepared to further evaluate the economic impacts of the various alternatives presented in this document on small business entities. This analysis is undertaken in support of a more thorough analysis for the potential impacts of various deep sea coral zone designations and management measures within those coral zone designations.

9.9.3.1 Initial Regulatory Flexibility Analysis

An IRFA which evaluates the economic impacts of the alternatives on small business entities is provided in this section. The purpose of this amendment is to identify and implement measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic region. When an agency publishes a general notice of proposed rulemaking for any proposed rule, the agency is required to prepare an IRFA describing the impacts of the proposed rule on small entities. Agencies are also required to prepare a Final Regulatory Flexibility Analysis (FRFA) when they promulgate the final rule. However, agencies may forgo the preparation of a regulatory flexibility analysis if they can certify that the rule would not have a significant economic impact on a substantial number of small entities.

9.9.3.2 Description of the Reasons Why Action by the Agency is Being Considered

Complete descriptions of the purpose and need of this action and the management objectives for the MSB fisheries are found under Sections 4.1 and 4.3 of this document, respectively.

9.9.3.3 The Objectives and Legal Basis of the Proposed Rule

Complete descriptions of the purpose and need of this action and the management objectives for the MSB fisheries are found under Sections 4.1 and 4.3 of this document, respectively. The proposed actions are consistent with, and do not modify those goals and objectives. This action is taken under the authority of the MSA and regulations at 50 C.F.R. part 648.

9.9.3.4 Estimate of the Number of Small Entities

The potential number of small entities (i.e., those which fit the definition of a small business) that may be affected by the proposed rule is presented below.

9.9.3.5 Reporting Requirements

There are no additional reporting requirements associated with the proposed action. This action does not consider any other changes to the existing reporting requirements previously approved under this FMP for vessel permits, dealer reporting, or vessel logbooks.

9.9.3.6 Conflict with Other Federal Rules

This action does not duplicate, overlap, or conflict with other Federal rules.

9.9.3.7 Analysis of Economic Impacts from the Proposed Action

A description of the managed resources and deep sea corals impacted by this action is presented in section 6.0 of the EA. In addition, a description of the human communities and economic environment associated with the managed resources is also presented in section 6.0 of the EA.

9.9.3.7.1. Description and Estimates of Number of Small Entities to Which the Rule Applies

The Small Business Administration (SBA) defines a small business in the commercial harvesting sector as a firm with receipts (gross revenues) of up to $5.5 and $20.5 million for shellfish and for finfish business, respectively. A small business in the party/charter recreational fishery is a firm with receipts of up to $7.5 million. The proposed deep sea coral zones measures in association with other management measures within the coral zones could affect any business entity that has an active federal fishing permit and fishes in the proposed zone/gear restricted areas.[63]

In order to identify firms, vessel ownership data, which have been added to the permit database, were used to identify all the individuals who own fishing vessels. With this information, vessels were grouped together according to common owners. The resulting groupings were then treated as a fishing business (firm, affiliate, or entity), for purposes of identifying small and large firms. The number of affiliates that could potentially be impacted by the evaluated combinations of coral zones and gear restrictions measures would vary depending of the evaluated coral zone measures (e.g., broad versus discrete) and gear restriction (e.g., all bottom-tending gear versus all mobile bottom-tending gear). According to the ownership data base, under preferred combined designation Area 1F Alternative 2B-1,[64] a total of 113 finfish firms (all small entities[65]) fished in during 2014. Also in 2014, there were 184 small and 16 large shellfish entities. Table 114 shows the finfish and shellfish firms that fished in combined designation Area 1F Alternative 2B-1 for years 2012-2014.

The ownership database shows that small finfish firms that operated in the combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $18,344 (in 2013) to $21,055 (in 2014). These revenues represented from 2.8% (in 2012) to 4.4% (in 2014) of the inside revenue (within the proposed closed area and impacted gear only). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.9% (in 2012) to 1.4% (in 2014). The total revenue generated by these small entities in the combined designation area for the 2012-2014 period ranged from $2.3 million in 2013 to $2.5 million in 2012 (Table 114).

The ownership database shows that small shellfish firms that operated in the combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $35,276 (in 2014) to $58,723 (in 2012). These revenues represented from 2.8% (in 2014) to 4.3% (in 2013) of the inside revenue (within the proposed closed area and impacted gear only). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.8% (in each 2013 and 20134 to 0.9% (in 2012). The total revenue generated by these small entities in the combined designation area for the 2012-2014 period ranged from $6.5 million in 2014 to $10.0 million in 2012 (Table 114).

The ownership database shows that large shellfish firms that operated in the combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $146,901 (in 2013) to $314,223 (in 2012). These revenues represented from 1.5% (in 2014) to 2.0% (in 2012) of the inside revenue (within the proposed closed area and impacted gear only). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.6% (in each 2013 and 2014) to 0.7% (in 2012). The total revenue generated by these large entities in the combined designation

[63] For example, *Illex* squid, longfin squid, silver have (whiting), summer flounder, scup, and black sea bass (bottom otter trawl); red crab (pots/traps); golden tilefish (bottom longline); and sea scallops (dredge). See sections 6.2.1 and 7.0 for more information on how these fisheries were identified.

[64] The landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries landward boundary approximately 200 meter deep contour employing bottom tending gear (all types combined) exempting the red crab fishery.

[65] Revenues for fishing year 2014 were used to determine small/large firms and average revenues for 2012-2014 were used to determine entity type (e.g., finfish versus shellfish) according to SBA guidelines.

area for the 2012-2014 period ranged from $2.6 million in 2013 to $5.0 million in 2012 (Table 114). While there is a deference between the total revenue generated by small shellfish and large shellfish firms in combined designation Area 1F Alternative 2B-1, the ratio of total revenue generated by both small and large shellfish firms compared to the total revenue of all fishing activities for those firms is nearly identical, as such, it is not expected that overall impacts would differ between small and large shellfish firms if the proposed combined designation would had been in place during the 2012-2014 period.

Table 114: Small and large size entities and associated revenues that fished in Area 1F Alternative 2B-1 (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions (Council preferred)), based on 2012-2014 VTR data.

Entity Size	Entity Type		Year		
			2012	2013	2014
Small	Finfish	Count of affiliate_id [b]	138	119	113
		Average of Inside_rev	18,344	19,610	21,055
		Average of total_rev	693,661	570,705	562,496
		Average of tot_affiliate_rev	1,385,333	1,252,829	1,204,269
		Average of ratio_imp_gear	2.8%	4.1%	4.4%
		Average of ratio_totaff_rev	0.9%	1.1%	1.4%
		Sum of Inside_rev	2,531,432	2,333,615	2,379,183
		Sum of total_rev	95,725,158	67,913,917	63,562,003
		Sum of tot_affiliate_rev	191,175,907	149,086,666	136,082,376
	Shellfish	Count of affiliate_id	171	154	184
		Average of Inside_rev	58,723	42,614	35,276
		Average of total_rev	1,734,052	1,297,941	1,137,142
		Average of tot_affiliate_rev	3,620,013	2,724,215	2,616,479
		Average of ratio_imp_gear	3.5%	4.3%	2.8%
		Average of ratio_totaff_rev	0.9%	0.8%	0.8%
		Sum of Inside_rev	10,041,652	6,562,519	6,490,823
		Sum of total_rev	296,522,951	199,882,873	209,234,180
		Sum of tot_affiliate_rev	619,022,306	419,529,081	481,432,217
Large	Shellfish	Count of affiliate_id	16	18	16
		Average of Inside_rev	314,223	146,901	182,274
		Average of total_rev	15,230,543	11,769,778	11,129,005
		Average of tot_affiliate_rev	26,029,320	17,201,693	18,866,793
		Average of ratio_imp_gear	2.0%	1.6%	1.5%
		Average of ratio_totaff_rev	0.7%	0.6%	0.6%
		Sum of Inside_rev	5,027,574	2,644,216	2,916,383
		Sum of total_rev	243,688,685	211,855,997	178,064,075
		Sum of tot_affiliate_rev	416,469,119	309,630,483	301,868,694

[b] See Appendix Table D2 for a description of column labels.

9.9.3.7.2 Analysis of Preferred Broad Zone Measures

<u>Landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone management combinations</u>

Under Alternative 1A (No Action/*Status Quo)* no action would be taken to designate a broad deep sea coral zone. This alternative would not be expected to affect fishing effort or the spatial and/or temporal distribution of current fishing effort. This alternative is not expected to affect current fishing activity and no economic impacts would occur. Therefore, there are no social or economic fishing impacts associated with it. However, under this alternative, protection to deep sea corals would not be established.

Under combined designation Area 1F Alternative 2A, a landward boundary simplified between 400 meter and 500 meter depth contour broad deep sea coral zone would be designated but no action would be taken to implement management measures in the designated broad deep sea coral zone. As such, while a broad deep sea coral zone would be designated, no measures that could affect fishing effort or the spatial and/or temporal distribution of current fishing effort would be implemented. Therefore, there are no social or economic fishing impacts associated with it.

<u>Combined Designation Area 1F Alternative 2B-1</u>

As indicated above, the ownership database shows that small finfish firms that operated in proposed combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $18,344 (in 2012) to $21,055 (in 2013). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.9% (in 2012) to 1.4% (in 2014; Table 114). The small finfish firms that would be impacted under the preferred alternative obtain revenue from a variety of species. For example, the average per firm ratio of inside revenue to total revenue (of impacted gear only) from golden tilefish for the 2012-2014 period was 9%, 15%, and 16%, respectively; from squid it was 4%, 6%, and 5%, respectively. From all other species it was approximately 5% or less (see Appendix Figure D7). As such, it may be more difficult for some entities than others to recuperate potential revenue losses due to the particular make-up of the species they target. That is, there may be particular species that make up a larger portion of their revenue that are more commonly found in the proposed closed area under this combined designation.

As indicated above, the ownership database shows that small shellfish firms that operated in proposed combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $35,276 (in 2014) to $58,723 (in 2012). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.8% (in each 2013 and 2014) to 0.9% (in 2012; Table 114). The small shellfish firms that would be impacted under the preferred alternative obtain revenue from a variety of species. For example, the average per firm ratio of inside revenue to total revenue (of impacted gear only) from golden tilefish for the 2012-2014 period was 12%, 18%, and 15%, respectively; from squid it was 13% each year; from hake it was 8%, 7%, and 11%, respectively; from fluke it was 8% each year. From all other species it was approximately 5% or less.

Finally, as also indicated above, the ownership database shows that large shellfish firms that operated in proposed combined designation Area 1F Alternative 2B-1 generated average revenues that ranged from $146,901 (in 2013) to $314,223 (in 2012). However, when compared to the total revenue of all fishing activity, these revenues represented a smaller proportion, ranging from 0.6% (in each 2013 and 2014) to 0.7% (in 2012; Table 114). The large shellfish firms that would be impacted under the preferred alternative obtain revenue from a variety of species. For example, the average per firm ratio of inside revenue to total revenue (of impacted gear only) from squid for the 2012-2014 period was 19%, 8%, and 16%, respectively; from fluke it was 8%, 9%, and 11%, respectively. From all other species it was approximately 2% or less. The species dependence for both small and large shellfish forms is relatively similar with the exception that some small shellfish firms showed that a portion of their revenues was derived from the tilefish fishery. However, for other species that generated the bulk of the revenues for small and large shellfish firms (e.g. scallop, squid, and fluke), the revenue dependence was relatively similar. As previously indicated, it is expected that revenue losses due to the implementation of combined designation Area 1F Alternative 2B-1 could be recuperated by redirecting fishing effort to other areas outside the broad coral zone closure.

Since the Council preferred discrete zone combined designation Area 3B-5 Alternative 4B-1 is a sub-set of the Council preferred broad zone combined designation Area 1F Alternative 2B-1, the potential impacts associated with its implementation are not further described in this section.

Combined designation Area 1F Alternative 2C would had potentially resulted in marginally lower overall average revenue reduction when compared to Area 1F Alternative 2B-1 due to the fact that this combined designation would prohibit all mobile bottom-tending gear if it would had been implemented during the 2012-2014 period. However, as indicated above, the difference in revenues generated between these two combined designations is minimal. Furthermore, revenue depended on a species bases for small and large firms are relatively similar between those two combined designations.

Other Broad Zone Management Measures for Consideration

In addition to the gear specific restrictive measures within the proposed broad coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone.

Alternative 2E: Allow for transit with gear stowage requirements (combined designation Area 1F Alternative 2E)

Under this alternative (Council preferred), vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). This alternative could generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas.

9.9.3.7.3. Analysis of Preferred Discrete Deep Sea Coral Zones Measures

Under Alternative 3A (No Action/*Status Quo)* no action would be taken to designate a discrete deep sea coral zone. This alternative would not be expected to affect fishing effort or the spatial and/or temporal distribution of current fishing effort. This alternative is not expected to affect current fishing activity and no economic impacts would occur. Therefore, there are no social or economic fishing impacts associated with it. However, under this alternative, protection to deep sea corals would not be established.

Under combined designation Area 3B-5 Alternative 4A, the Coral Workshop boundaries for discrete zones would be designated but no action would be taken to implement management measures in the designated discrete deep sea coral zone. As such, while a discrete deep sea coral zone would be designated, no measures that could affect fishing effort or the spatial and/or temporal distribution of current fishing effort would be implemented. Therefore, there are no social or economic fishing impacts associated with it.

As indicated above, since the Council preferred discrete zone combined designation Area 3B-5 Alternative 4B-1 is a sub-set of the Council preferred broad zone combined designation Area 1F Alternative 2B-1, the potential impacts associated with its implementation are not further described in this section.

9.9.3.7.4 Analysis of Preferred Framework Provision and VMS Alternatives

Framework Provisions

Framework actions facilitate expedient modifications to certain management measures. Framework actions can only modify existing measures and/or those that have been previously considered in an FMP amendment.

While amendments may take several years to complete and address a variety of issues, frameworks generally can be completed in 5-8 months and address one or a few issues in a fishery. The MSB FMP contains a list of actions that are able to be taken via framework action. The following alternatives would modify that list to allow framework actions related to the proposed deep sea coral measures in this amendment.

Recently completed research surveys have observed deep sea corals in several submarine canyons within the Mid-Atlantic Council management area. Additional research is planned or ongoing and many data products will not be available within the planned timeline for this amendment. Modifying the framework provisions of the FMP would allow the Council to modify deep sea coral zones or management measures in response to new information or issues arising after implementation of the amendment.

Alternative 5A: No Action (Non-Preferred)

Under this alternative, presented for purposes of comparison to the action alternatives, no changes would be made to the framework provisions of the MSB FMP. Any future modifications to the deep sea coral zones or associated management measures would likely have to be accomplished through an amendment to the FMP. This no action alternative would result in neutral impacts.

Alternative 5B: Option to modify coral zone boundaries via framework action (Council preferred)

This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.

Alternative 5C: Option to modify management measures within zones via framework action (Council preferred)

This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.

Alternative 5D: Option to add additional discrete coral zones via framework action (Council preferred)

This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.

Alternative 5E: Option to implement special access program via framework action (Council preferred)

This is an administrative alternative in nature which would result in neutral impacts. Any proposed action or future change will be analyzed through a separate NEPA process.

Alternative 6B: Vessel Monitoring Systems (VMS) requirement for Illex squid moratorium vessels (Council preferred)

This option would require use of VMS for all Illex squid moratorium vessels (regardless of whether fishing activity is occurring within or outside of any designated deep sea coral zones). Current Illex moratorium permit holders are already required to use VMS related to other permits they possess. As such, no economic impacts are expected.

Other Management Measures For Consideration

In addition to the gear restrictive measures within the proposed broad coral zones presented in this amendment, there are other measures that are considered in order to facilitate enforceability of the implementation of coral zones and gear restrictive measures within the broad coral zone.

Alternative 2D: Allow for transit with gear stowage requirements (combined designation Area 3B-1 Alternative 2D)

Under this alternative (Council preferred), vessels would be allowed to transit through gear-restricted broad coral zones, with a requirement that the vessel's net be on the reel (for trawl vessels) or that fishing gear be on board during transit (for other gear types). This alternative could generate positive economic impacts as vessels operating in these areas would not have to expend time and fuel transiting around the gear-restrictive areas.

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11.0 LIST OF AGENCIES AND PERSONS CONSULTED

In preparing this document the Council consulted with NMFS, the New England and South Atlantic Fishery Management Councils, the U.S. Fish and Wildlife Service, Department of State, and the states of Maine through North Carolina through their membership on the Mid-Atlantic and New England Fishery Management Councils. To ensure compliance with NOAA Fisheries formatting requirements, the advice of NOAA Fisheries GARFO personnel was sought.

12.0 LIST OF PREPARERS AND POINT OF CONTACT

This Environmental Assessment was prepared by the following Council staff: Kiley Dancy and José Montañez, in consultation with other staff members. This document was prepared and evaluated in consultation with the National Marine Fisheries Service and the New England Fishery Management Council. Members of the Deep Sea Corals Fishery Management Action Team (FMAT) prepared and reviewed portions of analyses and provided technical advice during the development of the Environmental Assessment. Current and former members of the Deep Sea Corals FMAT members include:

Agency	Role	FMAT Member
MAFMC	Council staff/FMAT Chair	Kiley Dancy
NMFS GARFO	General Counsel (consulted as needed)	Denise Desautels/Kevin Collins
NMFS GARFO	Sustainable Fisheries	Aja Szumylo/Carly Bari
NMFS GARFO	NEPA	Katherine Richardson
NMFS GARFO	Habitat	David Stevenson
NMFS GARFO	Protected Resources	Mark Minton
NMFS GARFO	Fisheries and Data Services	Greg Power
NMFS GARFO	Analysis and Program Support	Robert Vincent
NMFS GARFO	Stakeholder Engagement	Kevin Chu
NEFSC	Ecosystem Processes	David Packer
NEFSC	Social Sciences	Andrew Kitts

Questions about this environmental assessment or additional copies may be obtained by contacting. Christopher Moore, PhD, Executive Director, Mid-Atlantic Fishery Management Council, 800 N. State Street, Dover, DE 19901 (302-674-2331). This Environmental Assessment may also be accessed by visiting the NMFS Greater Atlantic Region website at http://www.greateratlantic.fisheries.noaa.gov/.

APPENDIX A: FMAT CORAL ZONE BOUNDARY DEVELOPMENT

This Appendix describes the reasoning and methodology behind the development of the discrete zone boundary alternative recommended by the MAFMC Deep Sea Corals FMAT in 2014 (Alternative 3B-2). Boundary Alternatives 3B-1, 3B-3, and 3B-4 were submitted to the Council by stakeholder organizations, with varying levels of documentation of methodology. Alternative 3B-5 was developed during a collaborative workshop to reconcile various boundary options. While a full description of the methodology used is not available for all boundary options, additional information can be found in the materials for the April 2015 Deep Sea Corals Alternatives Workshop, available at: http://www.mafmc.org/workshop/deep-sea-coral-workshop. In addition, the report from the April 2015 workshop, which describes the methods of deriving the Council preferred workshop Alternative 3B-5, can be found in the June 2015 Council meeting briefing materials, at http://www.mafmc.org/s/Tab-07_Deep-Sea-Corals.pdf.

Discrete Zone FMAT Boundaries

At the outset of this amendment, discrete zone boundaries were initially carried over from those developed by the NEFMC Habitat Plan Development Team (PDT) during development of the NEFMC's Omnibus Habitat Amendment 2 (prior to splitting deep sea coral alternatives into a separate omnibus amendment). These boundaries were derived using older information on coral presence and lower resolution slope and bathymetry data; therefore, in April 2015, the Council's Deep Sea Corals FMAT met to revise the original boundaries based on new scientific information. New information considered included an updated historical DSCRTP database (as of June 2013), higher resolution (25m) slope and bathymetry data, and the outputs of the deep sea coral habitat suitability model (see Section 6.3.2.4 for additional information on the habitat suitability model).

The FMAT reviewed the boundaries relative to new information available from a deep sea coral habitat suitability model, new high resolution bathymetry data, and recent observations of corals from research surveys. The following criteria were developed by the FMAT and used to guide the re-drawing of boundaries:

1. Identify the major geomorphological features of each canyon or slope area (major axes; overall shape) within the current range of alternatives, based on examination of high resolution slope, bathymetry and other data describing canyon features and morphology.
2. Encompass areas of high and very high habitat suitability[66] from the deep sea coral habitat suitability model outputs for Alcyonacean corals (gorgonian and non-gorgonian ouputs combined), within the geographic range of each proposed canyon or slope area. Note: the Alcyonacean model output is expected to be the best predictor of habitat suitability for structure-forming corals.
3. For each proposed canyon or slope area, encompass areas of slope greater than 30 degrees, with emphasis on areas of slope greater than 36 degrees[67], within approximately 0.4 nautical miles (2 habitat suitability model grid cells) of high or very high suitable habitat. Note: during 2012-2013 TowCam and Okeanos Explorer cruises, areas of slope >=36 degrees contained exposed hard bottom almost 100% of the time, and areas of slope >=30 degrees often contained hardbottom habitat.

