DRAFT

Omnibus Essential Fish Habitat Amendment 2

Amendment 14 to the Northeast Multispecies FMP
Amendment 14 to the Atlantic Sea Scallop FMP
Amendment 4 to the Monkfish FMP
Amendment 3 to the Atlantic Herring FMP
Amendment 2 to the Red Crab FMP
Amendment 2 to the Skate FMP
Amendment 3 to the Atlantic Salmon FMP

Including a

Draft Environmental Impact Statement

Prepared by the
New England Fishery Management Council
In cooperation with the
National Marine Fisheries Service

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COVER SHEET

RESPONSIBLE AGENCIES:

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

New England Fishery Management Council
50 Water Street
Newburyport, MA 01950

PROPOSED ACTIONS:

Adoption, approval, and implementation of Amendment 14 to the Northeast Multispecies FMP, Amendment 14 to the Atlantic Sea Scallop FMP, Amendment 4 to the Monkfish FMP, Amendment 3 to the Atlantic Herring FMP, Amendment 2 to the Red Crab FMP, Amendment 2 to the Skate FMP, Amendment 3 to the Atlantic Salmon FMP

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TYPE OF STATEMENT:

(X) DRAFT ( ) FINAL

ABSTRACT:

This document describes management alternatives to designate EFH, designate HAPCs, minimize fishing impacts on EFH, and protect deep-sea corals, and evaluates the environmental impacts of those alternatives. In addition, this document includes prey species information, a discussion of non-fishing impacts on EFH, and a summary of EFH-related research needs.

DATE BY WHICH COMMENTS MUST BE RECEIVED: ______________________

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Table of contents

Tables

Figures

Maps

3.3 Alternatives to integrate and optimize measures to minimize the adverse impacts to EFH across all Council managed FMPs

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires fishery management plans to minimize to the extent practicable the adverse effects of fishing on fish habitats. To meet this requirement, fishery managers would ideally be able to quantify such effects and visualize their distributions across space and time. The Swept Area Seabed Impact (SASI) model provides such a framework, enabling managers to better understand: (1) the nature of fishing gear impacts on benthic habitats, (2) the spatial distribution of benthic habitat vulnerability to particular fishing gears, and (3) the spatial and temporal distribution of realized adverse effects from fishing activities on benthic habitats.

The model combines fishing effort data with substrate data and benthic boundary water flow estimates in a geo-referenced, GIS-compatible environment. Contact and vulnerability-adjusted area swept, a proxy for the degree of adverse effect, is calculated by conditioning a nominal area swept value, indexed across units of fishing effort and primary gear types, by the nature of the fishing gear impact, the susceptibility of benthic habitats likely to be impacted, and the time required for those habitats to return to their pre-impact functional value. The SASI model was developed by the New England Fishery Management Council's (NEFMC) Habitat Plan Development Team.

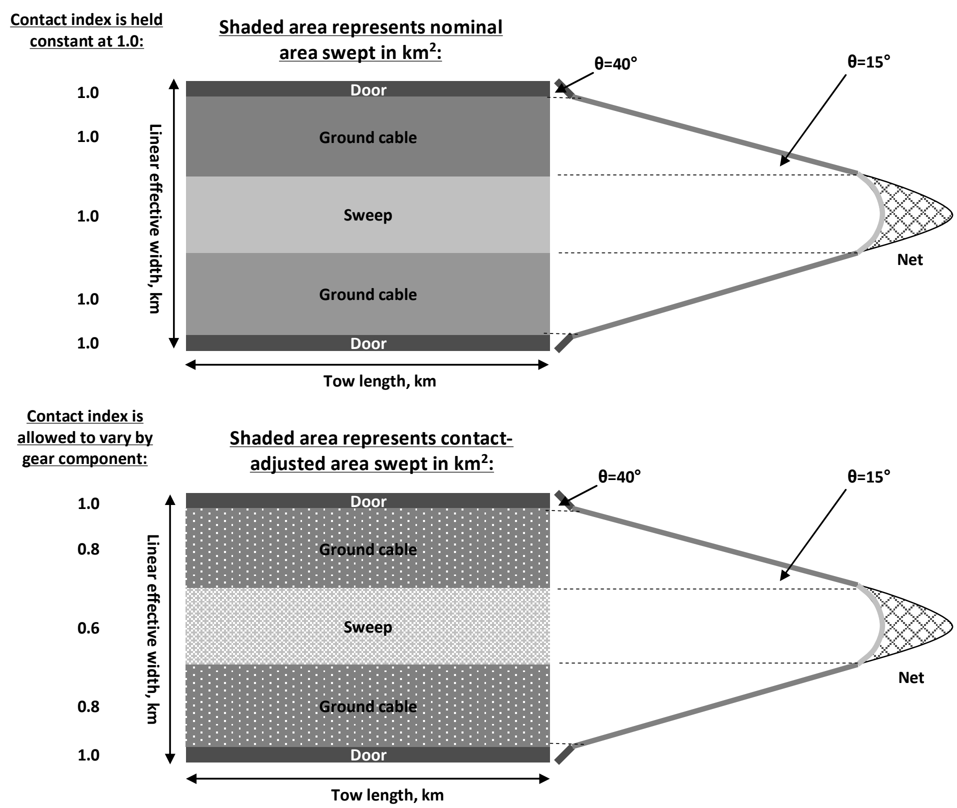
The SASI model can be updated and improved as new sources of fishing effort or habitat data become available, or as underlying assumptions are refined based on emerging research. Looking beyond the Omnibus EFH Amendment, the SASI model is intended for long-term use in evaluating the impacts of future management actions on fish habitats. A detailed description of the SASI model, including data sources and results, is provided in Appendix D.

Fishing effort estimation

In order to compare habitat impacts resulting from various types of fishing gears, all fishing effort in the SASI model is represented using a common area swept currency. The first step was to classify effort into nine major bottom-tending gear types: generic/groundfish trawls, shrimp trawls, squid trawls, raised footrope trawls, New Bedford-style scallop dredges, surf clam and ocean quahog hydraulic dredges, lobster and deep-sea red crab traps, bottom gill nets, and bottom longlines. These gear types are commonly used in areas designated as EFH for NEFMC-managed species, to target species managed by the NEFMC and/or Mid-Atlantic Fishery Management Council (MAFMC).

By gear type, assumptions were made regarding the angle of attack of each gear component in order to calculate a linear effective width for each gear component individually and then for the gear as a whole. This linear effective width was then multiplied by the length of the tow to generate nominal area swept. Next, assumptions about the contact of each gear component with the seabed were used to convert nominal area swept to contact-adjusted area swept. These contact indices are expressed as proportions, ranging from zero to one, such that contact adjusted area swept is always less than or equal to nominal area swept. A schematic of this calculation for trawl gears is shown in Figure 1. Although the area swept for each tow is calculated separately, resulting contact adjusted area swept values in km^2 may be summed by trip, year, gear type, etc.

Figure 1 – Area swept schematic (top down view). The upper portion shows nominal area swept, and the lower portion shows contact adjusted area swept.



Vulnerability Assessment

The purpose of the vulnerability assessment was to estimate the magnitude of the impacts that result from the physical interaction of fish habitats and fishing gears. The vulnerability information is then used to condition area swept via a series of susceptibility and recovery parameters. It is important to recognize that the vulnerability assessment only considers (a) adverse (vs. positive) effects and (b) habitat associated with the seabed (vs. the seabed and the water column). For ease in evaluating impacts, fish habitat was divided into components, geological and biological (non-living and living, respectively), which were further subdivided into features. Structural features identified include bedforms, biogenic burrows, sponges, macroalgae, etc. These may either provide shelter for managed species directly, or provide shelter for their prey.

The vulnerability assessment used a series of matrices to organize and present qualitative estimates of susceptibility and recovery for each feature by fishing gear type. While both components (geological, biological) were assumed to occur in every habitat type, the presence or absence of particular features was assumed to vary based on substrate type and natural disturbance (energy) regime. Thus, habitat types in the vulnerability assessment were distinguished by dominant substrate, level of natural disturbance, and the presence or absence of various features.

Susceptibility was defined as the percentage by which a feature is reduced in functional value due to the impact of a particular fishing gear, and recovery was defined as the amount of time it would take for the functional value of the diminished habitat feature to be restored following the cessation of impact. Recovery was evaluated separately for high and low energy environments. Both susceptibility and recovery were scored from 0-3. Values are assigned using knowledge of the fishing gears and habitat features combined with results from the scientific literature on gear impacts. As an example, the otter trawl/mud matrix with its component features is shown in Figure 2.

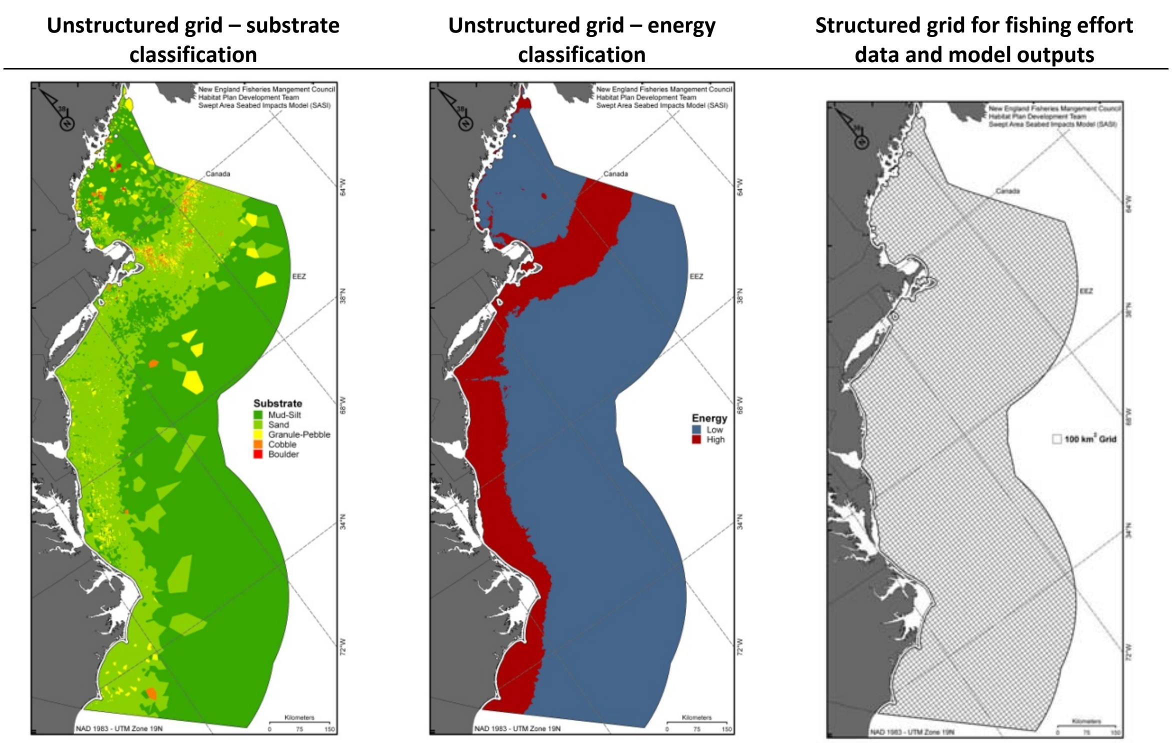
Figure 2 – Sample matrix for generic trawl gears in mud substrates.

Gear: Trawl							
Substrate: Mud							
Feature	**Gear effects**	**Literature high**	**Literature low**	**S High**	**S Low**	**R High**	**R Low**
Amphipods, tube-dwelling	crushing	34, 113, 119, 211, 228, 292, 334, 408, 409, 599, 658	89, 80, 97, 113, 149, 320, 575	1	1	0	0
Anemones, cerianthid burrowing	breaking, crushing, dislodging, displacing	none	none	2	2	2	2
Biogenic burrows	filling, crushing	334, 408, 409	101, 313, 333, 336, 407	2	2	0	0
Biogenic depressions	filling	236, 408, 409	101, 247, 336	2	2	0	0
Corals, sea pens	breaking, crushing, dislodging, displacing	none	101, 164	2	2	2	2
Hydroids	breaking, crushing, dislodging, displacing	408, 409	368	2	2	1	1
Mollusks, epifaunal bivalve, *Modiolus modiolus*	breaking, crushing, dislodging, displacing	21, 34, 368, 408, 409	89, 203, 368	2	2	3	3
Sediments, unfeatured surface	resuspension, compression, geochem	88, 92, 211, 236, 330, 334, 406, 408, 409, 599	88, 211, 247, 277, 283, 313, 320, 333, 335, 336, 338, 372, 407, 414	3	3	0	0

Model grid

To be useful for spatially explicit management strategies, SASI outputs must be spatially referenced. A substrate-based model grid was developed to provide a surface on which to combine area swept fishing effort data and vulnerability information. Two sources of substrate data, usSEABED and University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) video survey, were used to generate the grid. Across both data sets, substrates were classed based on particle size (using the Wentworth scale) into mud, sand, granule/pebble, cobble, and boulder. An unstructured grid was generated from the raw substrate data using a Voronoi tessellation procedure. Depending on the arrangement of samples in space, the grid cells vary in shape and may be larger or smaller, as shown below. Next, each of these grid cells was classified as having a high or low natural disturbance (energy) regime using critical shear stress and depth-based criteria. Finally, a 100 km^2 grid was overlaid on the unstructured grid, and the substrate composition of each 100 km^2 grid cell was calculated based on the attributes of the typically smaller unstructured cells.

Figure 3 – SASI model grids. From left: Substrate, showing mud (green), sand (light green), granule-pebble (yellow), cobble (orange), and boulder (red); Energy, with low energy in blue and high in red; structured grid for fishing effort data, with 100 km^2 cells.



Combining fishing effort, feature vulnerability, and spatial grids

The SASI model combines contact-adjusted area swept estimates with the substrate and energy surfaces and the assigned susceptibility and recovery scores for each of the seabed features to calculate the vulnerability-adjusted area swept (measured in km^2), represented by the letter Z. This value is the estimate of the adverse effects from fishing on fish habitat. The model can be used to estimate adverse effects based either on a simulated hypothetical amount of fishing area swept (Z_∞ outputs), or the realized area swept estimated from fishery-dependant data ($Z_{realized}$ outputs). The former estimate is intended to represent underlying habitat vulnerability, while the latter can be used to understand change in adverse effects over time. The latter approach can also be used to forecast the impacts of future management actions, given assumptions about shifts in the location and magnitude of area swept. These outputs are generated at the structured (100 km^2) grid cells level.

