

DRAFT

**Omnibus Essential Fish Habitat Amendment 2
Adverse effects alternatives and options**

**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**

**Decision document for:
August 30, 2011 Habitat Committee Meeting**

**Prepared by the
New England Fishery Management Council**

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1.0 Introduction

This document contains three sections:

1. Habitat management alternatives: five sets of combined options, plus the status quo alternative
2. Individual area-based options: options presented on an area-by-area basis. Each of these may be included in one or more of the alternatives in section 1.
3. Analysis of options and alternatives: Summary of habitat vulnerability, revenue, and practicability information for combined alternatives and individual areas

Options were developed at the August 15, 2011 Habitat PDT meeting, based on motions passed at the July 21, 2011 Habitat Committee meeting. Note that this document does not include any options for habitat research areas, as the PDT has not yet had the opportunity to further develop options based on the Committee's directives since the last Committee meeting.

Individual options are combined into packaged alternatives. A key finding from the SASI model is that adverse effects are proportional to the amount of bottom contact that fishing gears have. Bottom contact time is broadly related to the amount of fishing effort expended, and for a given catch of fish with a certain gear type, adverse effects will decrease if catch rates increase. In other words, catch efficiency and not just the location of fishing is assumed to influence the overall magnitude of adverse effects to EFH. If a fixed amount of quota is available for each species, area closures will cause fishing effort to shift into habitats that may be more, less, or similarly vulnerable, but these areas will almost certainly have lower catch rates. The relationship between catch efficiency and habitat vulnerability is therefore critical.

This assumption implies that reductions in adverse effects could be achieved by removing gear restrictions and allowing effort to shift naturally into the areas where fish could most efficiently be caught. This type of strategy forms part of the justification for removing some of the current habitat closed areas, and is the basis for alternative 5.

Alternatives are intended to facilitate both decision making and analysis, and each alternative can represent a different approach to achieving high-level goals and objectives for habitat management. While there are no specific objectives associated with the alternatives as currently drafted, the PDT arrived at these options and alternatives by attempting to (a) protect the most vulnerable habitats identified through the SASI modeling efforts and additional analysis designed to overcome known gaps in the SASI approach, and (b) minimize fishing effort displacement away from efficient (high-catch) areas towards inefficient (low-catch) areas. The options as combined in this document form alternatives that generally go from most restrictive to least restrictive, but the Committee may wish to identify objectives. For example, reducing total adverse

effects below current levels, complete protection of the most vulnerable or unique areas from all fishing impacts, protecting areas to benefit particular species, etc. With specific objectives in mind, the PDT can suggest ways to improve the mix of options included in each alternative.

In general, the degree of benefits to EFH realized from implementing habitat area designations and associated gear restrictions or modifications will depend on the inherent vulnerability of the habitat as well as the current magnitude of adverse effects in each area. Costs include loss of revenue from fishing in newly closed areas, and increasing adverse effects from fishing on habitats in other locations.