[66] "High" and "very high" likelihood classes for habitat suitability were taken directly from thresholded versions of the model output provided by NOAA/NCCOS model developers. See Section 6.3.2.4 for additional explanation of the thresholded logistic ouputs.
[67] Slope data derived from ACUMEN 25m resolution multibeam data.

4. Draw boundaries to approximate a buffer of 0.4 nautical miles (2 model grid cells) from target areas of high slope and areas of high habitat suitability (as described in steps 2 and 3 above).
5. Incorporate available data for coral observations from 2012-2013 fieldwork in Baltimore Canyon, Norfolk Canyon, Toms Canyon complex, Block Canyon, and Ryan Canyon. Ensure that boundaries encompass areas where corals were observed within the proposed canyons, if location data is available. Note: These observations have not yet been incorporated into the habitat suitability model or the DSCRTP coral database.
6. Identify additional areas of conservation interest based on database (historical) records of deep sea corals, with an emphasis on records of Alcyonaceans (soft corals and gorgonians) and Scleractinians (stony corals), particularly larger and/or structure-forming (including colonial) coral types.
7. For adjacent canyons or slope areas with identified conservation areas of interest, identify whether such adjacent areas should be collapsed into a single area. Eliminate overlap between proposed discrete zone boundaries. Simplify boundary lines where possible.
8. Identify whether these coral data-based boundaries conflict with any of the industry-proposed boundaries, and where there are major discrepancies, consider sub-options.

Broad Zone FMAT Boundaries

The broad deep sea coral protection zone alternatives were initially proposed with landward boundaries approximating a specific depth-contour. These depth contours were derived from bathymetry data, and consist of many thousands of points (vertices) resulting in very complex lines. For implementation and enforcement, these contour lines that serve as the landward boundary of the broad zone alternatives needed to be translated into points and lines on a map with precise locations, and thus were simplified from the contour lines derived from high-resolution bathymetry. The number of vertices was reduced in order to result in line segments that are more practical to implement and enforce.

The Deep Sea Corals FMAT recommended, and the Council supported, using the ESRI ArcGIS tool "Simplify Line" to initially approximate and simplify complex depth-contour based boundaries, followed by manual adjustment within the bounds approved by the Council in the recommendation of their preferred alternative. This methodology, in the context of the preferred broad zone alternative, is summarized below.

The Council preferred broad zone alternative (Alternative 1E) is a boundary designation that includes a landward boundary drawn between the 400 meter (219 fathom) contour as a hard landward boundary and the 500 meter (273 fathom) contour as a hard seaward boundary. The line created using this technique focuses on the center point (450 meters or 246 fathoms) between the hard landward and seaward boundaries, with a 50 meter depth tolerance in either direction as a guide used to draw this line as straight as possible without crossing the hard boundaries. In areas where there is conflict or overlap between this broad zone and any designated discrete zone boundaries, the discrete zone boundaries are prioritized. From the landward boundary, the broad zone boundaries extend along the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ as the eastward boundary

The landward boundary approximation was developed by initially using the "Simplify Line" tool to on the 450m high-resolution bathymetry contour. This tool is a fast and systematic way to simplify complex lines using a known algorithm to remove small fluctuations or extraneous bends from it while preserving its essential shape (Figure A1). Based on the FMAT's recommendation, the configuration of this tool included the use of the "point remove" method, which removes redundant vertices by keeping critical points that depict the essential shape of a line and removes all other points. The simplification tolerance, or the value determines the degree of simplification, in this exercise was specified as 0.5 km.

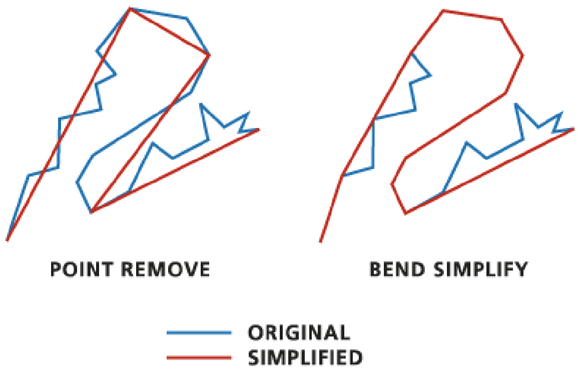

Figure A1: Simplify Line tool illustration. Source: ESRI ArcGIS.

The simplified line generated using this tool was then further adjusted manually within ArcGIS, using the Council's preferred "hard boundaries" (the 400m and 500m contours) as a guide. The Council's Law Enforcement Committee had originally suggested using a "tolerance" or buffer methodology in either direction of the true contour line, an idea adopted in the Council's final action motion on the broad zone alternative.[68] Thus, adjustments were ultimately made using a 50 meter depth tolerance in either direction from the simplified 450m contour. Note that when drawing straight lines to approximate depth contours, there will inevitably be "gains" and "losses," relative to a strictly depth-based boundary, in terms of areas captured within the proposed zone. That is, the approximated line will be shallower than the true contour in some places and deeper in other places. The Council specified a 50m depth tolerance to indicate how far they were comfortable with the line deviating from the true contour. This is not to be a buffer for enforcement or coral protection purposes, but only as a guide to draw straight line segments simplified from a complex contour.

In addition, the Council considered how to handle spatial overlap of broad and discrete zones. In some areas, the broad zone boundaries extend well shallower than the proposed discrete zones, and in other areas, broad zone contours cut through deeper areas of the proposed discrete zones. The FMAT and the Law Enforcement Committee both recommended that due to the time, effort, and compromise put into the Deep Sea Corals Workshop consensus boundaries, the discrete zones should trump any broad zone lines drawn, if both broad and discrete zones were to be selected by the Council. This recommendation was also adopted by the Council in their motion on broad zone designation. Thus, the broad zone lines approximate the desired depth contour until the intersection with a proposed discrete zone, at which point it would follow the workshop discrete zone boundaries.

Additional information on the broad zone boundary development is available in prior amendment documents, available on the Council's website at: http://www.mafmc.org/actions/msb/am16.

[68] See http://www.mafmc.org/briefing/june-2015 for the Law Enforcement Committee report from a May 5, 2015 webinar.

APPENDIX B: Image Survey Data from 2012-2014 TowCam Surveys

Tables B1 and B2 present detailed image survey data collected during the TowCam Surveys for deep sea corals, conducted in several mid-Atlantic canyons between 2012-2014 (see Section 6.3.2).

Table B1: Preliminary image survey of canyon fauna from TowCam surveys, 2012-2013. Images were captured at 10 second intervals through each dive. Each bottom image was visually screened for hard and soft corals, sponges, and fish fauna. Presence/absence information was logged for each image.

TowCam Dive #	Canyon Location	Date	Launch Lat N	Launch Lon W	Recovery Lat	Recovery Lon	No. of Images on bottom	No. images with corals	No. images with sponges	% images with corals	% images with sponges	Nominal Depth (m)
HB1204-01	Toms Canyon SE	7/7/2012	38 56.3823	72 25.7944	38 55.5772	72 25.6275	1734	828	2	47.75	0.12	1802
HB1204-02	Toms Canyon Lower West	7/8/2012	38 57.1788	72 27.2815	38 57.5213	72 27.5442	2067	557	121	26.95	5.85	1736 to 1694
HB1204-03	Toms Canyon Canyon Head	7/8/2012	39 06.2975	72 38.0914	39 05.8721	72 38.1695	1226	11	16	0.90	1.31	553 to 861
HB1204-04	Hendrickson Canyon Lower East Scarp	7/9/2012	38 57.6673	72 26.3203	38 57.5940	72 26.5532	1148	291	264	25.35	23.00	175 to 1705
HB1204-05	Middle Toms Canyon Mid	7/10/2012	38 56.9385	72 35.3163	38 56.8551	72 35.0058	1963	1016	522	51.76	26.59	1337 to 1591
HB1204-06	Toms Canyon Mid-East	7/10/2012	39 01.6231	72 33.2098	39 01.7749	72 33.1740	1781	154	83	8.65	4.66	1115 to 1216
HB1302-001	Ryan Canyon	6/10/2013	39 46.4979	71 41.9049	39 46.3115	71 41.9738	649	0	0	0.00	0.00	599
HB1302-002	Ryan Canyon	6/11/2013	39 43.8514	71 42.6188	39 43.9435	71 41.9149	420	2	0	0.48	0.00	771
HB1302-003	Ryan Canyon	6/12/2013	39 43.8357	71 42.1705	39 43.3885	71 41.3225	2262	48	497	2.12	21.97	992
HB1302-004	Ryan Canyon	6/12/2013	39 42.3582	71 38.6827	39 41.5694	71 38.3807	2079	62	496	2.98	23.86	1135
HB1302-005	Ryan Canyon	6/13/2013	39 34.7145	71 33.3316	39 35.317	71 32.6441	1358	584	9	43.00	0.66	1965
HB1302-006	Ryan-McMaster Inter-canyon area	6/13/2013	39 47.5719	71 42.7850	39 47.3285	71 40.5977	2230	1	52	0.04	2.33	498

Table B2: Preliminary image survey of canyon fauna from TowCam surveys, 2014. Images were captured at 10 second intervals. Each bottom image was visually screened for hard and soft corals, sponges, and fish. Presence/absence information was logged for each image.

TowCam Dive #	Canyon Location	Date	Launch Lat N	Launch Lon W	Recovery Lat	Recovery Lon	Depth range (m)	No. of bottom images	No. images w/ corals	No. images w/ sponges	% images w/corals	% images w/ sponges
HB1404- 01	Washington Canyon	8/6/2014	37 25.087	74 24.824	37 247125	74 24.4262	491-874	1680	70	74	4.17	4.40
HB1404- 02	Washington Canyon	8/7/2014	37 22.5827	74 17.2213	37 22.5846	74 17.2227	DIVE ABORTED	x	x	x	x	x
HB1404- 03	Washington Canyon	8/7/2014	37 22.5858	74 17.2234	37 22.7155	74 17.3077	DIVE ABORTED	x	x	x	x	x
HB1404- 04	Washington Canyon	8/7/2014	37 22.5815	74 17.2256	37 22.5437	74 17.8913	1126-1294	1004	81	47	8.07	4.68
HB1404- 05	Washington Canyon	8/8/2014	37 18.6327	74 13.0820	37 18.7444	74 12.4163	1515-1637	748	745	94	99.60	12.57
HB1404- 06	Accomac Canyon	8/8/2014	37 49.5832	74 03.0897	37 49.4621	74 03.3781	497-825	424	66	227	15.57	53.54
HB1404- 07	Leonard Canyon	8/8/2014	37 49.5877	73 55.7825	37 49.4592	73 55.4191	1167-1235	446	43	43	9.64	9.64
HB1404- 08	Leonard Canyon	8/9/2014	37 47.5576	73 55.4035	37 47. 5836	73 54.7282	1348-1522	707	574	118	81.19	16.69
HB1404- 09	Wilmington Canyon	8/9/2014	38 26.2101	73 32.5511	38 25.6822	73 31.8554	370-540	1321	401	1149	30.36	86.98
HB1404- 10	Wilmington Canyon	8/10/2014	38 19.9080	73 26.4575	38 19.2323	73 25.4968	1130-1492	1156	124	226	10.73	19.55
HB1404- 11	Wilmington Canyon	8/10/2014	38 22.7823	73 30.3828	38 22.6162	73 30.8392	640-818	700	0	0	0.00	0.00
HB1404- 12	Wilmington Canyon	8/10/2014	38 21.2480	73 26.7960	38 20.6120	73 26.5101	574-1031	1362	4	303	0.29	22.25
HB1404- 13	Wilmington Canyon	8/11/2014	38 17.1090	73 24.7006	38 17.5566	73 24.0859	1466-1610	932	737	35	79.08	3.76
HB1404- 14	Wilmington Canyon	8/11/2014	38 19.2628	73 30.9987	38 19.3828	73 31.4621	661-847	671	1	88	0.15	13.11
HB1404- 15	Spencer Canyon	8/12/2014	38 36.7995	73 07.9232	38 36.6291	73 7.7906	526-700	796	0	162	0.00	20.35
HB1404- 16	Spencer Canyon	8/12/2014	38 35.7369	73 08.8504	38 35.0430	73 09.0364	757-1020	659	286	410	43.40	62.22
HB1404- 17	Spencer Canyon	8/12/2014	38 34.4928	73 07.2639	38 34.1771	73 07.1344	1035-1313	1117	122	470	10.92	42.08
HB1404- 18	Spencer Canyon	8/13/2014	38 33.9234	73 06.3917	38 33.9026	73 04.8420	DIVE ABORTED			x	x	x
HB1404- 19	Spencer Canyon	8/13/2014	38 33.6988	73 06.1232	38 33.3535	73 05.9664	1302-1522	472	268	180	56.78	38.14
HB1404- 20	Spencer Canyon, very deep	8/13/2014	38 29.5745	73 04.1680	38 29.5526	73 03.9679	2002-2121	440	0	52	0.00	11.82
HB1404- 21	Lindenkohl Canyon, Shallow	8/14/2014	38 47.6467	73 01.2698	38 47.7220	73 00.8393	546-664	390	13	0	3.33	0.00
HB1404- 22	Lindenkohl Canyon, Mid	8/14/2014	38 46.1905	72 56.5147	38 45.9626	72 56.6090	945-1139	576	288	345	50.00	59.90
HB1404- 23	Lindenkohl Canyon, Deep	8/14/2014	38 44.0860	72 53.6111	38 43.9139	72 53.5711	1527-1607	238	206	35	86.55	14.71
HB1404- 24	Lindenkohl Canyon, Very deep	8/14/2014	38 42.0646	72 50.8507	38 41.9557	72 50.8198	1762-1946	390	215	110	55.13	28.21
HB1404- 25	Carteret Canyon, Deep	8/14/2014	38 50.9024	72 45.6454	38 50.7350	72 45.5056	1373-1478	309	105	107	33.98	34.63
HB1404- 26	Carteret Canyon, Very Deep	8/15/2014	38 48.6365	72 43.8868	38 48.5267	72 43.9589	1651-1724	288	144	17	50.00	5.90
HB1404- 27	Carteret Canyon, Mid	8/15/2014	38 51.2950	72 47.1788	38 51.3254	72 47.2947	1200-1286	382	33	95	8.64	24.87
HB1404- 28	Carteret Canyon, Shallow	8/15/2014	38 53.7168	72 51.3923	38 53.4874	72 51.3237	627-823	909	0	55	0.00	6.05

APPENDIX C: Geographic Coordinates for Coral Zone Alternatives

This Appendix gives the geographic coordinates for all discrete zone options (Alternatives 3B-1 through 3B-5; Tables C1 and C2) and the Council preferred broad zone (Alternative 1F; Table C3). Because the other broad zone alternatives did not include simplified boundaries and were based directly on high-resolution depth contours, the number of vertices comprising the landward boundaries of each is very large. Thus, only the Council preferred option (which includes a simplified boundary) is presented here. Shapefiles and coordinates for all broad and discrete zone alternatives are available from Council staff (see http://www.mafmc.org/contact/).

For the broad zone, the northernmost boundary is based on the New England and Mid-Atlantic inter-council boundary as defined in 50 CFR §600.105. This definition includes a starting point and a constant bearing toward the outward boundary of the US EEZ. Because this boundary is not defined by an exact set of coordinates, there was a need to develop a proxy set of boundaries for the purposes of this amendment. A technical summary of how this line was converted into a series of points, as a proxy for the actual boundary line, is described below.

The starting point was plotted in ArcGIS using the NAD83 projection, then projected, along with an EEZ shapefile, to a custom Azimuthal equidistant projection centered on the starting point. The Azimuthal equidistant projection measures true direction from its center. With its direction constrained, we drew a line segment from the starting point to the EEZ. To hold its position, we densified the line with vertices interpolated no more than 1 nautical mile apart. To preserve distance measurements, we projected the densified inter-council boundary to a custom equidistant conic projection. We then constructed points constrained to this line and spaced every 1852 meters (1 nmi) from the starting point. We projected these points to the NAD83 geographic coordinate system and calculated their longitude and latitude values. We used every 10th point as a proxy for defining any portion of the area boundary intended to be coincident with the inter-council boundary.

Table C1: Number of vertices associated with each boundary option for each discrete zones.

	Advisor 2013 (Alt. 3B-1)	FMAT 2014 (Alt. 3B-2)	GSSA 2015 (Alt. 3B-3)	NGO 2015 (Alt. 3B-4)	Workshop 2015 (Alt. 3B-5)
Block Canyon	-	9	17	17	8
Ryan_McMaster Canyons	-	10	47	12	10
Emery_Uchupi Canyons	-	7	18	10	8
Jones_Babylon Canyons	-	7	10	10	10
Hudson Canyon	-	14	49	27	19
Mey-Lindenkohl Slope	6[1]	19	105	32	31
Spencer Canyon	-	6	17	10	10
Wilmington Canyon	-	13	19	27	17
North Heyes and South Wilmington Canyons	-	7	12	10	13
South Vries Canyon	-	6	10	7	7
Baltimore Canyon	11	12	21	20	20
Warr_Phoenix Canyons	-	10	25	12	8
Accomac_Leonard Canyons	-	8	8	19	18
Washington Canyon	-	14	17	22	19
Norfolk Canyon	13	10	13	24	15

[1] Straight-line version only shown.

Table C2: Geographic coordinates of discrete zone options under Alternative 3B for each boundary option (decimal degrees).