Z can be represented using the following equation:

$$Z_{t+1} = Z_t + \left[\sum_{i=1}^{9} \sum_{j=1}^{n} \sum_{k=1}^{5} \sum_{l=1}^{2} \sum_{m=1}^{27} \left[\left(\lambda \left(\mathrm{A}_{i,j} \omega_{k,l} \right)_{t_0} \Delta t \right) - \left(\mathrm{A}_{i,j} \omega_{k,l} \right)_t \right] \right].$$

In this equation, **A** represents the nominal area swept by one unit of fishing effort and **ω** represents susceptibility, which in this case is a quality adjustment based on the vulnerability of habitats to fishing gears. The parameter **λ** represents the decay rate and is calculated as **1/τ**, where **τ** is the total number of time steps over which the adverse effects of fishing will decay (i.e. the recovery paremeter estimate). t_0 is the initial time unit that the affect enters the model and Δt is the contemporary time step, such that $\Delta t = t - t_0$ where t is the year for which the calculation is being made. The model is indexed across all units of fishing effort (***j***) by nine fishing gear types (***i***) and a matrix of habitat types determined by combinations of five substrates (***k*)**, two energy environments (***l***) and 27 individual habitat features (***m***).

Spatial clustering analysis (LISA)

One way in which Z_∞ (adverse effect) estimates were evaluated was through formal spatial analysis. The objectives of the SASI spatial clustering analysis were to (explore the spatial structure of the asymptotic area swept (Z_∞), and to define clusters of high and low Z_∞ for each gear type. The analysis was intended to focus the Habitat Committee and Council's attention on areas with clusters of high vulnerability grid cells, as one starting point for developing spatially based alternatives to minimize adverse effect. Local Indicators of Spatial Association (LISA) statistics developed by Anselin (1995), which are designed to test individual sites for membership in clusters, were used.

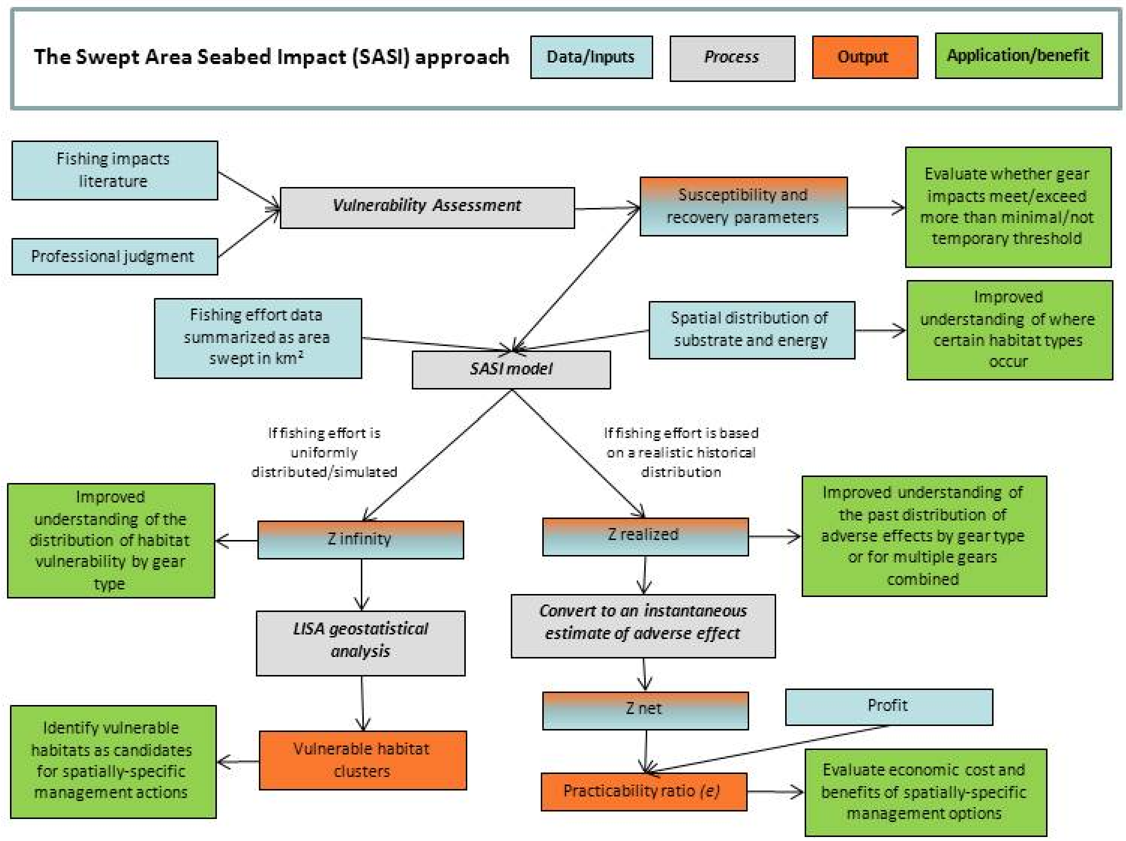
Practicability analysis (Z_{net}, *e*)

Z_{net} is an instantaneous variant of $Z_{realized}$ that can be compared with trip level revenue estimates to generate a practicability ratio, *e*. For gears with high habitat impact relative to revenue, the *e* ratio is large, while for gears with a low habitat impact relative to revenue, the *e* ratio is small, approaching zero for some gear types. Z_{net} and *e* were developed for evaluating the relative practicabilty of management alternatives, as the Council has expressed interest in optimizing its adverse effects minimization strategy across different gear types, fisheries, and areas.

Summary

The various model components, including fishing effort, the various grids, and habitat feature vulnerability, are combined as described in Figure 4.

Figure 4 – SASI model flowchart



The following management options were developed at the October 28, 2010 joint Habitat Committee/PDT meeting based on SASI model outputs and other sources of information. The sections below explain each option, provide a brief rationale, and summarize analyses conducted by the PDT to date to evaluate the option based on benefits to EFH. These analyses will be reviewed by the Committee in January 2011 and then individual options will be packaged into alternatives for further evaluation. Individual area-based options are likely to have synergistic effects on the total magnitude of adverse effects across one or more gear types/fisheries, because restrictions on fishing in one location will affect the magnitude of fishing in other locations. Thus, the PDT recommends that alternatives be developed that consist of a suite of individual area-based gear restriction and/or gear modification options. Further analyses of these alternatives will summarize and compare likely changes in adverse effects across all the options that comprise each alternative.

3.3.1 Measures for Georges Bank habitat closed areas

These habitat closed areas were implemented via Amendment 13 to the Multispecies FMP. Areas with the same boundaries will be written into the scallop regulations as habitat closed areas once Amendment 15 to the Atlantic Sea Scallop FMP is implemented, which is expected in mid-2011. Currently, the areas are closed to all mobile, bottom-tending gear on a year round basis. Note that with the exception of portions of the the NLCA habitat closed area, the boundaries of these closures lie within year-round multispecies mortality closures. The following options consider elimination of three of these closed areas from both the multispecies and scallop FMPs.

The analytical approach would be the same for all three areas, and is described in detail in a separate document. Briefly, for each area-based simulation, fishing effort would be allowed to occur in an area approximately the size of the habitat closed area being analyzed. The amount of fishing effort that goes into the reopened habitat closed area would be based on a redistribution of fishing effort from grid cells proximate to the area being evaluated. Note that the areas boundaries for the parcels evaluated in this analysis are not exactly those of the habitat closed areas. Nonetheless, the rough magnitude and direction of habitat benefits/impacts are expected to hold, given acceptance of the assumptions of the SASI model and the Z_{net} analysis. Results are presented on a gear-by-gear basis.

In the tables presented below, the total, global magnitude of the adverse effects of fishing on habitat for a gear type can be understood by examining the magnitude of the Z_{net} values themselves. To be clear, Z_{net} values appear in each table even if fishing with that gear type does not occur in a particular area because they are the global Znet estimates for that gear. These Z_{net} values can be compared between gear types, given the various underlying assumptions of the SASI model. For a single gear type, the change in adverse effects that results from reopening a particular parcel is best understood using the % change in Z_{net} values.

Also, note that if these options were implemented, if another overlapping closure prohibits fishing by certain gear types in the area, those prohibitions would hold. Specifically, restrictions associated with the mortality closures (no fishing by gear capable of catching groundfish) would remain. However, eliminating one or more of these habitat closed areas would open the door to reasonably forseeable future actions, including expansion or addition of sea scallop access areas, or of groundfish Special Access Program (SAP) fisheries. Thus, the results of the analysis as discussed below show potential habitat impacts/benefits that are contingent upon additional action on the part of the Council’s species committees.

3.3.1.1 Eliminate CAII habitat closed area

Rationale for this option: EAP analysis of generic otter trawl gear SASI model Z_{∞} outputs indicated that the grid cells overlapping the CAII habitat closure rank relatively high in terms of habitat vulnerability in comparison with other areas throughout the model domain of the same size. However, results of the LISA cluster analysis for trawl gear outputs indicate that the most vulnerable structural habitats in that region are centered slightly to the west (area known as cluster 5/Georges Shoal cluster). Therefore, this option would eliminate the current closed area, and a new habitat area might potentially be implemented via a separate option.

The following table shows Z_{net} simulation results for the CA2 north parcel, which is slightly larger than the CAII habitat closed area. Note that the global magnitude of adverse effect varies across gear types. Also, for gear types with no fishing activity in the vicinity of CAII, as would be expected, there is no change in global Z_{net} when fishing is allowed in the area. This is the case for raised footrope, shrimp, and squid trawls, as well as general category scallop dredges. For the other gear types, the percent decrease in Z_{net} after opening the CA2 North parcel ranges from 3% to 101% of the original global Z_{net} for that gear type.

Table 33 – Habitat impacts/benefits of eliminating CAII habitat closed area, based on Closed Area 2 North simulation results.

Gear	Sum of Z_{net} before opening	Sum of Z_{net} after opening	% change in Z_{net}	Habitat impact/benefit due to opening area
Generic otter trawl	125,932.90	110,050.90	-12.60%	Decrease in adverse effects
Raised footrope trawl	165	165	0.00%	No change
Shrimp trawl	5,390.30	5,390.30	0.00%	No change
Squid trawl	12,150.20	12,150.20	0.00%	No change
General category scallop dredge	1,055.00	1,055.00	0.00%	No change
Limited access scallop dredge	13,659.50	11,428.70	-16.30%	Decrease in adverse effects
Gillnet	61.4	51	-17.00%	Decrease in adverse effects
Longline	122.2	-1.7	-101.00%	Decrease in adverse effects
Pot/Trap	345.4	335.1	-3.00%	Decrease in adverse effects

3.3.1.2 Eliminate CAI habitat closed area(s)

Note that the CAI habitat closed area is comprised of two non-contiguous areas, CAI-N and CAI-S, and that this option as written would eliminate both areas.

Rationale for this option: EAP analyses of trawl gear type SASI model outputs indicated that the grid cells overlapping the CAI-N and CAI-S habitat closures rank relatively low in terms of habitat vulnerability in comparison with other areas throughout the model domain of the same size.

The following table shows Z_{net} simulation results for the three CA1 parcels, east, west, and north. Results are grouped by gear type. Again, note that the global magnitude of adverse effect varies across gear types, and for gear types with no fishing activity in the vicinity of CAI, as would be expected, there is no change in global Z_{net} when fishing is allowed in the area. This is the case for raised footrope, shrimp, and squid trawls. For the other gear types, the percent decrease in Z_{net} after opening the one of the CA1 parcels ranges from 0.1% to 80% of the original global Z_{net} for that gear type.

Table 34 – Habitat impacts/benefits of eliminating CAI habitat closed area, based on Closed Area 1 East, North, and West simulation results.

Area	Gear	Sum of Z_{net} before opening	Sum of Z_{net} after opening	% change in Z_{net}	Habitat impact/benefit due to opening area
CA1 E	Generic otter trawl	125,932.90	110,319.50	-12.40%	Decrease in adverse effect
CA1 N	Generic otter trawl	125,932.90	117,598.20	-6.60%	Decrease in adverse effect
CAI W	Generic otter trawl	125,932.90	108,994.30	-13.50%	Decrease in adverse effect
CA1 E	Raised footrope trawl	165	165	0.00%	No change
CA1 N	Raised footrope trawl	165	165	0.00%	No change
CAI W	Raised footrope trawl	165	165	0.00%	No change
CA1 E	Shrimp trawl	5,390.30	5,390.30	0.00%	No change
CA1 N	Shrimp trawl	5,390.30	5,390.30	0.00%	No change
CAI W	Shrimp trawl	5,390.30	5,390.30	0.00%	No change
CA1 E	Squid trawl	12,150.20	12,150.20	0.00%	No change
CA1 N	Squid trawl	12,150.20	12,150.20	0.00%	No change
CAI W	Squid trawl	12,150.20	12,150.20	0.00%	No change
CA1 E	General category scallop dredge	1,055.00	779.1	-26.20%	Decrease in adverse effect
CA1 N	General category scallop dredge	1,055.00	1,055.10	0.00%	No change
CAI W	General category scallop dredge	1,055.00	787.7	-25.30%	Decrease in adverse effect
CA1 E	Limited access scallop dredge	13,659.50	11,719.80	-14.20%	Decrease in adverse effect
CA1 N	Limited access scallop dredge	3,659.50	13,647.90	-0.10%	Decrease in adverse effect
CAI W	Limited access scallop dredge	13,659.50	11,380.10	-16.70%	Decrease in adverse effect
CA1 E	Gillnet	61.4	54.7	-10.90%	Decrease in adverse effect
CA1 N	Gillnet	61.4	59	-4.00%	Decrease in adverse effect
CAI W	Gillnet	61.4	52.9	-13.80%	Decrease in adverse effect
CA1 E	Longline	122.2	63	-48.40%	Decrease in adverse effect
CA1 N	Longline	122.2	82.6	-32.40%	Decrease in adverse effect
CAI W	Longline	122.2	24.7	-79.80%	Decrease in adverse effect
CA1 E	Pot/Trap	345.4	345.2	-0.10%	Decrease in adverse effect
CA1 N	Pot/Trap	345.4	340.7	-1.40%	Decrease in adverse effect
CAI W	Pot/Trap	345.4	339.1	-1.80%	Decrease in adverse effect

3.3.1.3 Eliminate NLCA habitat closed area

Rationale for this option: EAP analyses of trawl gear type SASI model outputs indicated that the grid cells overlapping the NLCA habitat closure rank relatively low in terms of habitat vulnerability in comparison with other areas throughout the model domain of the same size.

The following table shows Z_{net} simulation results for the NLCA west parcel. Again, note that the global magnitude of adverse effect varies across gear types, and for gear types with no fishing activity in the vicinity of NLCA west, as would be expected, there is no change in global Z_{net} when fishing is allowed in the area. This is the case for raised footrope, shrimp, and squid trawls, as well as for general category scallop dredges. For the other gear types, the percent decrease in Z_{net} after opening the NLCA west parcel ranges from 0.3% to 60% of the original global Z_{net} for that gear type.

Table 35 - Habitat impacts/benefits of eliminating NLCA habitat closed area, based on NLCA West simulation results.

