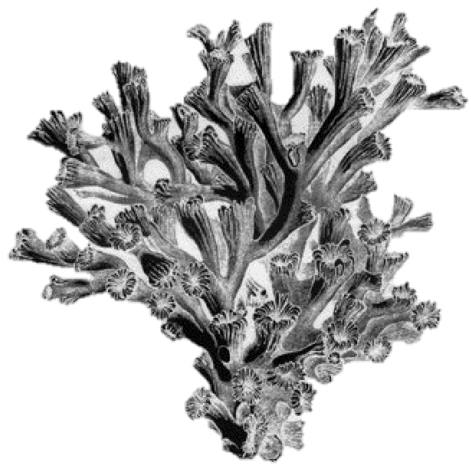
AMENDMENT 16
TO THE ATLANTIC MACKEREL, SQUID, AND BUTTERFISH (MSB) FISHERY MANAGEMENT PLAN (FMP)

Measures to Protect Deep Sea Corals from Impacts of Fishing Gear

Public Information Document

DRAFT for Council Review

AUGUST 2014



Mid Atlantic Fishery Management Council
in cooperation with
the National Marine Fisheries Service (NOAA Fisheries)

A Publication of the Mid-Atlantic Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award No. NA10NMF4410009

1.0 EXECUTIVE SUMMARY

[To be completed prior to public hearings]

2.0 LIST OF ACRONYMS AND ABBREVIATIONS

ACUMEN	Atlantic Canyons Undersea Mapping Expedition
ASMFC	Atlantic States Marine Fisheries Commission (Commission)
BOEM	Bureau of Ocean and Energy Management
CEA	Cumulative Effects Assessment
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
DMNH	Delaware Museum of Natural History
DOC	Department of Commerce
DSCRTP	Deep Sea Coral Research and Technology Program
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFP	Exempted Fishing Permit
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FMAT	Fishery Management Action Team
FMP	Fishery Management Plan
FR	Federal Register
GARFO	Greater Atlantic Regional Fisheries Office (formerly Northeast Regional Office/NERO)
IRFA	Initial Regulatory Flexibility Analysis
LOA	Letter of Acknowledgement
MAFMC	Mid-Atlantic Fishery Management Council
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSB	Mackerel, Squid, Butterfish
NAO	National Oceanic and Administration Administrative Order
NCCOS	National Centers for Coastal Ocean Science
NEFMC	New England Fishery Management Council
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA OER	NOAA Office of Exploration and Research
NOS	National Ocean Service
ROV	Remotely Operated Vehicle
SAFMC	South Atlantic Fishery Management Council
US	United States
USD	U.S. Dollars
VMS	Vessel Monitoring System
VTR	Vessel Trip Report
WHOI	Woods Hole Oceanographic Institution

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4.0 INTRODUCTION AND BACKGROUND

4.1 PURPOSE AND NEED FOR ACTION

The purpose of this amendment is to minimize the impacts of fishing gear on deep sea corals in the mid-Atlantic. Deep sea corals are fragile and slow-growing, and as such are highly vulnerable to disturbance by fishing gear. Bottom-tending gear poses a particular threat to deep sea coral ecosystems, with the potential to cause negative impacts ranging from scarring and damage to crushing or complete removal. The reauthorized Magnuson-Stevens Act (MSA) contains provisions giving the Regional Fishery Management Councils authority to implement management measures to mitigate fishery impacts to deep sea corals. This amendment is necessary to develop management measures under these provisions that would limit the impact of fishing on deep sea corals.

4.2 REGULATORY AUTHORITY

The range of alternatives in this document is based on application of discretionary provisions contained in the 2007 reauthorization of the Magnuson-Stevens Act (MSA) related to deep sea corals.[1] These provisions give the Regional Fishery Management Councils authority to designate zones where, and periods when, fishing may be restricted in order to protect deep sea corals from physical damage caused by fishing gear, or to prevent loss or damage to such gear. Such deep sea coral zones may include areas beyond known coral locations, if necessary, to ensure effectiveness. Management measures applied to deep sea coral zones may include restrictions on the location and timing of fishing activity, restrictions limiting fishing to specified vessel types, gear restrictions, and/or zones closed to fishing.

4.3 FMP HISTORY AND MANAGEMENT OBJECTIVES

Management of the Atlantic mackerel, *Longfin squid* and *Illex* squid, and butterfish 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 the years a wide variety of management issues have been addressed including rebuilding, habitat conservation, bycatch minimization, and limited entry. The original plans, amendments and frameworks that affected management of these fisheries can be found at http://www.mafmc.org/fisheries/fmp/msb.

The management goals and objectives, as described in the FMP as currently amended, 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 for the managed species as described in the FMP is currently all northwest Atlantic mackerel (*Scomber scombrus*), *Longfin squid pealeii*, *Illex illecebrosus*, and butterfish (*Peprilus triacanthus*) under U.S. jurisdiction, with a core fishery management area from North Carolina to

[1] http://www.nmfs.noaa.gov/msa2007/docs/act_draft.pdf#page=82.

Maine. However, the alternatives listed in this document for the protection of deep sea corals are not limited in scope to the Atlantic mackerel, squid, and butterfish 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 Atlantic mackerel, squid, and butterfish fishery as described in the FMP (even to activity or gears that are not used in these fisheries). However, these management measures would not apply to any species managed solely by the Atlantic States Marine Fisheries Commission (such as American lobster) unless the Commission took complementary action.

The Mid-Atlantic Fishery Management Council, the New England Fishery Management Council, and the South Atlantic Fishery Management Council 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.[2] 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).[3] The New England Fishery Management Council has agreed to develop management measures applicable within the boundaries of their council region, and the South Atlantic Council will continue to manage deep sea corals via its Coral, Coral Reef and Live/Hardbottom Fishery Management Plan.

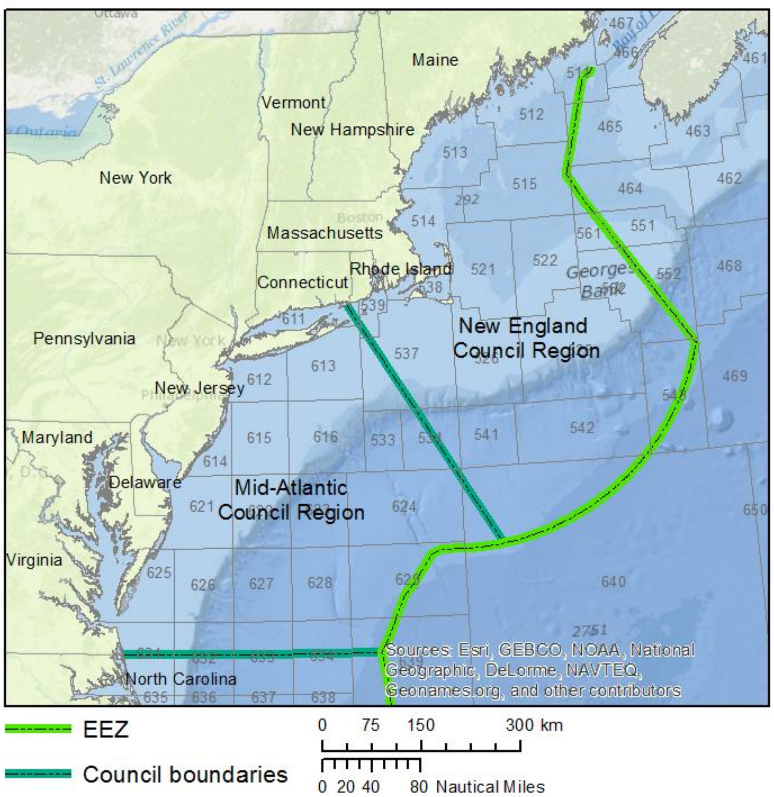

Figure 1: Mid-Atlantic and New England Council regions.

To promote continuity and consistency in deep sea coral measures between regions, the alternatives contained in this document were developed with consideration of consistency in approach to deep sea coral protections to that being considered by the New England Fishery Management Council (NEFMC). The NEFMC began developing deep sea coral alternatives as part of their Essential Fish Habitat Omnibus Amendment 2, which has since been split into a separate Omnibus Deep Sea Corals Amendment.[4]

[2] The full Memorandum of Understanding is available on the Council's website, at http://www.mafmc.org/actions/msb/am16.

[3] Council boundaries are defined in the Code of Federal Regulations (CFR), 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.

[4] For more information, see http://nefmc.org/habitat/index.html.

5.0 MANAGEMENT ALTERNATIVES

The alternative sets presented below provide a range of options for protections of deep sea corals from the impacts of fishing gear. Several options are proposed for designating "deep sea coral zones" under the discretionary provisions in the Magnuson-Stevens Act described in Section 4.2. These options are grouped into alternatives sets using a framework that combines options for "broad" coral zones with options for "discrete" coral zones, as described below.

Broad deep sea coral zones are intended to encompass larger areas where management measures could be applied to "freeze the footprint" of fishing, with the primary intention being to prevent expansion of effort into areas where little or no fishing occurs as a precautionary approach. Options for management measures in such broad zones could include some combination of gear restrictions and/or additional requirements for reporting, monitoring, or authorization. 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[5]:

> "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."

Discrete deep sea coral zones would be designated in smaller areas of known coral presence or highly likely (based on habitat suitability analysis) coral presence. These areas primarily include canyons or slope areas along the shelf/slope break.

These two types of deep sea coral zones could be implemented simultaneously. Different management measures could be applied in each type of zone, allowing the flexibility to protect areas of known deep sea coral presence, while taking a precautionary approach in other areas.

Consistent with this framework, six sets of alternatives are presented below: 1) options for the designation of broad deep sea coral zones, 2) options for management measures to be applied within broad zones, 3) options for designation of discrete deep sea coral zones, 4) options for management measures to be applied within discrete zones, 5) options for framework provisions for deep sea coral zones, and 6) options for Vessel Monitoring System (VMS) requirements.

[5]National Oceanic and Atmospheric Administration, Coral Reef Conservation Program. 2010. NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation. Silver Spring, MD: NOAA Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 11. 67 pp.

5.1 BROAD CORAL ZONE ALTERNATIVES

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*. Within the Mid-Atlantic Fishery Management Council region, there are currently no measures in place designed specifically for the protection of deep sea corals.

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 depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ (Figure 2).

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 depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ (Figure 2).

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 depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ (Figure 2).

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 depth contour and extending out to the northern and southern boundaries of the MAFMC management region, and to the edge of the EEZ (Figure 2).

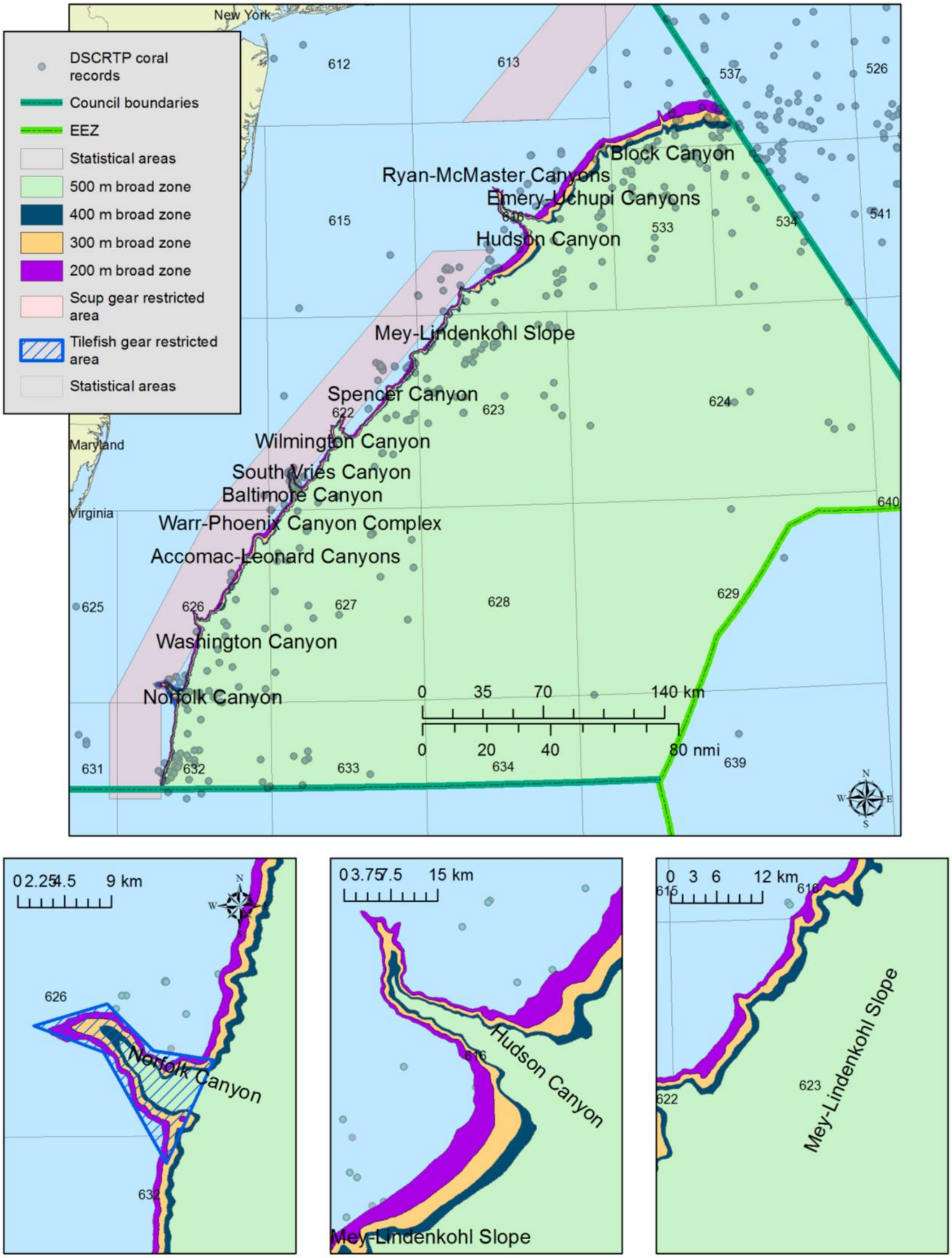

Figure 2: Broad coral zone alternatives.

5.2 MANAGEMENT MEASURES WITHIN BROAD CORAL ZONES

Alternative 2A: No Action

Under this alternative, no action would be taken to implement management measures in any potential broad deep sea coral zones.

Alternative 2B: Prohibit all bottom-tending gear

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[6], and sink or anchored gill nets.

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

If selected in conjunction with Alternative 2B, sub-alternative 2B-1 would exempt the red crab fishery from restrictions on all bottom-tending gear. The red crab fishery currently consists of only a few vessels that harvest crabs using traps, focusing effort along the center of a narrow range of depth (from approximately 550 to 750 meters). Thus, any prohibition on all bottom-tending gear within 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 selected 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. Selecting 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 other stationary or passive bottom-tending gear (other than red crab trap gear if sub-alternative 2B-1 above is selected).

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).

Alternative 2D: Require VMS for vessels fishing in broad coral zones

Under this alternative, vessels would be required to use an approved Vessel Monitoring System (VMS) as a condition for operating within any broad coral zones.

[6]As indicated in section 4.XX, alternatives contained in this document would not apply to non-federally managed fisheries, including species managed solely by the Atlantic States Marine Fisheries Commission, such as American lobster.

5.3 DISCRETE CORAL ZONE 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*.

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 (Table 1; Figure 3).

Note: The boundaries of the proposed discrete zones have been modified from their previous versions by the Fishery Management Action Team (FMAT) based on the best available information about coral presence and suitable habitat. Specifically, the areas were re-drawn using a habitat suitability model for deep sea corals that was not available when the original boundaries were drawn. Additional criteria, including areas of very high slope, were also used during the re-evaluation of the boundaries. Some areas that were previously proposed as separate discrete areas have been combined. The basis for the revised boundaries is outlined in **Appendix A**.

Additionally, the list of proposed discrete zones below was formerly listed under three categories (sub-alternatives). These categories included areas recommended on the basis of a) high observed coral presence, b) highly likely coral presence (suitable habitat), and c) possible coral presence. The FMAT has analyzed the proposed areas based on the results of the habitat suitability model and other biological data. The FMAT may re-evaluate the list below and re-categorize the proposed areas into two or more categories, based on the biological analysis described in Section 6. The FMAT recommends seeking public input during the public hearing process on the organization of the proposed discrete zones into categories, including the number of categories and basis for classification and/or prioritization.

Table 1: Proposed discrete zones.