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Block Canyon	--	1. 39.78774, -71.289731 2. 39.876659, -71.291825 3. 39.988634, -71.341745 4. 40.008863, -71.317141 5. 39.896106, -71.243622 6. 39.825087, -71.201942 7. 39.634903, -71.158382 8. 39.623376, -71.197887 9. 39.78774, -71.289731	1. 39.897044, -71.309333 2. 39.915348, -71.3167 3. 39.933827, -71.306609 4. 39.937844, -71.300998 5. 39.936164, -71.295913 6. 39.927222, -71.291305 7. 39.925996, -71.289676 8. 39.925846, -71.283818 9. 39.928616, -71.273564 10. 39.933171, -71.26773 11. 39.896118, -71.2436 12. 39.824509, -71.201345 13. 39.634908, -71.1584 14. 39.623164, -71.19776 15. 39.787526, -71.289902 16. 39.876668, -71.2918 17. 39.897044, -71.309333	1. 39.634683, -71.158997 2. 39.623067, -71.197642 3. 39.78756, -71.289915 4. 39.876765, -71.291914 5. 39.896893, -71.309286 6. 39.915443, -71.316618 7. 39.926938, -71.310382 8. 39.992481, -71.337107 9. 40.006748, -71.319749 10. 39.948676, -71.29185 11. 39.934975, -71.295303 12. 39.92727, -71.291399 13. 39.928627, -71.273639 14. 39.933195, -71.267743 15. 39.889725, -71.239826 16. 39.824521, -71.201315 17. 39.634683, -71.158997	1. 39.918023, -71.31025 2. 39.933154, -71.267755 3. 39.825079, -71.201942 4. 39.634894, -71.158382 5. 39.623368, -71.197886 6. 39.787732, -71.289731 7. 39.876651, -71.291824 8. 39.918023, -71.31025
Ryan-McMaster Canyons	--	1. 39.856433, -71.656995 2. 39.812567, -71.622869 3. 39.716074, -71.583466 4. 39.557149, -71.465226 5. 39.529234, -71.512775 6. 39.574391, -71.594714 7. 39.668678, -71.705951 8. 39.730725, -71.747437 9. 39.807072, -71.764012 10. 39.856433, -71.656995	1. 39.737502, -71.74869 2. 39.73746, -71.747205 3. 39.741716, -71.741056 4. 39.752825, -71.739469 5. 39.77098, -71.743501 6. 39.784218, -71.753505 7. 39.793379, -71.752649 8. 39.800118, -71.753182 9. 39.804514, -71.746171 10. 39.806631, -71.745645 11. 39.809213, -71.738293 12. 39.80517, -71.728702 13. 39.802114, -71.725019	1. 39.556876, -71.464844 2. 39.5293, -71.512672 3. 39.574193, -71.594942 4. 39.667479, -71.705265 5. 39.731951, -71.74876 6. 39.783036, -71.769005 7. 39.80658, -71.753107 8. 39.84761, -71.718016 9. 39.856243, -71.656342 10. 39.814174, -71.624682 11. 39.713742, -71.582474 12. 39.556876, -71.464844	1. 39.80011, -71.753182 2. 39.832905, -71.654841 3. 39.804768, -71.619683 4. 39.716066, -71.583466 5. 39.557141, -71.465225 6. 39.529226, -71.512774 7. 39.574383, -71.594714 8. 39.66867, -71.70595 9. 39.730717, -71.747437 10. 39.80011, -71.753182

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Ryan-McMaster Canyons (cont.)			14. 39.796668, -71.718049 15. 39.792321, -71.709326 16. 39.790532, -71.704096 17. 39.793026, -71.699512 18. 39.790988, -71.691318 19. 39.790582, -71.682833 20. 39.789756, -71.67692 21. 39.790514, -71.674757 22. 39.793862, -71.671406 23. 39.801512, -71.675077 24. 39.814064, -71.678088 25. 39.820094, -71.682476 26. 39.823795, -71.685701 27. 39.831268, -71.688958 28. 39.835569, -71.690241 29. 39.842284, -71.684173 30. 39.842035, -71.681207 31. 39.841343, -71.674219 32. 39.836204, -71.666595 33. 39.835518, -71.665565 34. 39.832913, -71.654841 35. 39.833644, -71.646084 36. 39.822832, -71.640867 37. 39.821339, -71.640302 38. 39.819408, -71.635929 39. 39.816819, -71.625847 40. 39.812568, -71.622901 41. 39.716191, -71.583614 42. 39.557158, -71.465201 43. 39.529409, -71.512948 44. 39.574138, -71.594208 45. 39.6689, -71.706493		

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
			46. 39.731072, -71.747505 47. 39.737502, -71.74869		
Emery-Uchupi Canyons	---	1. 39.601802, -71.938782 2. 39.695882, -71.920324 3. 39.679309, -71.821057 4. 39.513024, -71.603954 5. 39.454298, -71.652159 6. 39.483185, -71.757833 7. 39.601802, -71.938782	1. 39.593242, -71.926116 2. 39.599797, -71.919677 3. 39.610914, -71.924486 4. 39.641693, -71.91612 5. 39.672352, -71.90945 6. 39.678764, -71.903857 7. 39.68148, -71.895032 8. 39.677795, -71.88607 9. 39.674754, -71.876655 10. 39.672203, -71.867219 11. 39.673213, -71.862079 12. 39.681139, -71.851955 13. 39.68437, -71.85011 14. 39.679318, -71.821101 15. 39.513245, -71.603963 16. 39.454308, -71.652201 17. 39.483188, -71.757801 18. 39.593242, -71.926116	1. 39.513014, -71.604065 2. 39.454262, -71.652184 3. 39.481679, -71.76851 4. 39.602215, -71.939075 5. 39.650807, -71.916668 6. 39.688972, -71.914564 7. 39.687254, -71.885446 8. 39.68409, -71.849502 9. 39.678892, -71.819737 10. 39.513014, -71.604065	1. 39.619165, -71.930756 2. 39.662903, -71.895054 3. 39.659098, -71.794599 4. 39.513016, -71.603953 5. 39.45429, -71.652159 6. 39.483177, -71.757833 7. 39.565173, -71.876788 8. 39.619165, -71.930756
Jones-Babylon Canyons	--	1. 39.483566, -72.059996 2. 39.536426, -72.064091 3. 39.506185, -71.962041 4. 39.51045, -71.918768 5. 39.396763, -71.802576 6. 39.383278, -71.874694 7. 39.483566, -72.059996	1. 39.470692, -72.036471 2. 39.497982, -72.058507 3. 39.509442, -72.057829 4. 39.52132, -72.043873 5. 39.524418, -72.023267 6. 39.506188, -71.962001 7. 39.510458, -71.918801 8. 39.396768, -71.802601 9. 39.383288, -71.874701 10. 39.470692, -72.036471	1. 39.525333, -72.037543 2. 39.524775, -72.024381 3. 39.506292, -71.962127 4. 39.510475, -71.918671 5. 39.396778, -71.80209 6. 39.383194, -71.873936 7. 39.483495, -72.05966 8. 39.50575, -72.061873 9. 39.521811, -72.047438 10. 39.525333, -72.037543	1. 39.470999, -72.036733 2. 39.497974, -72.058507 3. 39.509434, -72.057828 4. 39.521311, -72.043872 5. 39.524383, -72.023432 6. 39.506177, -71.96204 7. 39.510442, -71.918767 8. 39.396755, -71.802576 9. 39.38327, -71.874693 10. 39.470999, -72.036733

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Hudson Canyon	---	1. 39.327043, -72.171462 2. 39.426641, -72.258094 3. 39.521758, -72.437455 4. 39.621235, -72.446075 5. 39.642328, -72.473969 6. 39.659156, -72.460385 7. 39.623482, -72.398714 8. 39.556164, -72.387105 9. 39.497259, -72.19586 10. 39.50198, -72.151079 11. 39.232239, -71.807301 12. 39.173104, -71.882917 13. 39.237879, -72.051478 14. 39.327043, -72.171462	1. 39.330537, -72.174973 2. 39.333955, -72.170756 3. 39.367604, -72.179375 4. 39.393171, -72.217813 5. 39.419557, -72.217218 6. 39.440879, -72.240429 7. 39.467365, -72.273898 8. 39.480056, -72.289755 9. 39.502695, -72.34022 10. 39.506399, -72.348258 11. 39.514403, -72.375221 12. 39.523003, -72.397624 13. 39.532402, -72.408637 14. 39.53597, -72.410777 15. 39.542462, -72.41781 16. 39.569595, -72.419078 17. 39.586528, -72.420724 18. 39.575504, -72.415674 19. 39.581351, -72.409543 20. 39.576005, -72.406558 21. 39.572961, -72.41213 22. 39.540069, -72.405169 23. 39.541313, -72.397849 24. 39.53512, -72.388534 25. 39.531087, -72.381412 26. 39.5308, -72.368694 27. 39.529239, -72.361935 28. 39.525556, -72.354802 29. 39.522929, -72.347629 30. 39.523487, -72.341245 31. 39.516366, -72.322428 32. 39.512425, -72.319399	1. 39.622514, -72.398265 2. 39.553718, -72.394356 3. 39.543792, -72.381361 4. 39.542706, -72.359997 5. 39.517203, -72.286269 6. 39.513499, -72.256849 7. 39.497584, -72.196026 8. 39.496563, -72.154065 9. 39.465177, -72.103255 10. 39.232038, -71.806808 11. 39.173241, -71.883019 12. 39.237259, -72.050277 13. 39.317862, -72.15912 14. 39.330425, -72.17492 15. 39.366745, -72.191622 16. 39.389565, -72.219592 17. 39.424141, -72.248494 18. 39.463461, -72.294579 19. 39.500518, -72.37809 20. 39.511062, -72.408008 21. 39.521949, -72.417595 22. 39.545984, -72.430491 23. 39.59006, -72.432656 24. 39.617903, -72.436802 25. 39.649371, -72.468198 26. 39.659438, -72.460034 27. 39.622514, -72.398265	1. 39.419549, -72.217217 2. 39.480048, -72.289754 3. 39.502687, -72.340219 4. 39.522995, -72.397623 5. 39.542454, -72.417809 6. 39.576187, -72.419591 7. 39.575552, -72.403907 8. 39.552904, -72.401611 9. 39.534533, -72.379579 10. 39.536131, -72.368068 11. 39.50493, -72.261802 12. 39.491503, -72.238334 13. 39.490738, -72.220739 14. 39.460448, -72.097904 15. 39.232231, -71.8073 16. 39.173096, -71.882917 17. 39.237871, -72.051477 18. 39.317986, -72.159263 19. 39.419549, -72.217217

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Hudson Canyon (cont.)			33. 39.50363, -72.289293		
			34. 39.500253, -72.265343		
			35. 39.497161, -72.253651		
			36. 39.484924, -72.242322		
			37. 39.485677, -72.229573		
			38. 39.490746, -72.22074		
			39. 39.485046, -72.203251		
			40. 39.483663, -72.189679		
			41. 39.469475, -72.170721		
			42. 39.473869, -72.163276		
			43. 39.474736, -72.15552		
			44. 39.474563, -72.13418		
			45. 39.465743, -72.119102		
			46. 39.464656, -72.103706		
			47. 39.400264, -72.021079		
			48. 39.317832, -72.159171		
			49. 39.330537, -72.174973		
Mey-Lindenkohl Slope	1. 38.774168, -73.061304	1. 39.222709, -72.43661	1. 38.716604, -73.020686	1. 38.578764, -72.893087	1. 38.716596, -73.020685
	2. 39.209146, -72.439761	2. 39.208663, -72.328219	2. 38.727681, -73.00592	2. 38.746054, -73.054089	2. 38.727673, -73.005919
	3. 38.989577, -72.192738	3. 38.980856, -72.19638	3. 38.743013, -73.004294	3. 38.777636, -73.018206	3. 38.749977, -73.004527
	4. 38.538973, -72.794805	4. 38.553495, -72.797882	4. 38.749985, -73.004528	4. 38.782329, -73.037319	4. 38.777932, -73.017862
	5. 38.74111, -73.031962	5. 38.580456, -72.895169	5. 38.744997, -73.013922	5. 38.826427, -73.036994	5. 38.792374, -73.037324
	6. 38.774168, -73.061304 (Straight-line option)	6. 38.660822, -72.953894	6. 38.76829, -73.019088	6. 38.831116, -73.030585	6. 38.797242, -73.037389
		7. 38.752375, -73.061855	7. 38.769124, -73.014609	7. 38.841157, -73.000126	7. 38.817188, -73.025566
		8. 38.823651, -73.061459	8. 38.77723, -73.005445	8. 38.821527, -72.956278	8. 38.807474, -73.016678
		9. 38.844915, -73.032483	9. 38.792584, -73.043458	9. 38.87209, -72.898174	9. 38.819103, -72.982956
		10. 38.846538, -72.984126	10. 38.79725, -73.03739	10. 38.909035, -72.897847	10. 38.800513, -72.944972
		11. 38.822966, -72.954489	11. 38.812223, -73.027533	11. 38.909679, -72.865452	11. 38.830665, -72.925643
		12. 38.870788, -72.899604	12. 38.817196, -73.025567	12. 38.933764, -72.840763	12. 38.873329, -72.875064
		13. 38.914253, -72.910859	13. 38.809107, -73.019544	13. 38.983054, -72.809495	13. 38.897885, -72.889253
		14. 38.91835, -72.861053	14. 38.808776, -73.014069	14. 39.015654, -72.778543	14. 38.902895, -72.87629
		15. 39.042031, -72.777149	15. 38.80605, -73.00596	15. 39.023073, -72.777907	15. 38.911579, -72.837679

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Mey-Lindenkohl Slope (cont.)		16. 39.063209, -72.723999	16. 38.811107, -73.003949	16. 39.033254, -72.763701	16. 38.953268, -72.795614
		17. 39.143114, -72.710109	17. 38.811041, -72.993134	17. 39.043209, -72.731411	17. 38.977382, -72.805868
		18. 39.146257, -72.623615	18. 38.822527, -72.988697	18. 39.06175, -72.716683	18. 38.988357, -72.797678
		19. 39.222709, -72.43661	19. 38.817137, -72.980316	19. 39.121312, -72.706217	19. 38.986919, -72.778243
			20. 38.816177, -72.97303	20. 39.136635, -72.69295	20. 39.002102, -72.757808
			21. 38.815464, -72.966346	21. 39.134479, -72.666721	21. 39.028082, -72.762338
			22. 38.80824, -72.962385	22. 39.137562, -72.625213	22. 39.024796, -72.727915
			23. 38.796326, -72.963298	23. 39.129863, -72.584314	23. 39.065009, -72.680449
			24. 38.801511, -72.936008	24. 39.152172, -72.560844	24. 39.122492, -72.687652
			25. 38.830673, -72.925644	25. 39.172972, -72.521271	25. 39.119368, -72.620222
			26. 38.834769, -72.917187	26. 39.200972, -72.466971	26. 39.10861, -72.596337
			27. 38.845671, -72.911195	27. 39.219617, -72.412876	27. 39.195518, -72.423261
			28. 38.873337, -72.875065	28. 39.208951, -72.328334	28. 38.98085, -72.1964
			29. 38.889568, -72.870588	29. 38.981366, -72.196532	29. 38.539809, -72.794776
			30. 38.89427, -72.880057	30. 38.568313, -72.686899	30. 38.581325, -72.896327
			31. 38.897893, -72.889254	31. 38.539957, -72.792531	31. 38.716596, -73.020685
			32. 38.899174, -72.880979	32. 38.578764, -72.893087	
			33. 38.902903, -72.876291		
			34. 38.904326, -72.869384		
			35. 38.903239, -72.862094		
			36. 38.908124, -72.861948		
			37. 38.906469, -72.856201		
			38. 38.90892, -72.853381		
			39. 38.907537, -72.849456		
			40. 38.911587, -72.83768		
			41. 38.915086, -72.838701		
			42. 38.917351, -72.845193		
			43. 38.920157, -72.842209		
			44. 38.922889, -72.841668		
			45. 38.926575, -72.84766		
			46. 38.92885, -72.848202		
			47. 38.928973, -72.841942		

Canyon or Complex	Advisor 2013 (Alt. 3B-1)	FMAT (Alt. 3B-2)	GSSA (Alt. 3B-3)	NGO (Alt. 3B-4)	Workshop (Alt. 3B-5)
Mey-Lindenkohl Slope (cont.)			48. 38.930723, -72.839905 49. 38.932515, -72.840155 50. 38.930346, -72.827211 51. 38.939415, -72.811454 52. 38.951392, -72.808366 53. 38.953276, -72.795615 54. 38.968116, -72.794248 55. 38.97607, -72.80307 56. 38.98023, -72.798407 57. 38.985821, -72.794605 58. 38.986927, -72.778244 59. 39.00211, -72.757809 60. 39.00991, -72.75847 61. 39.019989, -72.767226 62. 39.026942, -72.760655 63. 39.02399, -72.754395 64. 39.02164, -72.742672 65. 39.022737, -72.726302 66. 39.014035, -72.715691 67. 39.018916, -72.711904 68. 39.036549, -72.708613 69. 39.039433, -72.711243 70. 39.056161, -72.697991 71. 39.055593, -72.684106 72. 39.065017, -72.68045 73. 39.084951, -72.686155 74. 39.100262, -72.672936 75. 39.115515, -72.692425 76. 39.1225, -72.687653 77. 39.118746, -72.676871 78. 39.12143, -72.669513 79. 39.11704, -72.662388		

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Mey-Lindenkohl Slope (cont.)			80. 39.108875, -72.643577 81. 39.110831, -72.635334 82. 39.123565, -72.634908 83. 39.121147, -72.620448 84. 39.115972, -72.609718 85. 39.108618, -72.596338 86. 39.129791, -72.559263 87. 39.151777, -72.561231 88. 39.150057, -72.546744 89. 39.165215, -72.527121 90. 39.171057, -72.517448 91. 39.160642, -72.511824 92. 39.155979, -72.500253 93. 39.157239, -72.488327 94. 39.168937, -72.469701 95. 39.178525, -72.469838 96. 39.188861, -72.474444 97. 39.196305, -72.458712 98. 39.187638, -72.449635 99. 39.181681, -72.43741 100. 39.196414, -72.431417 101. 39.195526, -72.423262 102. 38.980858, -72.196401 103. 38.539817, -72.794776 104. 38.581333, -72.896328 105. 38.716604, -73.020686		

Canyon or Complex	Advisor 2013 (Alt. 3B-1)	FMAT (Alt. 3B-2)	GSSA (Alt. 3B-3)	NGO (Alt. 3B-4)	Workshop (Alt. 3B-5)
Spencer Canyon	---	1. 38.636721, -73.170169 2. 38.48241, -72.982743 3. 38.440803, -73.054008 4. 38.596312, -73.213369 5. 38.649062, -73.201402 6. 38.636721, -73.170169	1. 38.570135, -73.186798 2. 38.572223, -73.182809 3. 38.584979, -73.173759 4. 38.59476, -73.172141 5. 38.600705, -73.182947 6. 38.612352, -73.188988 7. 38.616842, -73.192643 8. 38.621007, -73.183976 9. 38.617769, -73.174468 10. 38.61546, -73.164253 11. 38.609322, -73.149856 12. 38.607793, -73.146643 13. 38.607333, -73.143059 14. 38.609798, -73.137517 15. 38.56608, -73.084062 16. 38.526844, -73.141881 17. 38.570135, -73.186798	1. 38.482231, -72.981991 2. 38.440731, -73.054043 3. 38.573653, -73.190454 4. 38.594556, -73.183859 5. 38.615626, -73.201006 6. 38.623983, -73.193962 7. 38.626081, -73.174728 8. 38.620464, -73.157273 9. 38.609446, -73.136728 10. 38.482231, -72.981991	1. 38.568989, -73.185615 2. 38.584971, -73.173758 3. 38.599059, -73.187528 4. 38.62614, -73.174789 5. 38.620241, -73.156906 6. 38.612066, -73.147524 7. 38.609828, -73.13743 8. 38.482402, -72.982742 9. 38.440795, -73.054007 10. 38.568989, -73.185615
Wilmington Canyon	---	1. 38.325674, -73.567834 2. 38.3879, -73.579415 3. 38.409756, -73.610422 4. 38.444974, -73.597796 5. 38.445383, -73.565857 6. 38.499172, -73.513929 7. 38.483336, -73.479313 8. 38.438146, -73.500016 9. 38.383916, -73.47815 10. 38.256381, -73.317134 11. 38.237692, -73.338236 12. 38.24964, -73.412196 13. 38.325674, -73.567834	1. 38.495308, -73.510889 2. 38.501812, -73.492177 3. 38.498576, -73.488565 4. 38.48525, -73.496353 5. 38.477568, -73.489479 6. 38.469632, -73.490952 7. 38.453981, -73.501146 8. 38.430095, -73.508801 9. 38.420037, -73.503708 10. 38.395654, -73.508333 11. 38.391246, -73.495721 12. 38.379384, -73.489039 13. 38.37499, -73.46058 14. 38.360804, -73.445448 15. 38.318007, -73.545494	1. 38.359851, -73.447827 2. 38.308609, -73.382536 3. 38.240167, -73.277267 4. 38.220562, -73.288625 5. 38.254505, -73.413423 6. 38.263136, -73.439667 7. 38.284259, -73.48304 8. 38.320585, -73.556956 9. 38.386402, -73.574007 10. 38.411577, -73.605034 11. 38.430429, -73.599594 12. 38.445129, -73.581137 13. 38.445574, -73.565895 14. 38.464886, -73.546799 15. 38.476387, -73.528046	1. 38.4953, -73.510888 2. 38.47756, -73.489477 3. 38.425428, -73.515586 4. 38.421005, -73.499421 5. 38.39588, -73.502707 6. 38.391156, -73.495026 7. 38.379376, -73.489038 8. 38.374982, -73.460579 9. 38.359844, -73.447826 10. 38.308601, -73.382535 11. 38.240159, -73.277265 12. 38.220554, -73.288624 13. 38.263128, -73.439666 14. 38.317355, -73.550391 15. 38.418035, -73.583226

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Wilmington Canyon (cont.)			16. 38.421269, -73.581677 17. 38.438662, -73.557364 18. 38.475749, -73.5251 19. 38.495308, -73.510889	16. 38.496144, -73.510208 17. 38.502195, -73.492283 18. 38.498438, -73.488729 19. 38.485403, -73.496265 20. 38.475674, -73.485891 21. 38.431568, -73.504715 22. 38.41695, -73.495666 23. 38.406275, -73.499093 24. 38.376257, -73.469543 25. 38.37505, -73.460674 26. 38.360751, -73.445366 27. 38.359851, -73.447827	16. 38.438654, -73.557363 17. 38.4953, -73.510888
North Heyes-South Wilmington Canyons	---	1. 38.325638, -73.5679 2. 38.249689, -73.412114 3. 38.205363, -73.353625 4. 38.184403, -73.370138 5. 38.185426, -73.478668 6. 38.268474, -73.629157 7. 38.325638, -73.5679	1. 38.318841, -73.543561 2. 38.290485, -73.495472 3. 38.228426, -73.556115 4. 38.254052, -73.603506 5. 38.258991, -73.597546 6. 38.263477, -73.602104 7. 38.279991, -73.597142 8. 38.293855, -73.589154 9. 38.299225, -73.578187 10. 38.30069, -73.556151 11. 38.315007, -73.545105 12. 38.318841, -73.543561	1. 38.184354, -73.37031 2. 38.184977, -73.478451 3. 38.254281, -73.603134 4. 38.269964, -73.615186 5. 38.281311, -73.611027 6. 38.309003, -73.574135 7. 38.316726, -73.549479 8. 38.248724, -73.410649 9. 38.205247, -73.353039 10. 38.184354, -73.37031	1. 38.249681, -73.412113 2. 38.205355, -73.353624 3. 38.184395, -73.370137 4. 38.185418, -73.478667 5. 38.254217, -73.603287 6. 38.269818, -73.615189 7. 38.281431, -73.611047 8. 38.281791, -73.60587 9. 38.293848, -73.589153 10. 38.309088, -73.573963 11. 38.306348, -73.55672 12. 38.316794, -73.549735 13. 38.249681, -73.412113