Gear	Sum of Z_{net} before opening	Sum of Z_{net} after opening	% change in Z_{net}	Habitat impact/benefit due to opening area
Generic otter trawl	125,932.90	108,100.50	-14.20%	Decrease in adverse effect
Raised footrope trawl	165	165	0.00%	No change
Shrimp trawl	5,390.30	5,390.30	0.00%	No change
Squid trawl	12,150.20	12,150.20	0.00%	No change
General category scallop dredge	1,055.00	1,055.00	0.00%	No change
Limited access scallop dredge	13,659.50	13,618.10	-0.30%	Decrease in adverse effect
Gillnet	61.4	37.2	-39.50%	Decrease in adverse effect
Longline	122.2	49	-59.90%	Decrease in adverse effect
Pot/Trap	345.4	222.3	-35.60%	Decrease in adverse effect

3.3.2 Measures for the WGOM habitat closed area

These options would either eliminate the WGOM habitat closure or change the regulations associated with that closure, depending on the sub-option selected. The WGOM habitat closure was implemented via Amendment 13 to the Multispecies FMP, and a habitat closure area with the same boundaries will be written into the scallop regulations once Amendment 15 to the Atlantic Sea Scallop FMP is implemented, which is expected in mid-2011.

3.3.2.1 Eliminate WGOM habitat closed area

This option would eliminate the WGOM habitat closure from both the multispecies and scallop FMPs. The analytical approach for this area is the same as that described for the three habitat closures on Georges Bank, described above.

The following table shows Z_{net} simulation results for the WGOM parcel. Again, note that the global magnitude of adverse effect varies across gear types, and for gear types with no fishing activity in the vicinity of the WGOM (raised footrope and squid trawl) there is no change in global Z_{net} when fishing is allowed in the area. For the other gear types, the percent decrease in Z_{net} after opening the NLCA west parcel ranges from 0.3% to 73% of the original global Z_{net} for that gear type.

Gear	Sum of Z_{net} before opening	Sum of Z_{net} after opening	% change in Z_{net}	Habitat impact/benefit due to opening area
Generic otter trawl	125,932.90	125,604.30	-0.30%	decrease in adverse effect
Raised footrope trawl	165	165	0.00%	no change
Shrimp trawl	5,390.30	1,463.70	-72.80%	decrease in adverse effect
Squid trawl	12,150.20	12,150.20	0.00%	no change
General category scallop dredge	1,055.00	676.1	-35.90%	decrease in adverse effect
Limited access scallop dredge	13,659.50	12,713.50	-6.90%	decrease in adverse effect
Gillnet	61.4	56.8	-7.40%	decrease in adverse effect
Longline	122.2	65.7	-46.20%	decrease in adverse effect
Pot/Trap	345.4	341.3	-1.20%	decrease in adverse effect

3.3.2.2 Change gear restrictions in WGOM habitat closed area

Currently, mobile bottom-tending gears (i.e. trawls and dredges) are excluded from the WGOM habitat closure. This includes trawl vessels targeting northern shrimp. One possible management option would be to allow shrimping in the WGOM habitat closed area, or a portion of it. As of Amendment 13 to the Multispecies FMP, shrimping is already allowed within the WGOM groundfish mortality closure, which overlaps the WGOM habitat closed area. This exemption was made for the mortality closure because bycatch of managed groundfish is generally low in shrimp trawls due to the requirement for a fish-excluding Nordmore grate. However, shrimping is precluded in most of the WGOM due to the existence of the habitat closure. Due to the distribution of shrimp, shrimping effort is minimal in the eastern portion of the WGOM mortality closure that does not overlap with the habitat closure (M. Raymond, personal communication). From an industry perspective, the most desirable area for shrimp fishery access would be the northern portion of the WGOM habitat closure (M. Raymond, personal communication).

Figure 5 shows the location of shrimp trawl effort before and after implementation of the WGOM habitat closure for two years with similar overall landings, 1997 and 2007. Table 36 summarizes 1996-2009 (calendar year) adverse effect ($Z_{realized}$) and area swept for the shaded cells in the figure. As expected, there has been a shift in area swept and adverse effect away from the shaded cells. However, this trend was evident prior to the May 2004 implementation of the habitat closed area.

Figure 5 – Comparison of 1997 (upper left panel) and 2007 (lower left panel) effort in the shrimp trawl fishery near the WGOM habitat and mortality closures. The northern part of the WGOM habitat closure that would be preferred for access by the shrimp industry is outlined in purple. SASI 100 km² grid cells most closely associated with this area are shaded grey in the right hand panel; numbers correspond to those in the table below.

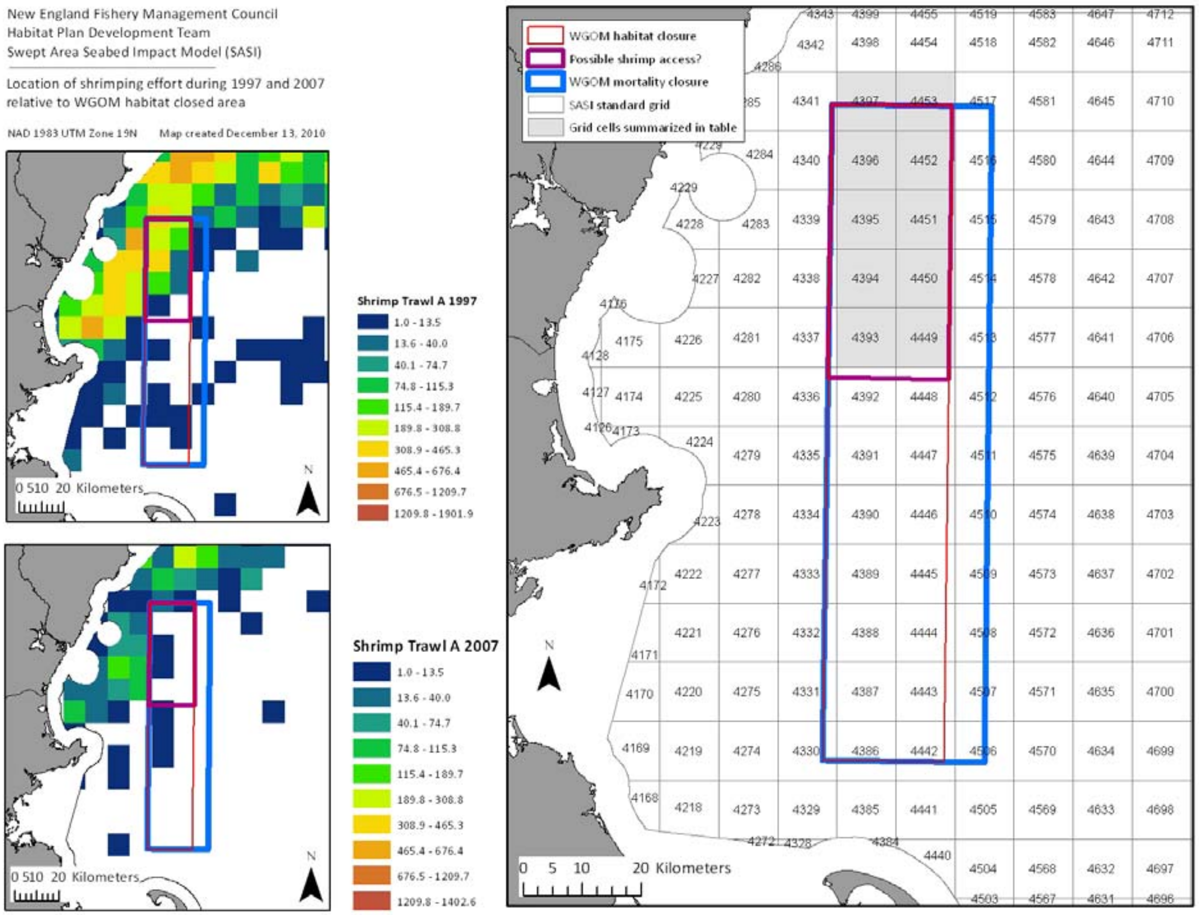


Table 36 – Shrimp trawl adverse effect and area swept for selected grid cells in and around northern portion of WGOM habitat closed area (shaded in figure above) by calendar year from 1996-2009. Note that the total for entire fishery includes all shrimp effort in GOM and off Carolina coast.

$Z_{realized}$ (Adverse effect, absolute value) km^2														
100km_ID	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
4393	7	6	2	15	4	2	1	1	0	0	0	0	1	0
4394	126	86	111	72	29	17	10	5	3	2	5	3	14	5
4395	248	195	120	74	34	19	10	5	3	2	2	2	1	1
4396	157	142	83	40	21	11	6	3	2	1	0	0	0	0
4397	95	141	81	42	22	27	10	6	5	3	6	9	8	3
4449	4	2	1	1	0	0	1	0	0	0	0	0	0	0
4450	7	9	6	3	2	1	1	0	0	0	0	0	0	0
4451	48	29	27	18	9	5	3	2	1	1	0	0	0	0
4452	152	122	78	45	30	18	10	6	4	2	9	4	2	1
4453	173	123	62	38	20	10	5	3	12	4	2	3	1	3
Total for cells in area	**1018**	**854**	**572**	**349**	**172**	**111**	**57**	**33**	**29**	**14**	**24**	**22**	**27**	**13**
Total for entire fishery	**13517**	**13802**	**11612**	**10817**	**10147**	**7837**	**5763**	**4232**	**3910**	**3049**	**2677**	**4274**	**4816**	**3408**
% of total adverse effect	**8%**	**6%**	**5%**	**3%**	**2%**	**1%**	**1%**	**1%**	**1%**	**0%**	**1%**	**1%**	**1%**	**0%**

Area swept km^2														
100km_ID	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
4393	14	11	0	45	0	0	0	0	0	0	0	0	4	0
4394	265	138	243	113	2	3	0	0	0	0	13	6	40	4
4395	519	348	150	71	0	4	0	0	0	0	3	6	0	3
4396	334	283	102	13	0	0	0	0	0	0	0	0	0	0
4397	195	340	118	28	0	42	0	3	3	0	14	25	18	0
4449	9	0	0	0	0	0	3	0	0	0	0	0	0	0
4450	13	18	8	2	0	0	0	0	0	0	0	0	0	0
4451	88	25	41	15	0	0	0	3	0	0	0	0	0	0
4452	252	151	42	0	8	0	0	0	0	0	29	0	0	0
4453	367	199	42	23	3	0	0	0	32	2	0	6	1	8
Total for cells in area	**2056**	**1513**	**748**	**310**	**12**	**50**	**3**	**5**	**36**	**2**	**59**	**43**	**62**	**14**
Total for entire fishery	**26879**	**27721**	**20637**	**19963**	**19145**	**12623**	**8340**	**5659**	**6547**	**4679**	**4438**	**10219**	**10878**	**5639**
% of total area swept	**8%**	**5%**	**4%**	**2%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**1%**	**0%**	**1%**	**0%**

3.3.2.3 Amend boundaries of WGOM habitat closed area

The Habitat Committee asked the PDT to look at other options for the WGOM area. The PDT discussed modifying the closed area boundaries to better encompass habitats identified as vulnerable by the SASI model, but has not had the opportunity to consider specific boundary changes as yet.

3.3.3 Measures for Georges Bank LISA clusters 5, 6, and 7

These options would establish new habitat areas in one or more locations centered around LISA trawl clusters 5 (Georges Shoals), 6 (Great South Channel), and/or 7 (Brown's Ledge). Depending on the sub-option selected, the areas would either restrict fishing by all mobile-tending bottom gear (i.e. all types of trawls and dredges), or trawls only.

The analytical approach would be the same for all three areas, and is similar to the Znet analyses conducted for the habitat closed areas in CAI, CAII, NLCA, and WGOM, except that results are presented for generic otter trawl and limited access scallop dredge only. Note that the Z_{net} values in the tables below are for inside the parcel only, and also that the percentages are shown as percent decrease, such that the signs indicate the opposite effect on adverse effects as compared to the previous Z_{net} tables.

To more accurately reflect current fishing practices we use parcel level mean profit and Z_{net} data from 2007 – 2009 only. For each closure scenario, we simply sum the amount of profit and Z_{net} that is found inside the proposed closure area, redistribute the 'missing' profits proportional to the observed spatial distribution of fishing effort, assign the corresponding Z_{net} estimate to the profits now generated outside the proposed area closure, and calculate the change in aggregate Z_{net}. Unlike the area opening analysis, no assumptions are made here regarding catch rates and profits for the redistributed fishing effort post-closure. Redistributed fishing effort will almost always result in lower profits and proportionally higher Z_{net}, and for this reason the estimates provided in this analysis are highly likely to overstate reductions in aggregate Z_{net}. Data for only the Georges Bank and Gulf of Maine regions are used to better reflect where displaced effort will likely fish. We focused our efforts for these analyses on the two most affected gear types – generic otter trawl and limited access scallop dredge.

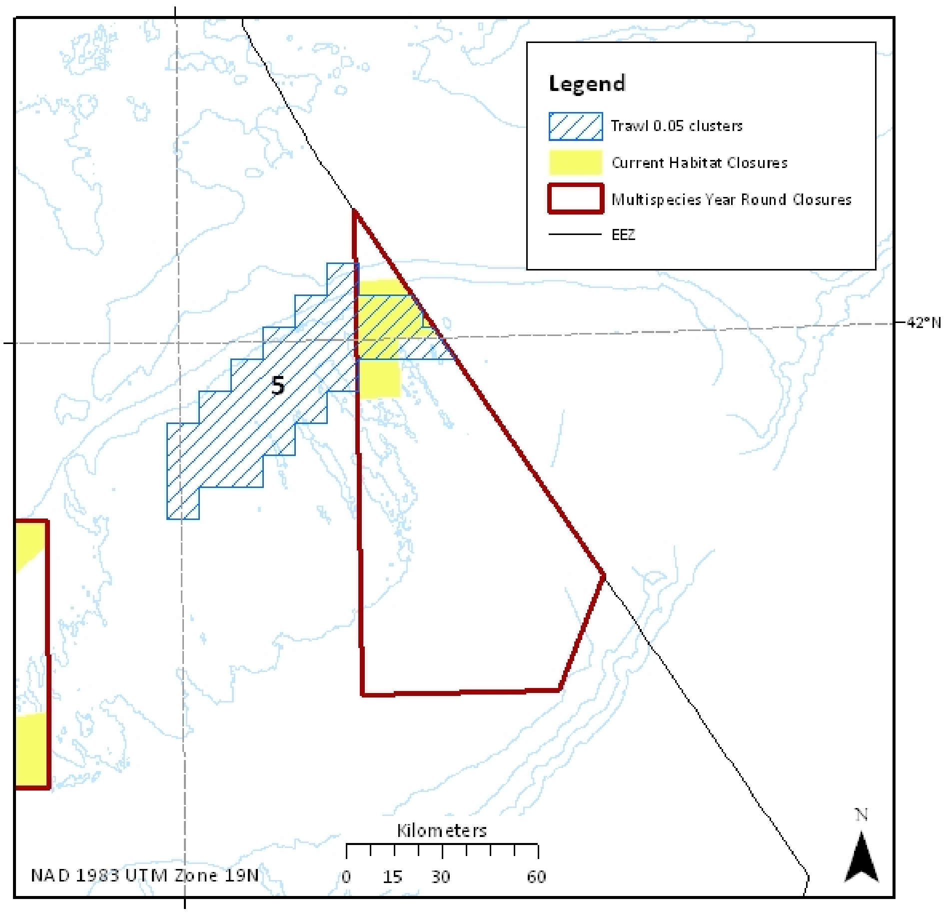
Area closure options for clusters 5 and 6 appear to potentially affect between $5-7.5 million of profits for these two gear types, representing less than 5% of their total aggregate profits from the Georges Bank and Gulf of Maine regions (see "profit at risk" in the tables below). However, the redistribution of these profits is estimated to have relatively minimal effects on aggregate Z_{net}. As with all adverse effects options, the largest net gains are to be had by regulating the otter trawl gear type, with Z_{net} reductions on the order of 1,000 km^2 for Cluster's 5 and 6. Closure of Cluster 5 is estimated to slightly increase adverse effects for the limited entry scallop dredge fishery.