	Canyon or Complex	Area (km^2)
1	Block Canyon	231.6
2	Ryan and McMaster Canyons	390.3
3	Emery and Uchupi Canyons	369.2
4	Jones and Babylon Canyons	166.1
5	Hudson Canyon	770.8
6	Mey-Lindenkohl Slope (encompassing several canyons, including Mey, Hendrickon, Toms, South Toms, Berkley, Carteret, and Lindenkohl Canyons, and the slope area between them)	2818.2
7	Spencer Canyon	163.3
8	Wilmington Canyon	268.1
9	North Heyes and South Wilmington Canyons	183.4
10	South Vries Canyon	142.6
11	Baltimore Canyon	231.0
12	Warr and Phoenix Canyon Complex	511.6
13	Accomac and Leonard Canyons	538.2
14	Washington Canyon	554.1
15	Norfolk Canyon	543.7

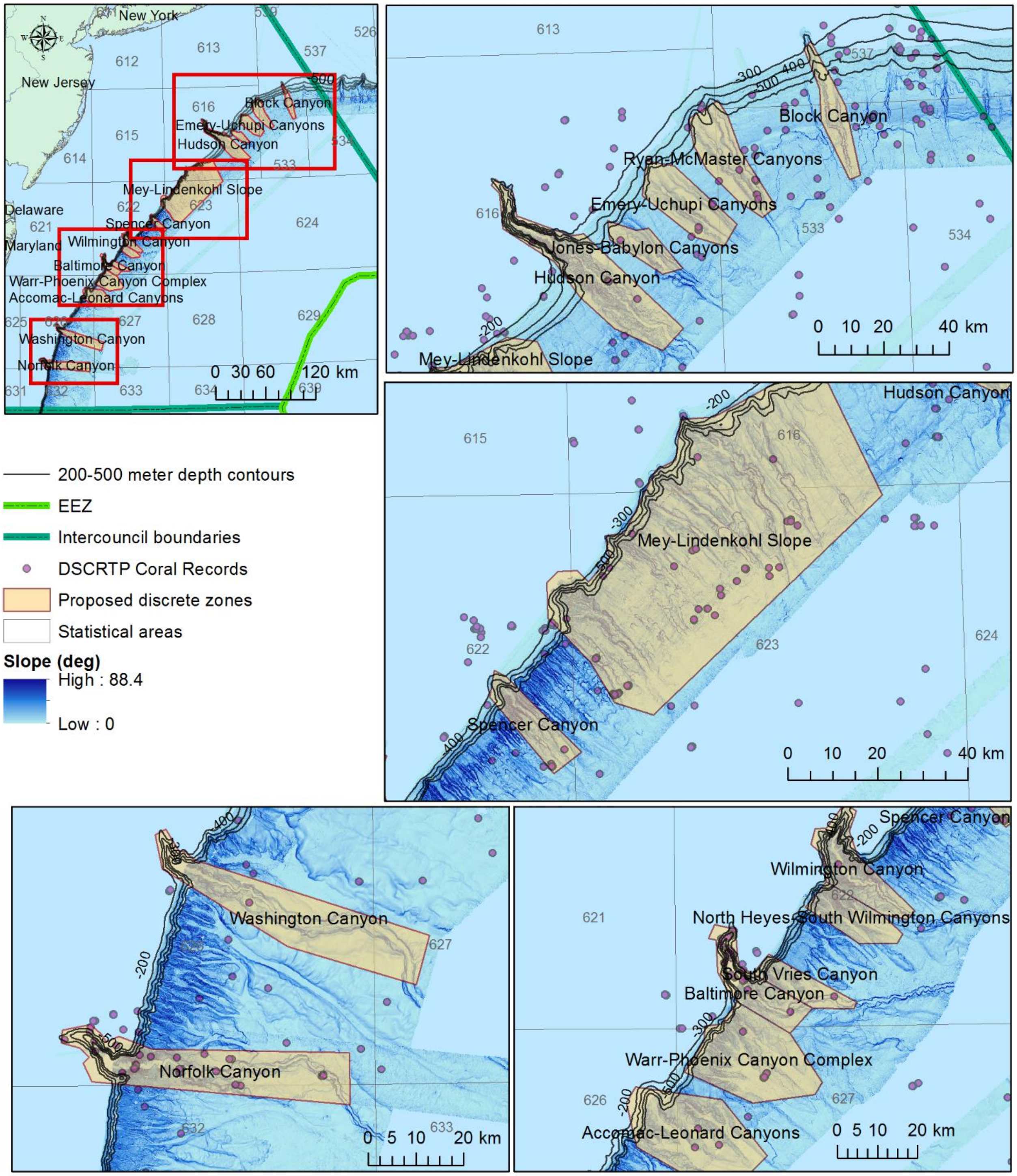

Figure 3: Discrete coral zone alternatives.

Sub-alternative 3B-1: *Advisor-proposed boundaries for specific canyons*

Under this sub-alternative, modified discrete zone boundaries would be implemented for Norfolk Canyon, Baltimore Canyon, and the Mey-Lindenkohl Slope, as proposed by a member of the Council's Mackerel, Squid, and Butterfish Advisory Panel following the April 2013 Deep Sea Corals Alternatives workshop (Table 2; Figure 4).

Table 2: Advisor-proposed boundaries for Norfolk Canyon, Baltimore Canyon, and the Mey-Lindenkohl Slope (sub-alternative 3B-1).

	Canyon or Complex	Area (km^2)
1	Mey-Lindenkohl Slope *(Advisor proposed; Straight line landward boundary)*	2445.3
2	Mey-Lindenkohl Slope *(Advisor proposed; Depth-based; landward boundary approximating 250 fathom contour)*	2458.8
3	Baltimore Canyon *(Advisor proposed)*	220.7
4	Norfolk Canyon *(Advisor proposed)*	598.4

5.4 MANAGEMENT MEASURES WITHIN DISCRETE CORAL ZONES

Alternative 4A: No Action

Under this alternative, no action would be taken to implement management measures in any potential discrete deep sea coral zones.

Alternative 4B: Prohibit all bottom-tending gear

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[7], and sink or anchored gill nets.

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. 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).

[7]As indicated in section 4.XX, alternatives contained in this document would not apply to non-federally managed fisheries, including species managed solely by the Atlantic States Marine Fisheries Commission, such as American lobster.

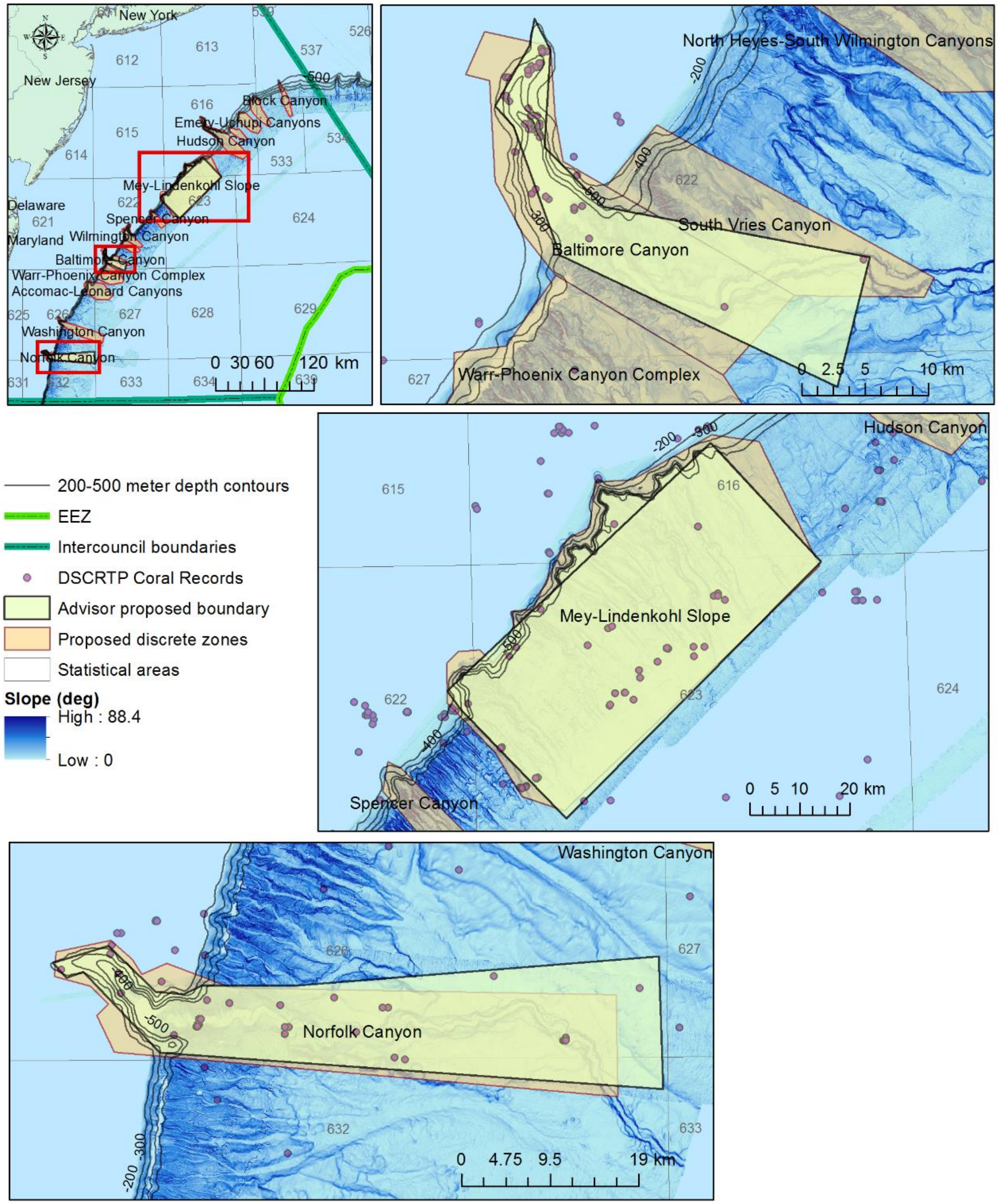

Figure 4: Advisor proposed boundaries (sub-alternative 3B-1).

5.5 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 a fishery management plan (FMP) amendments. 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 Mackerel, Squid, and Butterfish 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 protections in this amendment.

Recently completed research cruises have observed deep sea corals in several 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. Including options for framework provisions in this amendment may 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

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

Alternative 5B: Option to modify coral zone boundaries via framework action

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

Alternative 5C: Option to modify management measures within zones via framework action

This alternative would give the Council the option to modify fishing restrictions, exemptions, and other management measures within deep sea coral zones through a framework action.

Alternative 5D: Option to add additional discrete coral zones via framework action

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

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

5.6 MONITORING ALTERNATIVES

Alternative 6A: No Action

Under this alternative, no changes would be made to the VMS requirements for *Illex* squid moratorium vessels.

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

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 potential deep sea coral zones).

5.7 CONSIDERED BUT REJECTED FROM FURTHER ANALYSIS

The following section contains FMAT recommendations for alternatives to be moved to "considered but rejected."

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)

The FMAT recommends moving this alternative set to considered but rejected primarily due to existing exemption and access programs that would serve essentially the same purpose as these proposed alternatives. 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 CFR 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 within any potential broad zones, 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. Because this alternative would need further development to be included in the amendment, the FMAT recommends moving this sub-alternative to "considered but rejected" at this time. However, a Council special access program could be implemented at a later date via a framework action if this amendment considers making a special access program frameworkable (provided that Alternative 5E, option to implement a special access program via framework action, is selected by the Council).

For the purposes of **scientific research**, a statutory exemption is provided within the Magnuson-Stevens Act, 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. An 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.nero.noaa.gov/permits/forms/EFPLOAEEAAPossessionLOAGuidance.pdf.

2. Require observers on vessels fishing in broad coral zones

The FMAT recommends moving this alternative to "considered but rejected" due to ongoing efforts to resolve issues related to observer coverage funding and industry cost-sharing. Specifically, an Omnibus Observer Coverage Funding Amendment is currently being developed jointly between the Mid-Atlantic and New England Councils, and is directly related to proposed requirements like the one under this alternative. The Omnibus amendment was initiated following NMFS's partial disapproval of both Amendment 5 to the Atlantic Herring FMP and Amendment 14 to the Mackerel, Squid, and Butterfish 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. Without a clear and viable funding source for this requirement, this alternative is not practical at this time. Once the Omnibus Observer Coverage Funding Amendment is completed, the Council could address observer coverage requirements within broad coral zones through a future framework action if this amendment considers making management measures within broad zones frameworkable (provided that Alternative 5C, option to modify management measures within coral zones, is selected by the Council).

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. The FMAT recommends that this alternative be moved to "considered but rejected" at this time due to the need for more 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 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.

The FMAT recognizes that this proposed alternative is at least partially related to concerns regarding vessel movement in and around zones when fishing gear is not fully deployed. The FMAT also recognizes the need for more information and development of measures to address these issues. Specifically, there is a need to consider vessel needs for deployment and haulback of gear (which for squid trawl vessels often extends significantly behind the vessel). Squid trawlers target specific high productivity areas in and around the heads of the canyons, near the continental shelf-slope break. If any of the proposed coral zones are implemented, future fishing activity near these zones would likely occur very near the coral zone boundaries, posing a potential problem for vessels when positioning for gear deployment or haulback, or drifting into closed areas during these processes. Additionally, there is a need to consider potential allowances and associated restrictions for transit through any potential coral zones (for example, transit allowances for vessels with stowed gear, etc.). The FMAT recommends soliciting feedback and suggestions from the public and the Council's advisors on these issues during the public hearing process.

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

The FMAT recommends that the alternatives exempting the *Illex* and longfin squid fisheries from both broad and discrete zone be moved to "considered but rejected." If the Council wishes to avoid negative economic impacts to the squid fisheries, the FMAT believes that there is a sufficient range of options within the document that would allow this to occur, including the "no action" option under each alternative set as well as the option to designate the deepest depth-based broad 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 recommends 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, analysis of all proposed depth-contour based boundaries in combination with the model-based boundaries and additional advisor proposed boundaries would mean analyzing five to seven different sets of boundaries for each area. This would complicate any cumulative effects analysis given the need to analyze all alternatives in combination with each other alternative, and delay amendment development.

6.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 PHYSICAL ENVIRONMENT

[To be completed]

6.2 BIOLOGICAL ENVIRONMENT

6.2.1 Description of the Managed Resource

Atlantic mackerel is a semi-pelagic/semi-demersal (may be found near the bottom or higher in the water column) schooling fish species primarily distributed between Labrador (Newfoundland, Canada) and North Carolina. Additional life history information is detailed in the Essential Fish Habitat (EFH) document for the species, located at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. The status of Atlantic mackerel is unknown with respect to being overfished or not, and unknown with respect to experiencing overfishing or not. Recent results from the Northeast Fisheries Science Center (NEFSC) Spring Trawl survey (the spring survey catches the most mackerel) are highly variable, and are graphed in the "NEFSC Biological Update" that is created as part of the annual quota setting process. These are available at: http://www.mafmc.org/ssc-meeting-documents/ (see May 2014 Meeting Materials).

Atlantic butterfish is a semi-pelagic/semi-demersal schooling fish species primarily distributed between Nova Scotia, Canada and Florida. Additional life history information is detailed in the EFH document for the species, located at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. The status of butterfish is not overfished (above target biomass) with no overfishing occurring according to a recently accepted assessment (NEFSC 2014, available at: http://nefsc.noaa.gov/publications/crd/crd1403/).

Longfin squid is a semi-pelagic/semi-demersal schooling cephalopod species primarily distributed between Georges Bank and Cape Hatteras, NC. Additional life history information is detailed in the EFH document for the species, located at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. Based on a new biomass reference point from a 2010 stock assessment, the longfin squid stock was not overfished in 2009, but overfishing status was not determined because no overfishing threshold was recommended (though the assessment did describe the stock as "lightly exploited'). The 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. These are available at: http://www.mafmc.org/ssc-meeting-documents/ (see May 2014 Meeting Materials).

Illex squid is a semi-pelagic/semi-demersal schooling cephalopod species distributed between Newfoundland and the Florida Straits. Additional life history information is detailed in the EFH document for the species, located at: http://www.nefsc.noaa.gov/nefsc/habitat/efh/. The status of *Illex* is unknown with respect to being overfished or not, and unknown with respect to experiencing overfishing or not. 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. These are available at: http://www.mafmc.org/ssc-meeting-documents/ (see May 2014 Meeting Materials).

6.2.2 Deep Sea Corals

Deep sea corals, or cold water corals, are generally defined as corals occurring at ocean depths below 50 meters. Several types of deep sea corals are found in the northeastern United States. Types of deep sea corals observed to date in the mid-Atlantic range from small, solitary corals to larger colonies including complex structure-forming corals. Deep sea corals, in particular types that form complex structures, provide habitat for many species of fishes and invertebrates.

Records of deep sea coral observations are maintained in a database by NOAA's Deep Sea Coral Research and Technology Program (DSCRTP). These records include historical and current data from a variety of sources, including peer-reviewed literature, research surveys, museum records, and incidental catch records. The records contained in this database are mostly **presence-only**. **Many areas have not been adequately surveyed for the presence of deep sea corals.** There is very little absence or abundance information available for deep sea corals, although usable absence data may become available as data is processed from recent research cruises.

Recent Research Surveys

Several recent research efforts have resulted in new observations of deep sea corals in the mid-Atlantic. Some of this research is still ongoing, with plans for some work to continue into 2014 and 2015. Although some qualitative results are available, much of the processed/georeferenced data from recent cruises is not yet available. New information has been incorporated into the range of alternatives to the extent possible, and will be added to the analysis as it becomes available before the amendment is finalized. Findings from these surveys are described briefly in Section 7.1.2.

NEFSC Fishery Independent Surveys

The Northeast Fishery Science Center's fishery independent surveys have 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 significant 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 – trash being defined as any substrate or non-coded invertebrate species. The trash is loosely described and roughly quantified to the whole liter.

The general lack of deep-sea coral in both of these surveys may be due to the surveys fishing too shallow to encounter the more significant (i.e., 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*, *Primnoa*) may have been "fished out" in the shallower 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.

Northeast Fisheries Observer Program

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).

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 NE Observer Program certification). This program includes basic coral identification skills, sampling protocols, and how corals interface with the NEFOP Species Verification Program (SVP). 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.

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; it is important to remember that 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. Deep sea coral records from the NEFSC Fishery Independent Surveys are described in Section 7.1.3

6.2 ENDANGERED AND PROTECTED RESOURCES

[To be completed]

6.3 HUMAN COMMUNITIES AND ECONOMIC ENVIRONMENT

[To be completed]

7.0 IMPACTS OF THE ALTERNATIVES

7.1 Deep Sea Coral Distribution and Habitat Relative to Proposed Coral Zones

7.1.1 Deep Sea Coral Research and Technology Program Records

Coral presence data from NOAA's Deep Sea Coral Research and Technology Program database were analyzed using ArcGIS software and Microsoft Excel to determine how records of known corals overlap with proposed management areas. The DSCRTP database[8] contains 870 records of deep sea corals within the MAFMC management region. Of these, 635 records are included within proposed broad coral zones (73%; Table 3). There is only one coral record in the database that is contained within a proposed discrete zone that is *not* also encompassed by a broad zone alternative (one observation of *Dasmosmilia lymani*, a stony coral, in Baltimore Canyon). Within the proposed discrete zones, the areas of highest coral observations are contained within Baltimore Canyon, Norfolk Canyon, and the Mey-Linedenkohl Slope (Table 6). These areas are all included in the areas recommended based on high documented coral presence and suitable habitat.

The coral records within the total area of the proposed 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 (Table 5). The data below should be interpreted with caution. As described above, the data are presence-only, and many areas have not been explored for the presence of corals. 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; also, deep sea coral taxonomy is in a constant state of flux. 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 are easier to sample or are heavily studied for reasons other than deep sea corals. This analysis does not include the results of recent survey work, as data from these cruises has not yet been added to the DSCRTP database (however, some information is available; see Section 7.1.2 for additional discussion of recent research findings).

Table 3: Deep sea coral presence records within proposed MAFMC broad coral zones, in number (a) and percent (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*
	200 meter broad zone	**635**	**214**	**167**	**255**
	[between 200 m and 300 m]	*40*	*1*	*17*	*23*
	300 meter broad zone	**595**	**213**	**150**	**232**
	[between 300 m and 400 m]	*51*	*10*	*26*	*15*
	400 meter broad zone	**544**	**203**	**124**	**217**
	[between 400 m and 500 m]	*25*	*15*	*4*	*6*
	500 meter broad zone	**519**	**188**	**120**	**211**
	TOTAL (MAFMC Region)	**870**	**238**	**285**	**348**

[8] As of June 10, 2013.