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
South Vries Canyon	---	1. 38.121795, -73.780465 2. 38.165034, -73.7347 3. 38.053615, -73.486938 4. 38.039723, -73.496337 5. 38.042362, -73.612196 6. 38.121795, -73.780465	1. 38.100111, -73.735382 2. 38.110524, -73.736477 3. 38.115596, -73.740105 4. 38.138556, -73.730152 5. 38.139366, -73.712083 6. 38.143124, -73.702989 7. 38.151013, -73.70338 8. 38.129416, -73.655021 9. 38.088861, -73.711272 10. 38.100111, -73.735382	1. 38.053296, -73.486595 2. 38.039799, -73.496057 3. 38.042132, -73.611959 4. 38.118384, -73.773994 5. 38.154549, -73.73832 6. 38.15402, -73.710446 7. 38.053296, -73.486595	1. 38.105895, -73.746729 2. 38.124946, -73.753264 3. 38.15404, -73.710185 4. 38.053607, -73.486937 5. 38.039715, -73.496336 6. 38.042354, -73.612195 7. 38.105895, -73.746729
Baltimore Canyon	1. 38.150494, -73.835965 2. 38.107138, -73.783476 3. 38.068591, -73.544773 4. 37.977041, -73.575743 5. 38.073341, -73.823334 6. 38.165008, -73.863334 7. 38.180008, -73.880001 8. 38.222558, -73.848334 9. 38.241674, -73.843334 10. 38.219236, -73.829462 11. 38.150494, -73.835965	1. 38.126455, -73.880475 2. 38.197956, -73.884551 3. 38.202343, -73.906236 4. 38.232952, -73.888507 5. 38.222081, -73.829162 6. 38.172617, -73.825853 7. 38.139759, -73.81948 8. 38.042449, -73.61276 9. 37.986442, -73.677815 10. 38.059239, -73.827346 11. 38.089372, -73.856581 12. 38.126455, -73.880475	1. 38.073379, -73.823601 2. 38.103173, -73.859782 3. 38.160962, -73.866454 4. 38.199696, -73.877488 5. 38.229026, -73.845525 6. 38.219238, -73.829501 7. 38.199116, -73.831733 8. 38.181931, -73.839444 9. 38.170068, -73.827147 10. 38.154275, -73.828007 11. 38.142931, -73.820859 12. 38.125184, -73.801902 13. 38.125187, -73.802173 14. 38.118028, -73.793076 15. 38.10894, -73.783742 16. 38.094835, -73.759346 17. 38.099997, -73.735444 18. 38.042435, -73.61205 19. 37.98702, -73.677582 20. 38.051169, -73.810564 21. 38.073379, -73.823601	1. 38.131098, -73.80504 2. 38.116138, -73.791012 3. 38.115894, -73.768697 4. 38.100059, -73.735408 5. 38.042444, -73.612628 6. 37.986817, -73.677876 7. 38.059534, -73.826935 8. 38.09186, -73.854936 9. 38.126898, -73.876758 10. 38.162038, -73.882706 11. 38.199889, -73.877584 12. 38.219378, -73.859328 13. 38.22896, -73.845534 14. 38.222021, -73.829157 15. 38.199903, -73.831496 16. 38.18675, -73.837046 17. 38.169957, -73.827438 18. 38.154382, -73.827914 19. 38.141843, -73.819917 20. 38.131098, -73.80504	1. 38.103165, -73.859781 2. 38.127809, -73.869881 3. 38.150732, -73.87315 4. 38.168318, -73.871974 5. 38.199688, -73.877487 6. 38.229019, -73.845524 7. 38.21923, -73.8295 8. 38.181923, -73.839443 9. 38.17006, -73.827146 10. 38.154268, -73.828006 11. 38.139737, -73.825119 12. 38.126472, -73.798466 13. 38.116049, -73.787506 14. 38.10857, -73.783233 15. 38.094827, -73.759344 16. 38.105895, -73.746729 17. 38.042684, -73.612597 18. 37.986434, -73.677814 19. 38.054845, -73.818315 20. 38.103165, -73.859781

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Warr-Phoenix Canyon Complex	---	1. 37.98642, -73.677864 2. 37.875053, -73.588015 3. 37.848693, -73.609812 4. 37.830621, -73.785215 5. 37.902831, -73.978765 6. 37.975863, -73.920444 7. 38.00492, -73.919371 8. 38.009369, -73.872558 9. 38.059184, -73.827119 10. 37.98642, -73.677864	1. 37.894714, -73.956847 2. 37.911389, -73.954281 3. 37.927492, -73.94177 4. 37.939792, -73.930754 5. 37.949051, -73.920984 6. 37.956266, -73.917264 7. 37.964763, -73.911997 8. 37.968774, -73.908405 9. 37.974214, -73.898444 10. 37.988672, -73.894131 11. 37.987232, -73.883065 12. 37.998547, -73.869393 13. 38.009363, -73.86344 14. 38.009455, -73.853313 15. 38.019689, -73.846401 16. 38.024358, -73.8362 17. 38.034281, -73.836525 18. 38.039805, -73.816659 19. 38.044104, -73.807906 20. 38.051169, -73.810564 21. 37.986428, -73.677901 22. 37.875058, -73.588001 23. 37.84881, -73.609428 24. 37.830628, -73.785201 25. 37.894714, -73.956847	1. 37.848425, -73.60961 2. 37.83046, -73.785211 3. 37.895988, -73.961289 4. 37.910734, -73.959782 5. 37.932606, -73.949073 6. 37.975872, -73.913334 7. 37.992636, -73.907448 8. 38.010489, -73.871611 9. 38.059473, -73.82658 10. 37.98684, -73.677255 11. 37.875287, -73.588321 12. 37.848425, -73.60961	1. 37.89467, -73.956848 2. 37.917743, -73.954546 3. 38.054845, -73.818315 4. 37.986413, -73.677862 5. 37.875045, -73.588014 6. 37.848685, -73.609811 7. 37.830614, -73.785213 8. 37.89467, -73.956848

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Accomac-Leonard Canyons	---	1. 37.835283, -74.143579 2. 37.870241, -74.117882 3. 37.839925, -73.872492 4. 37.712727, -73.747729 5. 37.666, -73.805465 6. 37.667386, -73.970855 7. 37.735589, -74.116045 8. 37.835283, -74.143579	1. 37.826988, -74.038017 2. 37.778324, -74.099624 3. 37.82703, -74.100554 4. 37.854098, -74.091288 5. 37.866486, -74.07516 6. 37.856224, -74.054941 7. 37.843779, -74.044833 8. 37.826988, -74.038017	1. 37.856163, -74.05485 2. 37.843449, -74.044666 3. 37.836594, -74.002901 4. 37.842009, -73.976565 5. 37.850042, -73.95265 6. 37.839969, -73.872092 7. 37.713095, -73.747303 8. 37.665969, -73.805408 9. 37.662962, -73.957673 10. 37.704727, -74.075946 11. 37.737342, -74.156126 12. 37.774555, -74.112518 13. 37.80133, -74.124502 14. 37.821549, -74.13028 15. 37.843163, -74.119357 16. 37.839558, -74.101618 17. 37.854047, -74.091247 18. 37.866521, -74.075118 19. 37.856163, -74.05485	1. 37.826981, -74.038016 2. 37.837944, -74.011165 3. 37.836586, -74.002899 4. 37.842001, -73.976564 5. 37.849902, -73.952829 6. 37.839917, -73.872491 7. 37.71272, -73.747728 8. 37.665962, -73.805407 9. 37.667378, -73.970853 10. 37.735581, -74.116044 11. 37.764661, -74.124067 12. 37.778316, -74.099623 13. 37.827023, -74.100552 14. 37.85409, -74.091286 15. 37.866479, -74.075159 16. 37.856216, -74.05494 17. 37.843772, -74.044832 18. 37.826981, -74.038016

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Washington Canyon	---	1. 37.48498, -74.490361	1. 37.380732, -74.435981	1. 37.440569, -74.446754	1. 37.381137, -74.436006
		2. 37.44389, -74.460421	2. 37.395753, -74.459004	2. 37.428205, -74.427198	2. 37.407259, -74.476113
		3. 37.442667, -74.443996	3. 37.407266, -74.476114	3. 37.430543, -74.40365	3. 37.411098, -74.495217
		4. 37.428205, -74.427214	4. 37.411105, -74.495219	4. 37.418011, -74.388107	4. 37.43223, -74.502083
		5. 37.280134, -73.86869	5. 37.432237, -74.502085	5. 37.280229, -73.868773	5. 37.45423, -74.50333
		6. 37.18749, -73.901655	6. 37.454238, -74.503331	6. 37.187831, -73.900767	6. 37.476656, -74.510019
		7. 37.262292, -74.203454	7. 37.476664, -74.51002	7. 37.262182, -74.20341	7. 37.490513, -74.504757
		8. 37.40942, -74.499165	8. 37.49052, -74.504759	8. 37.345802, -74.3729	8. 37.492224, -74.499182
		9. 37.474163, -74.515847	9. 37.492232, -74.499184	9. 37.378966, -74.437393	9. 37.461318, -74.480406
		10. 37.48498, -74.490361	10. 37.46827, -74.484835	10. 37.381145, -74.436007	10. 37.450968, -74.479413
			11. 37.461468, -74.479976	11. 37.411281, -74.495145	11. 37.439765, -74.462625
			12. 37.450975, -74.479415	12. 37.432295, -74.502135	12. 37.438349, -74.447772
			13. 37.439772, -74.462626	13. 37.454233, -74.50339	13. 37.428198, -74.427197
			14. 37.438356, -74.447774	14. 37.476762, -74.509864	14. 37.430535, -74.403649
			15. 37.428208, -74.427201	15. 37.490526, -74.504803	15. 37.418003, -74.388105
			16. 37.430538, -74.403648	16. 37.492228, -74.499225	16. 37.280222, -73.868772
			17. 37.380732, -74.435981	17. 37.478468, -74.491037	17. 37.187823, -73.900765
				18. 37.478445, -74.485553	18. 37.262174, -74.203408
				19. 37.460904, -74.47265	19. 37.378958, -74.437391
				20. 37.454003, -74.477267	20. 37.381137, -74.436006
				21. 37.442662, -74.466154	
				22. 37.440569, -74.446754	

Canyon or Complex	**Advisor 2013 (Alt. 3B-1)**	**FMAT (Alt. 3B-2)**	**GSSA (Alt. 3B-3)**	**NGO (Alt. 3B-4)**	**Workshop (Alt. 3B-5)**
Norfolk Canyon	1. 37.066802, -74.61689 2. 37.064491, -74.583474 3. 37.072652, -74.562421 4. 37.071906, -74.452035 5. 37.097752, -74.009743 6. 36.969157, -74.005932 7. 37.007949, -74.61231 8. 37.046657, -74.657813 9. 37.086344, -74.704632 10. 37.080699, -74.724846 11. 37.095141, -74.741201 12. 37.111394, -74.674232 13. 37.066802, -74.61689	1. 37.106029, -74.73736 2. 37.116496, -74.671283 3. 37.098401, -74.644961 4. 37.083947, -74.634098 5. 37.094481, -74.60339 6. 37.070478, -74.525718 7. 37.060821, -74.061304 8. 36.962493, -74.060574 9. 37.00855, -74.667581 10. 37.043962, -74.688259 11. 37.055423, -74.674148 12. 37.072563, -74.69525 13. 37.082113, -74.739563 14. 37.106029, -74.73736	1. 37.060856, -74.567107 2. 37.015584, -74.58411 3. 37.015487, -74.609917 4. 37.01998, -74.627022 5. 37.086348, -74.704601 6. 37.091714, -74.704953 7. 37.103823, -74.705455 8. 37.111398, -74.674201 9. 37.077514, -74.637048 10. 37.059327, -74.617125 11. 37.065733, -74.598621 12. 37.060905, -74.586042 13. 37.060856, -74.567107	1. 37.116765, -74.671035 2. 37.098298, -74.644568 3. 37.074873, -74.627225 4. 37.087043, -74.599427 5. 37.086819, -74.589863 6. 37.069393, -74.539515 7. 37.073296, -74.509606 8. 37.060804, -74.061068 9. 36.962536, -74.060196 10. 36.996245, -74.500071 11. 36.970579, -74.549183 12. 36.966441, -74.569739 13. 36.977136, -74.616002 14. 37.00632, -74.636637 15. 37.012355, -74.669813 16. 37.044015, -74.688317 17. 37.055472, -74.674407 18. 37.072577, -74.695372 19. 37.081877, -74.739331 20. 37.090688, -74.738822 21. 37.097232, -74.759451 22. 37.10218, -74.737587 23. 37.106011, -74.737334 24. 37.116765, -74.671035	1. 37.075328, -74.558448 2. 37.069385, -74.539513 3. 37.073288, -74.509605 4. 37.060797, -74.061067 5. 36.962529, -74.060195 6. 36.996237, -74.500069 7. 36.970571, -74.549182 8. 36.966433, -74.569738 9. 36.976944, -74.616111 10. 37.073889, -74.683889 11. 37.097222, -74.759444 12. 37.116111, -74.68 13. 37.075278, -74.629444 14. 37.066944, -74.563889 15. 37.075328, -74.558448

Table C3: Geographic coordinates for Council preferred broad zone (Alt. 1F) in decimal degrees. Note that this includes only vertices for the landward boundary (points 1-173), the New England-Mid-Atlantic inter-Council boundary, and the South Atlantic-Mid-Atlantic inter-Council boundary. The remaining boundary follows the edge of the U.S. EEZ in the deep sea.

1. 36.551154, -74.702326
2. 36.55116, -74.702326
3. 36.574064, -74.703782
4. 36.592163, -74.693132
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APPENDIX D: RIR/IRFA Tables and Figures

Table D1. Fishing activity in proposed broad coral zone Area 1B (Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) and selected management measures within broad zone) based on dealer VTR data, 2012-2014.

	Area 1B Alternative 2B (Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with Alternative 2B: Prohibit all bottom-tending gear (Council preferred))			**Area 1B Alternative 2B-2** (Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with *Sub-alternative 2B-2: Exempt golden tilefish fishery from broad zone restriction* (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	515	449	494	508	446	492
Average of inside_rev	$44,557	$34,153	$33,180	$43,805	$32,859	$31,901
Average of total_rev	$1,025,340	$769,185	$776,039	$1,031,966	$765,389	$772,391
Average of tot_permit_rev	$2,118,978	$1,618,882	$1,662,793	$2,140,198	$1,625,523	$1,667,093
Average of ratio_imp_gear	4.6%	5.7%	5.0%	4.4%	5.9%	4.8%
Average of ratio_totperm_rev	1.3%	1.4%	1.6%	1.3%	1.3%	1.4%
Sum of inside_rev	$22,946,788	$15,334,725	$16,391,099	$22,253,110	$14,655,100	$15,695,413
Sum of total_rev	$528,049,861	$345,364,247	$383,363,203	$524,238,801	$341,363,339	$380,016,324
Sum of tot_permit_rev	$1,091,273,880	$726,877,929	$821,419,952	$1,087,220,765	$724,983,041	$820,209,813
	Area 1B Alternative 2B-1 (Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with *Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred))			**Area 1B Alternative 2C** (Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with Alternative 2C: Prohibit all mobile bottom-tending gear (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	512	446	491	428	361	421
Average of inside_rev	$43,056	$32,489	$31,641	$49,370	$37,827	$34,697
Average of total_rev	$1,026,410	$770,101	$776,944	$1,193,796	$914,938	$877,851
Average of tot_permit_rev	$2,120,898	$1,612,673	$1,656,727	$2,420,082	$1,851,139	$1,832,023
Average of ratio_imp_gear	4.4%	5.4%	4.7%	4.0%	4.6%	4.2%
Average of ratio_totperm_rev	1.3%	1.3%	1.5%	1.3%	1.3%	1.4%
Sum of inside_rev	$22,044,905	$14,490,169	$15,535,504	$21,130,381	$13,665,545	$14,607,635
Sum of total_rev	$525,522,117	$343,464,967	$381,479,514	$510,944,759	$330,292,626	$369,575,458
Sum of tot_permit_rev	$1,085,899,747	$719,252,159	813,452,975	$1,035,795,013	$668,261,029	$771,281,864
[a] See Appendix Table D2 for a description of column labels.						

Table D2. Raw label definitions for Appendix Tables D1 and D3-D25.

Raw Label	Description
Count of permit	Number of vessels
Average of inside_rev	Average per vessel revenue inside closed areas
Average of total_rev	Average per vessel total revenue (inside and outside) of gear that is impacted by closed areas
Average of tot_permit_rev	Average per vessel total revenue from all fishing activity
Average of ratio_imp_gear	Average per vessel ratio of inside revenue to total revenue (impacted gear only)
Average of ratio_totperm_rev	Average per vessel ratio of inside revenue to total revenue (all fishing activity)
Sum of inside_rev	Total inside revenue
Sum of total_rev	Total revenue (inside and outside) of impacted gear
Sum of tot_permit_rev	Total revenue from all fishing activity
Count of affiliate_id	Number of Entities
Average of Inside_rev	Average per entity revenue inside closed areas
Average of total_rev	Average per entity total revenue (inside and outside) of gear that is impacted by closed areas
Average of tot_affiliate_rev	Average per entity total revenue from all fishing activity
Average of ratio_imp_gear	average per entity ratio of inside revenue to total revenue (impacted gear only)
Average of ratio_totaff_rev	Average per entity ratio of inside revenue to total revenue (all fishing activity)
Sum of Inside_rev	Total inside revenue
Sum of total_rev	Total revenue (inside and outside) of impacted gear
Sum of tot_affiliate_rev	Total revenue from all fishing activity

Table D3. Fishing activity in proposed broad coral zone Area 1F (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) and selected management measures within broad zone) based on VTR data, 2012-2014.

	Area 1F Alternative 2B (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with Alternative 2B: Prohibit all bottom-tending gear (Council preferred))			**Area 1F Alternative 2B-2** (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with *Sub-alternative 2B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	491	427	465	483	424	463
Average of inside_rev	$37,634	$28,714	$26,912	$37,563	$28,017	$26,191
Average of total_rev	$1,005,880	$771,629	$737,050	$1,014,926	$767,653	$733,042
Average of tot_permit_rev	$2,169,666	$1,667,905	$1,702,762	$2,197,140	$1,675,237	$1,707,504
Average of ratio_imp_gear	3.8%	4.6%	4.0%	3.7%	4.8%	3.9%
Average of ratio_totperm_rev	1.0%	1.1%	1.2%	1.0%	1.0%	1.1%
Sum of inside_rev	$18,478,450	$12,261,086	$12,514,159	$18,142,908	$11,879,358	$12,126,300
Sum of total_rev	$493,886,986	$329,485,766	$342,728,425	$490,209,080	$325,484,859	$339,398,584
Sum of tot_permit_rev	$1,065,305,765	$712,195,309	$791,784,369	$1,061,218,604	$710,300,421	$790,574,230
	Area 1F Alternative 2B-1 (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with *Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred))			**Area 1F Alternative 2C** (Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with Alternative 2C: Prohibit all mobile bottom-tending gear (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	488	424	462	413	347	399
Average of inside_rev	$36,294	$27,266	$25,512	$41,801	$31,927	$28,188
Average of total_rev	$1,006,884	$772,610	$737,759	$1,158,283	$911,875	$829,396
Average of tot_permit_rev	$2,171,991	$1,661,721	$1,696,574	$2,448,355	$1,889,658	$1,863,722
Average of ratio_imp_gear	3.6%	4.3%	3.8%	3.4%	3.7%	3.4%
Average of ratio_totperm_rev	1.0%	1.0%	1.1%	1.0%	1.1%	1.1%
Sum of inside_rev	$17,711,643	$11,560,653	$11,786,388	$17,263,820	$11,078,641	$11,247,045
Sum of total_rev	$491,359,243	$327,586,486	$340,844,736	$478,370,836	$316,420,601	$330,928,941
Sum of tot_permit_rev	$1,059,931,632	$704,569,539	$783,817,392	$1,011,170,707	$655,711,184	$743,624,902

[a] See Appendix Table D2 for a description of column labels

Table D4. Fishing activity in proposed discrete coral zone Area 3B-1 (Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) and selected management measures within broad zone) based on VTR data, 2012-2014.