Cluster 7 is estimated to have the smallest impact, both on industry profits and adverse effects minimization.

3.3.3.1 Cluster 5 (Georges Shoals)

These sub-options evaluate two levels of gear restrictions in cluster 5 (Map 96).

Map 96 – Cluster 5 (Georges Shoals). Based on trawl gear Z∞ SASI outputs evaluated using LISA analysis with probability criteria of 0.05.



3.3.3.1.1 Close to all mobile bottom-tending gear

This option would close an area based on cluster 5 to all trawl and dredge gears. For generic trawl gear, this option would result in a slight decrease in adverse effects, while for limited access scallop dredge gear, this option would result in a slight increase in adverse effects.

Table 37 – Closure option for Cluster 5 (Georges Shoal), change in Z_{net} (2007-2009 VTR, profits in 1,000 dollars)

Gear	Pre-closure profit	Profit at risk	Pre-closure Z_{net}	Closure Z_{net}	% reduction in Z_{net}	Habitat benefits/impacts as a result of closure
Generic otter trawl	$57,076	$2,921	37,816	36,946	2.3%	Decrease in adverse effects
Limited access scallop dredge	$105,998	$4,483	6,526	6,592	-1.0%	Increase in adverse effects

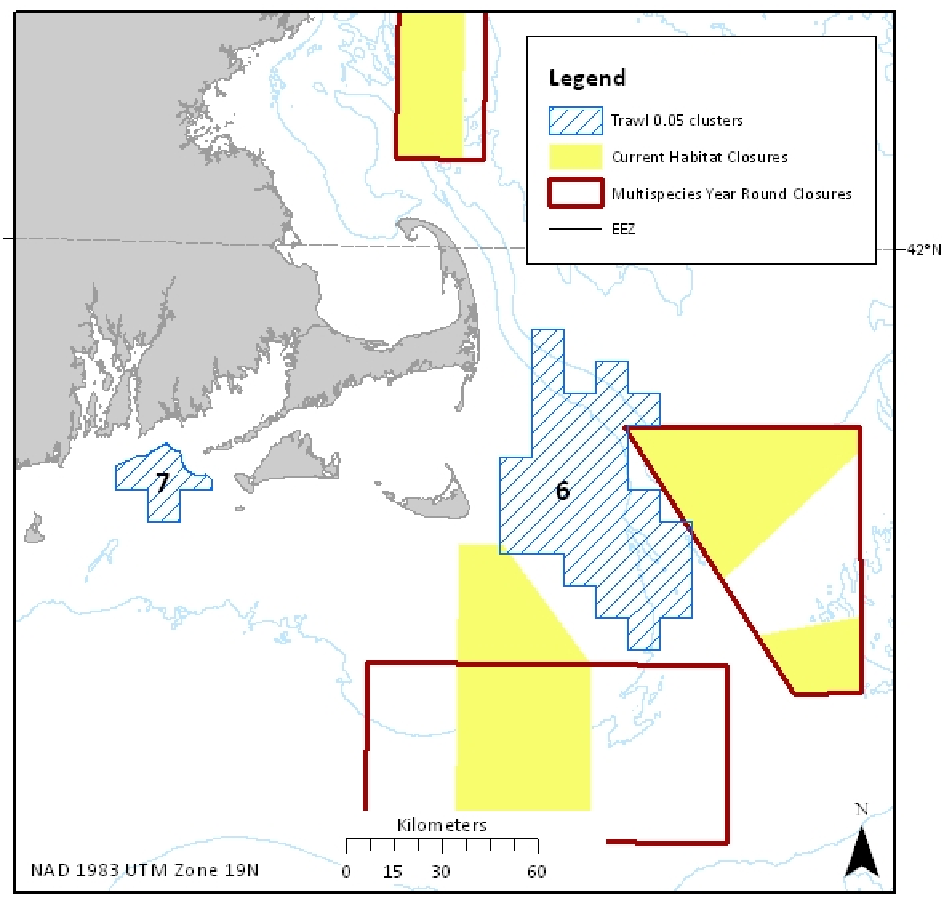
3.3.3.1.2 Close to all trawl gear

This option would close an area based on cluster 5 to all trawl gears. As noted above, for generic trawl gear, this option would result in a slight decrease in adverse effects.

3.3.3.2 Cluster 6 (Great South Channel)

These sub-options evaluate two levels of gear restrictions in cluster 6 (Map 97).

Map 97 – Clusters 6 (Great South Channel) and 7 (Brown's Ledge). Based on trawl gear Z∞ SASI outputs evaluated using LISA analysis with probability criteria of 0.05.



3.3.3.2.1 Close to all mobile bottom-tending gear

This option would close an area based on cluster 6 to all trawl and dredge gears. As shown below, this option would result in a decrease in adverse effects across both gear types.

Table 38 – Closure option for Cluster 6 (Great South Channel), change in Z_{net} (2007-2009 VTR, profits in 1,000 dollars)

Gear	Pre-closure profit	Profit at risk	Pre-closure Z_{net}	Closure Z_{net}	% reduction in Z_{net}	Habitat benefits/impacts as a result of closure
Generic otter trawl	$57,076	$1,996	37,816	36,695	3.0%	Decrease in adverse effects
Limited access scallop dredge	$105,998	$3,048	6,526	6,071	7.0%	Decrease in adverse effects

3.3.3.2.2 Close to all trawl gear

This option would close an area based on cluster 6 to all trawl gears. As noted above, adoption of this option is expected to result in a decrease in adverse effects from fishing with the generic trawl gear type.

3.3.3.3 Cluster 7 (Brown's Ledge)

These sub-options evaluate two levels of gear restrictions in cluster 7 (Map 97).

3.3.3.3.1 Close to all mobile bottom-tending gear

This option would close an area based on cluster 7 to all trawl and dredge gears. Based on the simulation, a slight increase in adverse effects resulting from the use of generic otter trawl gear would be expected following closure of the cluster, while the closure is expected to have no effect on scallop dredge adverse effects.

Table 39 – Closure option for Cluster 7 (Brown's Ledge), change in Z_{net} (2007-2009 VTR, profits in 1,000 dollars)

Gear	Pre-closure profit	Profit at risk	Pre-closure Z_{net}	Closure Z_{net}	% reduction in Z_{net}	Habitat benefits/impacts as a result of closure
Generic otter trawl	$57,076	$310	37,816	37,862	-0.1%	Slight increase in adverse effects
Limited access scallop dredge	$105,998	$-	6,526	6,526	0.0%	No change.

3.3.3.3.2 Close to all trawl gear

This option would close an area based on cluster 7 to all trawl gears. As noted above, a slight increase in adverse effects resulting from the use of generic otter trawl gear would be expected following closure of the cluster.

3.3.4 Gear restriction/closure measures for SBNMS

These options would implement gear restrictions or closures within the boundaries of SBNMS. They need to be further developed and analyzed by the PDT.

3.3.4.1 Closed to all bottom-tending gear

This option would close all/part of SBNMS to all bottom-tending gears, including trawls, dredges, and fixed gears.

3.3.4.2 Closed to all mobile bottom-tending gear

This option would close all/part of SBNMS to all mobile bottom-tending gears.

3.3.4.3 Closed to selected mobile-bottom tending gear

This option would close all/part of SBNMS to some mobile bottom-tending gears, such as some or all types of trawls, and/or some types of dredges.

3.3.5 Measures for the Georges Bank mortality closures

These options would modify the Georges Bank mortality closures, while maintaining some level of spawning closures (either year-round or seasonal) depending on the sub-option selected.

3.3.5.1 No action – all current areas remain closed

This option would maintain the current mortality closures on Georges Bank (NLCA, CAI, CAII).

3.3.5.2 Open non-spawning areas within mortality closures to fishing year round

This option would demonstrate the EFH benefits/impacts of opening portions of the mortality closures on a year-round basis. Spawning areas would be excluded and would remain closed to gears capable of catching groundfish. These spawning areas would be identified in collaboration with the groundfish committee/PDT. **Because the Council at their November 2010 meeting voted not to consider removal of groundfish mortality closures as a 2011 management priority, this option will not be evaluated further as collaboration to identify specific seasonal spawning closures was not supported.**

3.3.5.3 Open mortality closures year round, with specific seasonal spawning closures

This option would demonstrate the EFH benefits/impacts of the mortality closures on a year-round basis. Spawning areas would remain closed seasonally to gears capable of catching groundfish. These spawning areas would be identified in collaboration with the groundfish committee/PDT. **Because the Council at their November 2010 meeting voted not to consider removal of groundfish mortality closures as a 2011 management priority, this option will not be evaluated further as collaboration to identify specific seasonal spawning closures was not supported.**

3.3.6 Measures to reduce adverse effects via gear restrictions

Two types of gear restriction options are described and evaluated in the following sections, including a maximum ground gear size and a maximum ground cable size.

3.3.6.1 Implement ground gear maximum sizes in cluster areas 1, 3, and 4

Ground gear is defined as attachments to the bottom portion of the net to allow the net to be fished on certain bottom types, or to adjust selectivity for certain species. **These options would place an upper limit on ground gear size in one or more of the GOM cluster areas 1, 3, and 4.**

Rationale: The Committee discussed that closure of these areas to various gears was not a reasonable option, given data limitations for these three cluster areas. Restrictions on trawl gear configurations were discussed as an option that would continue to allow fishing in the areas, while hopefully achieving benefits in terms of minimizing impacts to EFH. Specifically, restricting the use of roller gears to smaller sizes would be expected to make it more difficult to fish in areas dominated by large gravel substrate.

Background: Different ground gear materials and ground gear sizes/compositions are used for various applications. For example, when fishing for certain species over smooth bottom, a chain sweep may be used consisting of loops of chain suspended from a steel cable, with only a few links of each loop contacting the seabed. At this time it is unclear how extensive this gear is or what species are targeted. An alternative is a sweep comprising a single length of chain in a raised footrope trawl. The chain contacts the seabed along its entire length. Another alternative is to use a cookie sweep, consisting of a wire (or chain) passed through rubber disks (cookies). Each cookie is similar in diameter (4 – 5 in) and usually tightly fitted (compressed) against one another to ensure no space between adjacent cookies. They do not usually roll when in seabed contact.

Rockhopper gear is possibly the most commonly used sweep design in the groundfish fishery. This gear is often constructed from rubber disks compressed together with larger diameter disks fitted at regular intervals. The disks are generally punched out truck or car tires. The 'classic' rockhopper sweep has a wire passing through each roller to prevent rolling and facilitate their passage over large obstacles (Classic rockhopper sweep, Figure 6), although not all fishermen use this additional wire (Classic rockhopper sweep – without additional wire, Figure 6). The diameter of the large disks may decrease in towards the wingends of the trawl. This gear allows the trawl to pass over rough substrates, and only the larger diameter disks contact the seabed.

Rockhopper gear can also be used on smooth seabed and the space between individual rollers can allow the escapement of bottom dwelling animals. For example, there are reports of some groundfish fishermen using this sweep to reduce the capture of skates. An additional modification to this gear is to fit thin rubber disks at intervals between the large disks to prevent escapement of flatfish. The thin disks are the same diameter as the larger disks, so these too contact the seabed (Classic rockhopper sweep with thin disks, Figure 6).

Roller gear is another variation sometimes used. It consists of large diameter, wide (thick) rubber disks or bead-like rollers designed to roll over the seabed (Roller gear images, Figure 6). Along the wings of the trawl, the rollers are often replaced with cookies compressed together or a rockhopper-style ground gear without wire passing through each disk (Wings of roller sweep, Figure 6). The curvature of the sweep allows only the middle rollers to rotate; those located along the shoulders of the trawl are dragged laterally over the seabed.

As a general rule, ground gear type and construction reflects expected rugosity of the seabed and escape behavior of target species. The diameter of cookies may measure from 10 to 41 cm (4 to 16 in). Rubber disk diameter may measure around 15 cm (6 in) and the larger disks 45 to 90 cm (18 to 36 in).

It is unlikely that fishermen finesse their gear sufficiently to add/remove weight of ground gear unless under exceptional circumstances. The sweep is not frequently altered, particularly at sea, and it is often preferred to use another net with modified sweep attached, rather than exchanging sweeps between nets. Also noteworthy is that the weight of ground gear does not change substantially with depth. A change in volume is required for this to occur, and compressive forces on ground gear components do not significantly alter volume between depths. Towing speed, rigging, or use of materials with different specific weight (density) will have a greater impact on ground gear weight in water and degree of seabed contact. Also, note that rubber disks lose about 70% of their weight in air as soon as they are submerged (and at greater depths the change is relatively minor because there is little further compression/change in volume that occurs).

Figure 6 – Ground gear configurations.

Classic rockhopper sweep

Classic rockhopper sweep – without additional wire


Classic rockhopper sweep with thin disks


Roller gear


Roller gear


Roller gear


Wings of roller sweep

3.3.6.1.1 12 inch maximum diameter

Analysis to be completed.

3.3.6.1.2 20 inch maximum diameter

Analysis to be completed.

3.3.6.1.3 28 inch maximum diameter

Analysis to be completed.

3.3.6.2 Implement ground cable length maximum sizes in cluster areas 1, 3, and 4

Ground cables are defined as wires extending along the seabed between the trawl doors and the bridles or net; for the purpose of herding fish and increasing the area of seabed fished (swept) by the trawl gear. Ground cable diameter can be increased be passing the wires through rubber disks (cookies) or rollers; this modification is designed to assist passage of the ground cables over the seabed. T**hese options would place an upper limit on ground cable length in one or more of the GOM cluster areas 1, 3, and 4.**

Rationale: The Committee discussed that closure of these areas to various gears was not a reasonable option, given data limitations for these three cluster areas. Restrictions on trawl gear configurations were discussed as an option that would continue to allow fishing in the areas, while hopefully achieving benefits in terms of minimizing impacts to EFH. Specifically, restricting the ground cable size would reduce area swept for each tow, and thus reduce overall seabed contact and therefore habitat impacts.