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%*
	200 meter broad zone	**73%**	**90%**	**62%**	**73%**
	[between 200 m and 300 m]	*5%*	*0%*	*6%*	*7%*
	300 meter broad zone	**68%**	**89%**	**56%**	**67%**
	[between 300 m and 400 m]	*6%*	*4%*	*10%*	*4%*
	400 meter broad zone	**62%**	**85%**	**46%**	**62%**
	[between 400 m and 500 m]	*3%*	*6%*	*5%*	*2%*
	500 meter broad zone	**60%**	**79%**	**40%**	**61%**
	TOTAL (MAFMC Region)	**100%**	**100%**	**100%**	**100%**

Table 4: Composition of deep sea corals presence records by type within proposed broad and discrete zones. Data from DSCRTP database as of June 2013.

	Broad Zones		**Discrete Zones**[a]	
Coral Type	Number of Records within Broad Zones	% Composition of Broad Zone Records by Coral Type	Number of Records within Discrete Zones	% Composition of Discrete Zone Records by Coral Type
Soft corals and gorgonians	213	33.5%	82	35.6%
Stony corals	167	26.3%	64	27.8%
Sea pens	255	40.2%	84	36.5%
TOTAL	**635**	**100%**	**230**	**100%**

[a] All records within proposed discrete zones are also contained within the shallowest broad zone option (200 m), with the exception of two records in Norfolk Canyon (one sea pen and one stony coral).

Table 5: Deep sea coral presence records within the Mid-Atlantic region but NOT within any of the proposed zones. Data from DSCRTP database as of June 2013.

Coral Type	Number of Records OUTSIDE of proposed coral zones	% by Coral Type
Soft corals and gorgonians	23	10%
Stony corals	117	50%
Sea pens	92	40%
TOTAL	**232**	**100%**

Table 6: Deep sea coral historical presence records by proposed discrete zone. Note that these records reflect varying spatial concentrations of survey effort, and many areas have not been surveyed for corals. This data also does not contain any new records from recent research surveys (2012-2013).

	Coral Type (Order)				
Canyon or Complex	**Alcyonacea**	**Gorgonacea**	**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	1	1		3	**5**
Mey-Lindenkohl Slope	9	13	40	12	**74**
Spencer Canyon		1	9	2	**12**
Wilmington Canyon			2		**2**
North Heyes-South Wilmington Canyons					**0**
South Vries Canyon	1			1	**2**
Baltimore Canyon	7	21	1	25	**54**
Warr-Phoenix Canyon Complex			14		**14**
Accomac-Leonard Canyons	1		3	2	**6**
Washington Canyon				1	**1**
Norfolk Canyon	5	16	5	11	**37**
Grand Total	**25**	**57**	**84**	**64**	**230**

7.1.2 Recent Research Survey Data

As noted previously, deep sea corals have recently been observed within the boundaries of several proposed discrete coral zones, including Ryan Canyon, Block Canyon, the Mey-Lindenkohl Slope, Norfolk Canyon, and Baltimore Canyon. Although some qualitative results are available, much of the processed/georeferenced data from recent cruises is not yet available. New information has been incorporated into the range of alternatives to the extent possible, and will be added to the analysis as it becomes available before the amendment is finalized. Findings from each survey are briefly described below.

2012 BOEM Survey

In 2012, research cruises funded by the Bureau of Ocean Energy Management (BOEM) explored mid-Atlantic deepwater hard bottom habitat, focusing on canyon habitats and coral communities. This survey included many dives in Baltimore Canyon using a remotely operated vehicle (ROV), and a few 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 5). *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.[9] Several other coral types were observed in both Baltimore and Norfolk Canyons, including dense areas of *Paragorgia*, *Anthothela*, *Primnoa*, and *Acanthogorgia* communities (georeferenced data not yet available). Many sightings of lost fishing gear were also recorded in the two canyons, including traps, fishing lines, and nets. Baltimore and Norfolk Canyons are currently included in the range of possible deep sea coral discrete zones under Alternative 3B.

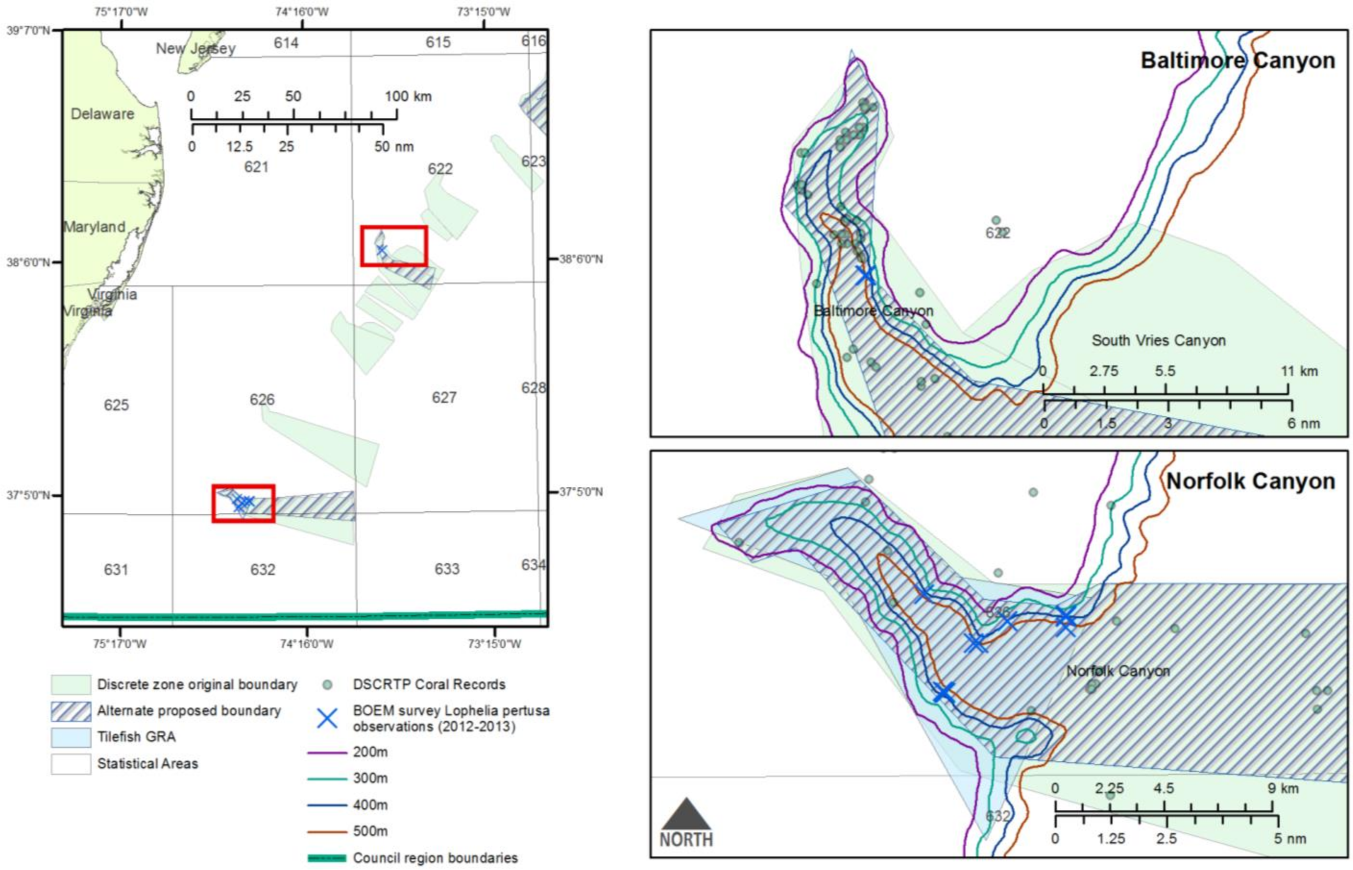

Figure 5: Observations of *Lophelia pertusa* from BOEM cruises in Baltimore and Norfolk Canyons, 2012 and 2013. Source: Brooke and Ross (2013).

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 Deep-Sea Coral Research and Technology Program from aboard the NOAA ship *Henry Bigelow*.[10] 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*

[9] Brooke, S., and Ross, S.W. In press. First observations of the cold-water coral *Lophelia pertusa* in mid-Atlantic canyons of the USA. Deep-Sea Res. II. http://dx.doi.org/10.1016/j.dsr2.2013.06.011.

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

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 (recommended based on coral presence). 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 (Table 7). The majority of corals were octocorals, with fewer observations of scleractinians (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.

2013 DSCRTP 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 logical 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. Five tows were made, covering shallow, mid, and deeper depths within the canyon. Based on data collected from approximately 9,000 bottom images, corals were virtually nonexistent along the shallowest (closest to the canyon head) tow tracks. Corals were significantly more abundant at the deepest tow (Table 7). Similar to results from the 2012 expedition, in the areas surveyed, the majority of corals observed were octocorals and differences in coral distribution within Ryan Canyon likely reflect differences in depth and substrate type. One camera tow survey, following the 500 m contour, was made in the intercanyon area between Ryan and McMaster canyons. Corals were observed in only one image.

2013 Okeanos Explorer Survey

In the summer of 2013, the NOAA vessel *Okeanos Explorer* explored mid-Atlantic 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.[11]

2014 Fieldwork in the Mid-Atlantic Region

A 12-day cruise aboard the *Henry Bigelow* will begin Tuesday, August 5, 2014 and will conduct towed camera surveys in several Mid-Atlantic canyons. Using the WHOI camera system TowCam, researchers will explore Carteret, Lindenkohl, Spencer, Wilmington, Accomac, and Washington canyons. Results from this cruise will likely influence the choice of canyons selected by NOAA OER for exploration during the 18-day Okeanos Explorer September 2014 seamount cruise. Seven to ten ROV dives will be dedicated to canyons during that cruise.

[11] http://oceanexplorer.noaa.gov/okeanos/explorations/ex1304/dailyupdates/dailyupdates.html

Table 7: Preliminary image survey of NE 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

7.1.3 Northeast Fisheries Observer Program Records

Records of deep-sea coral bycatch in the Northeast region observer program data 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, because fishermen tended to toss the pile over the side, for most of the records, the total weight (in pounds) for deep-sea coral in a given haul was 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.

Within the Mid-Atlantic Council region, only 11 records of deep sea corals have been reported in the observer data since 1994 (Table 9). Of these, six of were recorded as interactions with gill nets in state waters in the Chesapeake Bay area. Of the remaining 5 records in federal waters, none occur within any of the currently proposed deep sea coral zones (Figure 6).

Table 8: NEFOP records of deep sea interactions in the Northeast 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**

Table 9: NEFOP records of deep sea corals within the Mid-Atlantic Council Region, 1994-2014. NK= not known.

Coral Records by Gear Type	Number of observations	Total weight (kg)
DREDGE, SCALLOP,SEA	**3**	**10.6**
CORAL, STONY, NK	3	10.6
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	**6**	**120**
CORAL, STONY, NK	6	120
TRAWL,OTTER,BOTTOM,FISH	**2**	**100.1**
CORAL, SOFT, NK	1	0.1
CORAL, STONY, NK	1	100
Grand Total	**11**	**230.7**

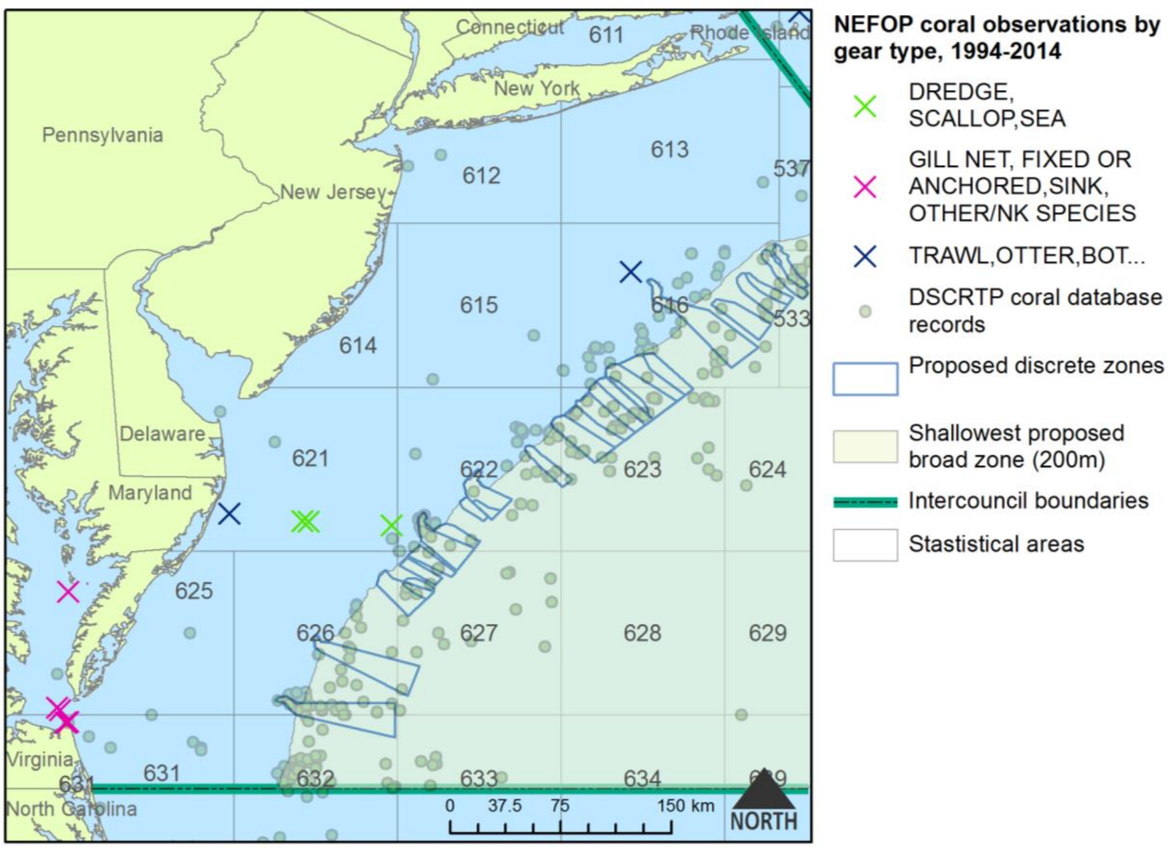

Figure 6: NEFOP records of deep sea corals in the Mid-Atlantic, 1994-2014.

7.1.4 Deep Sea Coral Habitat Suitability Model

The following summarizes the results of a habitat suitability model for deep sea corals in the Northeast region, developed in partnership between NOAA's National Centers for Coastal Ocean Science (NCCOS) and NOAA Northeast Fisheries Science Center (NEFSC).[12] This predictive habitat model was developed by relating two types of data: 1) known deep sea coral presence locations (from the Deep Sea Coral Research & Technology Program database), and 2) environmental and geological predictor variables. A variety of environmental inputs were incorporated, including variables for slope, depth, depth change, aspect ratio, rugosity, salinity, oxygen, substrate, temperature, turbidity, and others.

In the Northeast 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 was used to evaluate each proposed discrete zone (Table 10-11, Figures 7-18). Model outputs are displayed in Figures 7 through 18 below, and reflect the predicted likelihood of deep sea coral habitat for a given area. In these maps, the values for predicted likelihood of coral habitat suitability are displayed by the following likelihood categories: very low, low, medium, high, and very high.

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.

However, 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 square km (although there are plans to improve model resolution to the 25 km scale within the next several years). These maps should be viewed as representing only the general locations of predicted suitable coral habitat (within approximately 350-750 meters, or approximately two model grid cells). Also, model predictions are of coral presence, and high likelihood of presence will not necessarily correlate with high abundance.

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[12] Kinlan BP, Poti M, Drohan A, Packer DB, Nizinski M, Dorfman D, Caldow C. 2013. Digital data: Predictive models of deep-sea coral habitat suitability in the U.S. Northeast Atlantic and Mid-Atlantic regions. Downloadable digital data package. Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Monitoring and Assessment (CCMA), Biogeography Branch. Released August 2013. Available at: <http://coastalscience.noaa.gov/projects/detail?key=35>. Funding for this research was provided by the National Marine Fisheries Service - Northeast Fisheries Science Center, the NOAA Deep Sea Coral Research and Technology Program, and the National Ocean Service - National Centers for Coastal Ocean Science.

Table 10: Percent of each proposed discrete zone area within each predicted habitat suitability likelihood class (very low, low, medium, high, and very high), and total discrete zone area.