	Area 3B-1 Alternative 4B (Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with Alternative 4B: Prohibit all bottom-tending gear (Council preferred))			**Area 3B-1 Alternative 4B-2** (Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	363	310	242	358	308	241
Average of inside_rev	$8,990	$5,175	$6,921	$8,989	$5,021	$6,671
Average of total_rev	$1,101,108	$829,463	$521,464	$1,111,145	$827,953	$516,759
Average of tot_permit_rev	$2,664,732	$2,015,330	$1,978,710	$2,692,494	$2,012,699	$1,983,664
Average of ratio_imp_gear	1.0%	1.1%	1.6%	0.9%	1.2%	1.5%
Average of ratio_totperm_rev	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%
Sum of inside_rev	$3,263,419	$1,604,198	$1,674,929	$3,218,058	$1,546,510	$1,607,734
Sum of total_rev	$399,702,237	$257,133,375	$126,194,356	$397,790,004	$255,009,411	$124,539,025
Sum of tot_permit_rev	$967,297,666	$624,752,221	$478,847,815	$963,912,808	$619,911,347	$478,062,930
	Area 3B-1 Alternative 4B-1 (Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred))			**Area 3B-1 Alternative 4C** (Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	360	306	239	332	279	208
Average of inside_rev	$8,802	$4,853	$6,660	$9,362	$5,092	$7,237
Average of total_rev	$1,104,925	$835,585	$521,615	$1,185,988	$901,165	$575,687
Average of tot_permit_rev	$2,661,050	$2,012,694	$1,970,213	$2,821,562	$2,126,338	$2,149,083
Average of ratio_imp_gear	0.9%	1.0%	1.6%	0.9%	0.9%	1.4%
Average of ratio_totperm_rev	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%
Sum of inside_rev	$3,168,753	$1,484,951	$1,591,658	$3,108,199	$1,420,607	$1,505,395
Sum of total_rev	$397,772,909	$255,688,961	$124,666,065	$393,748,075	$251,425,067	$119,742,855
Sum of tot_permit_rev	$957,978,007	$615,884,332	$470,880,838	$936,758,683	$593,248,191	$447,009,254

[a] See Appendix Table D2 for a description of column labels.

Table D5. Fishing activity in proposed discrete coral zone Area 3B-3 (Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) and selected management measures within broad zone) based on VTR data, 2012-2014.

	Area 3B-3 Alternative 4B (Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with Alternative 4B: Prohibit all bottom-tending gear (Council preferred))			**Area 3B-3 Alternative 4B-2** (Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	461	402	447	453	400	445
Average of inside_rev	$10,681	$6,875	$6,753	$10,568	$6,537	$6,435
Average of total_rev	$1,033,829	$786,039	$739,298	$1,046,212	$783,156	$736,533
Average of tot_permit_rev	$2,273,871	$1,747,686	$1,748,698	$2,302,688	$1,753,614	$1,753,838
Average of ratio_imp_gear	1.2%	1.3%	1.1%	1.1%	1.3%	1.1%
Average of ratio_totperm_rev	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Sum of inside_rev	$4,923,715	$2,763,795	$3,018,530	$4,787,285	$2,614,860	$2,863,616
Sum of total_rev	$476,595,313	$315,987,839	$330,466,131	$473,933,925	$313,262,525	$327,757,385
Sum of tot_permit_rev	$1,048,254,401	$702,569,785	$781,667,868	$1,043,117,825	$701,445,471	$780,457,730
	Area 3B-3 Alternative 4B-1 (Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred))			**Area 3B-3 Alternative 4C** (Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	459	398	444	401	340	392
Average of inside_rev	$10,281	$6,323	$6,336	$11,369	$6,918	$6,726
Average of total_rev	$1,033,317	$789,573	$740,546	$1,161,361	$902,662	$818,310
Average of tot_permit_rev	$2,273,230	$1,742,970	$1,742,570	$2,494,666	$1,917,994	$1,881,084
Average of ratio_imp_gear	1.1%	1.1%	1.1%	1.1%	1.0%	0.9%
Average of ratio_totperm_rev	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Sum of inside_rev	$4,718,994	$2,516,700	$2,812,988	$4,558,937	$2,351,967	$2,636,525
Sum of total_rev	$474,292,369	$314,250,131	$328,802,411	$465,705,607	$306,904,917	$320,777,537
Sum of tot_permit_rev	$1,043,412,479	$693,701,896	$773,700,892	$1,000,361,226	$652,118,010	$737,384,899
[a] See Appendix Table D2 for a description of column labels.						

Table D6. Fishing activity in proposed discrete coral zone Area 3B-5 (Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) and selected management measures within broad zone based on VTR data, 2012-2014.

	Area 3B-5 Alternative 4B (Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with Alternative 4B: Prohibit all bottom-tending gear (Council preferred))			**Area 3B-5 Alternative 4B-2** (Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	461	401	446	453	399	444
Average of inside_rev	$14,655	$9,394	$9,276	$14,550	$8,969	$8,922
Average of total_rev	$1,032,414	$789,743	$734,328	$1,044,771	$786,872	$731,535
Average of tot_permit_rev	$2,275,004	$1,752,737	$1,743,704	$2,303,842	$1,758,704	$1,748,833
Average of ratio_imp_gear	1.6%	1.7%	1.5%	1.5%	1.8%	1.4%
Average of ratio_totperm_rev	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Sum of inside_rev	$6,756,086	$3,766,981	$4,137,198	$6,591,205	$3,578,588	$3,961,200
Sum of total_rev	$475,942,802	$316,687,067	$327,510,496	$473,281,414	$313,961,753	$324,801,438
Sum of tot_permit_rev	$1,048,776,816	$702,847,408	$777,692,143	$1,043,640,240	$701,723,094	$776,482,005
	Area 3B-5 Alternative 4B-1 (Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred))			**Area 3B-5 Alternative 4C** (Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred))		
Year	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**
Count of permit [a]	459	397	443	401	339	390
Average of inside_rev	$14,068	$8,748	$8,738	$15,616	$9,607	$9,396
Average of total_rev	$1,031,895	$793,323	$735,546	$1,160,370	$907,292	$814,588
Average of tot_permit_rev	$2,274,368	$1,748,059	$1,737,529	$2,496,407	$1,924,471	$1,880,180
Average of ratio_imp_gear	1.5%	1.5%	1.4%	1.4%	1.3%	1.2%
Average of ratio_totperm_rev	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Sum of inside_rev	$6,457,079	$3,472,862	$3,870,753	$6,262,213	$3,256,697	$3,664,414
Sum of total_rev	$473,639,858	$314,949,359	$325,846,777	$465,308,417	$307,571,976	$317,689,359
Sum of tot_permit_rev	$1,043,934,893	$693,979,519	$769,725,167	$1,001,059,234	$652,395,633	$733,270,102

[a] See Appendix Table D2 for a description of column labels.

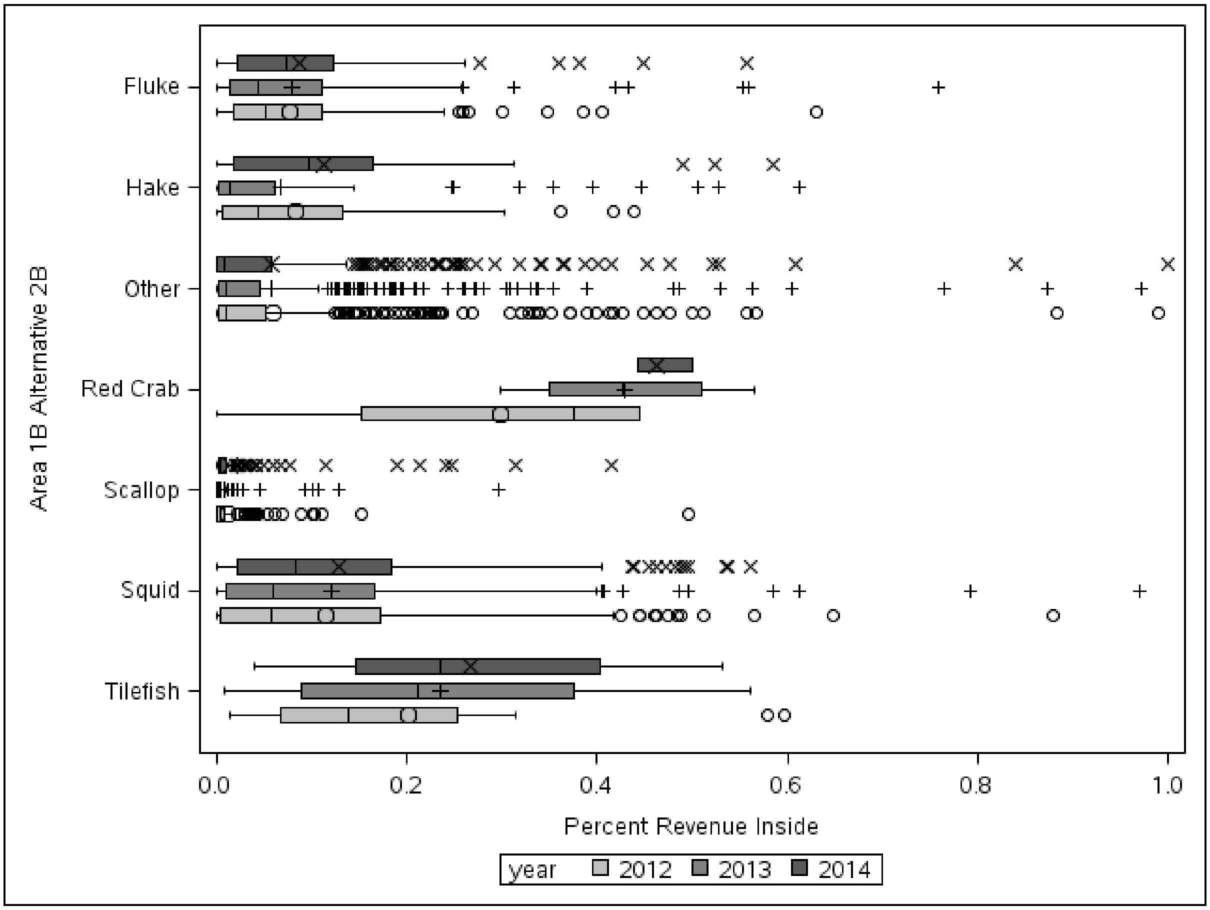

Figure D1. Percent revenue inside proposed close Area 1B Alternative 2B (broad zone Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with Alternative 2B: Prohibit all bottom-tending gear (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014. **Note:** See Appendix Figure D2 for an illustration of the elements of the skeletal box-and-whisker plots presented in this section.

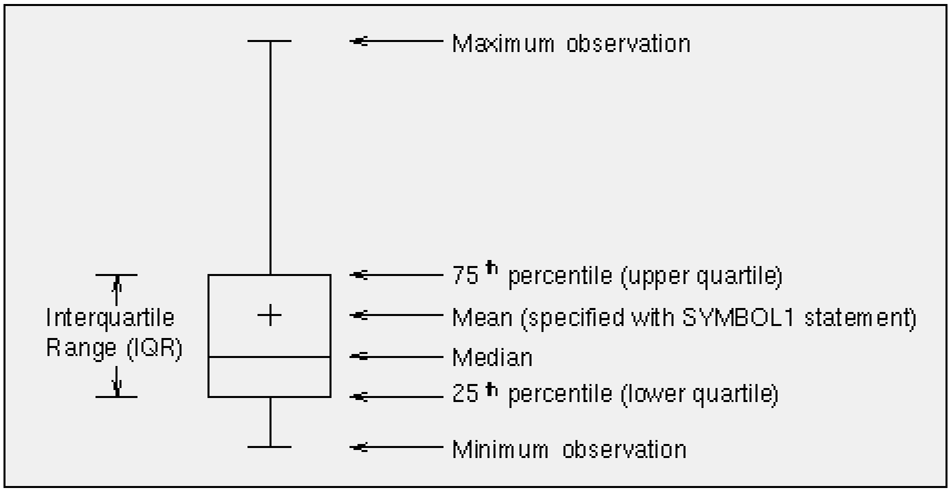

Figure D2. The elements of the skeletal box-and-whisker plots presented in this appendix. Source: https://v8doc.sas.com/sashtml/stat/chap18/sect5.htm#boxstyleoption.

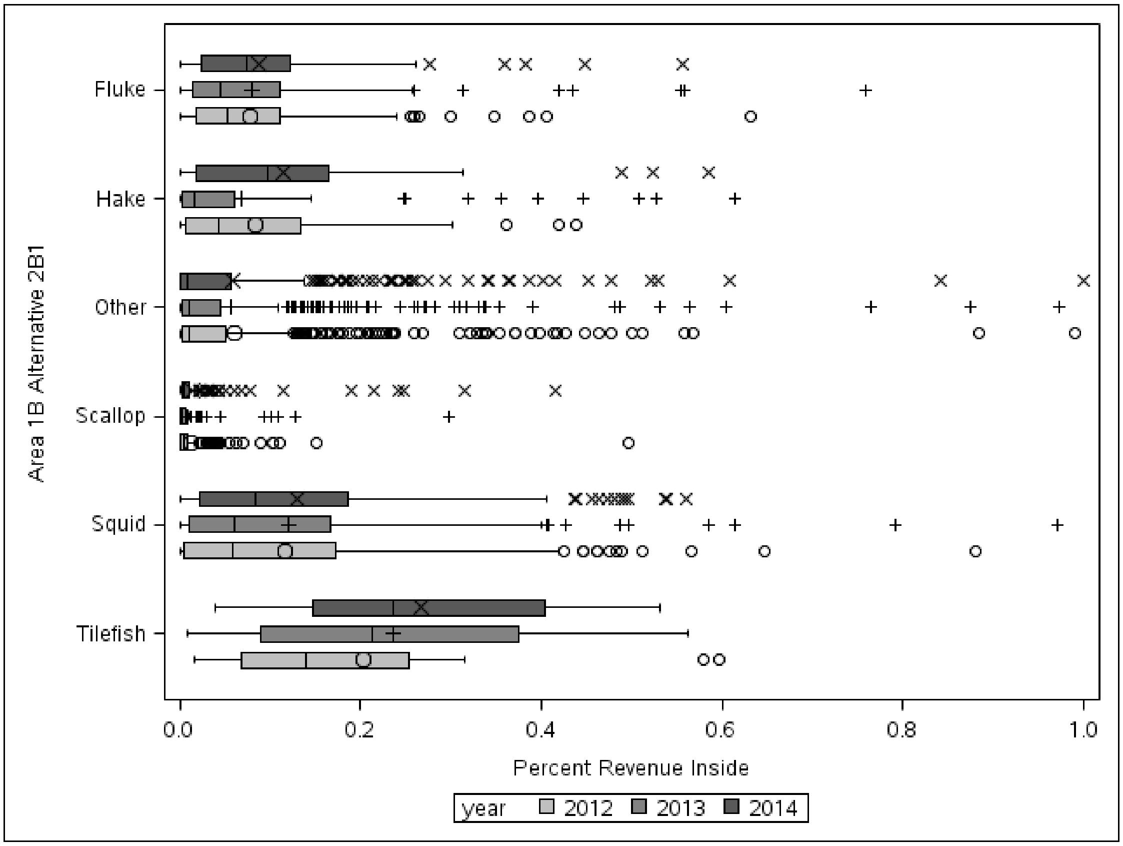

Figure D3. Percent revenue inside proposed close Area 1B Alternative 2B-1 (broad zone Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with *Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

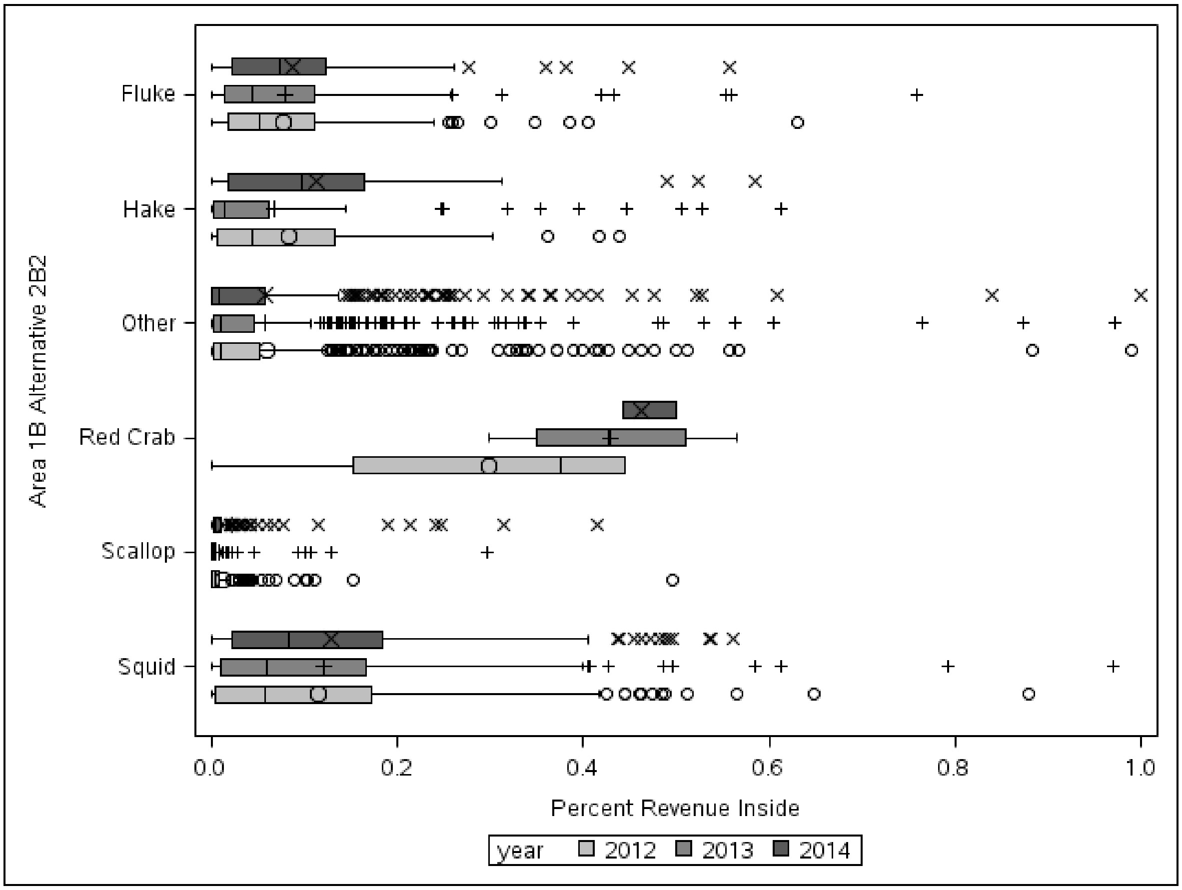

Figure D4. Percent revenue inside proposed close Area 1B Alternative 2B-2 (broad zone Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with *Sub-alternative 2B-2: Exempt golden tilefish fishery from broad zone restriction* (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