Background: Ground cables are typically constructed from steel wire rope (twisted), often with small diameter rubber disks (cookies) compressed together along the entire cable length (Figure 7). There are some reports that a few fishermen use chain as an alternative to wire rope. Cable diameter ranges from 9/16 in to ¾ in, with 1¾ to 3 in diameter cookies (2 in to 2 3/8 in cookies are commonly used).

Ground cable length varies between boats and typically is 30-80 ftm (55-146 m) although some larger boats may use up to 120 ftm (219 m). Generally, longer lengths are used on smooth seabeds, when the risk of hooking up on obstacles is small, and/or when targeting flatfish. Inshore boats (which also tend to be smaller) tend to use shorter ground cables (30 – 50 ftm, 55-91 m) so they can maneuver the trawl gear around rocky outcrops and other potential hook up sites.

Some fishermen do not vary ground cable length much under different circumstances as it affects the herding angle of the cables and catch rates. Others have been known to add or remove substantial lengths to their ground cables; however it is not known if this is a regular or infrequent activity, or the circumstances that result in such a change. It appears that there is little variation cable/cookie in composition when targeting ground fish, although a small number of fishermen may change ground cables when changing nets.

Figure 7 - Ground cable with cookies

3.3.6.2.1 90 m (50 ftm)

Analysis to be completed.

3.3.6.2.2 150 m (80 ftm)

Analysis to be completed.

3.3.6.2.3 225 m (120 ftm)

Analysis to be completed.

3.3.7 Measures to designate Dedicated Habitat Research Areas

3.3.7.1 Create a DHRA in SBNMS

This option would establish a DHRA in and around Jeffreys Ledge/SBNMS/WGOM Closed Area. Note that an option to create a DHRA in SBNMS is being developed by SBNMS staff/stakeholders and will be evaluated by the PDT at a later time. The following information, which is focused on Jeffreys Ledge, was compiled by the Habitat PDT.

Rationale: The Omnibus/SASI development process has identified a variety of habitat research needs. Addressing these needs may be best accomplished by designating a DHRA with specific goals and regulations associated with it.

Habitat types and ecology: The largest closure in the GoM is the Western Gulf of Maine Closed Area (WGOM) which covers 2,962 km^2 of seascape. The WGOM encompasses parts of Stellwagen Bank, Jeffrey's Ledge and Wildcat Knoll. Within the WGOM, there are several habitat types such as mud, gravel, cobble, exposed rock ledge and a mix of biogenic structures that are potentially used by groundfish. These shallow waters were historically productive fishing and nursery grounds (Ames 1997, Kurlansky 1997), especially for cod.

Previous research in the area: Jeffreys Bank in particular has served as a hotbed for research on groundfish habitat and the effects of closures on habitat recovery and groundfish populations in the Gulf of Maine. The effects of fishing on habitat were examined in the northern section of the Gulf of Maine (Knight et al. 2008). Grabowski et al. (2006) determined that the proximity of habitat was more important than closure status for several groundfish species in the northern section of the Gulf of Maine. A network of scientists used a multi-pronged approach to studying the central portion of Jeffreys Bank where they developed and groundtruthed high resolution habitat maps using multibeam backscatter data and examined the effects of fishing on habitat recovery (Grizzle et al. 2009). They also determined that groundfish are inversely related to spiny dogfish abundances inside the reserve, and that individuals tend to be larger in the reserve (Grizzle et al. 2009). Witman and Sebens (1992) determined that adult groundfish populations and predation pressure on macro-invertebrates were much higher on offshore ledges including the southern portion of Jeffreys Ledge in the 1980's than in coastal waters of the Gulf of Maine. Grabowski et al. (unpublished data) has also examined the season and spatial patterns of juvenile cod use of habitat on Jeffreys Ledge.

Possible DHRA boundaries: Because the WGOM closed area is rather extensive, a DHRA could be created in each of the northern, central and southern sections of the existing closure. If only one was selected, the central/western portion makes sense given that detailed habitat maps that have been groundtruthed exist for this part of the WGOM/Jeffreys Bank.

Why would this area be a good DHRA? Jeffrey's Ledge would be a productive location for a DHRA for the following reasons: (1) Jeffrey's Ledge has been noted as important habitat for an array of commercially valuable fish species. (2) The high resolution maps of the central/western portion provides the opportunity to examine fish/habitat associations and determine which habitats provide essential fish habitat for key life-history stages of cod and other groundfish species.

What are key research goals for area? (1) Use DHRA to examine groundfish habitat associations/essential fish habitat criteria. (2) Use DHRA to study impacts of fishing gear impacts on habitat susceptibility and recovery.

Note that as the area is already closed to fishing, it is unclear whether any additional regulations associated with the DHRA would be necessary. In addition, is is not clear whether a sunset date for the DHRA would be appropriate, given that there are no sunset dates associated with the WGOM Habitat Closure or the WGOM Mortality Closure.

3.3.7.2 Create a DHRA on Cashes Ledge (Ammen Rock)

This option (from 6/10/10 meeting) would establish a DHRA around Ammen Rock on Cashes Ledge. Note that removal of the Cashes Ledge habitat closed area and the Cashes Ledge mortality closure are not being considered in this amendment, such that fishing would be restricted in some or all of the proposed DHRA.

Rationale: The Omnibus/SASI development process has identified a variety of habitat research needs. Addressing these needs may be best accomplished by designating a DHRA with specific goals and regulations associated with it.

Habitat types and ecology: The Gulf of Maine consists of a series of basins that occupy approximately 30% of the Gulf, with ledges and banks accounting for the remaining 70% (Uchupi and Bolmer, 2008). Cashes Ledge is one of the most prominent examples of these ledges and banks, and extends roughly 57 km long and 8-10 km wide. Cashes Ledge rises from local depths of 200 m to a depth of 9 m (Ammen Rock Pinnacle), and consists of Ordovician granite that is rugged and heavily fissured on the summit. Many of the recesses towards the top of the Ledge have been filled with reworked glacial deposits (Uchupi and Bolmer, 2008). Ammen Rock Pinnacle is covered by a thick expanse of *Laminaria laminaria* that extends to roughly 30 m (Vadas and Steneck, 1988) and encompasses a volume of 2.12-2.45 x 10^6 m^3 (McGonigle et al. 2011). This *Laminaria* kelp zone transitions to an *Agarum cribrosum* kelp zone that extends from ~20 m to 40 m water depth. These kelp areas are noted as important juvenile cod and other groundfish habitat (Witman and Sebens 1992, Steneck 1996).

Previous research in the area: Vadas and Steneck (1988) examined the extent of kelp on Cashes Ledge in the 1980's. McGonigle et al. (2011) estimated the volumetric extent of and mapped the kelp habitat on Cashes Ledge using high resolution multibeam acoustic backscatter data. McGonigle et al. (unpublished data) are working on developing a groundtruthed habitat map of the other habitats on Cashes Ledge. Witman and Sebens (1992) and Steneck (1996) determined that adult groundfish populations and predation pressure on macro-invertebrates were much higher on Cashes Ledge in the 1980's than in coastal waters of the Gulf of Maine. Grabowski et al. (unpublished data) have reexamined these processes over the past 5 years and found similar trends especially in offshore closed areas. Offshore open areas such as Platts Bank resemble inshore areas with groundfish stocks that are largely considered to be depleted. Grabowski et al. (unpublished data) have also examined the season and spatial patterns of juvenile cod use of habitat on Cashes Ledge, and interactions between cod and spiny dogfish.

Possible DHRA boundaries: An area that encompasses up to half of the kelp zone and the surrounding rock and sand habitats would be useful.

Why would this area be a good DHRA? Cashes Ledge would be a productive location for a DHRA for the following reasons: (1) Cashes Ledge has been noted as important habitat for an array of commercially valuable fish species. (2) The kelp habitat on Cashes Ledge is unique to the offshore waters of the Gulf of Maine, and is important nursery habitat for juvenile cod and other economically and ecologically important species. (3) The high resolution maps of the kelp habitat at Cashes Ledge provide the opportunity to examine fish habitat associations and determine which habitats provide essential fish habitat for key life-history stages of cod and other groundfish species. (4) Resident cod likely exist at Cashes Ledge, which suggests that this area is particularly important for cod, and also provides an in situ laboratory to examine fish biology research questions.

What are key research goals for area? (1) Use DHRA to examine groundfish habitat associations/essential fish habitat criteria. (2) Use DHRA to study impacts of fishing gear impacts on habitat susceptibility and recovery

Note that as the area is already closed to fishing, it is unclear whether any additional regulations associated with the DHRA would be necessary. In addition, is is not clear whether a sunset date for the DHRA would be appropriate, given that there are no sunset dates associated with the Cashes Ledge Habitat Closure or the Cashes Ledge Mortality Closure.

3.3.7.3 Create a DHRA on Jeffreys Bank (trawl LISA cluster 2)

This option would establish a DHRA in and around Jeffreys Bank/trawl cluster 2. Note that removal of the Jeffreys Bank habitat closed area is not being considered in this amendment, such that fishing would be restricted in some of the proposed DHRA, depending on the boundaries selected.

Rationale: The Omnibus/SASI development process has indentified a variety of habitat research needs. Addressing these needs may be best accomplished by designated a DHRA with specific goals and regulations associated with it.

Upon preliminary review, the PDT recommends that areas such as Cashes Ledge and Jeffreys Ledge be prioritized for designations as DHRAs over Jeffreys Bank. Historically, less research has been conducted on Jeffreys Bank as compared to either Jeffreys Ledge or Cashes Ledge. The area is more remote as compared to Jeffreys Ledge, and the water depths are greater (mean depth for p=0.05 cluster cells is 125.6 m), which makes it less conducive to future study.

3.3.8 Alternatives to minimize the adverse effects of fishing on EFH

Individual area-based options are likely to have synergistic effects on the total magnitude of adverse effects across one or more gear types/fisheries, because restrictions on fishing in one location will affect the magnitude of fishing in other locations. Thus, the PDT recommends that alternatives be developed that consist of a suite of individual area-based gear restriction and/or gear modification options. Further analyses of these alternatives will summarize and compare likely changes in adverse effects across all the options that comprise each alternative.

3.3.8.1 No action alternative (status quo)

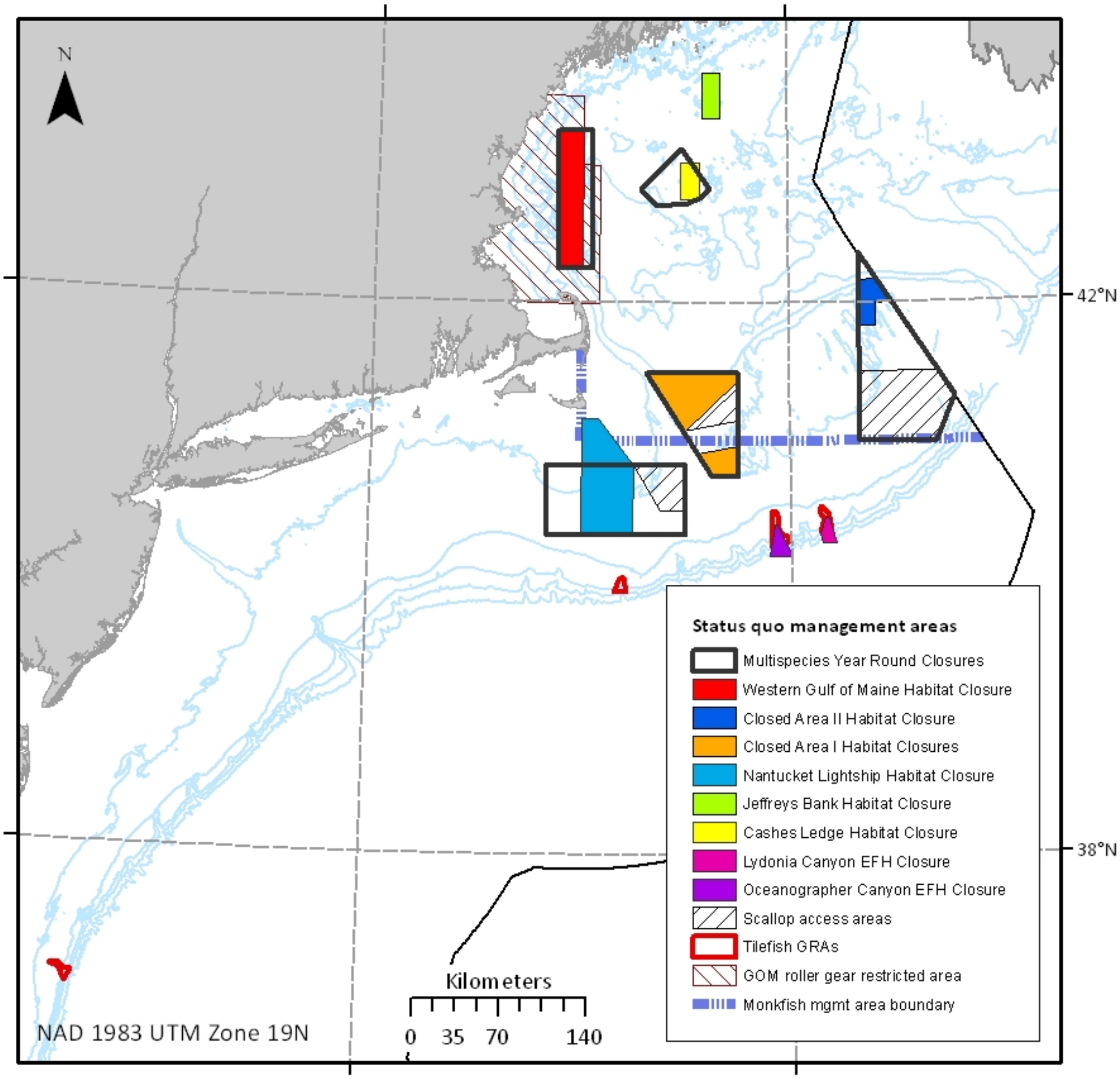
This alternative would maintain current EFH closed areas and gear restrictions, including the following (Figure 8):

- Habitat closed areas: Nantucket Lightship, Closed Area I, Closed Area II, Western Gulf of Maine, Cashes Ledge, Jeffreys Bank, Lydonia Canyon, Oceanographer Canyon - closed to all mobile bottom tending gear
- Inshore GOM 12 inch roller gear restriction
- Roller gear restriction for vessels fishing on a monkfish DAS in the southern monkfish management area
- Tilefish gear restricted areas (GRAs)

Mortality closed areas, including Nantucket Lightship, Closed Area I, Closed Area II, Western Gulf of Maine, and Cashes Ledge are also shown on the figure for reference. These are closed to all gear capable of catching groundfish, with some exemptions (e.g. scallop access areas, groundfish SAPs).