	Percent of canyon area within each likelihood class of predicted habitat suitability for Alcyonacean and Gorgonian Corals					
Canyon or Complex	**Very Low**	**Low**	**Medium**	**High**	**Very High**	**Total canyon Area (km^2)**
Block Canyon	9%	22%	61%	6%	2%	231.6
Ryan-McMaster Canyons	17%	19%	49%	11%	4%	390.3
Emery-Uchupi Canyons	18%	27%	42%	10%	2%	369.2
Jones-Babylon Canyons	12%	19%	46%	17%	5%	166.1
Hudson Canyon	12%	15%	30%	12%	30%	770.8
Mey-Lindenkohl Slope	18%	27%	41%	9%	6%	2818.2
Mey-Lindenkohl Slope *(Advisor proposed; Straight line)*	20%	28%	39%	8%	5%	2445.3
Mey-Lindenkohl Slope *(Advisor proposed; Depth-based)*	20%	27%	38%	9%	7%	2458.8
Spencer Canyon	18%	16%	49%	7%	10%	163.3
Wilmington Canyon	5%	7%	23%	15%	50%	268.1
North Heyes-South Wilmington Canyons	2%	10%	47%	27%	14%	183.4
South Vries Canyon	8%	11%	39%	30%	12%	142.6
Baltimore Canyon	8%	6%	31%	13%	42%	231.0
Baltimore Canyon *(Advisor proposed)*	13%	7%	23%	16%	41%	220.7
Warr-Phoenix Canyon Complex	5%	10%	51%	24%	10%	511.6
Accomac-Leonard Canyons	22%	20%	44%	12%	2%	538.2
Washington Canyon	45%	19%	22%	5%	10%	554.1
Norfolk Canyon	51%	8%	20%	8%	14%	543.7
Norfolk Canyon *(Advisor proposed)*	55%	8%	17%	7%	12%	598.4

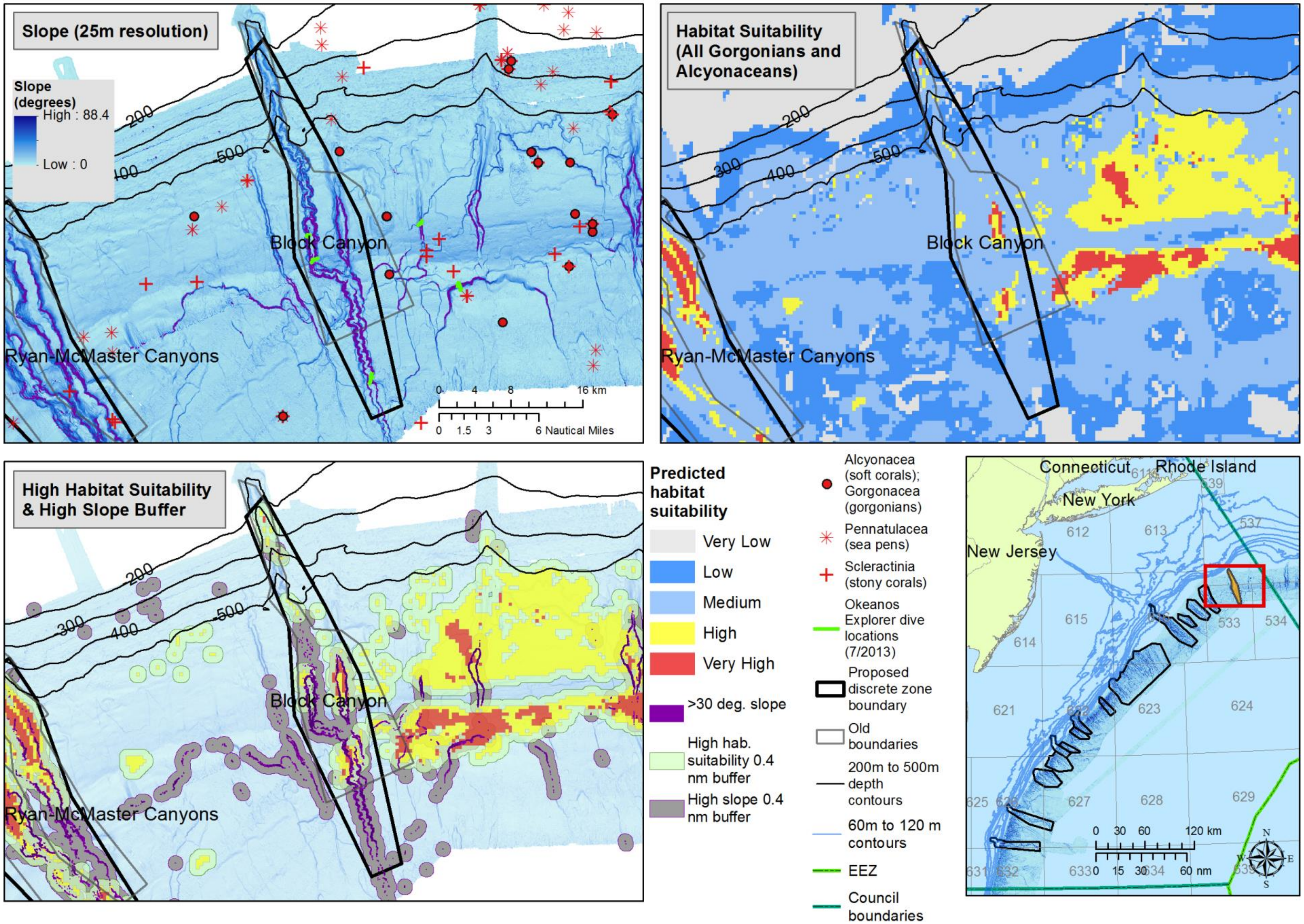

Figure 7: Block Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

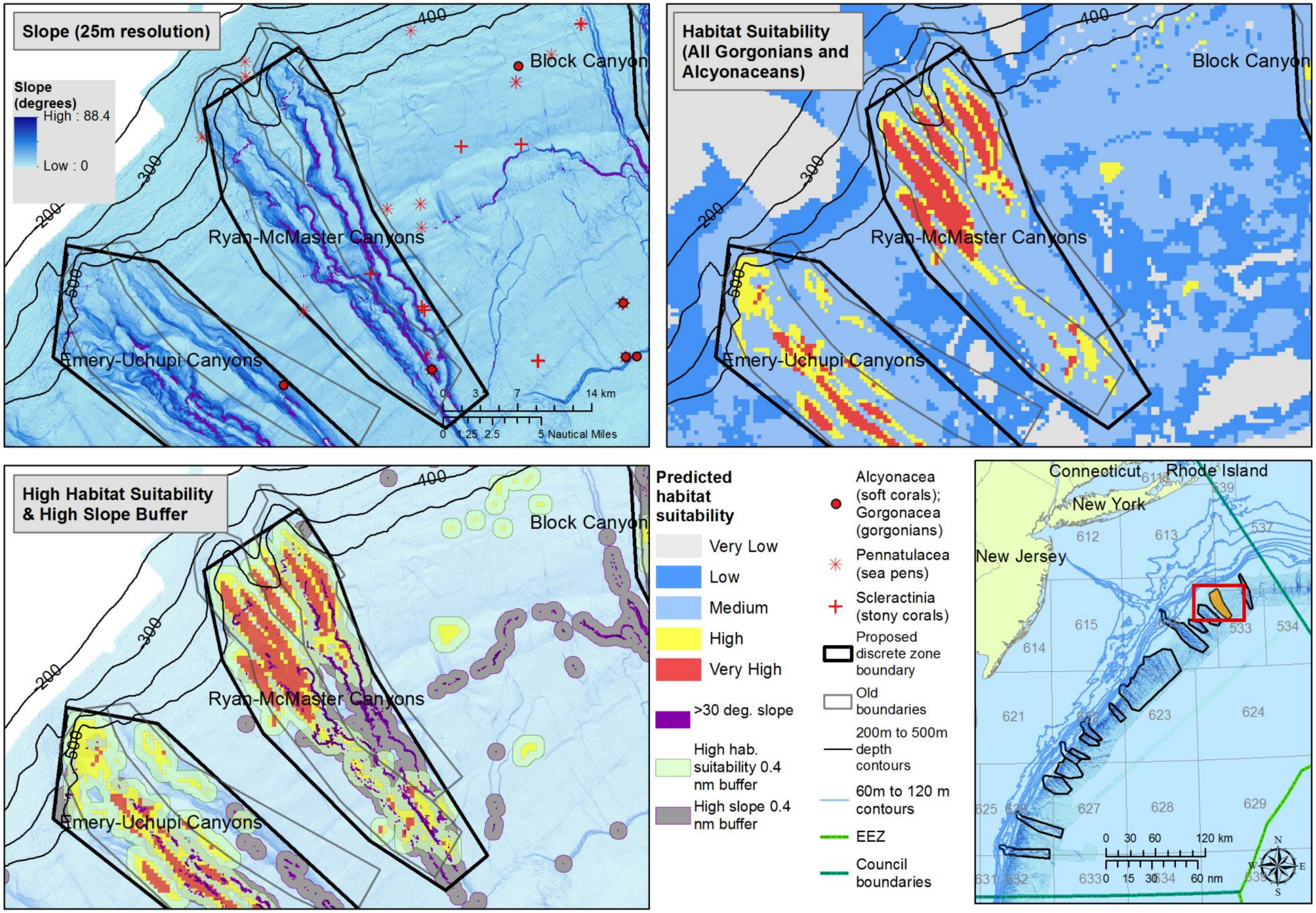

Figure 8: Ryan and McMaster Canyons areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

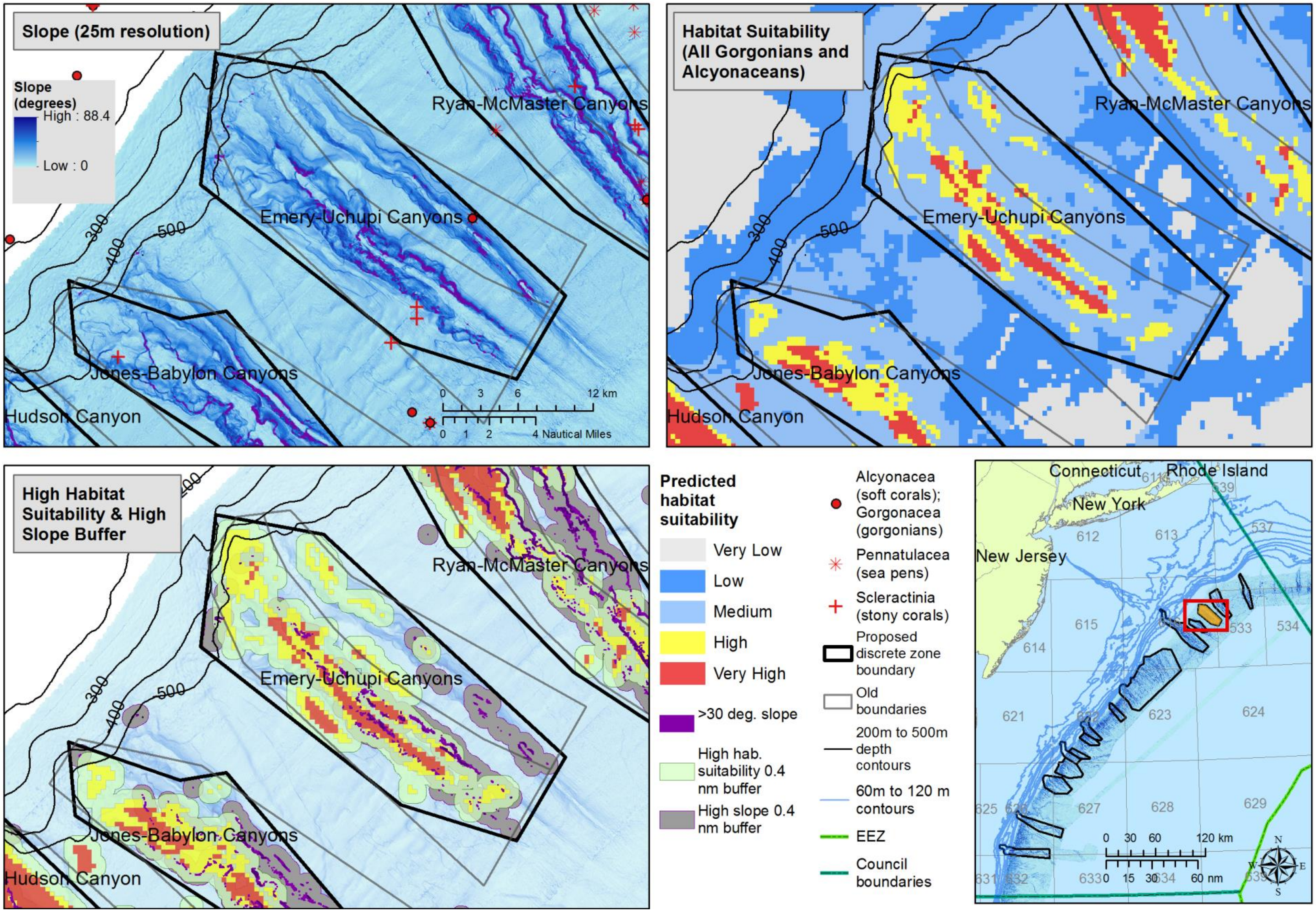

Figure 9: Emery and Uchupi Canyons areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

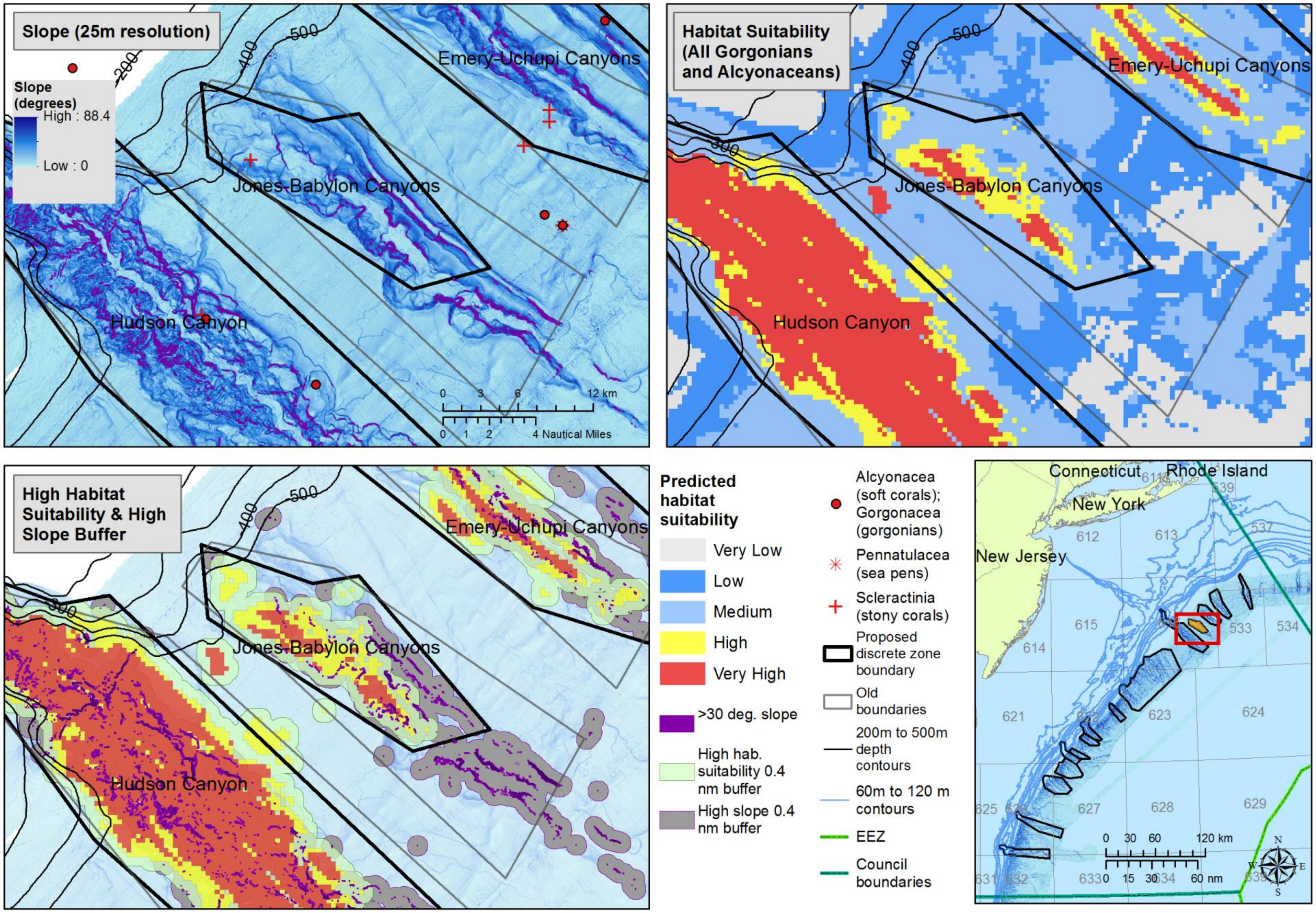

Figure 10: Jones and Babylon Canyons areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