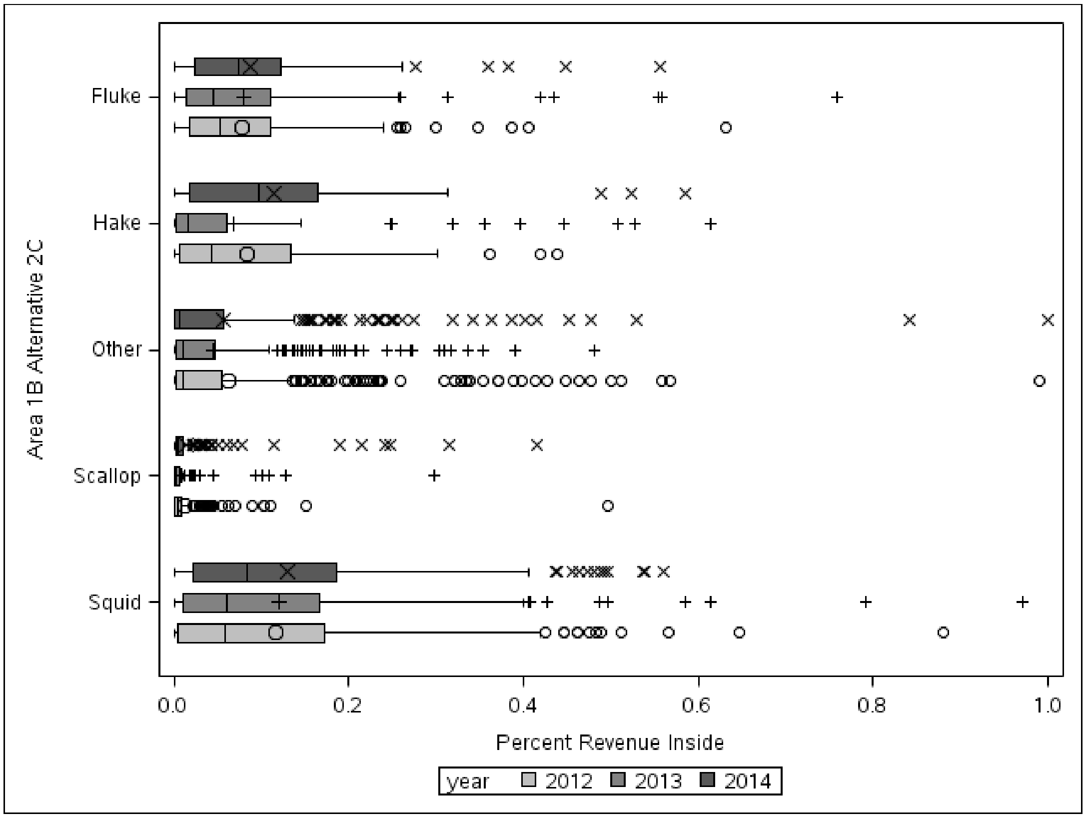

Figure D5. Percent revenue inside proposed close Area 1B Alternative 2C (broad zone Alternative 1B: Landward boundary approximating 200 meter depth contour (Council non-preferred) in combination with Alternative 2C: Prohibit all mobile bottom-tending gear (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

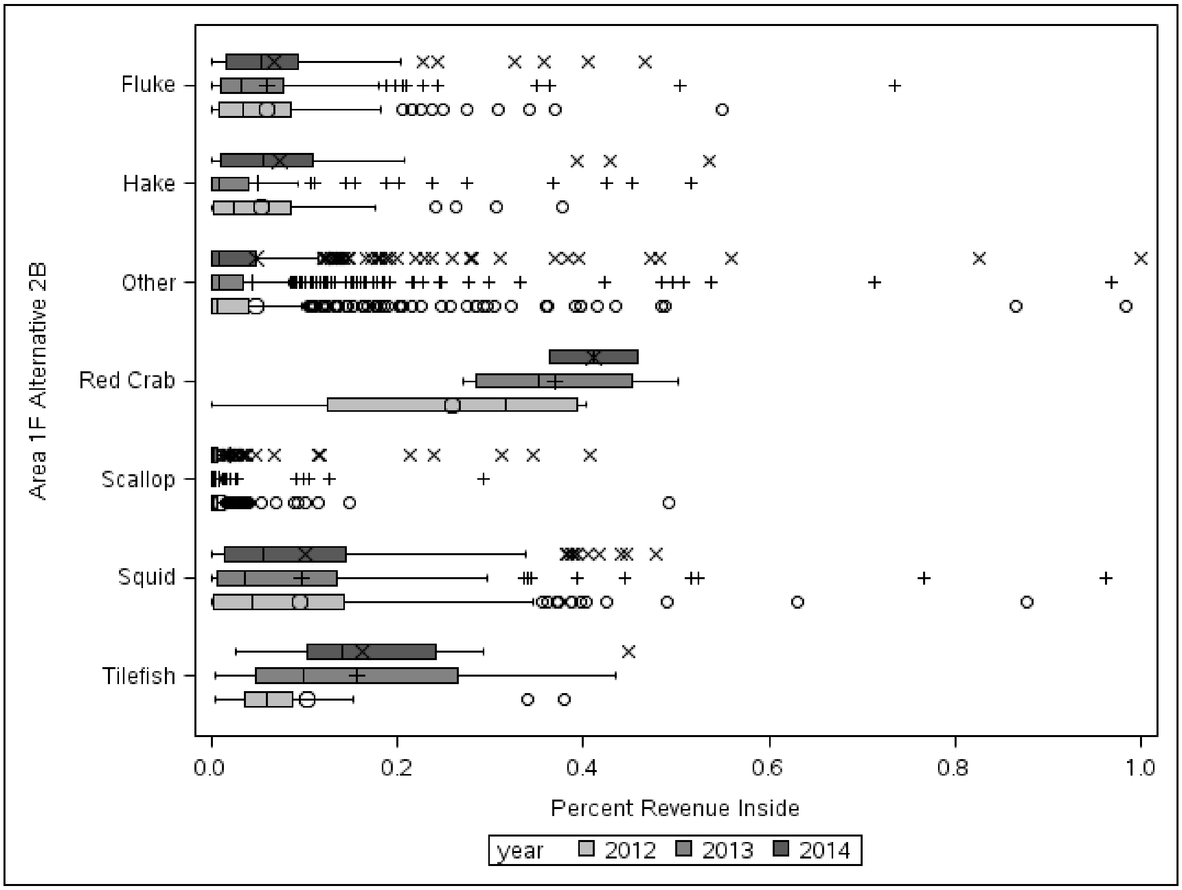

Figure D6. Percent revenue inside proposed close Area 1F Alternative 2B (broad zone Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with Alternative 2B: Prohibit all bottom-tending gear (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

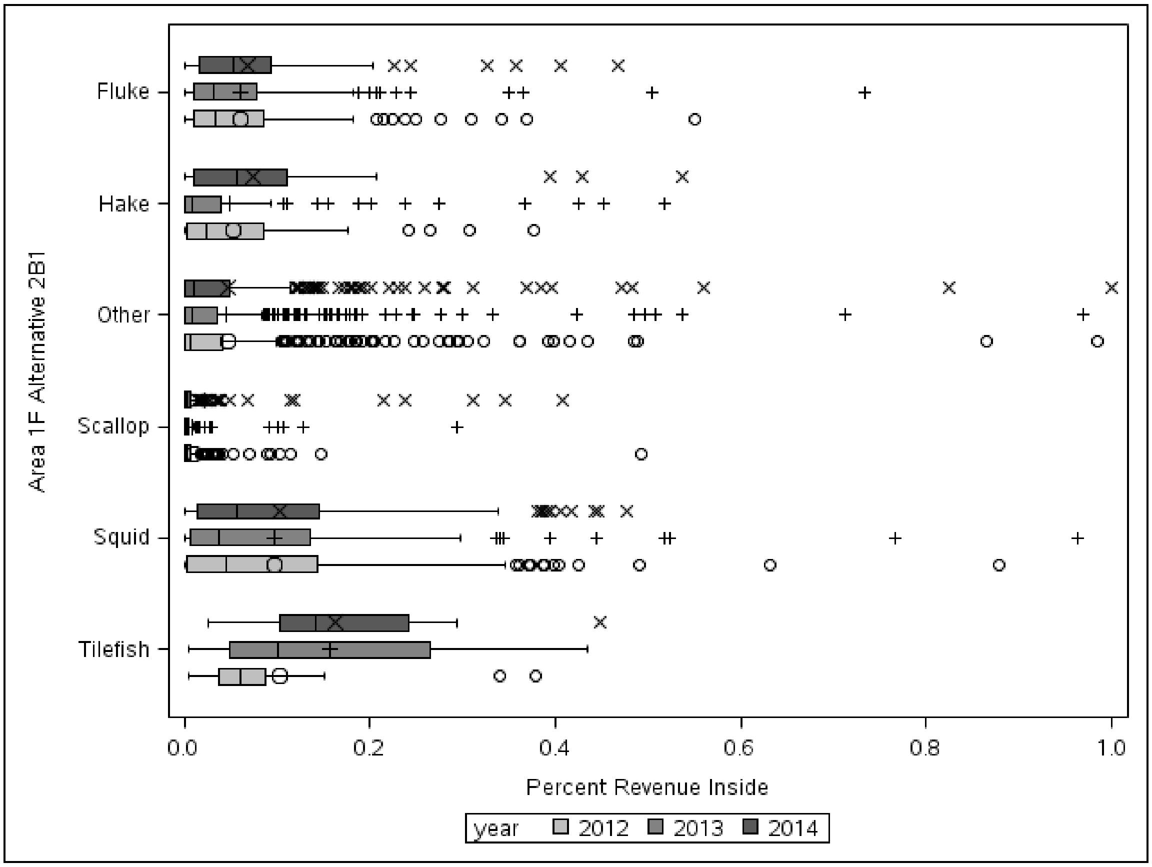

Figure D7. Percent revenue inside proposed close Area 1F Alternative 2B-1 (broad zone Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with *Sub-alternative 2B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

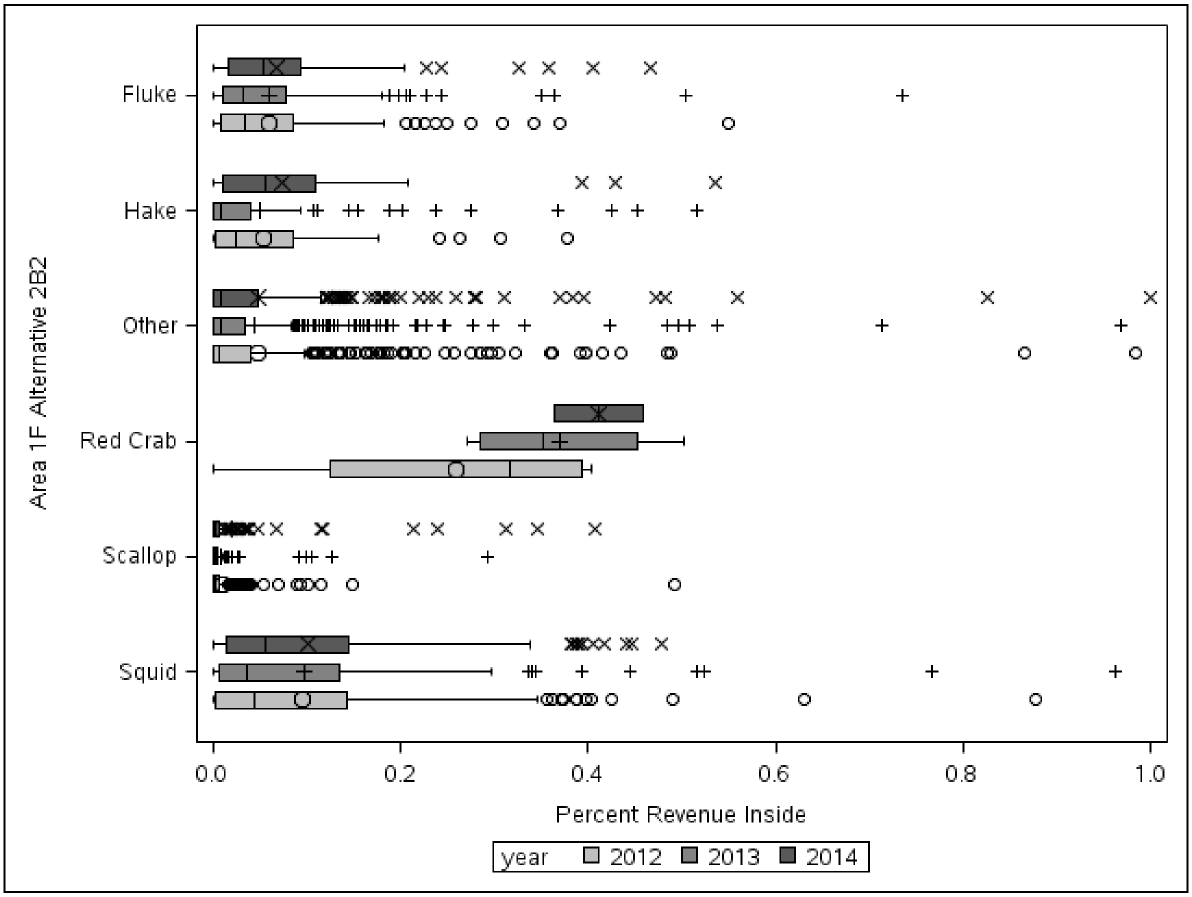

Figure D8. Percent revenue inside proposed close Area 1F Alternative 2B-2 (broad zone Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with *Sub-alternative 2B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

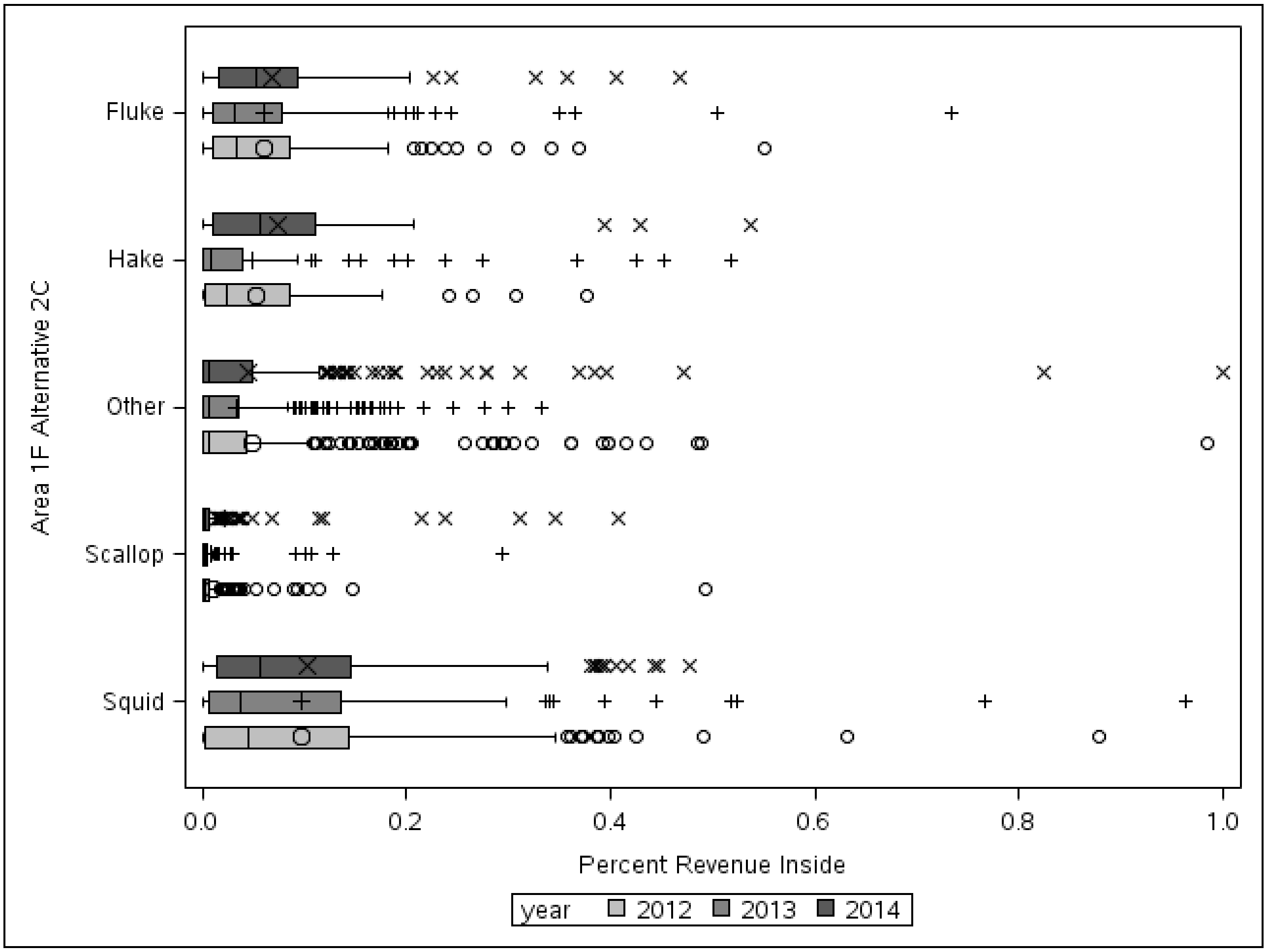

Figure D9. Percent revenue inside proposed close Area 1F Alternative 2C (broad zone Alternative 1F: Landward boundary simplified between 400 meter and 500 meter depth contour and prioritizing discrete zone boundaries (Council preferred) in combination with Alternative 2C: Prohibit all mobile bottom-tending gear (Council non-preferred)) by species group, for all vessels, based on dealer VTR data, 2012-2014.

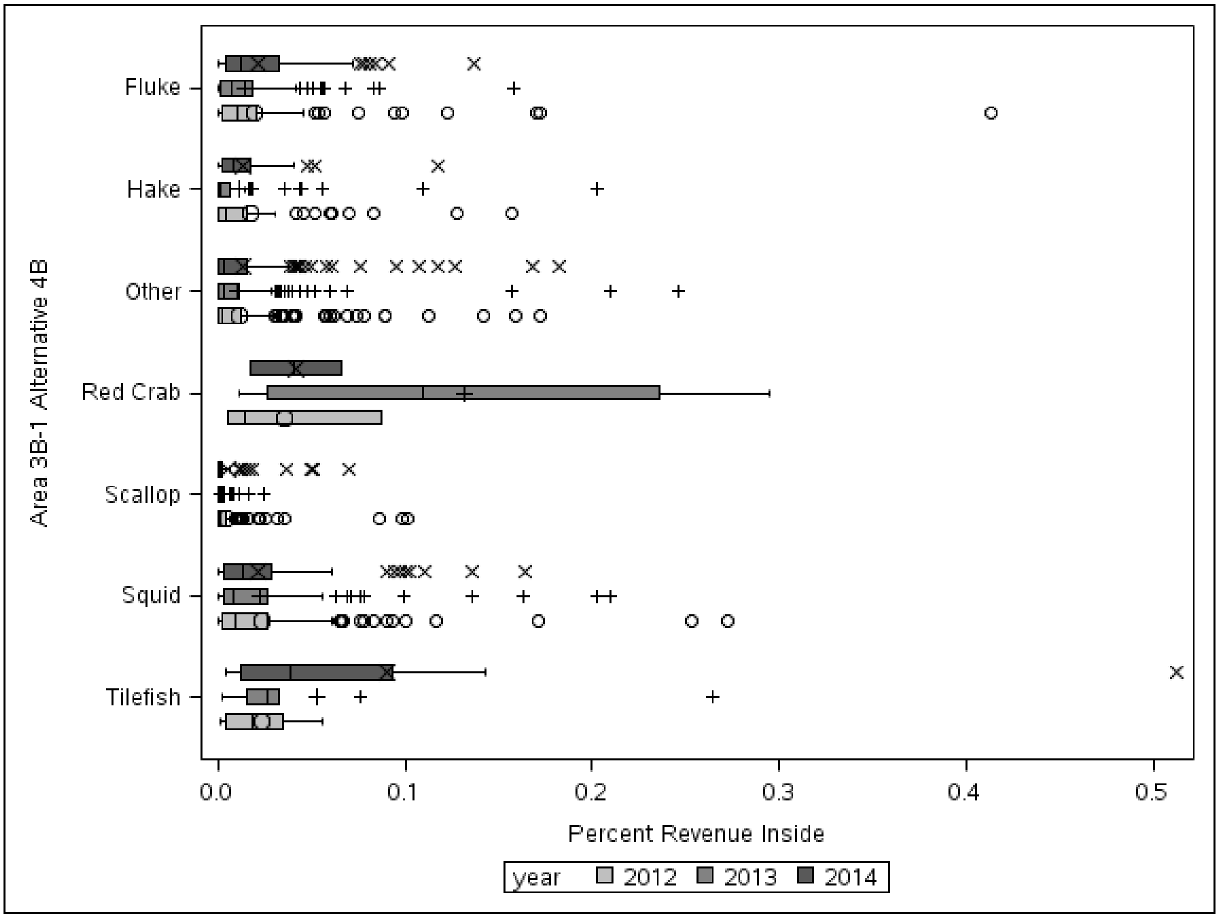

Figure D10. Percent revenue inside proposed close Area 3B-1 Alternative 4B (discrete zone Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with Alternative 4B: Prohibit <u>all</u> bottom-tending gear (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