Analysis of this alternative will be completed at a later time once other alternatives have been developed.

Figure 8 - Status quo management areas



3.3.8.2 Alternative 1

To be developed as a combination of preferred individual options.

3.3.8.3 Alternative 2

To be developed as a combination of preferred individual options.

3.3.8.4 Alternative 3

To be developed as a combination of preferred individual options.

3.4 Alternatives to protect deep-sea corals

Cold-water or deep-sea corals in the northwest Atlantic are a diverse assortment of Anthozoa that include the subclass Hexacorallia (Zoantharia), which includes the **hard or stony corals** (order Scleractinia) and **black and thorny corals** (order Antipatharia); and subclass Octocorallia (Alcyonaria or octocorals), which includes the **true soft corals** (order Alcyonacea), **gorgonians** (sea fans, sea whips, order Gorgonacea), and **sea pens** (order Pennatulacea). Worldwide, deep-sea corals can build reef-like structures or occur as thickets, isolated colonies, or solitary individuals, and often are significant components of deep-sea ecosystems, providing habitat (substrate, refugia) for a diversity of other organisms, including many commercially important fish and invertebrate species. They are suspension feeders, but unlike most tropical and subtropical corals, do not require sunlight and do not have symbiotic algae (zooxanthellae) to meet their energy needs. Deep-sea corals can be found from near the surface to 6000 m depth, but most commonly occur between **50-1000 m** on hard substrate (Puglise and Brock 2003), hence their "deep-sea" appellation. Descriptions of species found in the Northeast region, including information about their vulnerability to fishing, can be found in section 5.2 the Swept Area Seabed Impact (SASI) model document.

<u>Authority and guidance</u>

Corals may be protected under the EFH authority in the MSA as a component of essential fish habitat, in the context of minimizing, to the extent practicable, the effects of fishing on EFH (see section 305(b)). Of course, any action taken under the EFH authority must occur within areas that are designated as EFH. In the Northeast region, this authority has been used in Monkfish FMP Amendment 2 to protect deep-sea corals and associated habitat features in two offshore canyons, Lydonia and Oceanographer, from fishing activity occurring under a monkfish day at sea. Options for minimizing the adverse effects of fishing on EFH include fishing equipment restrictions, time/area closures, and harvest limits (in this case, direct harvest of corals).

A second mechanism by which to protect deep-sea corals is via the Section 303 discretionary provisions found in the 2007 reauthorization of the MSA:

> —Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, may—
> (A) designate zones where, and periods when, fishing shall be limited, or shall not be permitted, or shall be permitted only by specified types of fishing vessels or with specified types and quantities of fishing gear;
> (B) designate such zones in areas where deep sea corals are identified under section 408, to protect deep sea corals from physical damage from fishing gear or to prevent loss or damage to such fishing gear from interactions with deep sea corals, after considering long-term sustainable uses of fishery resources in such areas; and
> (C) with respect to any closure of an area under this Act that prohibits all fishing, ensure that such closure—

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

Section 408, referenced above, describes the deep-sea coral research and technology program:

(a) IN GENERAL. The Secretary, in consultation with appropriate regional fishery management councils and in coordination with other federal agencies and educational institutions, shall, subject to the availability of appropriations, establish a program—
   (1) to identify existing research on, and known locations of, deep sea corals and submit such information to the appropriate Councils;
   (2) to locate and map locations of deep sea corals and submit such information to the Councils;
   (3) to monitor activity in locations where deep sea corals are known or likely to occur, based on best scientific information available, including through underwater or remote sensing technologies and submit such information to the appropriate Councils;
   (4) to conduct research, including cooperative research with fishing industry participants, on deep sea corals and related species, and on survey methods;
   (5) to develop technologies or methods designed to assist fishing industry participants in reducing interactions between fishing gear and deep sea corals; and
   (6) to prioritize program activities in areas where deep sea corals are known to occur, and in areas where scientific modeling or other methods predict deep sea corals are likely to be present.

(b) REPORTING. Beginning 1 year after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary, in consultation with the Councils, shall submit biennial reports to Congress and the public on steps taken by the Secretary to identify, monitor, and protect deep-sea coral areas, including summaries of the results of mapping, research, and data collection performed under the program.

In May 2010, the Council received guidance from NMFS NERO regarding implementation of the discretionary provisions. Important aspects of this guidance include:

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

- Closure of zones to fishing.

- Protective measures can apply to any MSA regulated fishing activity, even if that activity or gear type is not managed by the FMP that includes the measures.
- Long-term sustainable use of fishery resources must be considered prior to designating DSC protection zones.
- Action taken under the discretionary authority may be used to complement action taken under the EFH authority.
- Unlike the EFH authority, the discretionary authority does not carry a consultation requirement.
- Councils may adopt gear restrictions via an omnibus amendment that applies to several FMPs, and can include in such an amendment measures that apply to fisheries under the jurisdiction of other Councils. Environmental, economic, and social analyses must be conducted, and consultation with the other affected Council will almost certainly be required.
- For coral management provisions to apply to fisheries managed under the Atlantic Coastal Cooperative Fisheries Management Act (ACA), either the ASMFC must take complementary action in their FMP, or there must be a Council FMP for the same resource. The relevant example in our region is the offshore component of the American lobster fishery, which would not be subject to coral protection measures enacted in an MSA FMP.

Other sections of the MSA can also be interpreted as applying to deep-sea corals and associated ecosystems (NOAA 2010b, p 9):

- Section 301(a)(9) requires Councils to include conservation and management measures that, to the extent practicable, minimize bycatch.
- Section 303(b)(12), authorizes Councils to include management measures in FMPs to conserve target and non-target species and habitats.

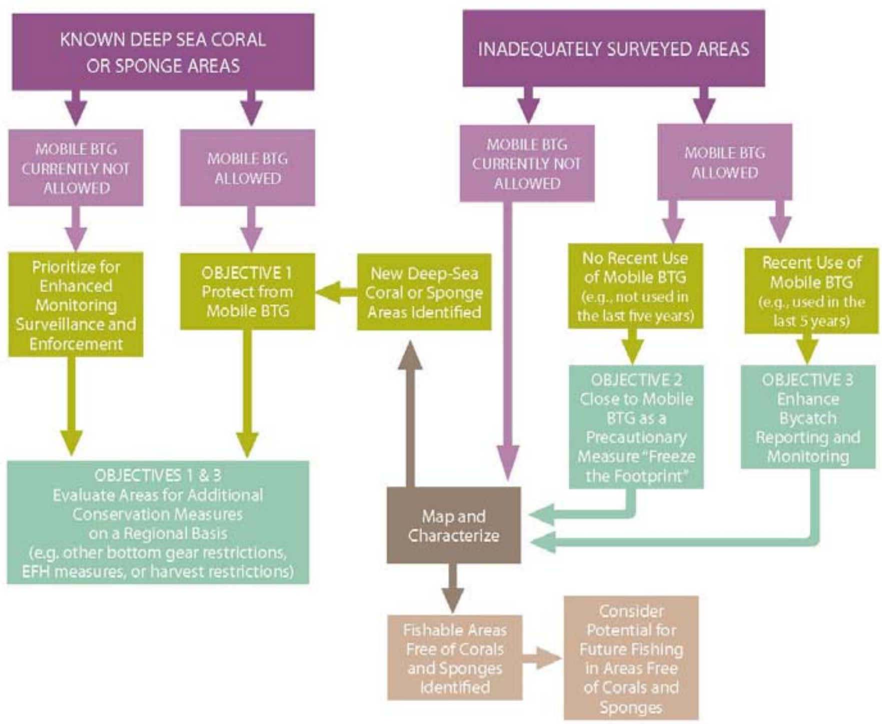
Additional NOAA guidance on coral conservation is provided in the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems (NOAA 2010b). This plan has six conservation and management objectives; those in bold are most relevant to the Council's decisions. Objective 2 appears to be somewhat more precautionary than the regional guidance discussed above.

1. **Protect areas containing known deep-sea coral or sponge communities from impacts of bottom-tending fishing gear.**
2. **Protect areas that may support deep-sea coral and sponge communities where mobile bottom-tending fishing gear has not been used recently, as a precautionary measure.**
3. **Develop regional approaches to further reduce interactions between fishing gear and deep-sea corals and sponges.**

4. Enhance conservation of deep-sea coral and sponge ecosystems in National Marine Sanctuaries and Marine National Monuments.
5. **Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge ecosystems.**
6. Provide outreach and coordinated communications to enhance public understanding of these ecosystems.

Figure 9, which is reproduced from the Strategic Plan, depicts the agency's approach to managing the impacts of mobile bottom-tending gears on deep-sea corals and associated ecosystems.

Figure 9 – NOAA's precautionary approach to manage bottom-tending gear (BTG), especially mobile BTG and other adverse impacts of fishing on deep-sea coral and sponge ecosystems. Reproduced from NOAA 2010b.



3.4.1 Alternatives to define Deep-Sea Coral Zones

The following series of alternatives outline criteria for the designation of deep-sea coral zones. These zones or portions of them would then be subject to fishing restrictions as necessary (see section 3.4.2) to protect the corals therein. Some of these alternatives could be combined; the various options are listed in the flowchart below in order from most general to most specific.

Types of corals considered

The alternatives were developed primarily to protect hard corals, gorgonians, and soft corals. The PDT recommends that the Habitat Committee may wish to exclude sea pens from explicit management consideration at this stage for the following reasons:

- The two most common sea pen species are widely distributed in soft sediments throughout the region. *P. aculeata* (common sea pen) is common in the Gulf of Maine (Langton et al. 1990), and there are numerous records of *Pennatula* sp. on the outer continental shelf as far south as the Carolinas in the Theroux and Wigley database. *S. elegans* (white sea pen) is abundant on the Mid-Atlantic coast outer shelf (Theroux and Wigley 1998). Unlike other types of corals, these species are not dependent on hard bottom habitats, which are relatively rare in the deep ocean. Other known sea pen taxa in the region are found in soft sediments at continental slope depths (200-4300 m).
- Because the two species listed above are relatively common, sea pen vulnerability to fishing gears was considered as part of the Vulnerability Assessment for the SASI model.

<u>Distribution of deep-sea corals off the northeastern U.S.</u>

The deep corals of the continental margin and several canyons off the northeastern U.S. were surveyed in the 1980s via submersible and towed camera sled (Hecker et al. 1980, 1983). Corals were denser and more diverse in the canyons, and some species, such as those restricted to hard substrates, were found only in canyons while the soft substrate types were found both in canyons and on the continental slope (Hecker and Blechschmidt 1980). They appear to be mostly restricted to hard substrates on the shelf.

A variety of data sets are available that document locations of the various deep-sea coral species (Table 40). Generally, these data sets show presence of corals only, vs. presence/absence and/or presence/absence with abundance information. The records vary in age from the 1850s through present. Unlike the more widely known trawl surveys, which provide broad spatial coverage, the various coral surveys tend to be narrowly focused/of limited spatial extent. These datasets were compiled and audited by the US Geological Survey and NOAA's Deep-Sea Coral Research and Technology Program (DSCRTP), with the assistance of NEFSC and others (the compiled database is referred to as the USGS Cold-Water Coral Geographic Database (CoWCoG)).

Table 40 – Deep-sea coral data sources for the Northeast Region

Data set	Citation
Deichmann, 1936	Deichmann, Elisabeth, 1936, The Alcyonaria of the western part of the Atlantic Ocean: Memoirs of the Museum of Comparative Zoology at Harvard College, v. 53, 317 p.
Hecker et al., 1980	Hecker, Barbara, Blechschmidt, Gretchen, and Gibson, Patricia, 1980, Epifaunal zonation and community structure in three mid- and north Atlantic canyons—final report for the canyon assessment study in the mid- and north Atlantic areas of the U.S. outer continental shelf: U.S. Department of the Interior,

	Bureau of Land Management Monograph, 139 p.
NEFSC HUDMAP[1]	Records from 2001, 2002, and 2004 video samples taken near the head of Hudson Canyon between 100-200 m depth. Corals sampled include sea pens and the stony coral *Dasmosmilia lymani*.
NEFSC Sea Pens[1]	Records of sea pens compiled from various sources, including submersible surveys, trawl surveys, and towed camera surveys. Data collected between 1956 and 1984.
NES CR Dives	These data summarize dives locations of samples collected during NOAA Ocean Explorer "Mountains in the Sea" cruises to the New England seamounts during 2003 and 2004.
Smithsonian	Records off all coral types from various research vessel surveys conducted from 1873 through present. Surveys conducted in GOM as well as along shelf/slope break on Georges Bank and in Mid-Atlantic Bight.
Theroux and Wigley	Theroux, Roger B. and Wigley, Roland L., 1998, Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States
US Fish Commission	Records for *Dasmosmilia lymani* off NJ/VA
VIMS for BLM/MMS	Mostly *Dasmosmilia lymani* records; fewer records of *Stylatula elegans, Isozoanthus* sp.
Watling and Auster, 2005	Watling, L., and Auster, P. J., 2005, Distribution of deepwater Alcyonacea off the northeast coast of the United States, *in* Freiwald, Andre, and Roberts, J. M., eds., 2005, Cold-water corals and ecosystems:ß Springer-Verlag, Berlin, p. 279-296.
Watling et al, 2003	Watling, L., Auster, P.J., Babb, I., Skinder, C., and Hecker, B., 2003, A geographic database of deepwater alcyonaceans of the northeastern U.S. continental shelf and slope: Groton, National Undersea Research Center, University of Connecticut, Version 1.0 CD-ROM.
Yale University Peabody Museum Collection	Yale University Peabody Museum Collection, Yale Invertebrate Zoology—Online Catalog: accessed July 2007 at http://peabody.research.yale.edu/COLLECTIONS/iz/

NOAA's DSCRTP has identified the following areas as containing deep-sea corals (Table 41).

Table 41 – Deep-sea coral areas and current management status. Adapted from NOAA 2010a.