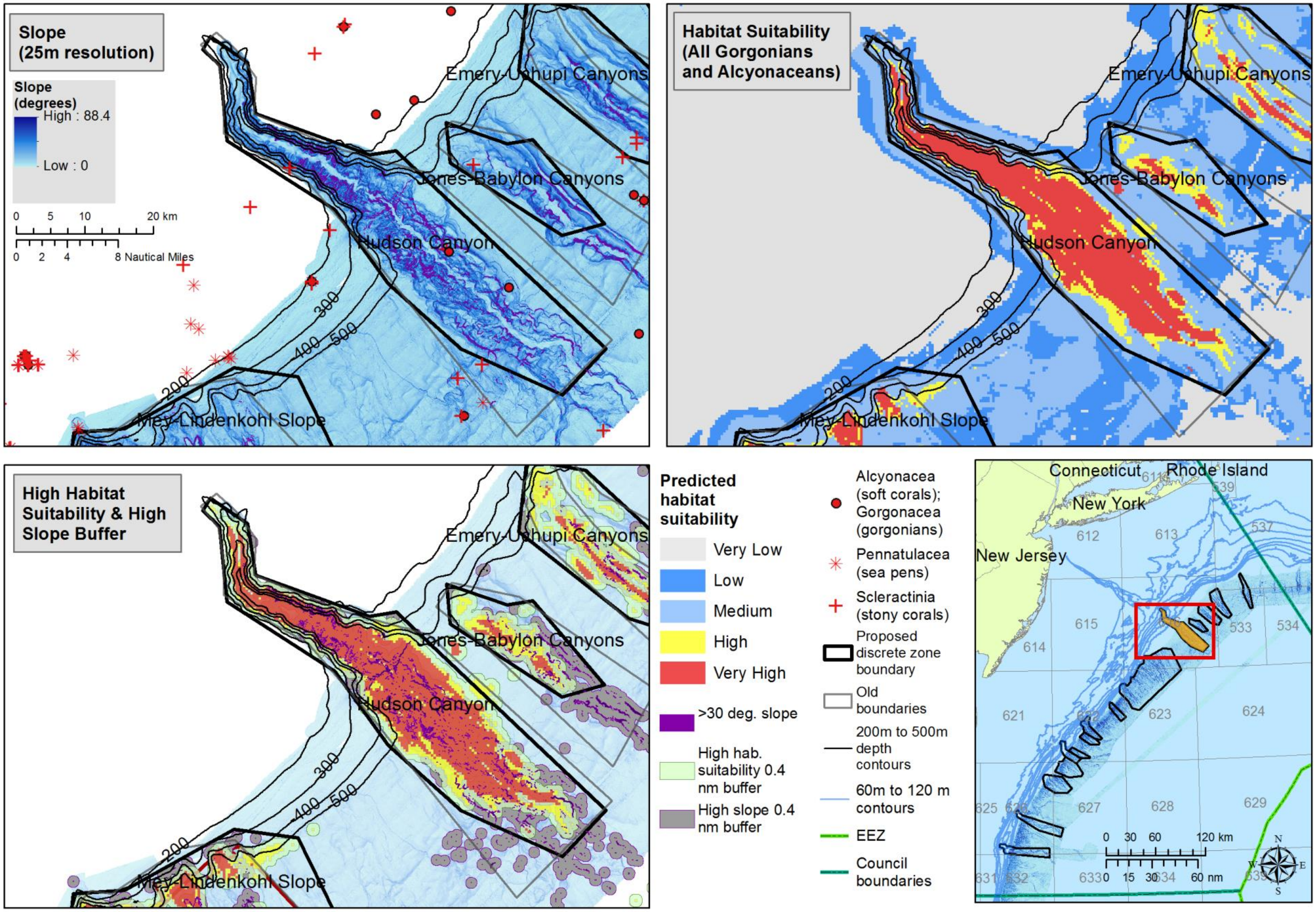

Figure 11: Hudson Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

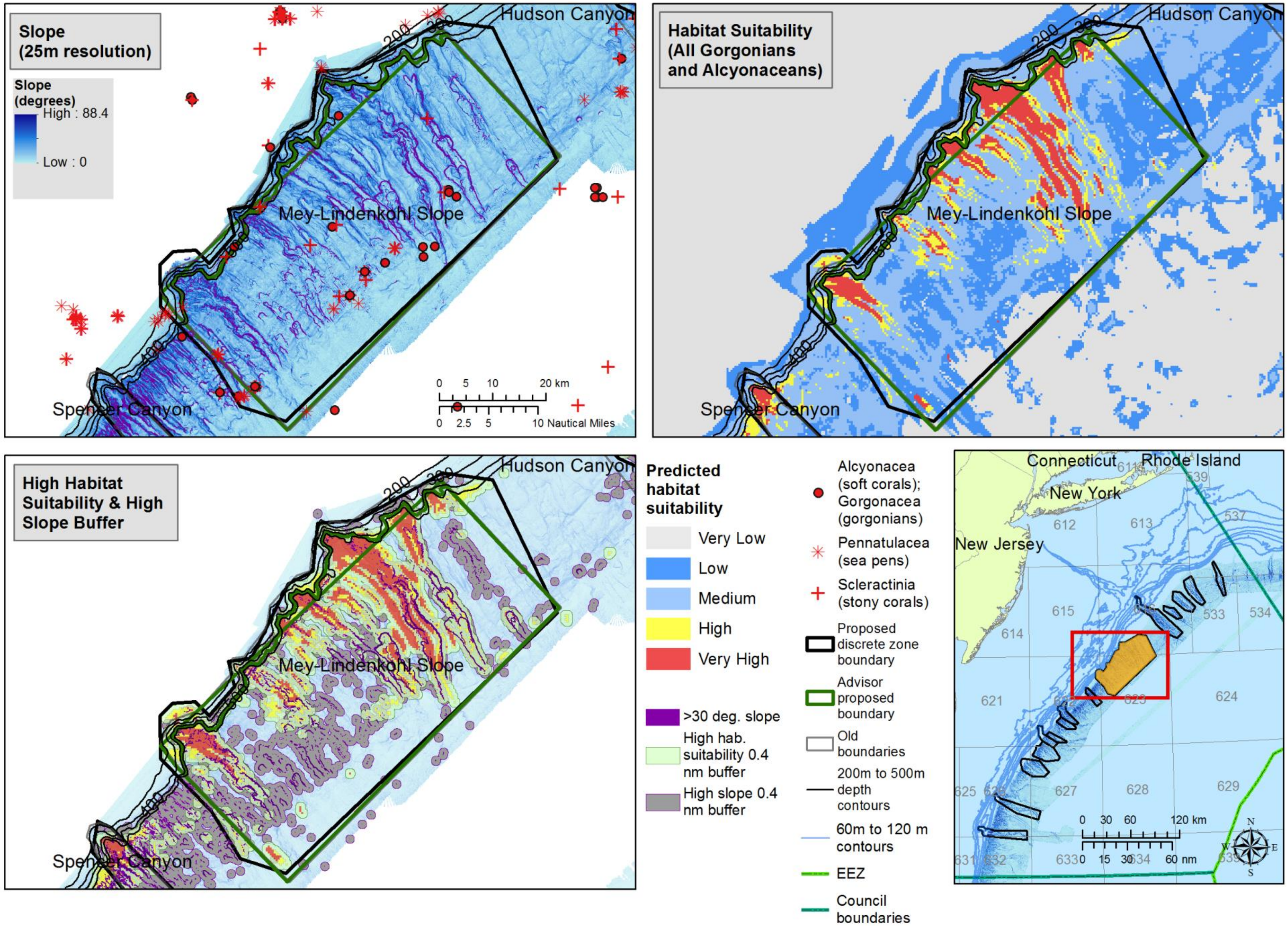

Figure 12: Mey-Lindenkohl Slope areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

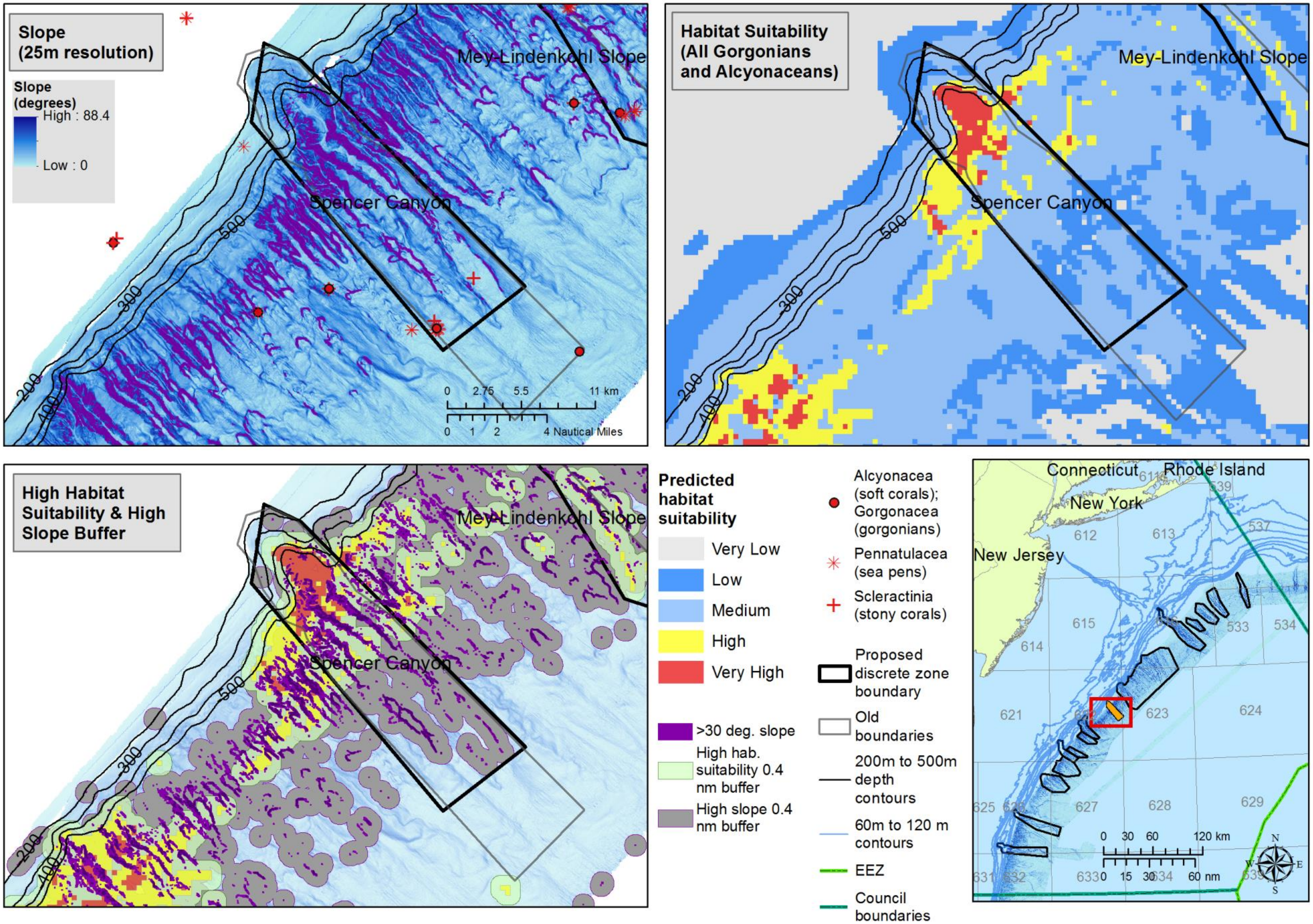

Figure 13: Spencer Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

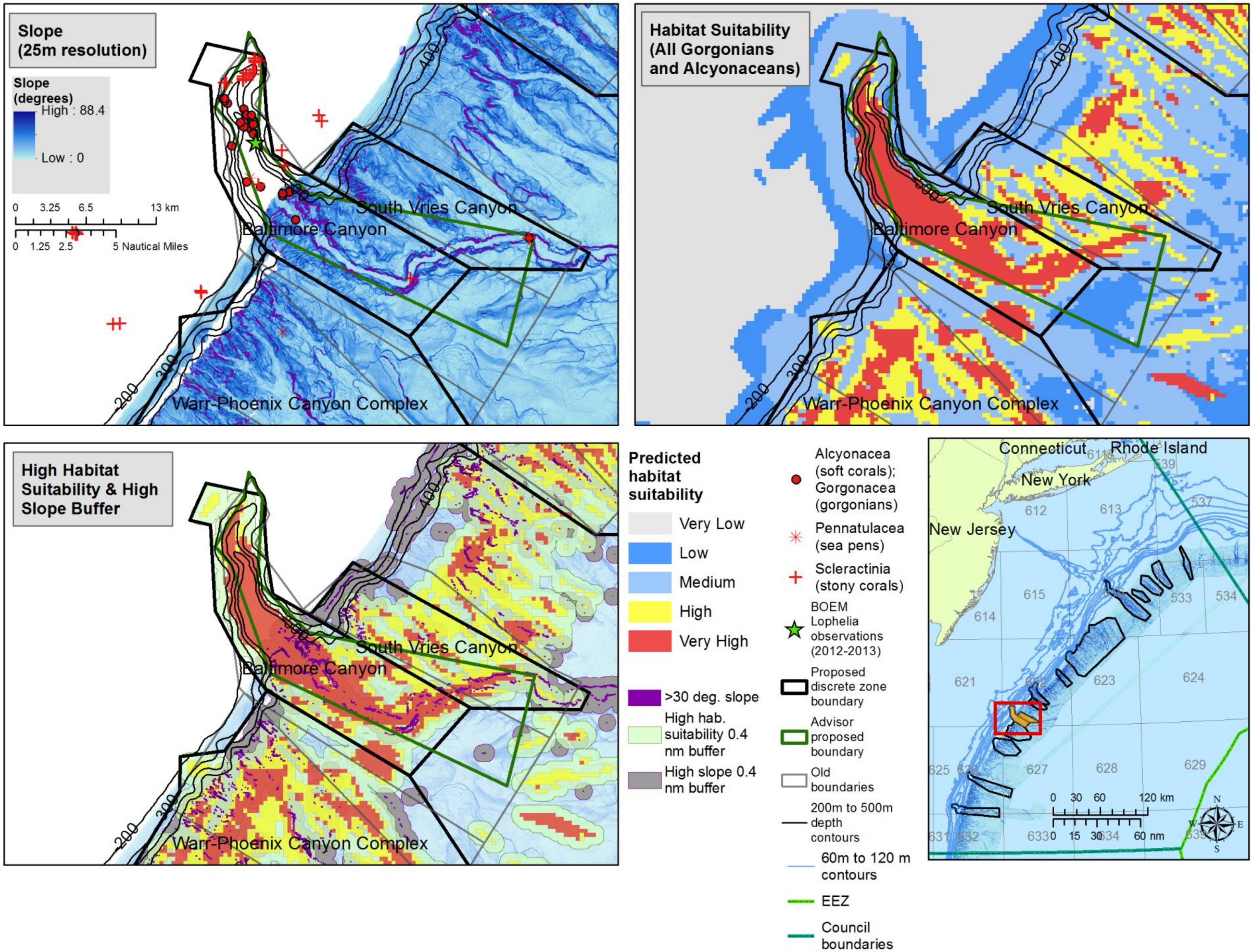

Figure 14: Baltimore Canyon and South Vries Canyons (two separate proposed areas) areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

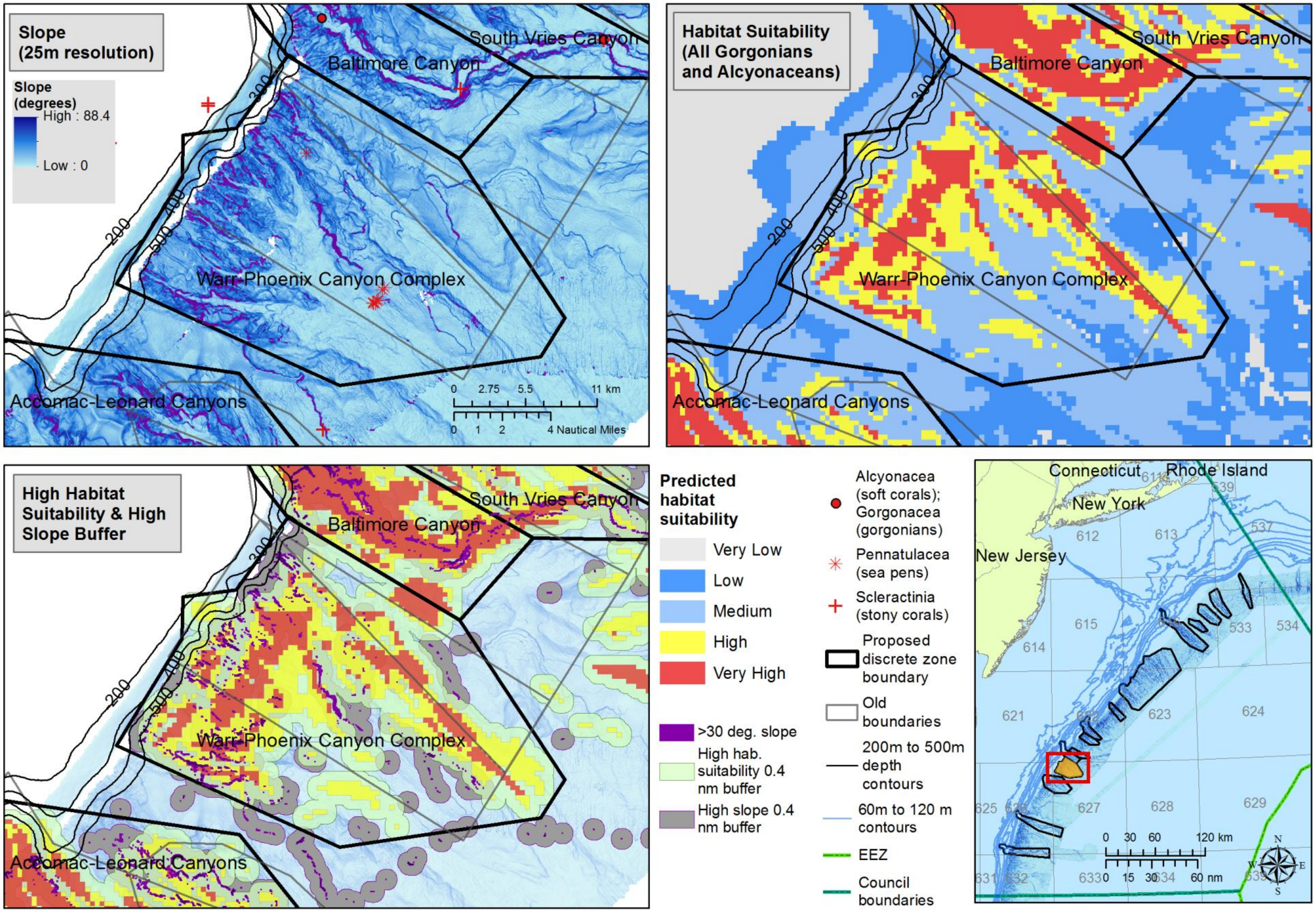

Figure 15: Warr-Phoenix Canyon Complex areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

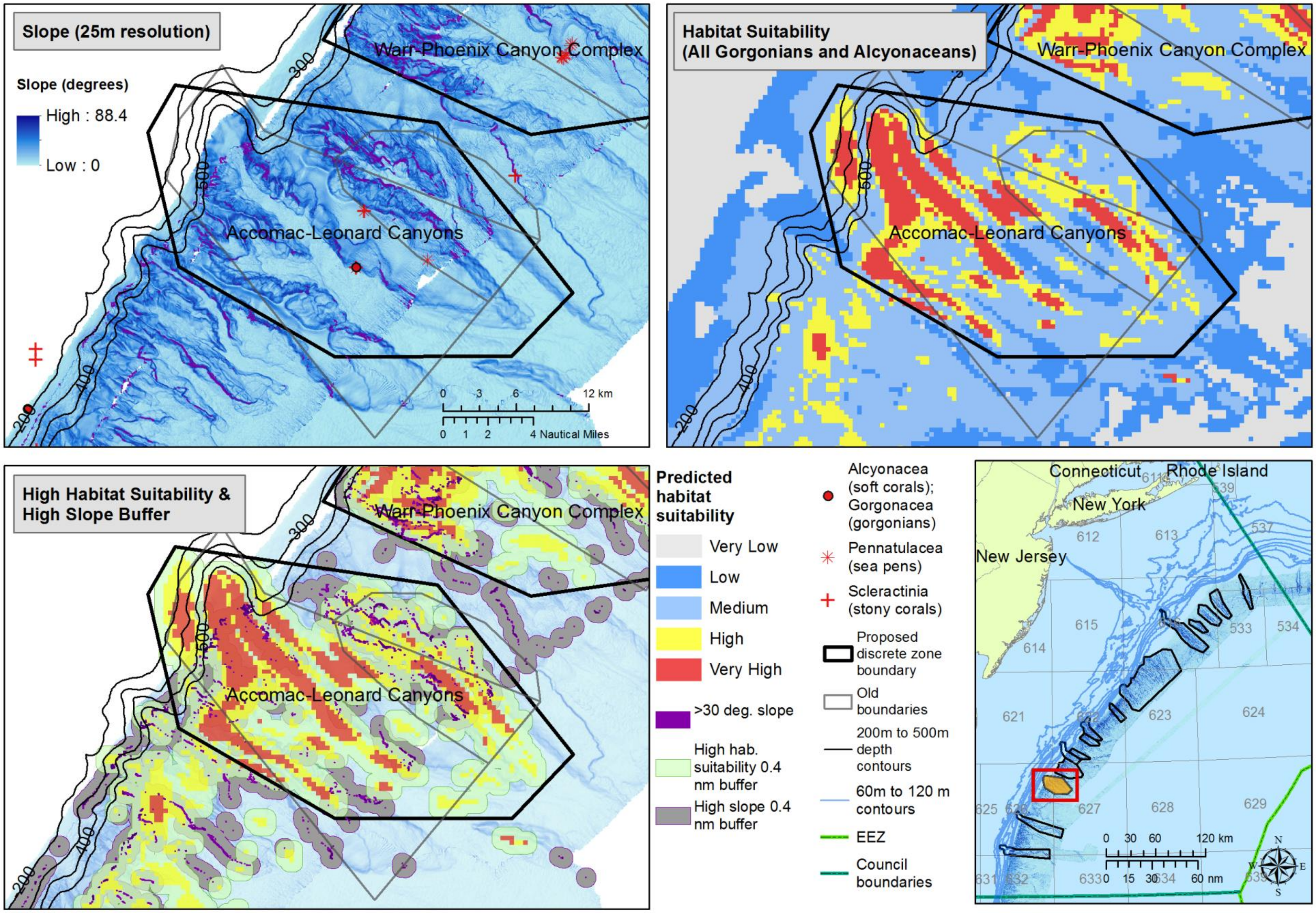

Figure 16: Accomac and Leonard Canyons areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