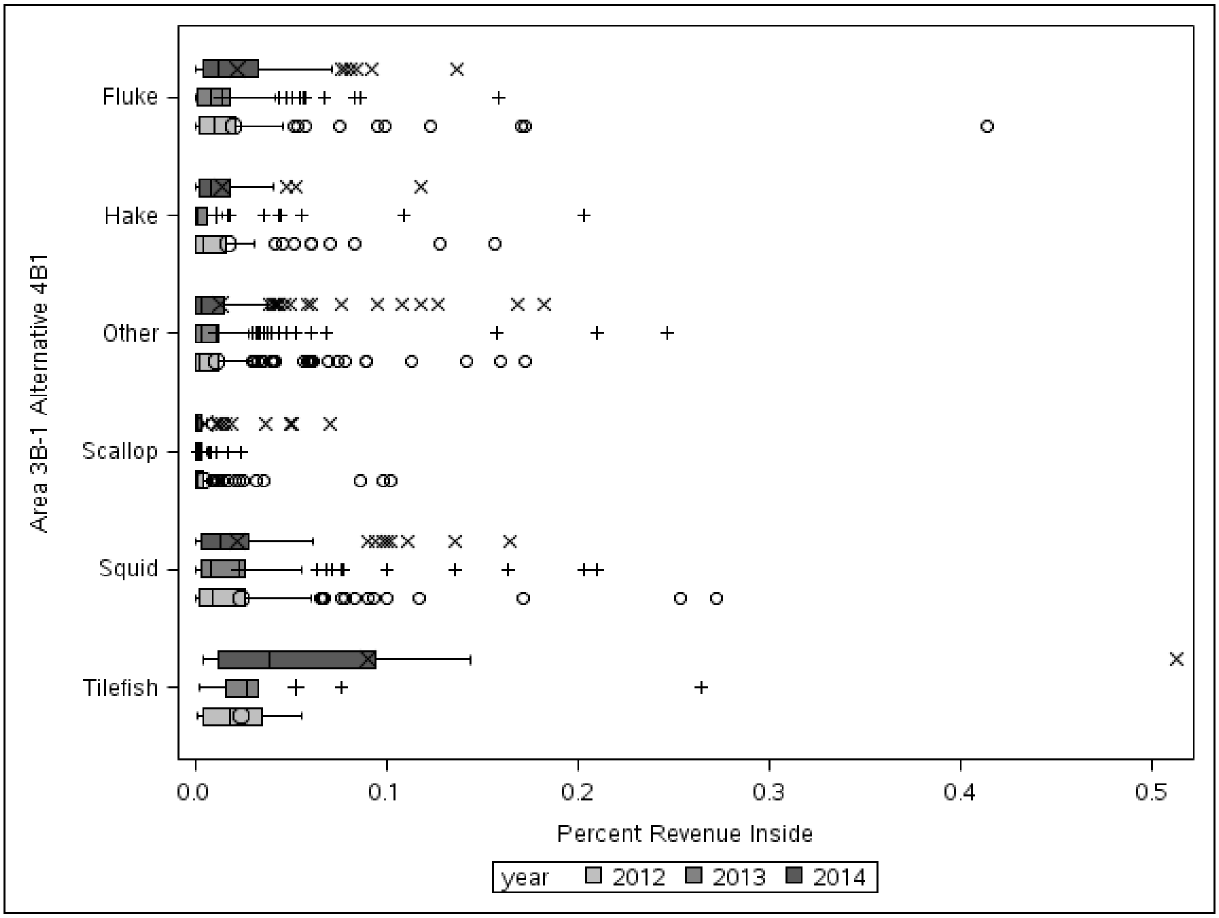

Figure D11. Percent revenue inside proposed close Area 3B-1 Alternative 4B-1 (discrete zone Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

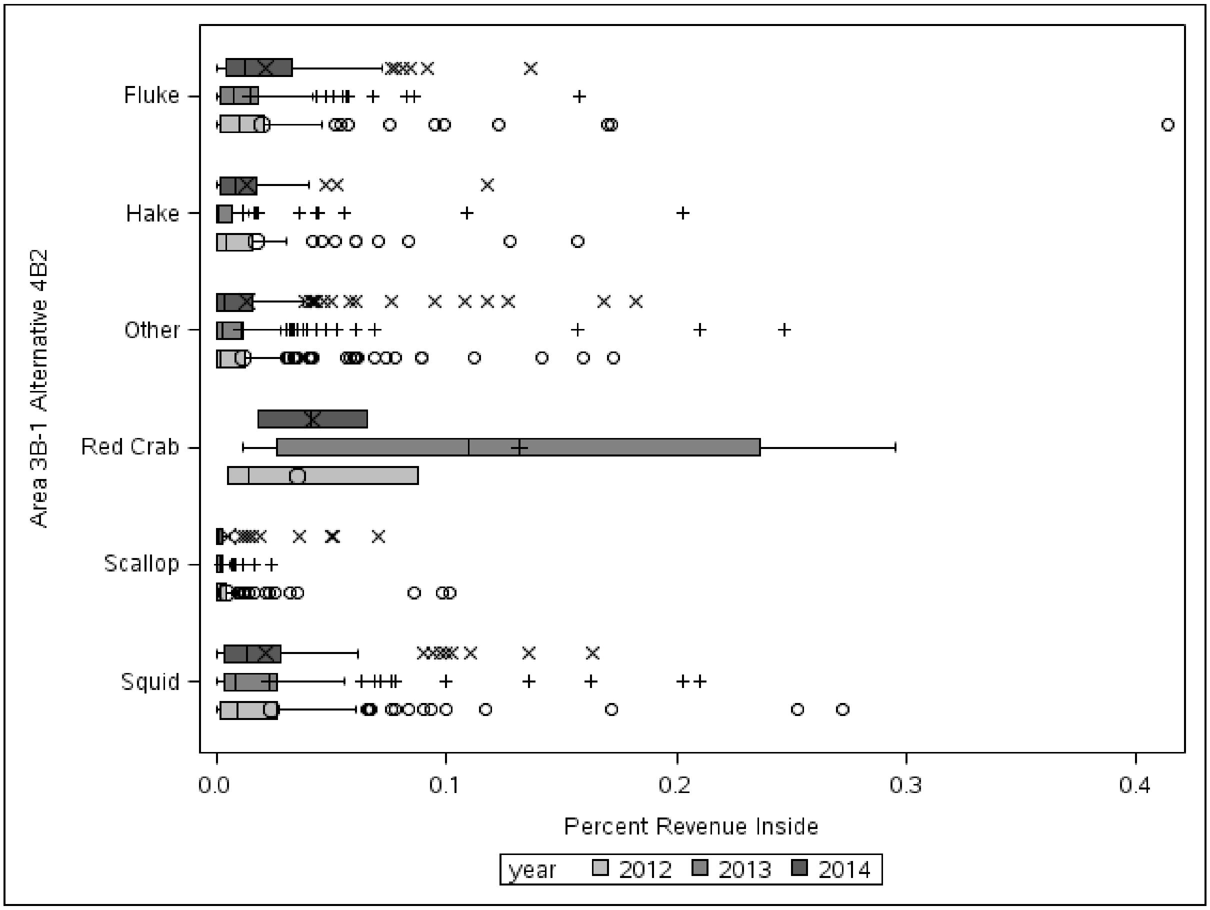

Figure D12. Percent revenue inside proposed close Area 3B-1 Alternative 4B-2 (discrete zone Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

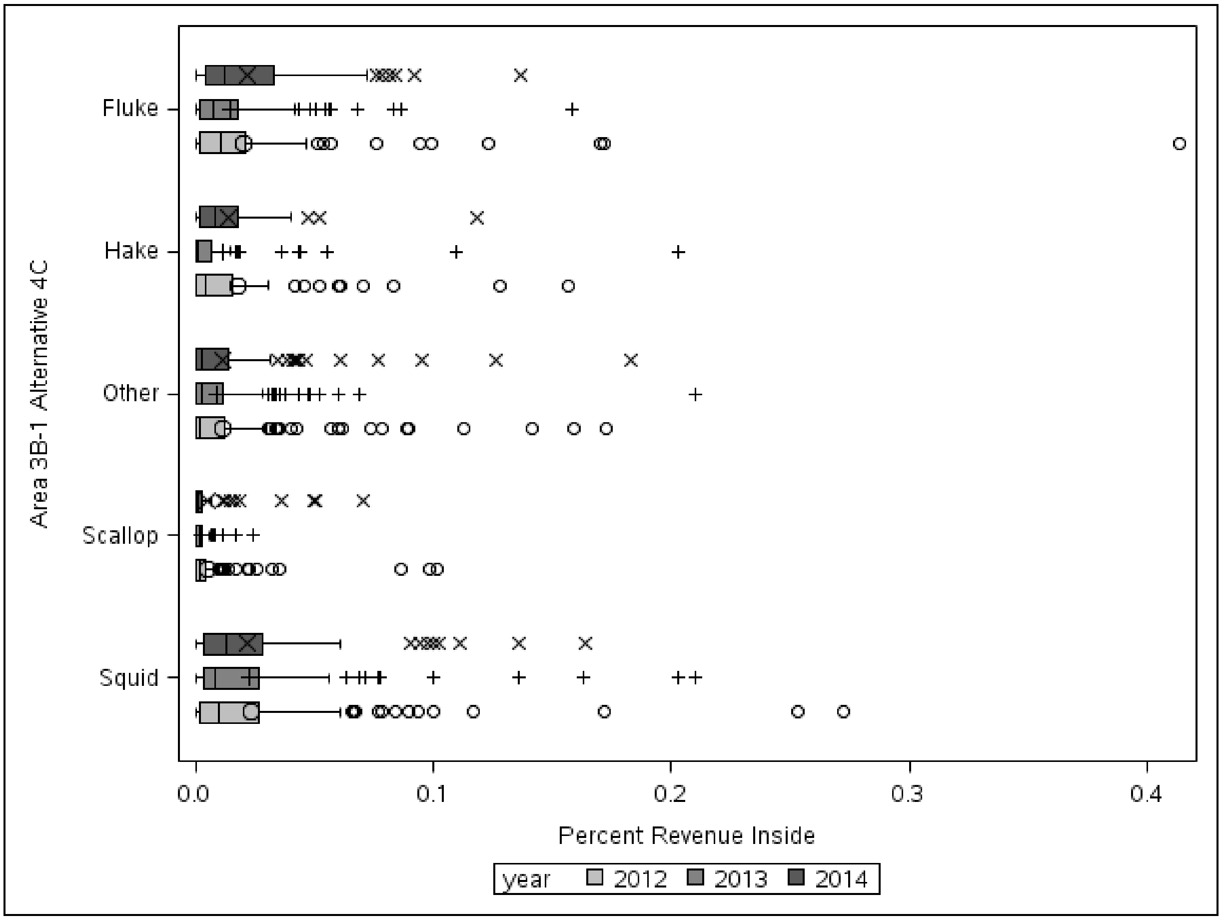

Figure D13. Percent revenue inside proposed close Area 3B-1 Alternative 4C (discrete zone Sub-alternative 3B-1: Advisor-proposed boundaries for three discrete zones (Council non-preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

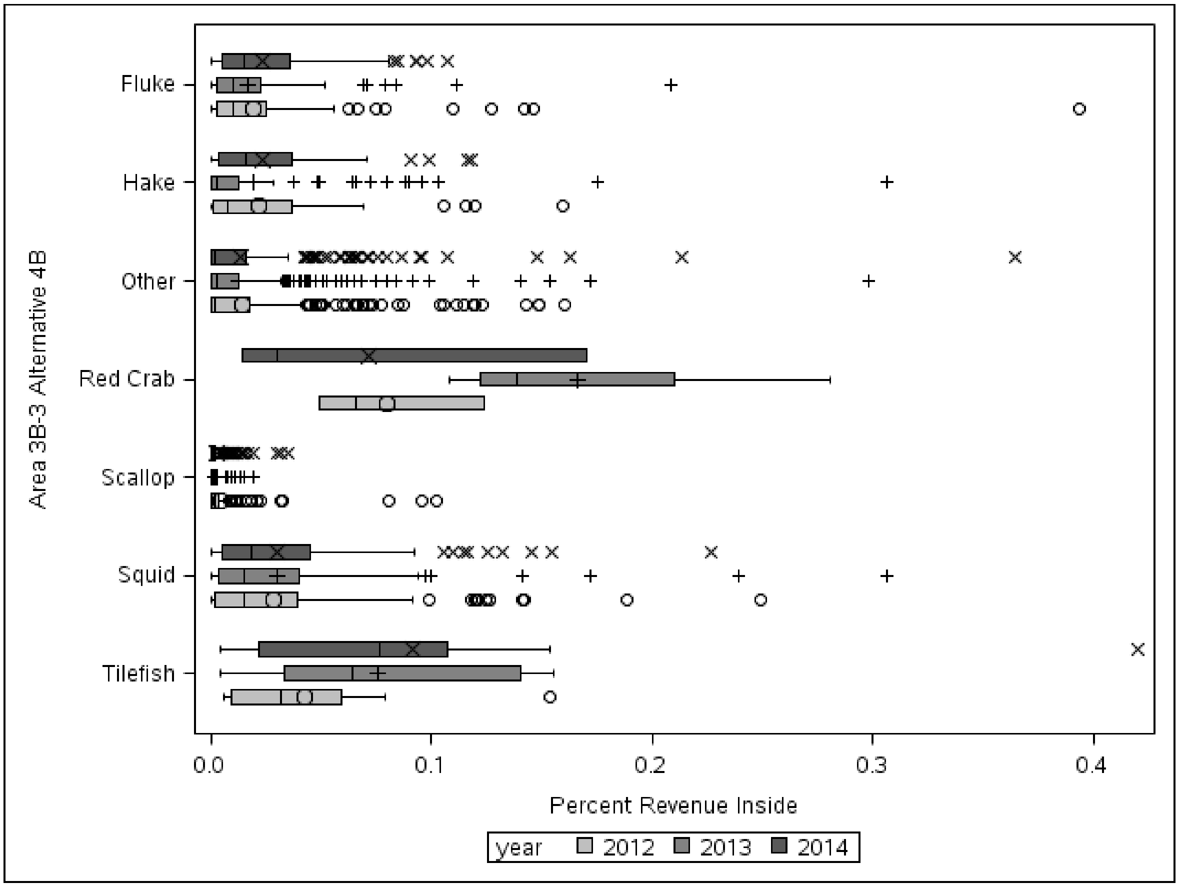

Figure D14. Percent revenue inside proposed close Area 3B-3 Alternative 4B (discrete zone Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with Alternative 4B: Prohibit all bottom-tending gear (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

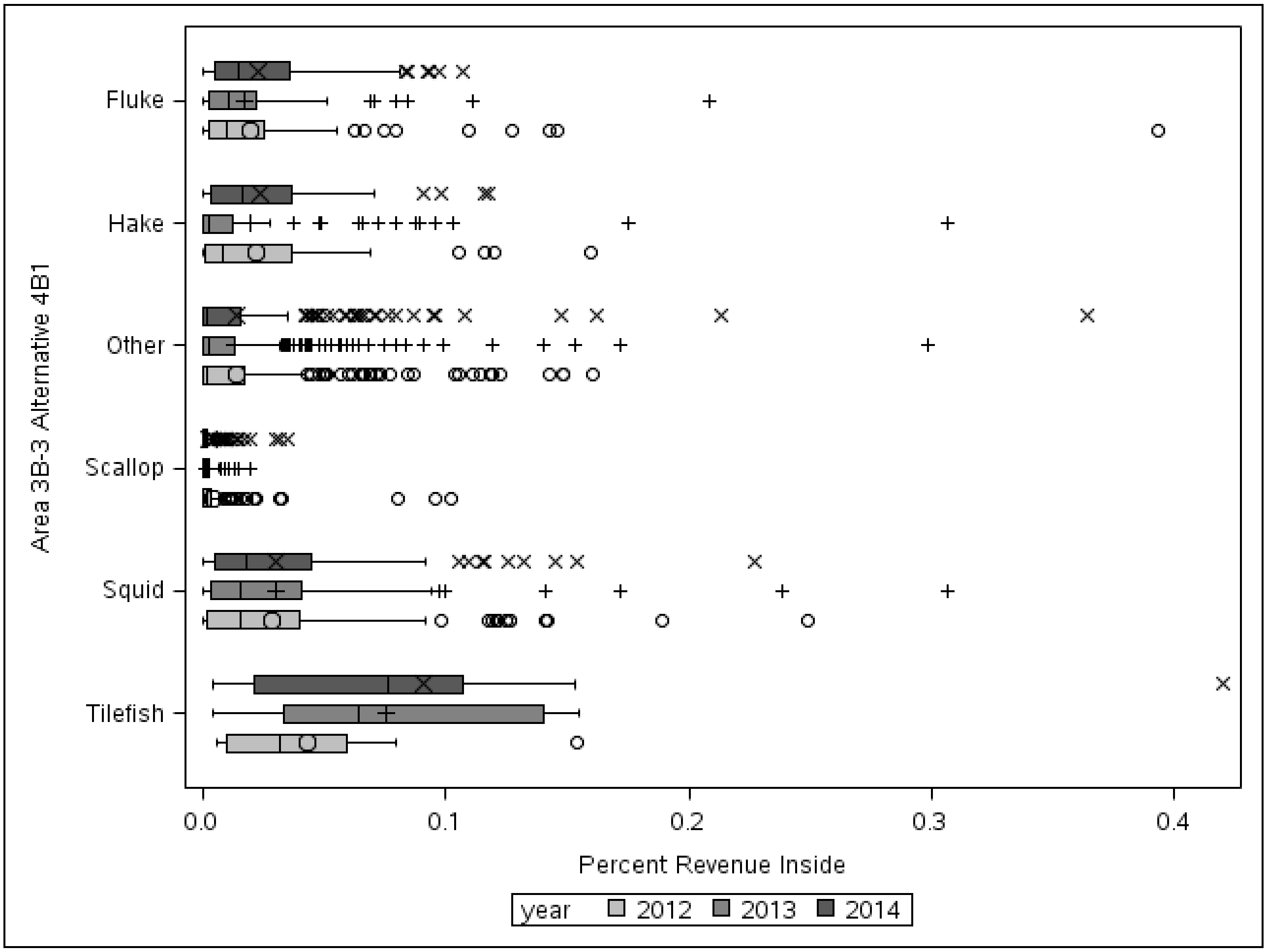

Figure D15. Percent revenue inside proposed close Area 3B-3 Alternative 4B-1 (discrete zone Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

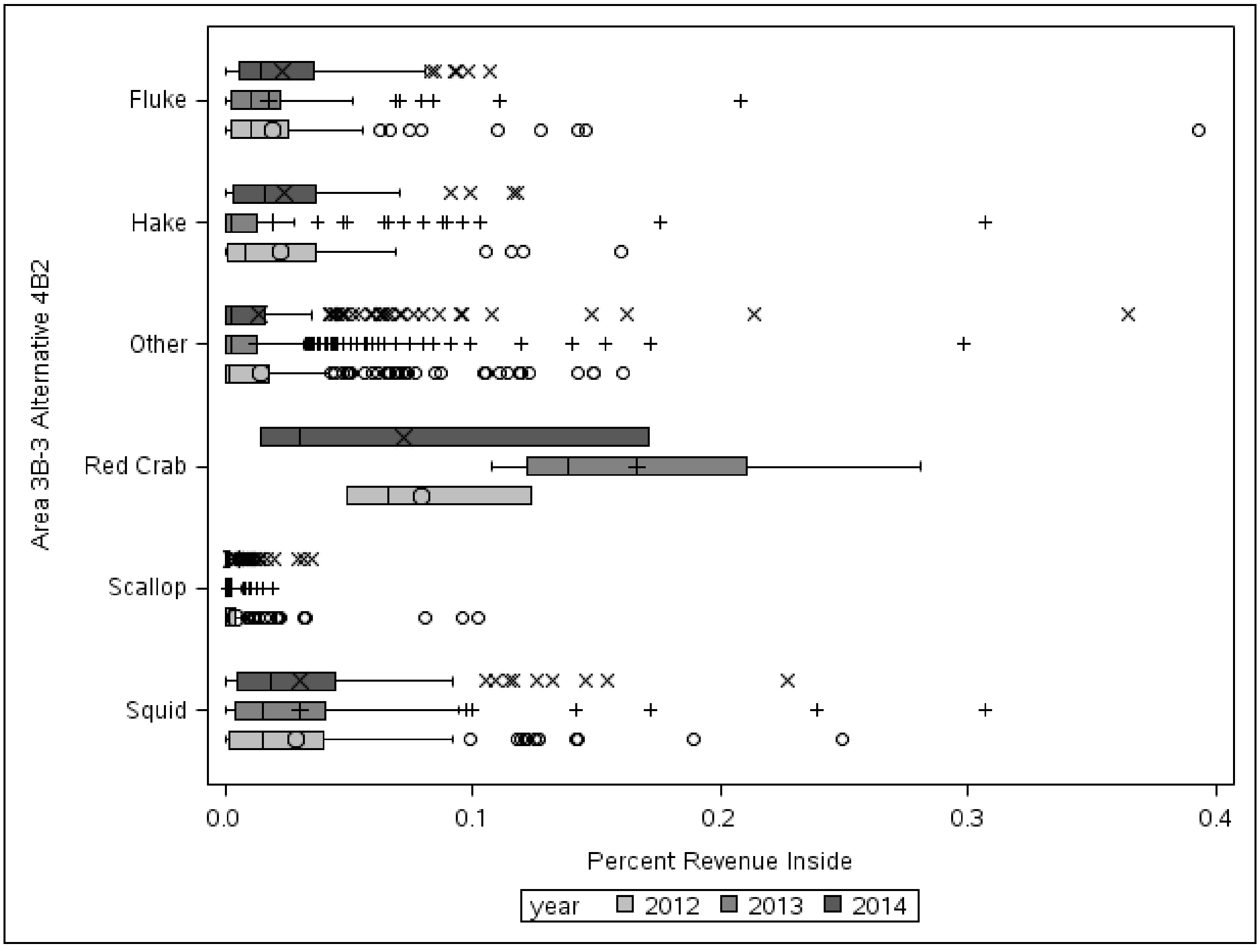

Figure D16. Percent revenue inside proposed close Area 3B-3 Alternative 4B-2 (discrete zone Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred)) by species group, for all vessels, based VTR data, 2012-2014.