Identified areas with deep-sea corals	Current status	Reference
Bear seamount	NEFMC proposed HAPC	Packer et al. 2007; NEFMC 2007
Retriever seamount	NEFMC proposed HAPC	Packer et al. 2007; NEFMC 2007
Heezen Canyon	NEFMC proposed HAPC	Hecker and Belchschmidt 1980; Watling et al. 2003; Packer et al. 2007; NEFMC 2007

Identified areas with deep-sea corals	Current status	Reference
Lydonia Canyon	NE & MAFMC monkfish bottom-trawl & gill net closure; MAFMC squid, mackerel, & butterfish bottom-trawl closure; MAFMC closed to bottom-trawling to protect tilefish EFH; NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008a; MAFMC 2008b (final rule effective 2009); NEFMC 2007
Oceanographer Canyon	NE & MAFMC monkfish bottom-trawl & gill net closure; MAFMC squid, mackerel, & butterfish bottom-trawl closure; MAFMC closed to bottom-trawling to protect tilefish EFH; NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008a; MAFMC 2008b (final rule effective 2009); NEFMC 2007
Veatch Canyon	MAFMC closed to bottom-trawling to protect tilefish EFH, NEFMC proposed HAPC	Hecker and Belchschmidt 1980; Hecker et al. 1983; Watling et al. 2003; Packer et al. 2007; MAFMC 2008b (final rule effective 2009); NEFMC 2007
Slope near Alvin Canyon	NEFMC proposed HAPC	Hecker and Belchschmidt 1980; Watling et al. 2003; Packer et al. 2007; NEFMC 2007
Toms/Cartaret Canyon	NEFMC proposed HAPC	Hecker and Belchschmidt 1980; Watling et al. 2003; Packer et al. 2007; NEFMC 2007
Hendrickson Canyon	NEFMC proposed HAPC	Watling et al. 2003; Packer et al. 2007; NEFMC 2007
Baltimore Canyon	NEFMC proposed HAPC	Watling et al. 2003; Packer et al. 2007; NEFMC 2007
Norfolk Canyon	MAFMC closed to bottom-trawling to protect tilefish EFH; NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008; NEFMC 2007
Western Jordan Basin	No special protections	Auster 2005 and Watling et al. 2003; Auster (unpublished)
Mount Desert Rock Area	No special protections	Auster 2005 and Watling et al. 2003
Georges Tower off the Northern Edge of Georges Bank	No special protections	Watling and Auster 2005

Distributions of individual coral types (hard/stony coral, black corals, and soft and gorgonian corals, are further described below), with additional details given in the SASI document.

Hard (stony) corals (Order Scleractinia)

Cairns and Chapman (2001) list 16 species of stony corals from the Gulf of Maine and Georges Bank to Cape Hatteras (see also Cairns 1981). Most of the stony corals in this region are **solitary organisms** and one species, *Astrangia poculata*, can occur in very shallow water, at depths of only a few meters. Theroux and Wigley (1998) described the distribution of deep corals in the northwest Atlantic, based on samples taken from 1956-1965. There appears to be a general lack of stony corals on Georges Bank, but they are present **along the continental margin**. They are found mostly on **hard substrates**. Moore *et al*. (2003, 2004) reported several species of solitary and colonial stony corals on Bear Seamount; one notable solitary species, *Vaughanella margaritata*, represents the first record of this species since its original description over 100 years ago, and is endemic to the northwest Atlantic (Cairns and Chapman 2001). Other recent expeditions to the New England and Corner Rise Seamounts have also found stony corals (Adkins *et al*. 2006; Watling *et al*. 2005, Shank *et al*. 2006).

Black Corals (Class Anthozoa, Order Antipatharia)

Antipatharians are predominantly tropical, but some species are known to occur in the northwest Atlantic. Watling et al. (2005) collected at least 8 species of black coral from the **seamounts** during their 2004 expedition; Brugler and France (2006) observed and collected 15 species of black coral during their 2005 expedition to the New England and Corner Rise Seamounts, including 7 species that they did not previously observe on the seamounts.

Gorgonians (Order Gorgonacea) and true soft corals (Order Alcyonacea)

Seventeen species in seven gorgonian families were recorded for the northeastern U.S. shelf and slope north of Cape Hatteras (Packer et al. 2007). These families (Acanthogorgiidae, Paramuriceidae, Anthothelidae, Paragorgiidae, Chrysogorgiidae, Primnoidae, and Isiddae) are the best documented because of their larger sizes, as well as being most abundant in the deeper waters of the continental slope (Watling and Auster 2005). Nine species of true soft corals in three families were recorded for the northeastern U.S. shelf and slope north of Cape Hatteras (Packer et al. 2007). Two species that are very numerous in nearshore records are the true soft corals *Gersemia rubiformis* and *Alcyonium* species (Watling and Auster 2005). It should be noted that, for a variety of reasons, there is uncertainty about the accuracy of the identifications of species from these two orders from the various historical surveys (Watling and Auster 2005), so these identifications and surveys should be interpreted with caution.

Theroux and Wigley (1998) found that both gorgonians and true soft corals were present along the **outer margin of the continental shelf and on the slope and rise, and were sparse and patchy in all areas**, particularly in the northern section. **They were not collected in samples taken at < 50 m in depth, and were most abundant between 200-500 m**. Gorgonians and true soft corals were collected from **gravel and rocky outcrops** (Theroux and Wigley 1998).

Watling and Auster (2005) noted two distinct distributional patterns for the gorgonians and true soft corals. **Most are deepwater species that occur at depths > 500 m**; these include species of gorgoninans in the genera *Acanthogorgia*, *Acanella*, *Anthothela*, *Lepidisis*, *Radicipes*, and *Swiftia*, and true soft corals in the genera *Anthomastus* and *Clavularia*. **Other species occur throughout shelf waters to the upper continental slope** and include the gorgonians *Paragorgia arborea*, *Primnoa resedaeformis*, and species in the genus *Paramuricea*. *Paragorgia arborea* was described by Wigley (1968) as a common component of the gravel fauna of the Gulf of Maine, while Theroux and Grosslein (1987) reported *Primnoa resedaeformis*, as well as *Paragorgia arborea*, to be common on the Northeast Peak of Georges Bank. Both species are widespread in the North Atlantic (Tendal 1992); *Primnoa resedaeformis* has been reported south to off Virginia Beach, Virginia (37°03'N) (Heikoop et al. 2002). The majority of records for *Acanthogorgia armata*, *Paragorgia arborea*, and *Primnoa resedaeformis* in the Watling et al (2003) database come from Lydonia, Oceanographer, and Baltimore canyons. In addition, *Primnoa resedaeformis* was found throughout the Gulf of Maine and on the Northeast Peak of Georges Bank, affirming Theroux and Grosslein's (1987) observations.

3.4.1.1 Shelf-slope area from 200 m (110 ftm) to the edge of the EEZ

This alternative would designate the entire shelf-slope area between 200 m (110 ftm) and the EEZ as a deep-sea coral zone. The specific northern and southern extents of this coral zone would need to be determined. This alternative was proposed at the 9/27/10 committee meeting. The rationale was that 200 m was deeper than much of the fishing effort, and that taking the boundary of the zone to the EEZ would be a precautionary approach that would protect areas that contain corals and currently contain little fishing.

According to data compiled for the SASI document, seven of the 16 regional stony coral species occur shallower than 200 m. Of the nine known soft coral species in the region, depth range information was available for seven. All of these have observed minimum depths greater than 200 m (depth ranges were not specified for *Gersemia rubiformis* or *Clavularia modesta*). Of the 21 gorgonian species known in the region, depth ranges were specified for 13. Of these, only one species, *Primnoa resedaeformis*, is known to occur shallower than 200 m. A minimum depth of 200 m is sufficiently shallow to protect most species known in the region, however, a variety of stony corals are known to occur between 100-200 m.

3.4.1.2 Shelf-slope area from 100 m to 2000 m (55 ftm to 1100 ftm)

This alternative would designate the entire shelf-slope area between depths of 100 and 2000 m (55 ftm to 1100 ftm) as a deep-sea coral zone. The specific northern and southern extents of this coral zone would need to be determined.

According to data compiled for the SASI document, only two of the 16 regional stony coral species occur shallower than 100 m. At the deep end of the depth range for this alternative, two stony coral species have observed depth ranges extending deeper than

2000 m, and one species is known exclusively from depths greater than 2000 m. Of the nine known soft coral species in the region, depth range information was available for seven, and none of them occurred shallower than 100 m (depth ranges were not specified for *Gersemia rubiformis* or *Clavularia modesta*). Only two species have documented occurrence below 2000 m (*Anthomastus grandiflorus*, *Gersemia fruticosa)*. Of the 21 gorgonian species known in the region, depth ranges were specified for 13. Of these, six have known occurrence below 2000 m, while only one species, *Primnoa resedaeformis*, has known occurrence shallower than 100 m. Thus, the maximum depth associated with this alternative may lead to a lack of protection for some species, especially some of the gorgonians. A minimum depth of 100 m is sufficiently shallow to protect all species known in the region.

3.4.1.3 All canyon and seamount HAPCs plus some inter-canyon areas

These alternatives would designate deep-sea coral zones in all the proposed canyon and seamount HAPCs from Phase 1: Heezen, Lydonia, Oceanographer, Hendrickson, Toms/Cartaret, Baltimore, Norfolk, Gilbert (between Lydonia and Oceanographer), Veatch, Alvin/Atlantis, Hudson, Hydrographer, Wilmington, and Washington Canyons, in addition to on Bear and Retriever Seamounts (see Map 98). In addition, this alternative would include some inter-canyon areas. The rationale for this is that inter-canyon areas may provide important habitat for some coral species. Canyons in close proximity where designation of inter-canyon areas might be appropriate were designated in combination as HAPCs during Phase 1. These include Lydonia/Gilbert/Oceanographer, Alvin/Atlantis, and Toms/Middle Toms/Hendrickson (Cartaret canyon is close to Toms Canyon).

Canyon areas are defined as those locations with steeper topography, while inter-canyon areas are defined as those areas between canyons with a more gradual slope. The figure below indicates the intended meanings of 'canyon' and 'inter-canyon', using Lydonia, Gilbert, and Oceanographers canyons as an example.

For this alternative, as well as for alternatives 3.4.1.4, 3.4.1.5, and 3.4.1.6, the proposed HAPC boundaries might be modified to best account for both fishing and coral distributions, as well as to accommodate enforcement considerations. For example, the shallow boundary of the Lydonia/Gilbert/Oceanographer HAPC runs roughly along the 100 m contour, which may be shallower than desired in terms of its overlap with fishing activities, and the deeper boundary is at the 1500 m contour, which is irregular and might present challenges from an enforcement perspective. For some HAPC designations, the 1500 m contour was used as the seaward boundary because it represents the maximum depth of EFH along the continental slope, but the footprint of EFH designations would not restrict the boundaries of coral zones designated under the discretionary authority.

Map 98 – All canyon and seamount HAPCs.

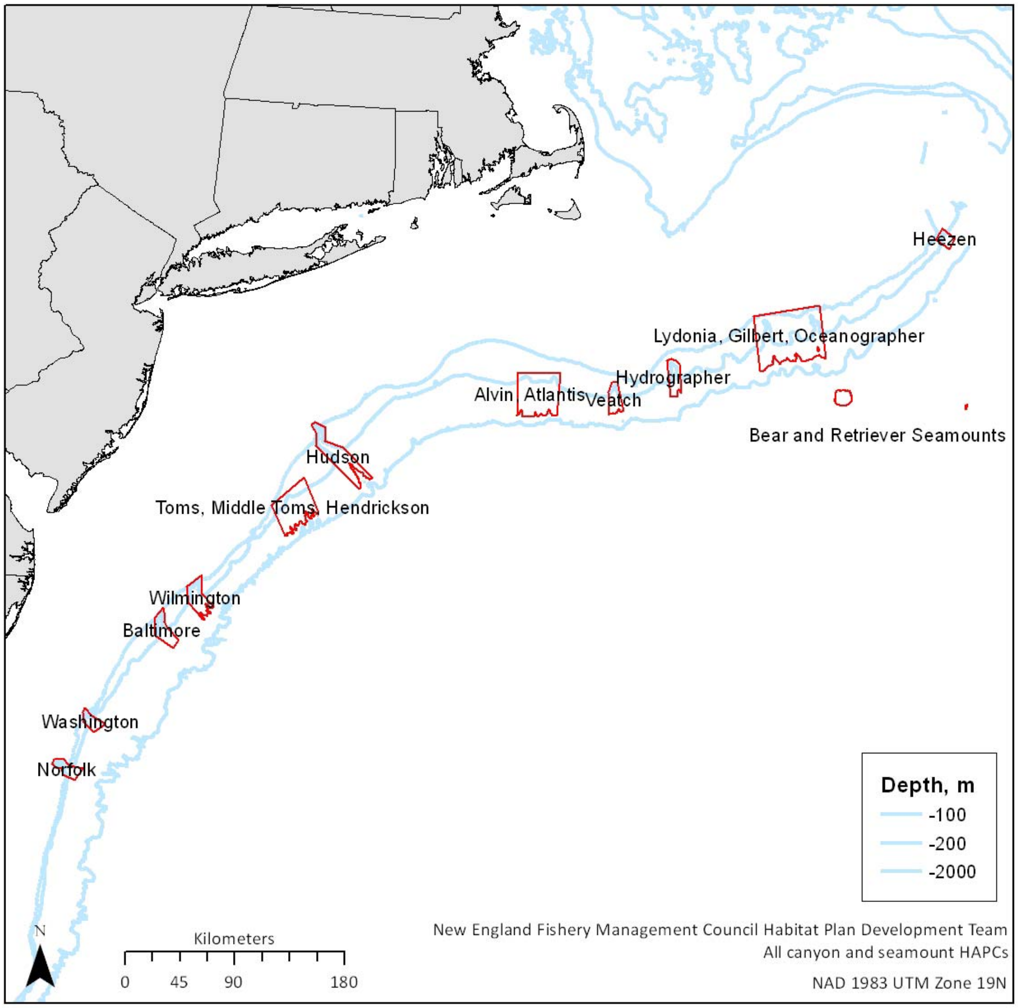
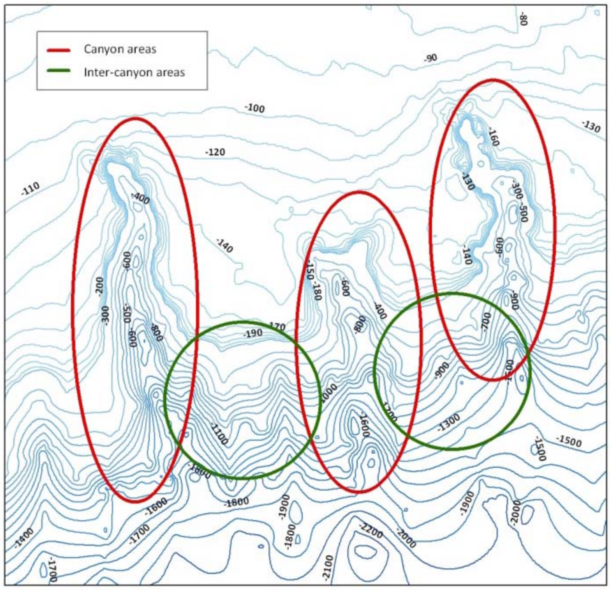


Figure 10 – Distinction between 'canyon areas' and 'inter-canyon areas', using the Lydonia/Gilbert/Oceanographer Canyon region as an example.