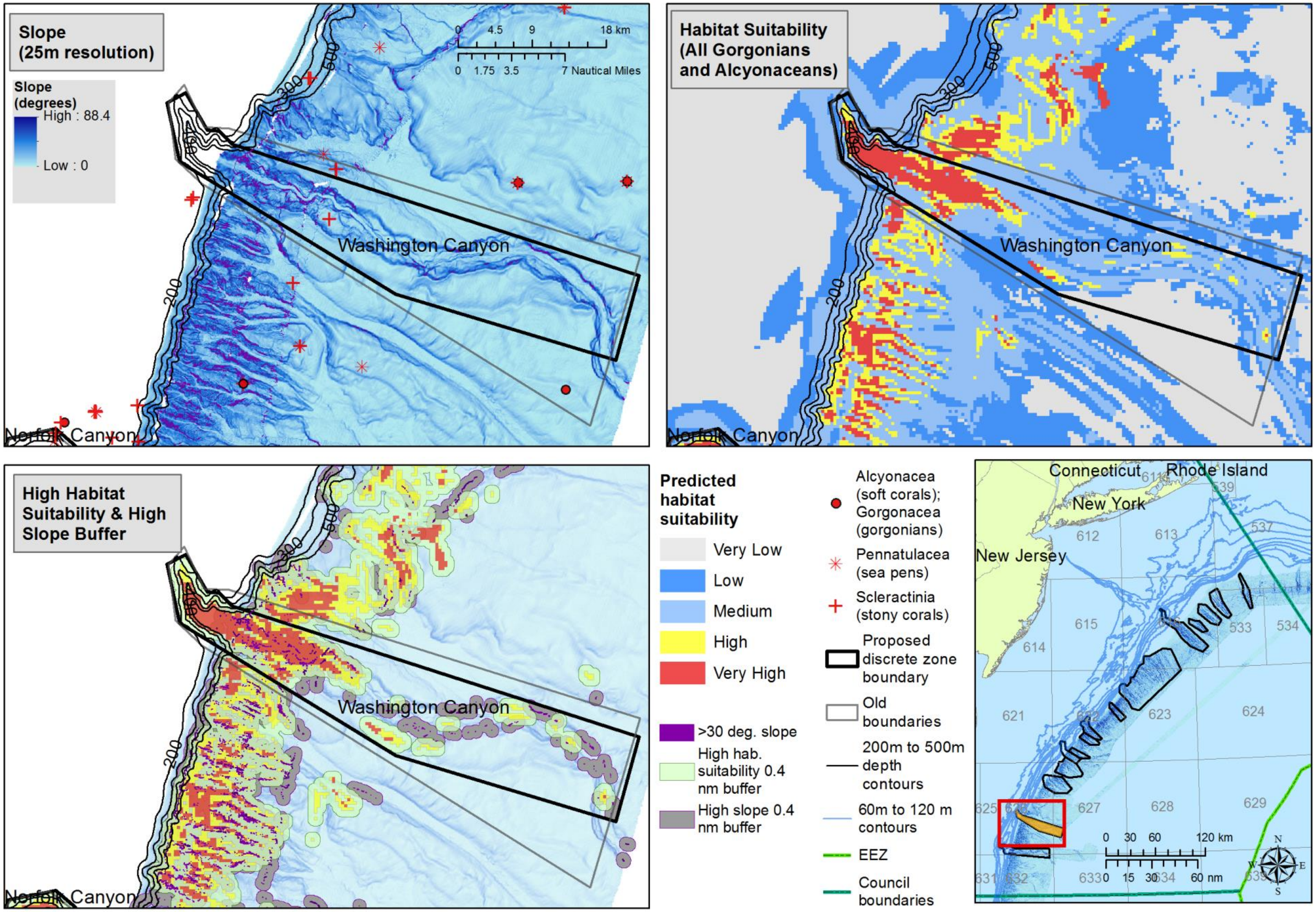

Figure 17: Washington Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

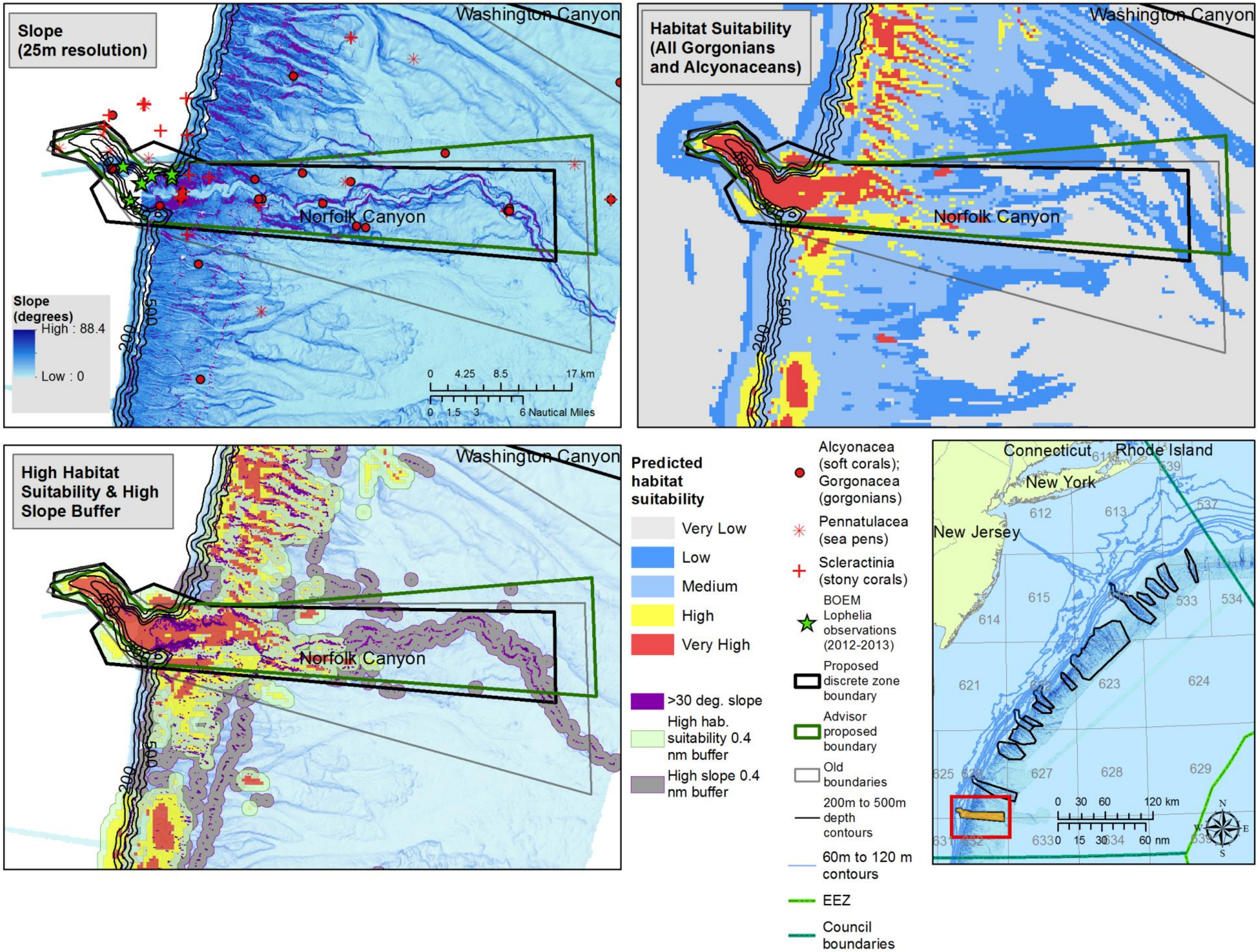

Figure 18: Norfolk Canyon areas of high slope, deep sea coral habitat suitability, and discrete zone boundaries.

Table 11: Summary of analysis across proposed discrete zones 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)	Recent fieldwork with coral observations?	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	231.6	0	✓	17.7	7.6%	16.5	7.1%
Ryan-McMaster Canyons	390.3	16	✓	59.3	15.2%	15.0	3.9%
Emery-Uchupi Canyons	369.2	6		44.1	11.9%	12.0	3.3%
Jones-Babylon Canyons	166.1	1		37.4	22.5%	9.0	5.4%
Hudson Canyon	770.8	5		329	42.7%	82.7	10.7%
Mey-Lindenkohl Slope	2818.2	74	✓	414.1	14.7%	178.9	6.3%
Spencer Canyon	163.3	12		28	17.1%	22.6	13.8%
Wilmington Canyon	268.1	2		172.8	64.5%	24.1	9.0%
North Heyes-South Wilmington Canyons	183.4	0		74	40.3%	12.0	6.6%
South Vries Canyon	142.6	2		59.9	42.0%	13.5	9.5%
Baltimore Canyon	231	54	✓	126.8	54.9%	19.5	8.5%
Warr-Phoenix Canyon Complex	511.6	14		174.1	34.0%	19.5	3.8%
Accomac-Leonard Canyons	538.2	6		70.6	13.1%	19.5	3.6%
Washington Canyon	554.1	1		81.6	14.7%	12.0	2.2%
Norfolk Canyon	543.7	37	✓	118.4	21.8%	45.1	8.3%

7.2 FISHERY EFFORT AND ECONOMIC IMPACTS

7.2.1 Northeast Fisheries Observer Program Data

Observer data from the Northeast Fisheries Observer Program (NEFOP) were obtained for bottom trawl, bottom longline, and sink/anchored gillnet gear types for years 2000 through 2013 for the MAFMC region. Records with incomplete geographic coordinates were unable to be plotted and were removed. Observer hauls were analyzed relative to proposed broad zones. Although observer overage varies by fishery and by year, aggregating the data over many years can reveal patterns in fishing effort with a higher degree of spatial accuracy than can be obtained using VTR data.

Observed Bottom Trawl Effort

Within the MAFMC management region, there were 25,073 total observed hauls (on 3,967 trips) using bottom trawl gear within this time period (Table 12; Figure 15). Tables 13-16 show the number of 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 Tables 13-16 if 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 19). For observed bottom trawl hauls over this time period, 14% intersect the 200 meter broad zone, 6% intersect the 300 meter broad zone, 0.03% intersect the 400 meter broad zone, and 0.01% intersect the 500 m broad zone.

Table 12: 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**	**87 m (48 ftm)**

Table 13: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by gear type and target species, intersecting the **200 meter broad zone** alternative, 2000-2013. Records removed for species observed on less than 5 hauls.

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**	**202 m (110 ftm)**

Table 14: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by gear type and target species, intersecting the **300 meter broad zone** alternative, 2000-2013. Records removed for species observed on less than 5 hauls.

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**	**222 m (122 ftm)**

Table 15: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by gear type and target species, intersecting the **400 meter broad zone** alternative, 2000-2013. Records removed for species observed on less than 5 hauls.

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**	**225 m (123 ftm)**

Table 16: NEFOP observed bottom trawl hauls, trips, and average haul start depth, by gear type and target species, intersecting the **500 meter broad zone** alternative, 2000-2013.

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**	**192 m (105 ftm)**

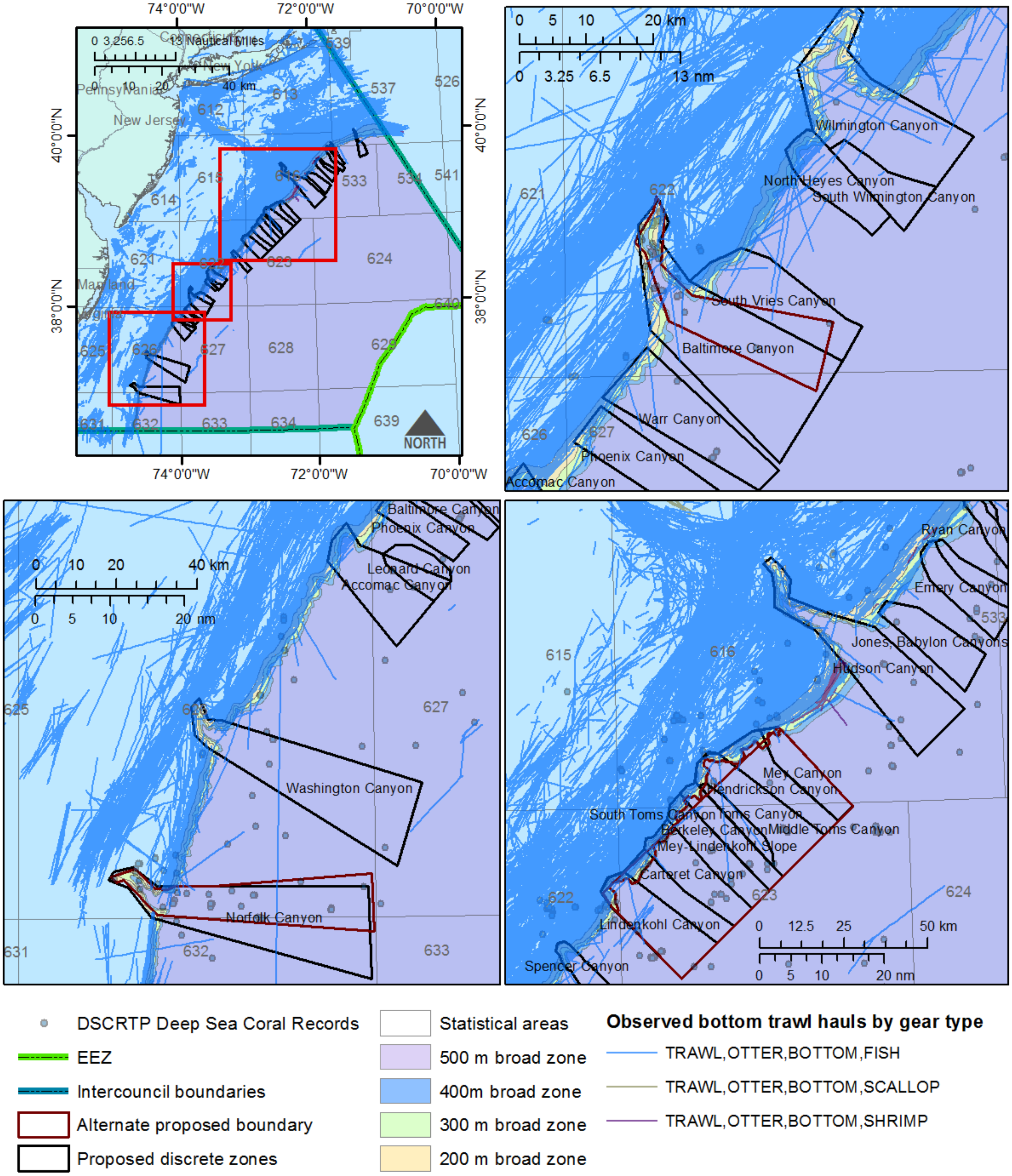

Figure 19: NEFOP observed bottom trawl hauls in the mid-Atlantic region by gear type, 2000-2013.

Observed Gillnet Effort

Observer data indicate that in the Northeast 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 MAFMC region, there were 13,928 observed hauls using gillnet gear, on 3,432 trips (Table 17a). Of these observed hauls, only six intersected any of the proposed coral zones (0.0004%). 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 20).

The vast majority of observed gillnet effort since 2000 has occurred in waters significantly shallower than the depths of any of the proposed coral zones in the mid-Atlantic (Table 17). Only about 0.006% of observed gillnet trips and 0.005% of observed gillnet hauls occurred deeper than 75 fathoms (137 meters), according to haul depth information recorded in the observer data.

Table 17: 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 Depth
GILL NET, ANCHORED-FLOATING, FISH	32	135	10 m (5 fathoms)
GILL NET, DRIFT-FLOATING, FISH	197	621	20 m (11 fathoms)
GILL NET, DRIFT-SINK, FISH	496	2,045	8 m (15 fathoms)
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	2,707	11,127	12 m (22 fathoms)
Total	**3,432**	**13,928**	**11 m (21 fathoms)**

b) Within proposed coral zones

Gear Type	Trips	Hauls	Average Haul Depth
GILL NET, FIXED OR ANCHORED,SINK, OTHER/NK SPECIES	2	6	282 m (154 fathoms)
Total	**2**	**6**	**282 m (154 fathoms)**

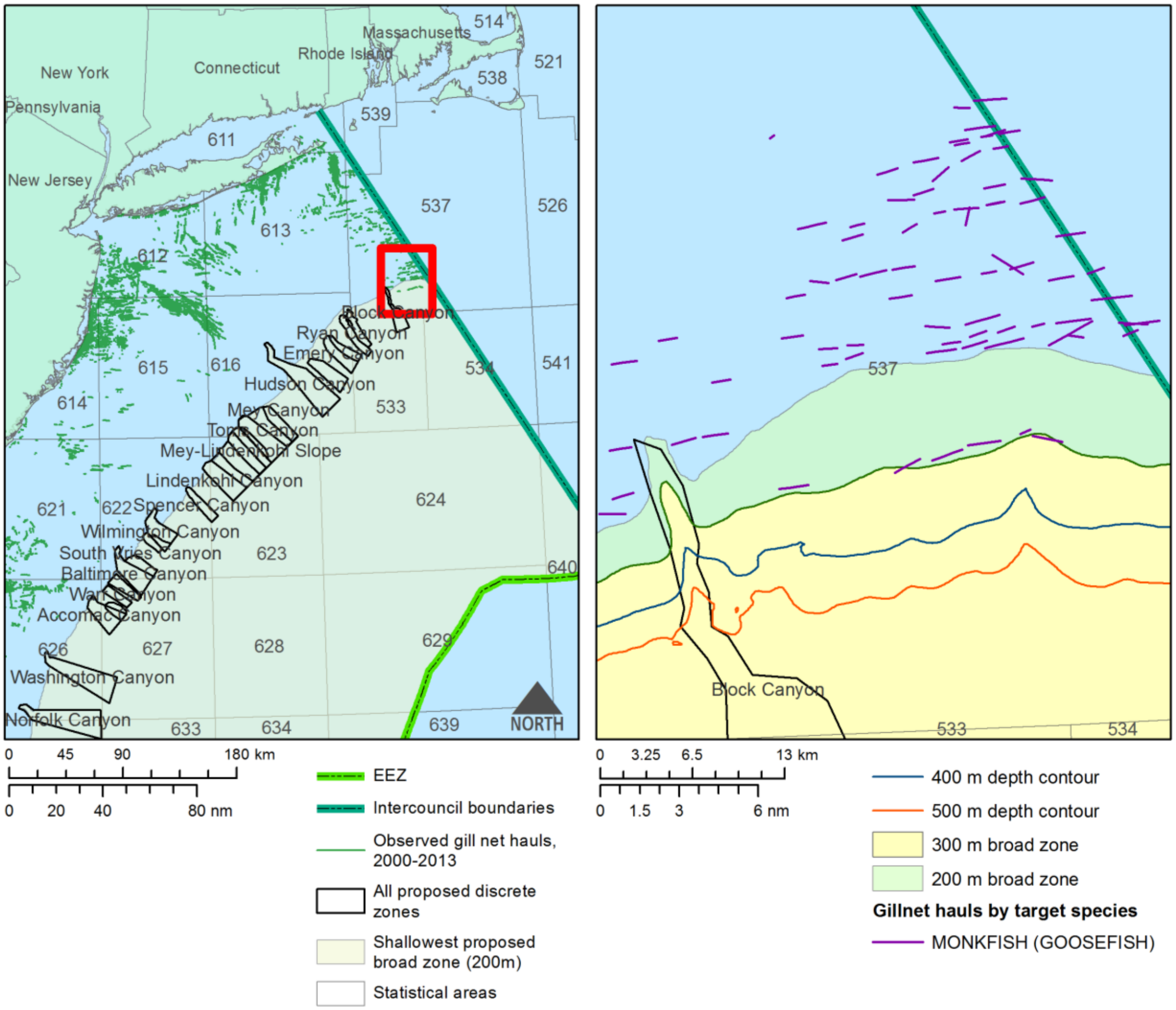

Figure 20: NEFOP observer hauls for gillnet gear in the mid-Atlantic, 2000-2013, and area of intersection with proposed MAFMC broad coral zones.