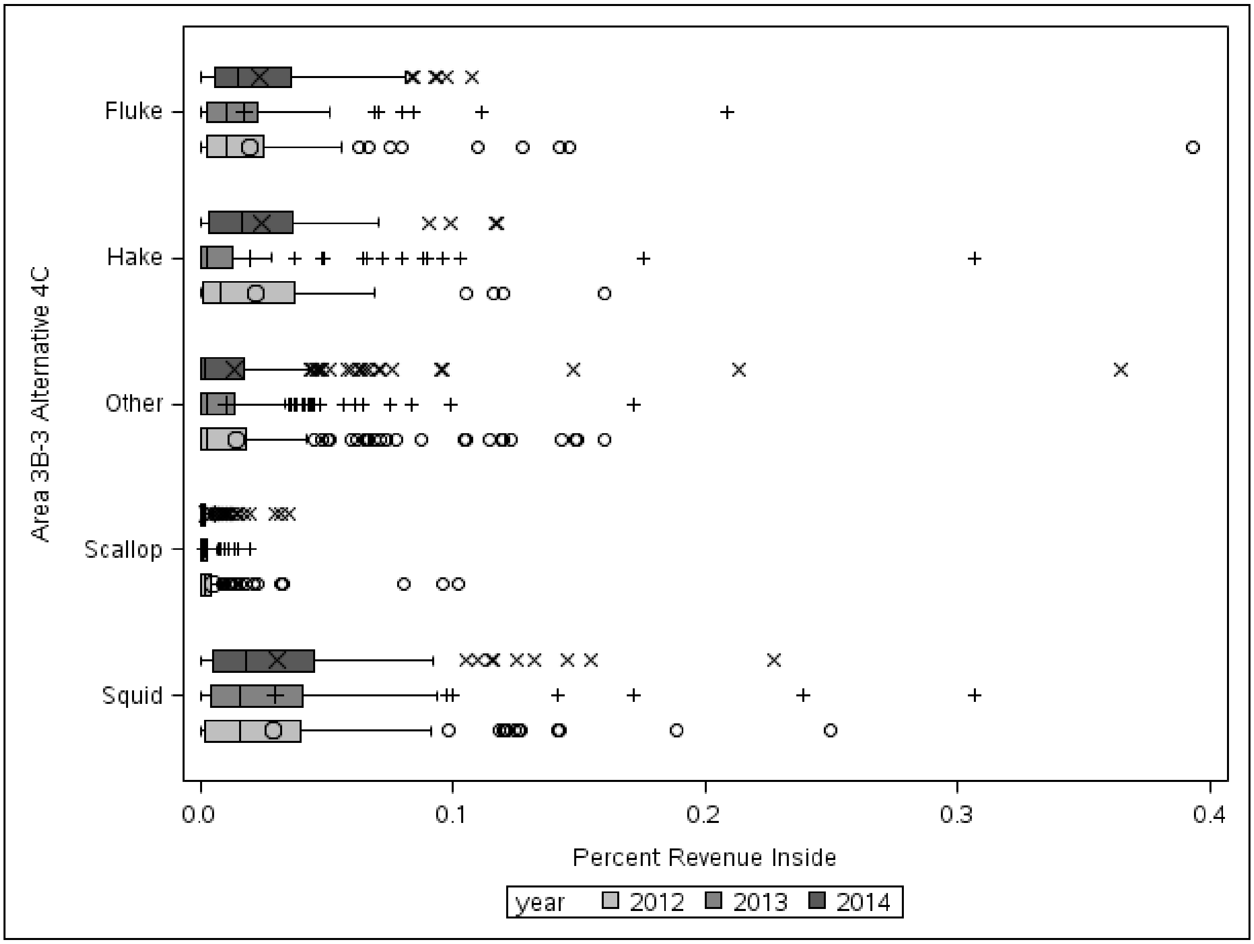

Figure D17. Percent revenue inside proposed close Area 3B-3 Alternative 4C (discrete zone Sub-alternative 3B-3: Garden State Seafood Association boundaries (Council non-preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

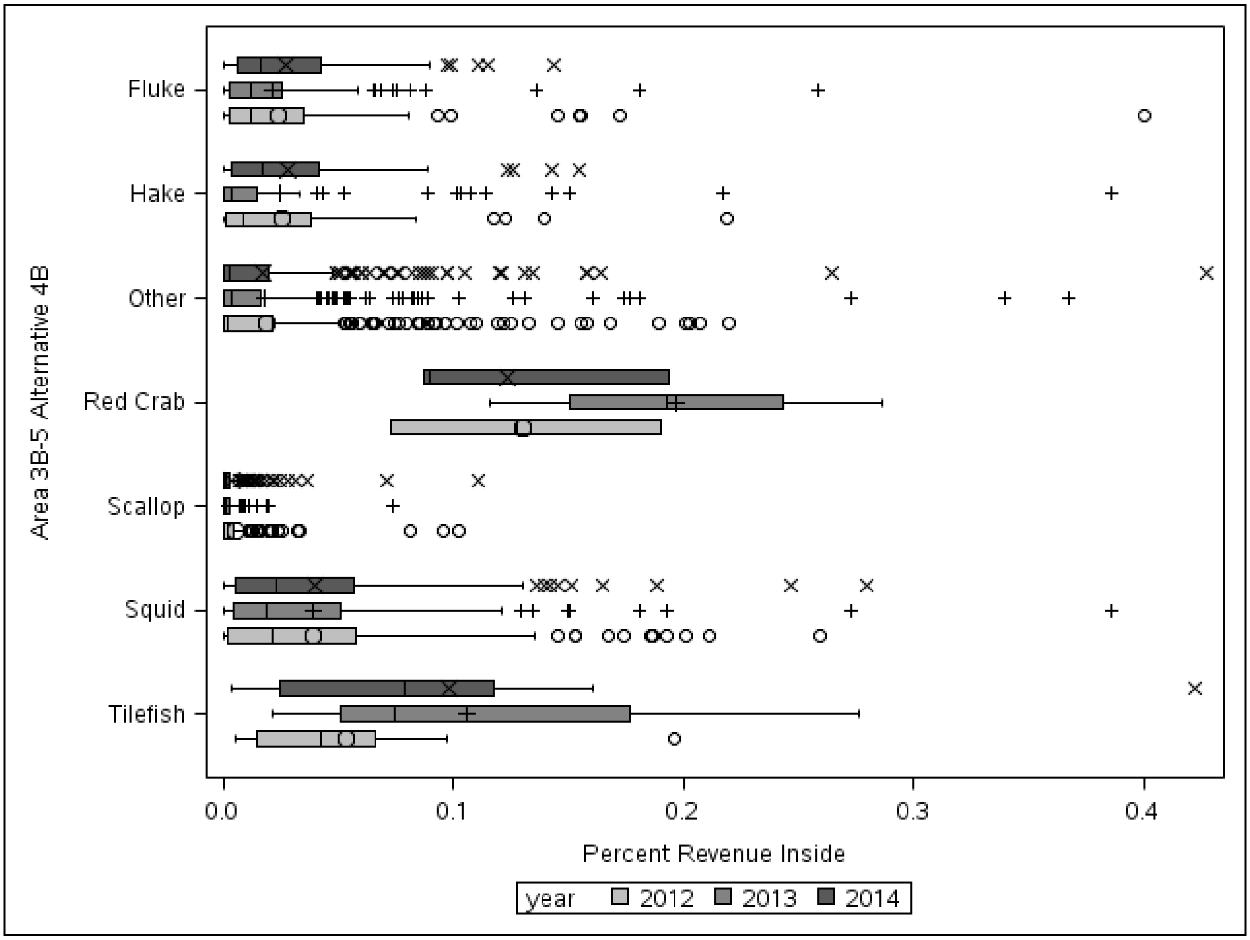

Figure D18. Percent revenue inside proposed close Area 3B-5 Alternative 4B (discrete zone Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with Alternative 4B: Prohibit all bottom-tending gear (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

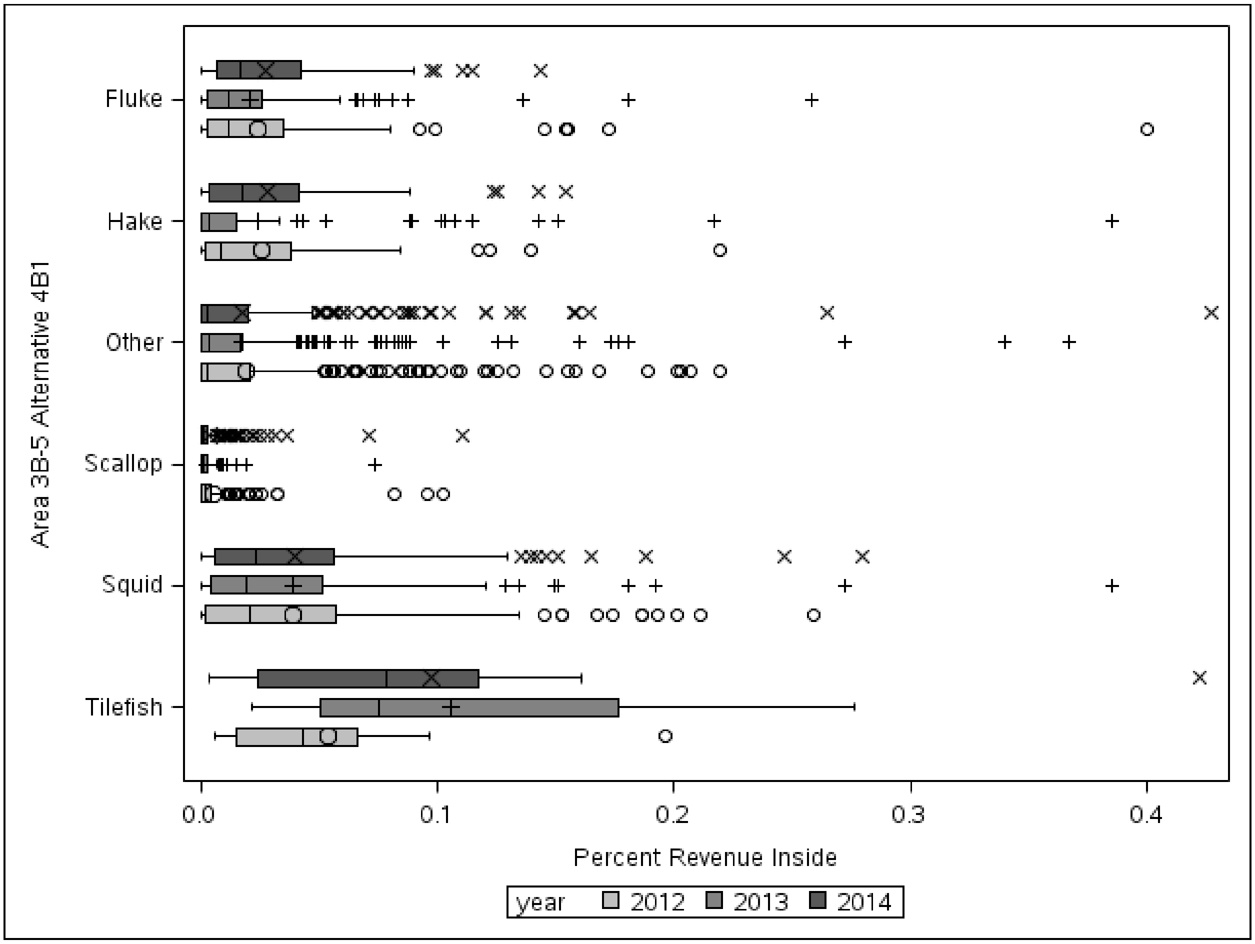

Figure D19. Percent revenue inside proposed close Area 3B-5 Alternative 4B-1 (discrete zone Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with *Sub-alternative 4B-1: Exempt red crab fishery from broad zone restrictions* (Council preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

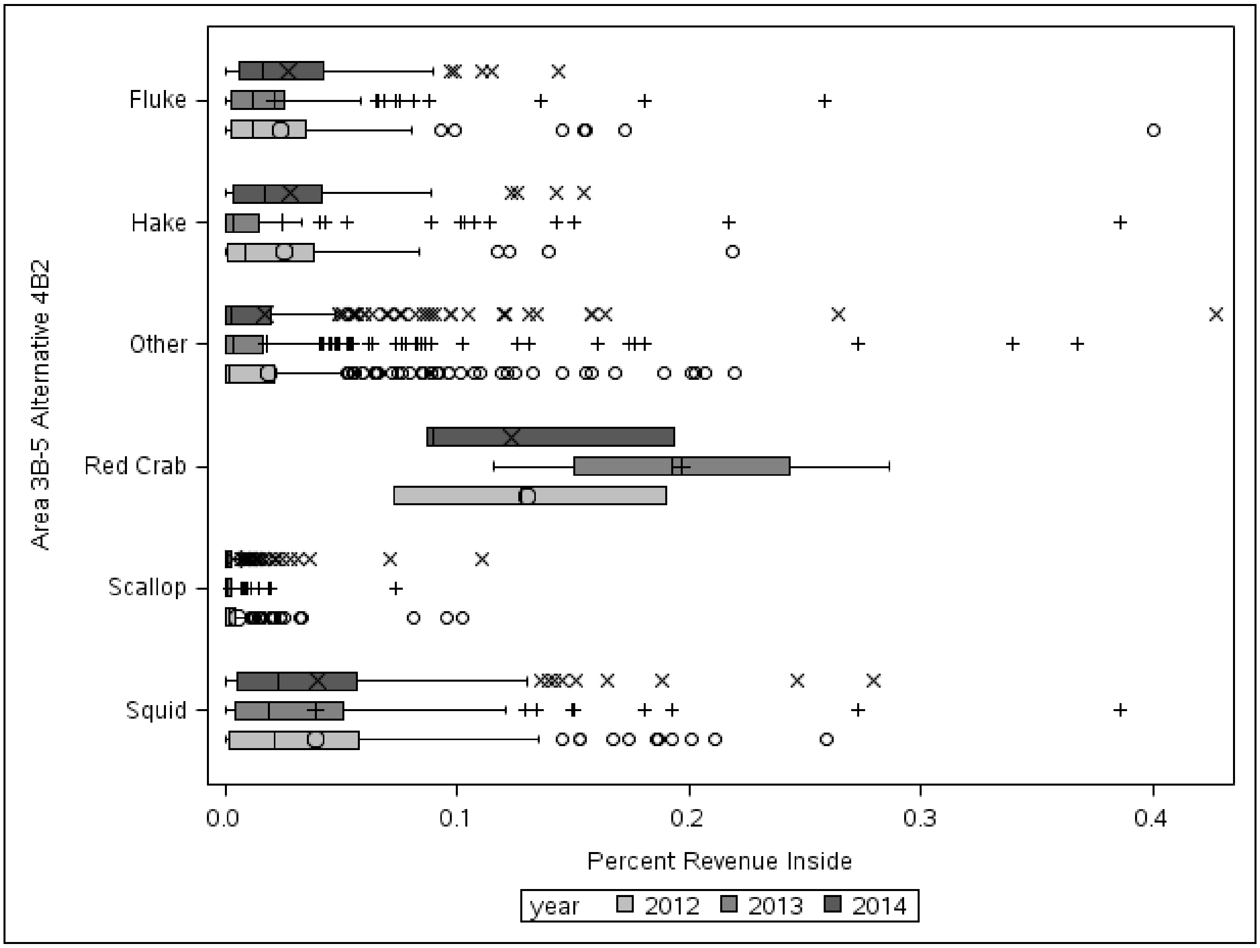

Figure D20. Percent revenue inside proposed close Area 3B-5 Alternative 4B-2 (discrete zone Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with *Sub-alternative 4B-2: Exempt golden tilefish fishery from broad zone restrictions* (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.

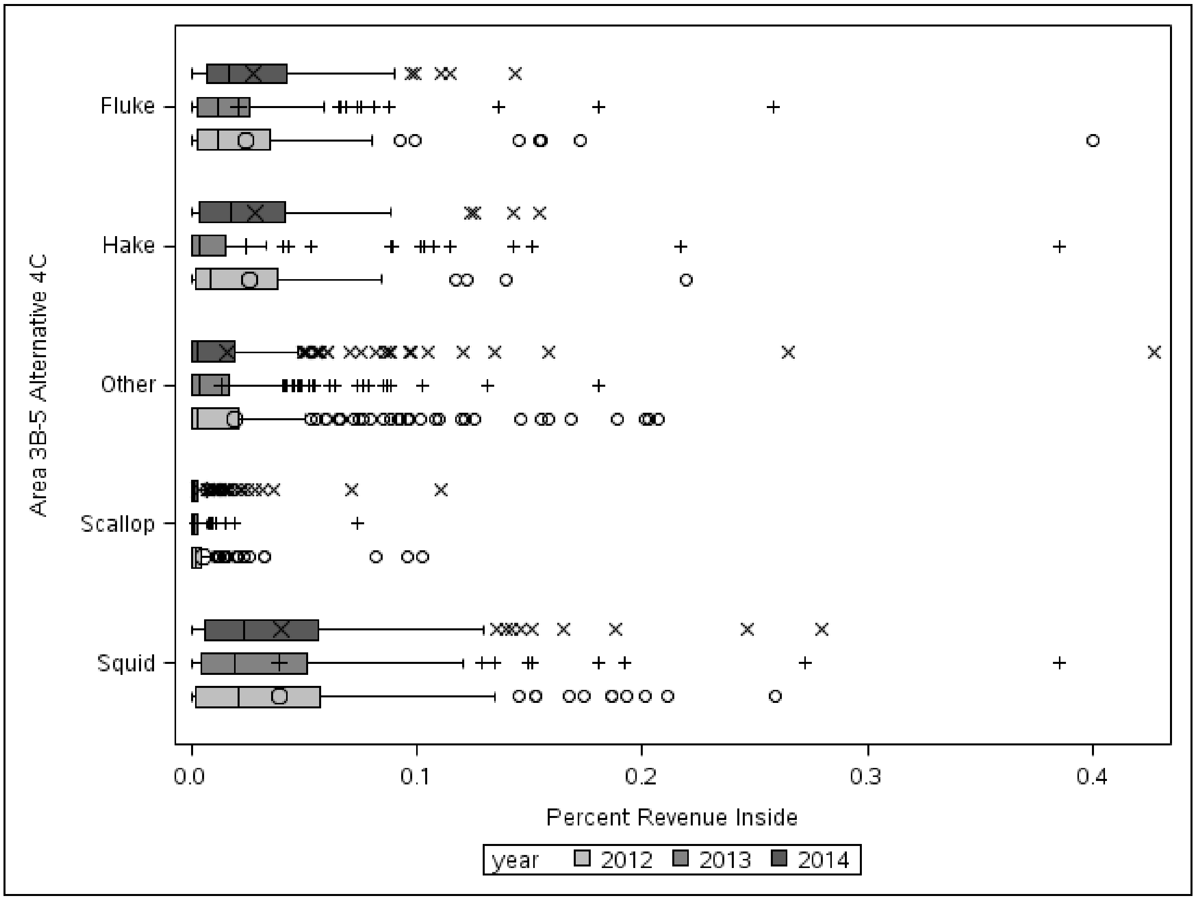

Figure D21. Percent revenue inside proposed close Area 3B-5 Alternative 4C (discrete zone Sub-alternative 3B-5: Corals Workshop boundaries (Council preferred) in combination with Alternative 4C: Prohibit all mobile bottom-tending gear (Council non-preferred)) by species group, for all vessels, based on VTR data, 2012-2014.