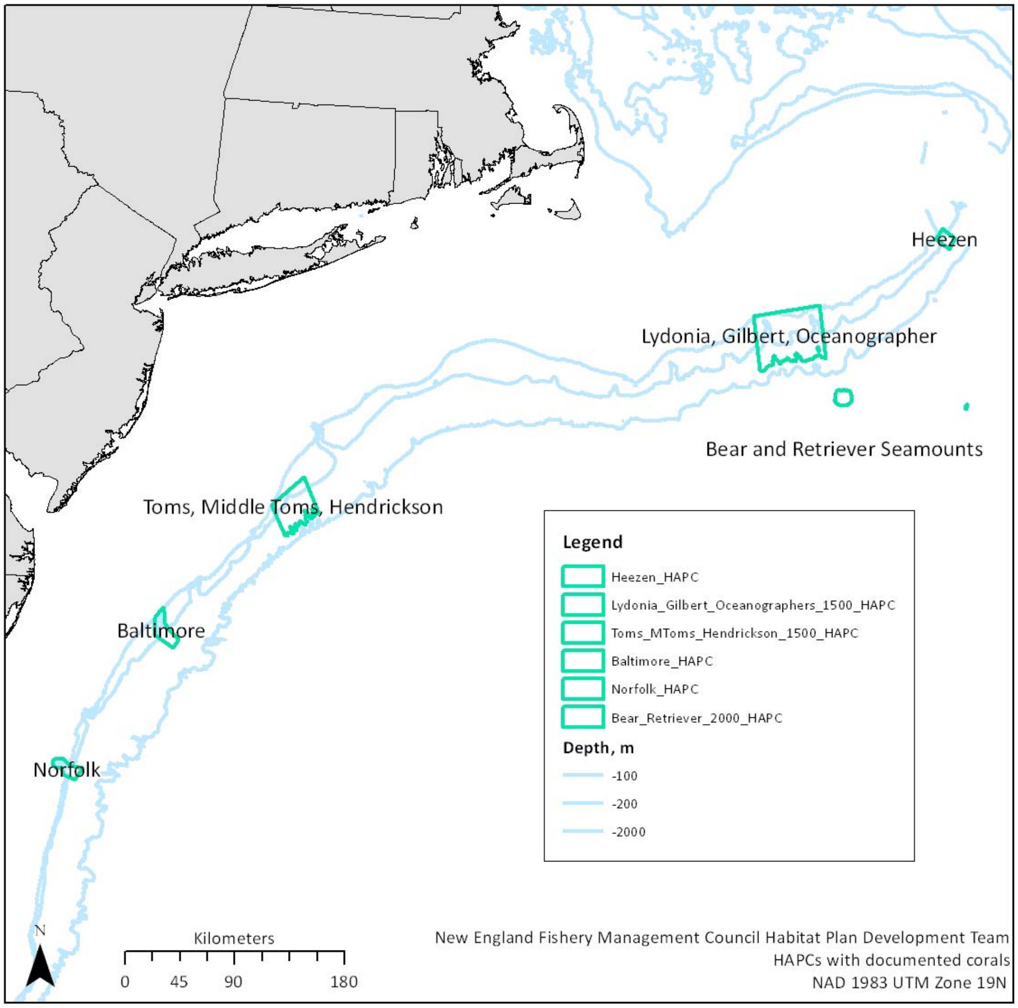
3.4.1.4 All canyon and seamount HAPCs

These alternatives would designate deep-sea coral zones based on the proposed canyon and seamount HAPCs from Phase 1: Heezen, Lydonia/Gilbert/Oceanographer, Toms/Middle Toms/Hendrickson, Baltimore, Norfolk, Gilbert (between Lydonia and Oceanographer), Veatch, Alvin/Atlantis, Hudson, Hydrographer, Wilmington, and Washington Canyons, in addition to on Bear and Retriever Seamounts (see Map 98). Note that there are additional named canyon areas in the Northeast Region that might warrant inclusion in this alternative. While the HAPC boundaries might be modified into coral zone boundaries according to fishing, coral distribution, and enforcement considerations, the intention of theis alternative was to focus on the deeper and steeper canyon areas.

3.4.1.5 Canyon and seamount HAPCs with known corals, and neighboring inter-canyon areas

This alternative would designate deep-sea coral zones based on the proposed canyon and seamount HAPCs with documented corals (good data support). These HAPCs include Heezen, Lydonia/Gilbert/Oceanographer, Toms/Middle Toms/Hendrickson (corals documented as heads of canyons – presence assumed in deeper areas), Baltimore, and Norfolk Canyons, in addition to Bear and Retriever Seamounts (see Map 99). This alternative would designate inter-canyon areas in addition to the canyons as deep-sea coral zones. The rationale for this is that inter-canyon areas may provide important habitat for some coral species. Canyons in close proximity where designation of inter-canyon areas might be appropriate were designated in combination as HAPCs during Phase 1. These include Lydonia/Gilbert/Oceanographer and Toms/Middle Toms/Hendrickson (note that Cartaret Canyon is close to Toms Canyon, and also has documented corals). The HAPC boundaries might be modified into coral zone boundaries according to fishing, coral distribution, and enforcement considerations.

Map 99 – Canyon and seamount HAPCs with known corals.



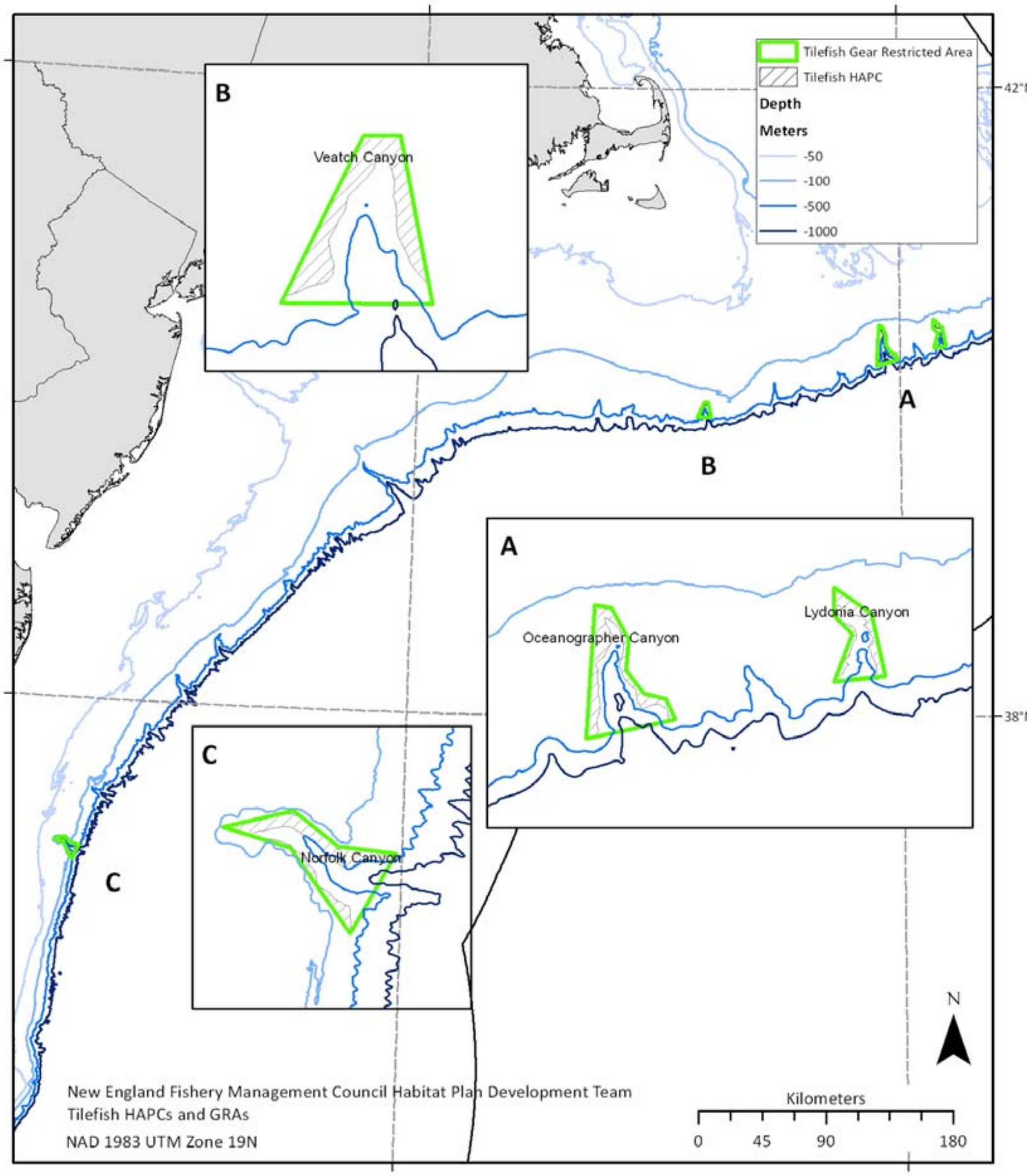
3.4.1.6 Canyon and seamount HAPCs with known corals

This alternative would designate deep-sea coral zones based on the proposed canyon and seamount HAPCs with documented corals (good data support). These include Heezen, Lydonia/Gilbert/Oceanographer, Toms/Middle Toms/Hendrickson (corals documented as heads of canyons – presence assumed in deeper areas), Baltimore, and Norfolk Canyons, in addition to on Bear and Retriever Seamounts (see Map 99). While the HAPC boundaries might be modified into coral zone boundaries according to fishing, coral distribution, and enforcement considerations, the intention of theis alternative was to focus on the deeper and steeper canyon areas.

3.4.1.7 Existing tilefish GRAs

This alternative would designate the four existing Tilefish Amendment 1 Gear Restricted Areas as deep-sea coral zones. The rationale for this alternative is that these areas are already exisiting, and are already closed to all mobile bottom tending gear types. Three of the tilefish GRAs (Lydonia Canyon, Oceanographer Canyon, and Norfolk Canyon) have documented corals, while corals have been documented near but not within Veatch Canyon.

Map 100 – Tilefish Gear Restricted Areas and associated HAPCs.



3.4.1.8 Gulf of Maine coral zones

The PDT also discussed the designation of coral zones in the Gulf of Maine – two areas identified by the DSCRTP are western Jordan Basin and the Mount Desert Rock area. The available information on GOM corals needs to be further investigated.

3.4.2 Management measures for deep-sea coral zones

Once coral zones alternatives have been narrowed down to preferred options, the impacts of implementing these zones with varying levels of fishing restrictions can be evaluated using fishing distribution data compiled for the SASI model. Other projects are also underway to relate fishing locations and locations with documented corals using VMS and observer data.

3.4.2.1 Gear restrictions

The following range of alternatives would protect deep-sea corals via restrictions on various types of commercial and/or recreational fishing within deep-sea coral zones.

3.4.2.1.1 Status quo

This alternative would maintain any existing gear restrictions in designated deep-sea coral zones. These would include the mobile gear restrictions implemented via Amendment 1 to the Tilefish FMP in the four canyons identified as Tilefish GRAs, as well as prohibitions on fishing during a monkfish DAS enacted via Amendment 2 to the Monkfish FMP.

3.4.2.1.2 Prohibition on mobile bottom tending gears

This alternative would prohibit all mobile bottom-tending fishing gear operation in deep-sea coral zones.

3.4.2.1.3 Prohibition on all commercial bottom-tending gears

This alternative would prohibit all commercial bottom-tending fishing gear operation in deep-sea coral zones.

3.4.2.1.4 Prohibition on all commercial fishing gear

This alternative would prohibit all commercial fishing gear operation in deep-sea coral zones.

3.4.2.1.5 Prohibition on all fishing gear

This alternative would prohibit all commercial and recreational fishing gear operation in deep-sea coral zones.

3.4.2.2 Access areas

This alternative would allow access to designated deep-sea coral zones or portions of those zones for specific fisheries/gear types, following the South Atlantic Fishery Management Council (SAFMC) example. The SAFMC finalized 'Comprehensive

Ecosystem-Based Amendment 1 for the South Atlantic Region (CE-BA 1)' in October 2009, which was implemented by NMFS effective July 22, 2010 (see SAFMC 2009 and Federal Register Vol. 75 No. 119, pp 35330-35335). This action designated Deepwater Coral Habitat Areas of Particular Concern (CHAPCs) and created Shrimp Fishery Access Areas (SFAA) and Allowable Golden Crab Fishing Areas within the CHAPCs. The intention of the action was to strike a balance between established fishery uses of the areas, and precautionary protection of deepwater corals and associated species and live/hard bottom habitats by allowing fishing to continue to historic fishing grounds while preventing expansion into sensitive habitats. The boundaries of the CHAPCs were drawn based on a series of scientific reports commissioned by the SAFMC, and the SFAAs and Allowable Golden Crab Fishing Areas were designated in a collaborative process involving industry advisory panels, conservation groups, and others.

The preferred alternatives in CE-BA 1 were structured as follows:

- Action 1 – Alternative 1 – No action. Alternative 2 – Establish CHAPCs in one or more of the five proposed areas and prohibit possession of coral species and use of all bottom damaging gear, including bottom longline, trawl (bottom and mid-water), dredge, pot or trap, use of anchors, anchor and chain, or grapple and chain by all fishing vessels. The definition of coral species had been previously established in the Coral FMP. The five CHAPCs ranged in size from 10 km^2 to 60,937 km^2.
- Action 2 – Alternative 1 – No action. Alternative 2 – Create SFAAs within some portions of some of the designated CHAPCs, as appropriate, where shrimp trawling is allowed by vessels holding rock shrimp limited access permits.
- Action 3 – Alternative 1 – No action. Alternative 2 – Create Allowable Golden Crab Fishing Areas within some portions of some of the designated CHAPCs, as appropriate, where crab trapping is allowed.

Note that development of these alternatives required designation of CHAPCs followed by evaluation of areas within those CHAPCs to be considered for fishery access. Note also that in CE-BA 1 the coral areas were established via EFH authority, vs. under the discretionary authority (which was implemented after development of CE-BA 1 commenced).

3.4.3 Research recommendations

3.4.3.1 Fully document all coral catch in NEFSC survey data

This alternative would require documentation of deep sea corals during Northeast Fishery Science Center resource surveys, with documentation to include identification to lowest taxonomic level possible and quantification of catch by weight.

3.4.3.2 Fully document all coral bycatch during observed fishing trips

This alternative would require documentation of deep sea corals during observed fishing trips, with documentation to include identification to lowest taxonomic level possible and quantification of catch by weight.

3.4.3.3 Additional focused coral surveys

This alternative would specify Council support for resource surveys specific to coral distribution mapping. Specific suggested locations include Hudson Canyon, Gilbert Canyon, and along the shelf/slope break.

3.4.3.4 Create coral guide to support collection of data during research trips and fishing trips

This alternative would specify Council support for the development of a deep sea coral guidebook, which would support identification of corals during research and fishing trips. Staff at NEFSC's Sandy Hook lab would direct guidebook development.