Observed Bottom Longline Effort

For years 2000-2013, a total of 885 trips and 4,791 hauls using bottom longline gear were recorded for the Northeast Region in the NEFOP database. The majority of these records occurred within the management region of the New England Fishery Management Council, 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 18; Figure 21).

In total, the proposed coral zones are intersected by most of these observed longline trips occurring within the MAFMC region (92%), but 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 21). 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 18: NEFOP Observer data records of hauls using bottom longline gear from 2000-2013 a) in the MAFMC region, and b) within proposed coral zones.

a) Within MAFMC Region

Gear Type, Target Species	Trips	Hauls	Average Haul 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 coral zones

Gear Type, Target Species	Trips	Hauls	Average Haul Depth
LONGLINE, BOTTOM			
TILEFISH, GOLDEN	10	54	205 m (112 ftm)
TILEFISH, NOT KNOWN	2	15	195 m (106 ftm)
Grand Total	**12**	**69**	**203 m (111 ftm)**

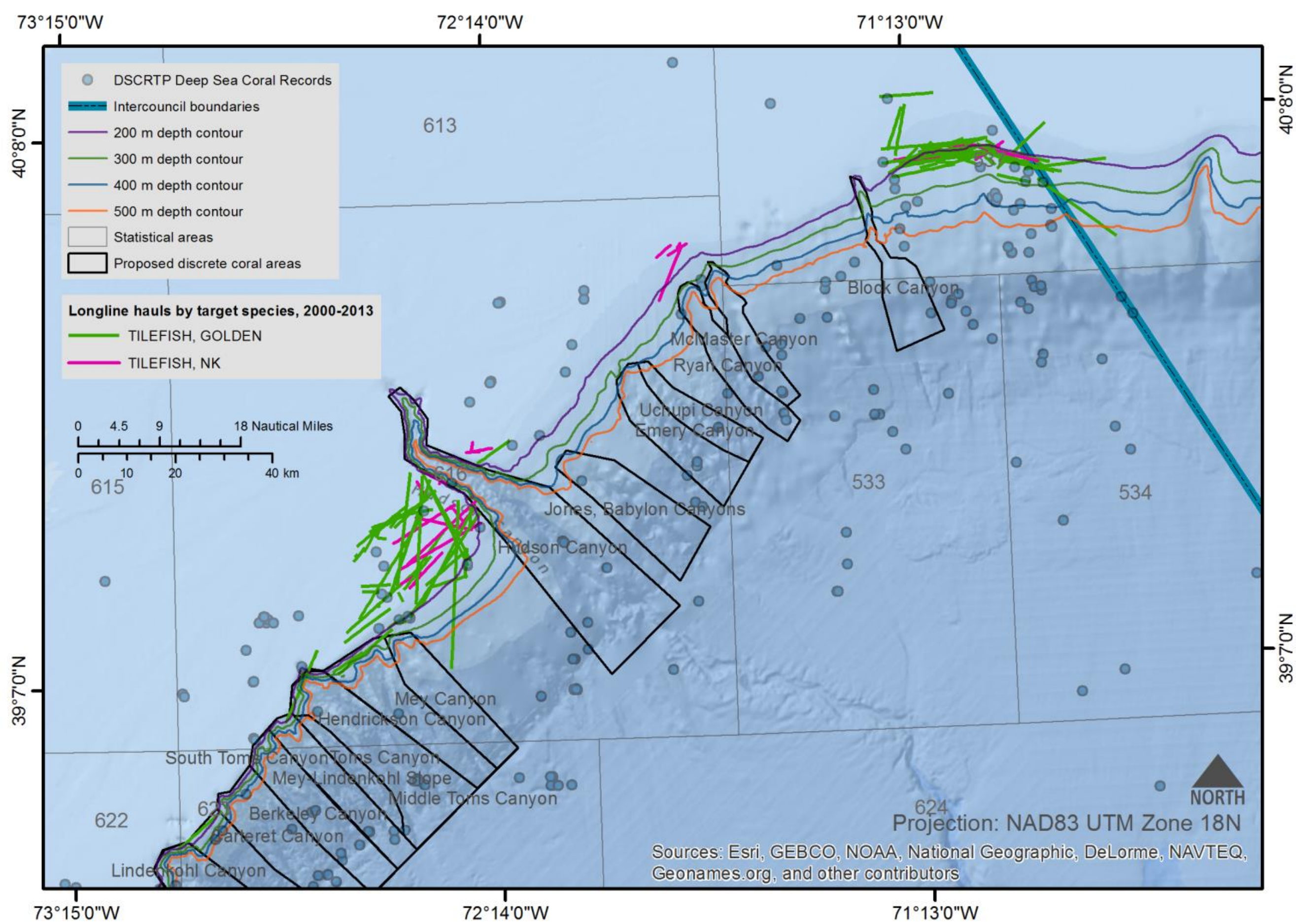

Figure 21: Observed bottom longline hauls in the MAFMC region, 2000-2013.

7.2.2 VTR Revenue Mapping Model

Economic impacts of proposed coral zones were analyzed using a Vessel Trip Report (VTR)-based revenue mapping model produced by the Northeast Fisheries Science Center. 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. The revenue-mapping model covers the years 2007-2012, and estimates revenue generated from fishing trips in a given area based on specified parameters such as gear type, species, or port of landing. The model takes into account uncertainty around reported VTR points, and can be used to identify areas important to specific fishing communities, species, gears, and seasons to establish a baseline of commercial fishing effort.

VTR-point data were used to identify the primary gear-species combinations that occur within proposed broad and discrete zones (Figures 22-24), in order to identify which combinations to query within the revenue mapping model. Revenue-intensity maps (Figures 25-30) were then generated for gear-species combinations that in total accounted for approximately 95% of estimated revenue generated within the proposed coral zones.

The primary gear types used 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 (Figure 22). The primary species caught include longfin squid, *Illex* squid, sea scallops, deepsea red crab, American lobster, summer flounder, silver hake (whiting), golden tilefish, Jonah crab, scup, and black sea bass (Figure 23).

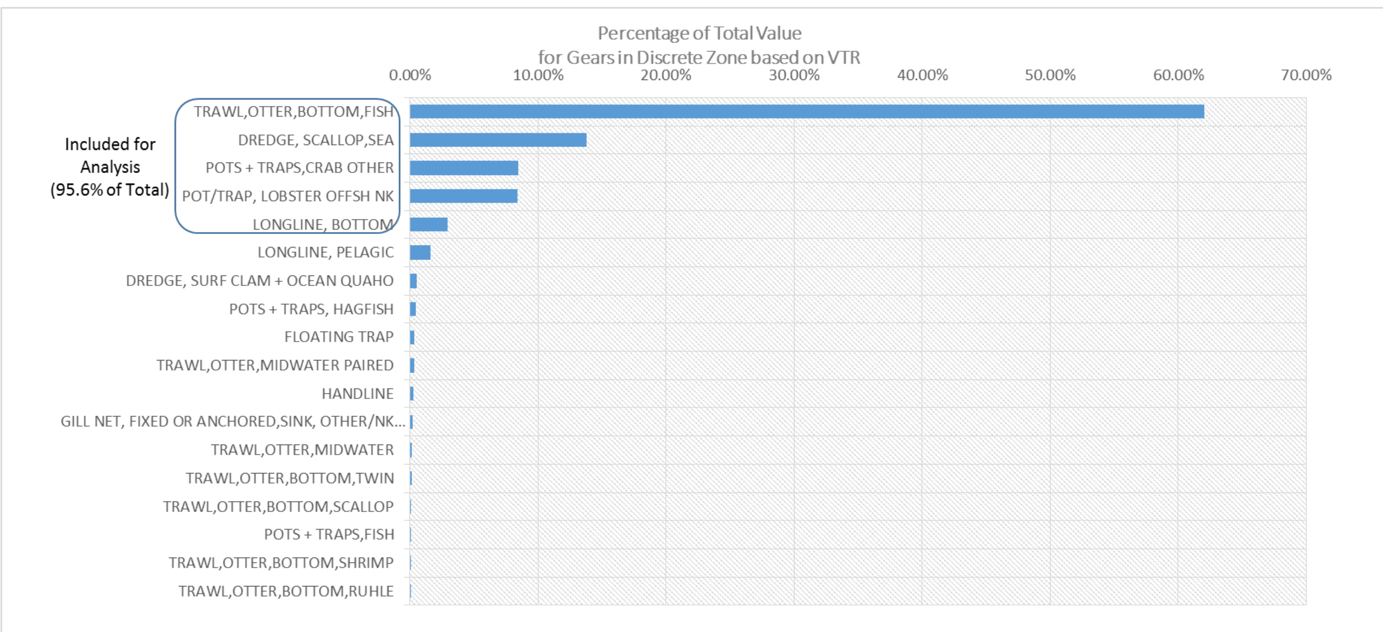

Figure 22: Primary gears used within proposed coral zones, based on VTR data.

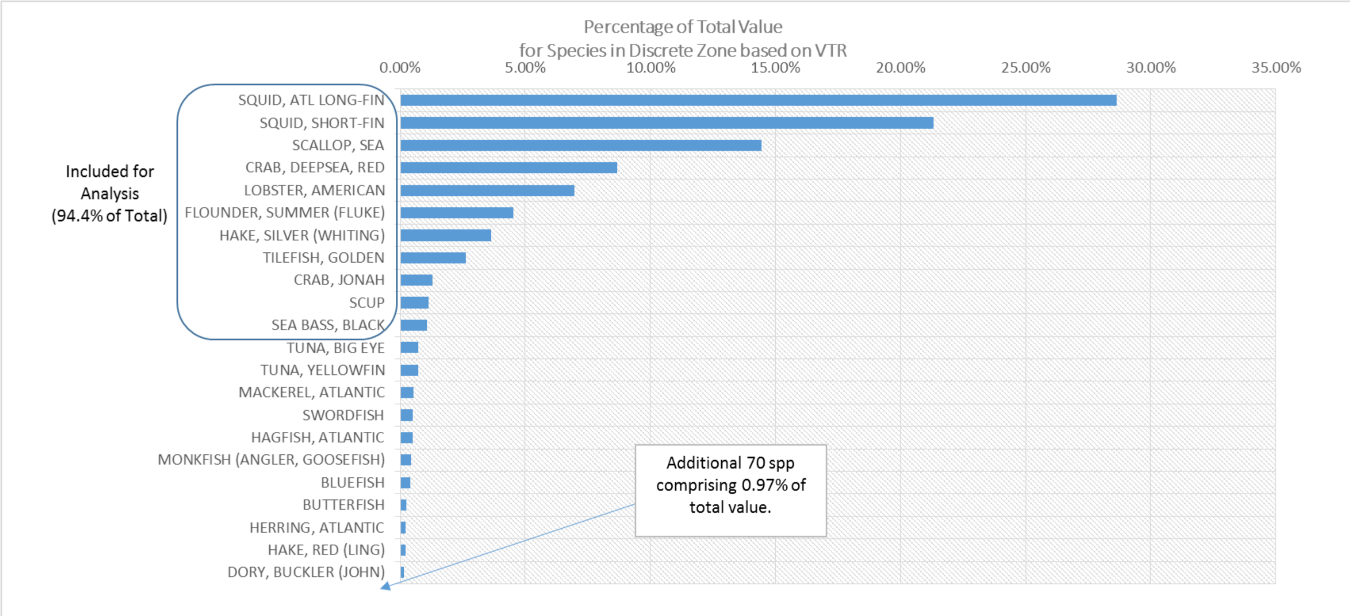

Figure 23: Primary species caught within proposed coral zones, based on VTR point data.

The primary gear-species combinations identified for further analysis (Figure 24) include:

1. Bottom otter trawl – Squid (*Illex* and longfin)
2. Bottom otter trawl – Hake
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
7. Lobster pots – American lobster
8. Lobster pots – Jonah crab

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. Management measures applied under the discretionary provisions of the MSA to designate deep sea coral zones would be applicable to Federally-managed fisheries only, meaning they would not impact lobster pots, since lobster is managed solely by the Atlantic States Marine Fisheries Commission (i.e., not jointly managed with NMFS or the Councils). Jonah crabs are caught as bycatch within the lobster pot fishery, and generally retained for sale.

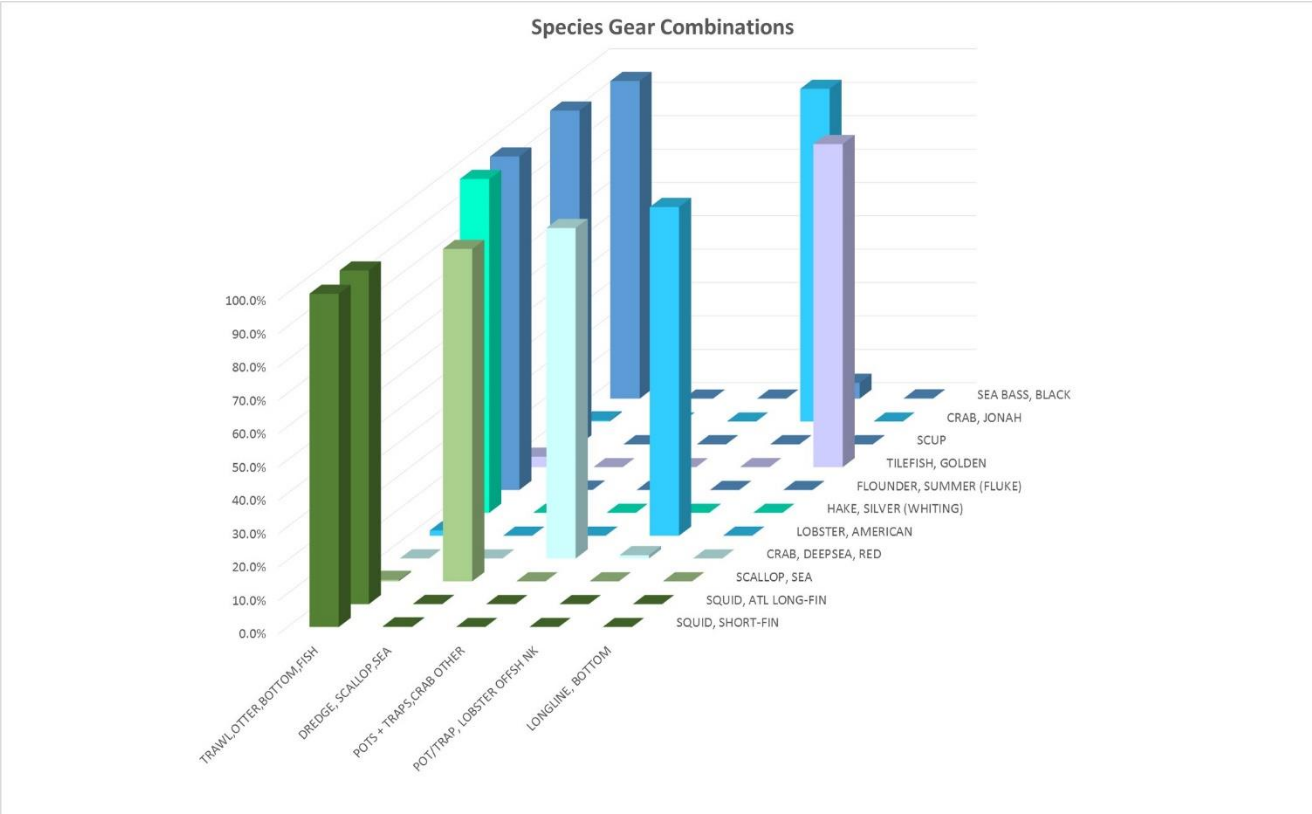

Figure 24: Major species-gear combinations within proposed coral zones, 2007-2012, based on VTR point data.

Revenue estimates in U.S. dollars were then calculated for each species-gear combination within each proposed discrete zone (Table 19) and broad zone (Table 20). Highest estimated revenues were unsurprisingly associated with larger areas. The highest estimated revenue across most gear-species combinations originated from the Hudson Canyon and Mey-Lindenkohl slope areas, which are the two largest proposed discrete zones by area (Table 19). The highest estimated revenue was generated from the bottom otter trawl squid fisheries for both the broad and discrete zones, while the lowest estimated revenue within the proposed zones originated from the bottom longline tilefish fishery. Revenue intensity maps shown in Figures 25-30 reveal spatial concentrations of effort that provide some context to these estimates. For instance, for both tilefish and hake, estimated revenue drops off significantly south of Hudson Canyon. Squid fisheries, on the other hand, are concentrated along the shelf-slope break throughout the Mid-Atlantic region, but generate lower estimates of revenue in the northernmost proposed canyons.

Table 19: VTR model-estimated cumulative revenue (USD) by proposed discrete zone for major species-gear combinations, 2007-2012, Maine through North Carolina. BOT = bottom otter trawl; BLL = bottom longline; DRG = dredge.

Canyon	Area	BOT-Squid Value	BOT-Hake Value	BOT-SFSCBSB Value	POT-RedCrab Value	BLL-Tile Value	DRG-Scall Value	Total
Block Canyon	232	27,644	129,821	22,488	0	0	0	642,460
Ryan-McMaster Canyons	390	58,780	97,142	47,904	72,016	0	0	607,001
Emery-Uchupi Canyons	369	32,291	78,549	9,476	115,304	0	0	253,733
Jones-Babylon Canyons	166	23,333	271	0	26,253	200,761	392,828	643,446
Hudson Canyon	766	3,476,787	977,172	612,444	418,568	652,372	192,493	6,395,169
Mey-Lindenkohl Slope	2,808	4,138,775	118,779	1,015,517	813,022	82,816	1,819,913	8,527,034
Spencer Canyon	163	2,115,127	785	18,809	108,675	0	213,804	2,501,598
Wilmington Canyon	268	1,563,093	5,818	157,115	402,654	70,569	214,083	3,051,588
South Vries Canyon	143	2,548,415	2,419	49,516	0	0	786,016	3,388,854
Baltimore Canyon	231	2,099,788	1,297	457,605	433,368	0	389,905	3,541,174
Warr-Phoenix Canyon Complex	511	746,578	16,327	3,403	244,208	0	92,174	1,219,502
Accomac-Leonard Canyons	538	441,171	3,133	16,880	269,682	0	309,641	1,065,818
Norfolk Canyon	542	1,989,953	13,288	36,165	81,063	9,834	625	2,326,221
North Heyes-South Wilmington Canyon	183	363,222	732	3,414	168,538	0	358,561	894,467
Washington Canyon	554	78,193	0	173,297	209,592	0	682,272	1,268,753

Table 20: VTR model-estimated cumulative revenue (USD) by proposed broad zone for major species-gear combinations, 2007-2012, Maine through North Carolina. BOT = bottom otter trawl; BLL = bottom longline; DRG = dredge.

Area	BOT-Squid Value	BOT-Hake Value	BOT-SFSCBSB Value	POT-RedCrab Value	BLL-Tile Value	DRG-Scall Value	Total
200 m broad zone	5,095,728	444,772	1,064,780	626,886	431,275	2,917,199	10,580,640
300 m broad zone	4,608,815	350,884	913,685	599,678	312,446	2,636,159	9,421,667
400 m broad zone	4,157,989	274,475	796,440	569,745	255,053	2,385,016	8,438,718
500 m broad zone	4,000,807	238,380	745,802	555,932	221,050	2,294,912	8,056,883

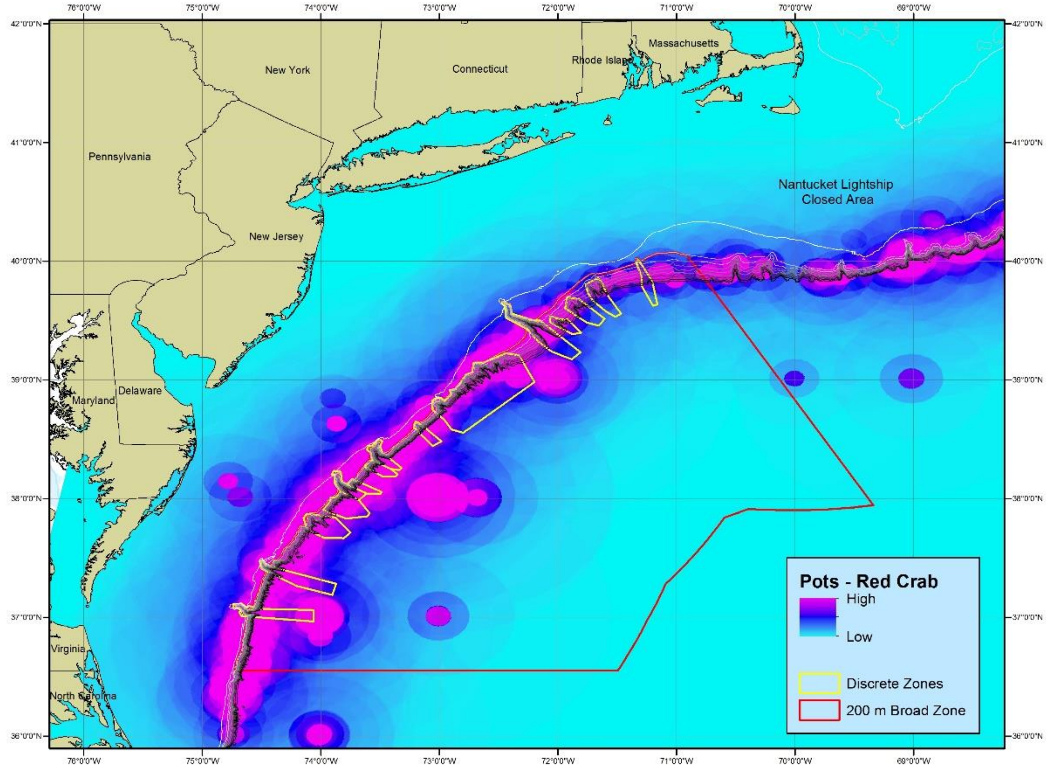

Figure 25: Areas of high cumulative estimated revenue (USD) for red crab caught using pots, 2007-2012, Maine through Virginia.

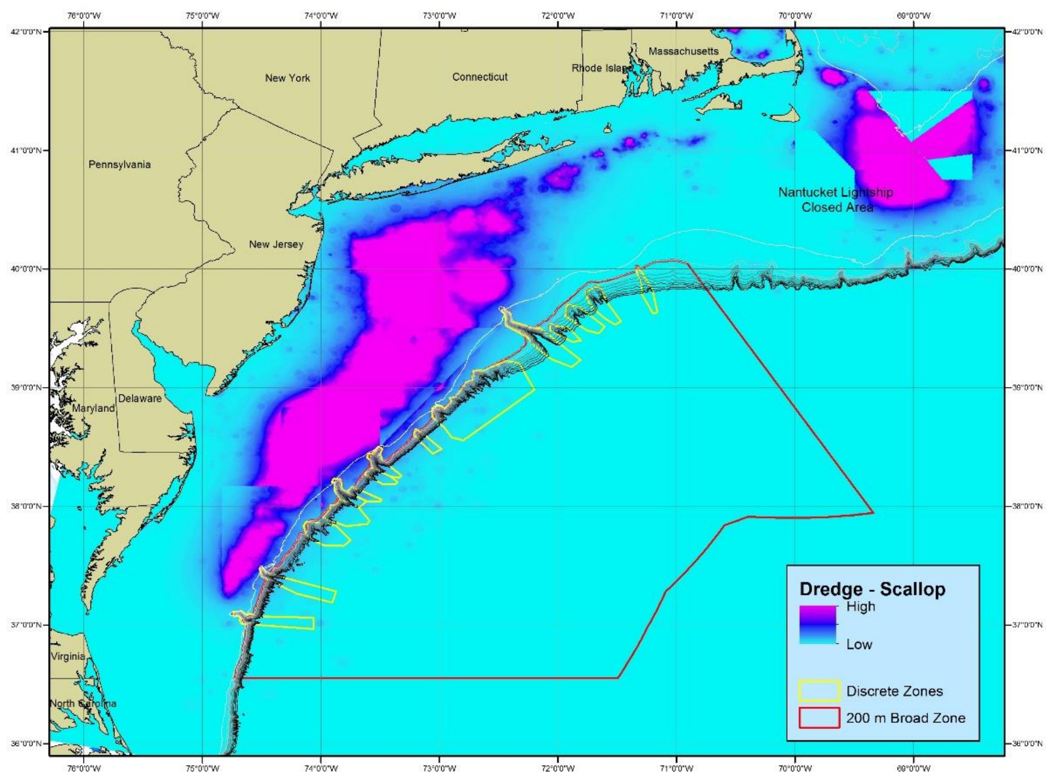

Figure 26: Areas of high cumulative estimated revenue (USD) for scallops caught using dredge gear, 2007-2012, Maine through Virginia.

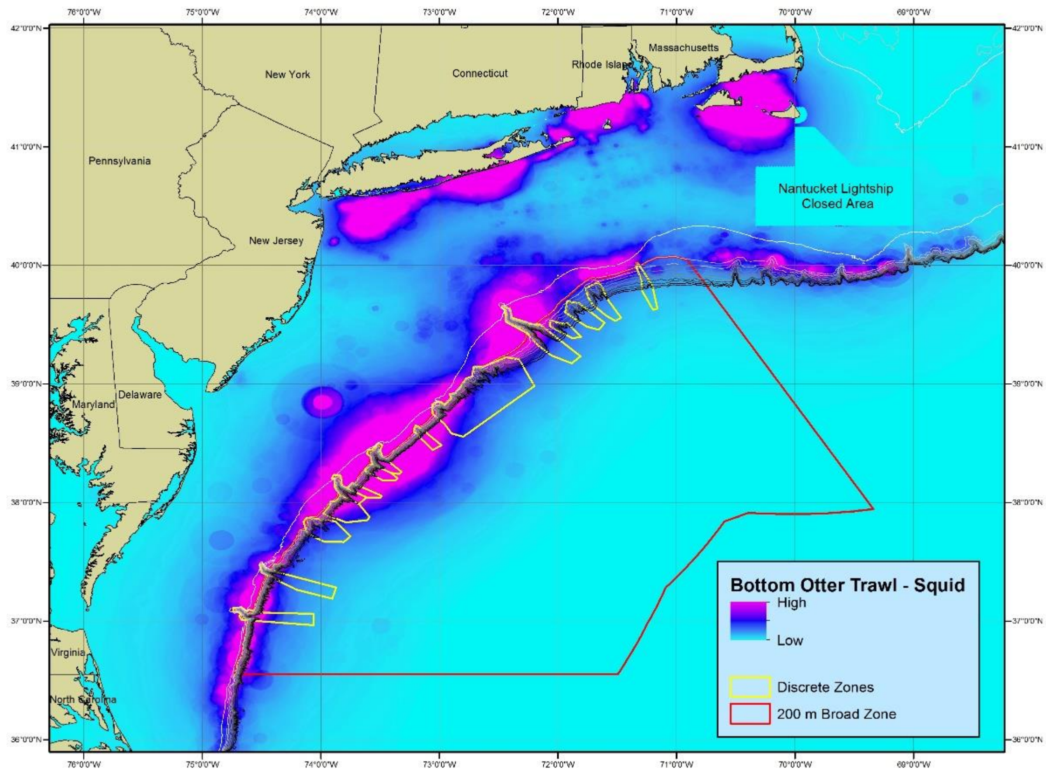

Figure 27: Areas of high cumulative estimated revenue (USD) for *Illex* and longfin squid caught using bottom otter trawls, 2007-2012, Maine through Virginia.

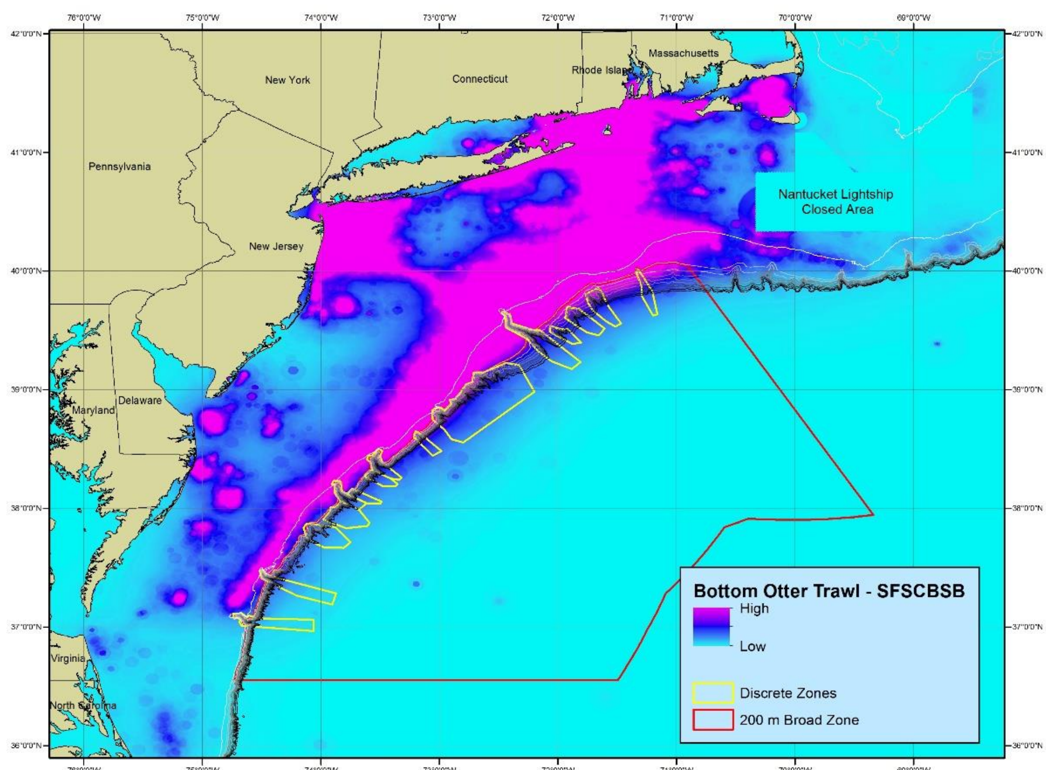

Figure 28: Areas of high cumulative estimated revenue (USD) for summer flounder, scup, and black sea bass caught using bottom otter trawl gear, 2007-2012, Maine through Virginia.

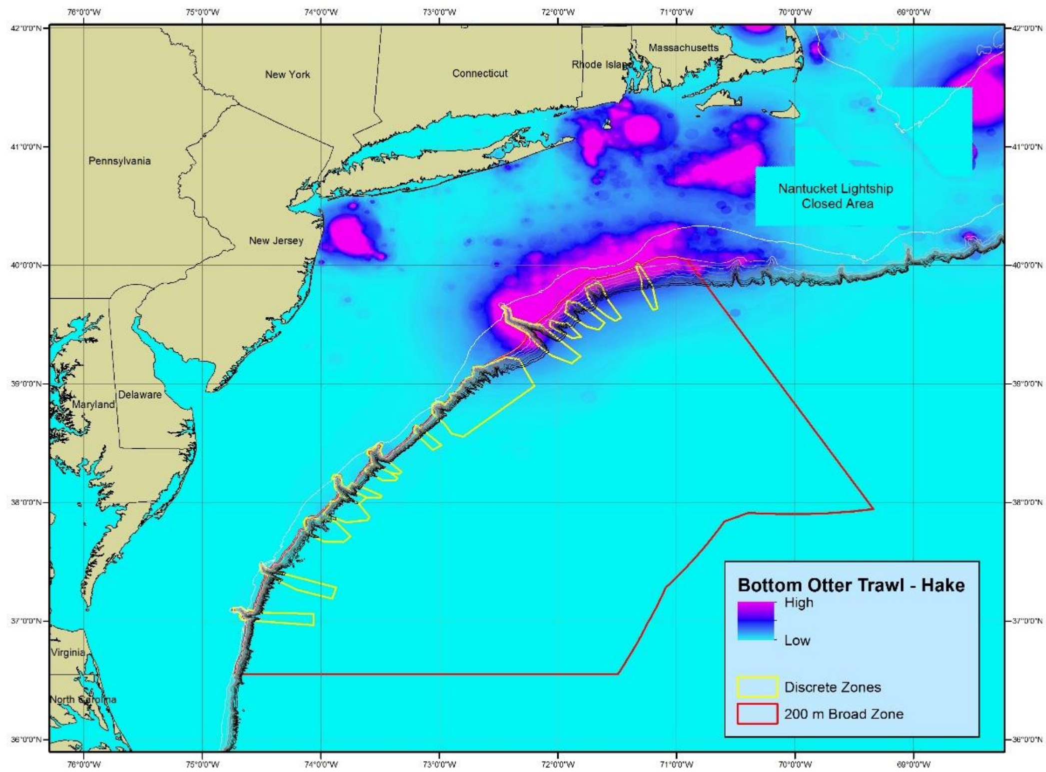

Figure 29: Areas of high cumulative estimated revenue (USD) for silver hake (whiting) caught using bottom otter trawl gear, 2007-2012, Maine through Virginia.

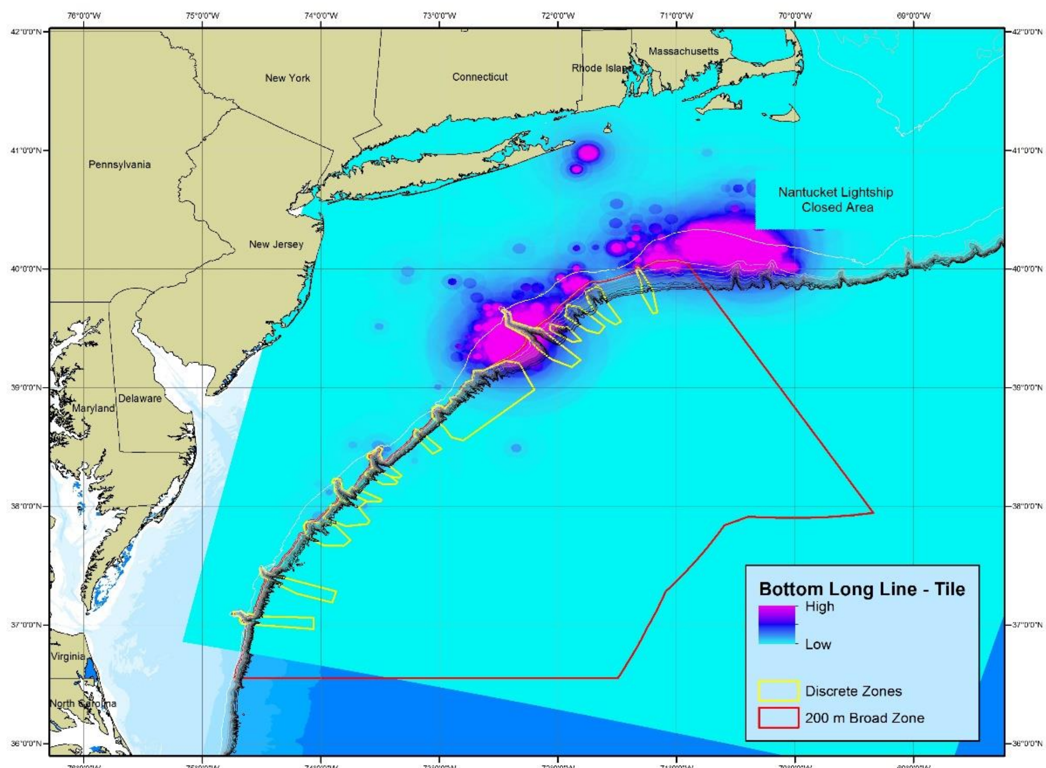

Figure 30: Areas of high cumulative estimated revenue (USD) for golden tilefish caught using bottom longline gear, 2007-2012, Maine through Virginia.

APPENDIX A: Criteria for revisions to original discrete zone boundaries

The Council's Deep Sea Corals FMAT met in April 2014 to discuss revisions to the original discrete zone boundaries based on new scientific information. Original boundaries were developed by the New England Habitat Plan Development Team (PDT) during development of the New England Council's Omnibus Habitat Amendment 2 (prior to splitting deep sea coral alternatives into a separate omnibus amendment).

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[1] from the deep sea coral habitat suitability model outputs for Alcyonacean corals (gorgonian and non-gorgonian 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[2], 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.
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.

[1] "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.
[2] Slope data derived from ACUMEN 25m resolution multibeam data.