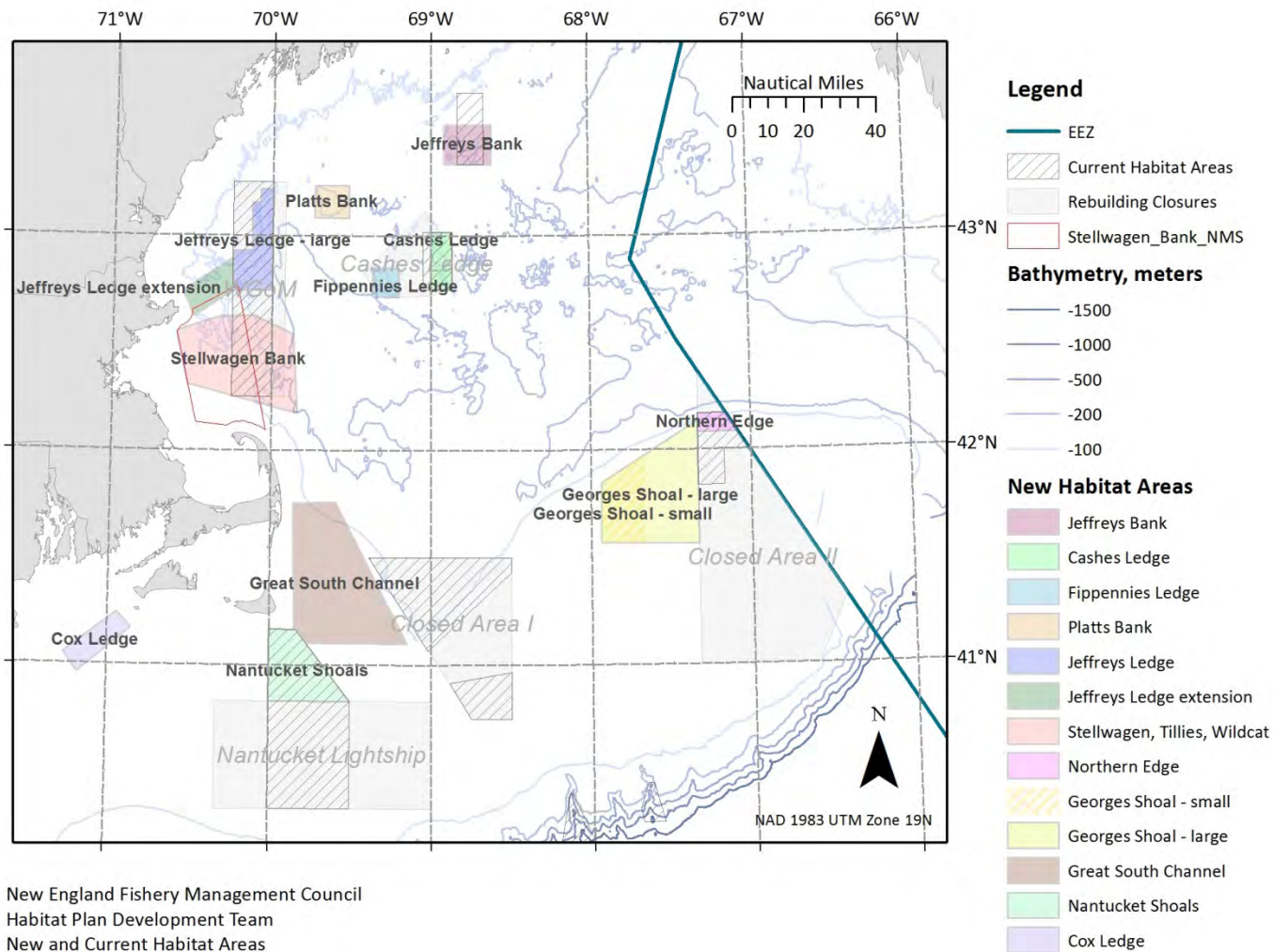
A detailed assessment of these costs and benefits was not completed for this meeting, as complexities associated with the Area Closure Analysis component of the SASI Approach are still being explored. Such an analysis will likely require further input from the habitat and species PDTs, advisors, and committees, and the results will be most realistic when a set of measures for different areas can be considered simultaneously, as the total footprint of fishing will depend on the mosaic of areas that are opened or closed to particular gears, as well as the total allocations of fish available, and the distribution of fishery resources. However, Section 4.0 of this document does include summary information about (1) the estimated vulnerability of potential areas, both individually and aggregated as alternatives, and (2) the current revenues by gear type from each of the areas and the immediately surrounding grid cells.

2.0 Habitat management alternatives

This section presents a series of possible alternative management scenarios to minimize the adverse effects of fishing on EFH. There is a no action alternative, plus five additional alternatives that range from most restrictive (Alternative 1) to least restrictive (Alternative 5). As noted above, these alternatives, which include options developed by the PDT at their most recent meeting on August 15, 2011, should be viewed as a starting point for discussion. A separate figure (Map 2-Map 7) is provided for each alternative, to aid in the Committee in visualizing the options included.

Map 1 shows all of the areas suggested by the PDT, in addition to the current habitat closed areas and the current groundfish rebuilding closures. Detailed sub-regional maps are shown alongside the area-based options (see section 3.0). Table 1 lists all of the options, including the status quo options, and indicates the association between options and one or more alternative(s).

Map 1 – All habitat areas



New England Fishery Management Council
Habitat Plan Development Team
New and Current Habitat Areas
Map date 22 August 2011

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Table 1 – Draft adverse effects minimization alternatives. Under area status, ‘new’ does not differentiate between modified versions of existing habitat closures and entirely new areas; see notes.

Area name	Area status	Associated fishing restrictions	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Notes
CAII Habitat Closure	Existing	Closed to MBTG	X						
Northern Edge Habitat Area	New	Closed to all fishing gears		X	X	X	X		Subset of CAII habitat closure
Georges Shoal Large Habitat Area	New	Shortened ground cables reqd		X		X	X		West of CAII habitat closure
Georges Shoal Small Habitat Area	New	Closed to MBTG		X	X	X			West of CAII habitat closure, subset of corresponding large area
CAI Habitat Closure(s)	Existing	Closed to MBTG	X						
NLCA Habitat Closure	Existing	Closed to MBTG	X						
Nantucket Shoals Habitat Area	New	Closed to MBTG		X	X	X	X		Subset of NLCA habitat closure
Great South Channel Habitat Area	New	Closed to MBTG		X					
Great South Channel Habitat Area	New	Shortened ground cables reqd			X	X	X		
Cox Ledge Habitat Area	New	Closed to MBTG		X	X				
WGOM Habitat closure	Existing	Closed to MBTG	X						
Jeffreys Ledge Habitat Area	New	Closed to MBTG			X	X			Subset of WGOM habitat closure
Jeffreys Ledge Habitat Area, extended	New	Closed to MBTG		X					Combination of JL Large and extension
Stellwagen Bank/Tillies Bank/Wildcat Knoll ¹	New	Closed to MBTG		X	X	X	X		Overlap with existing WGOM habitat area
Jeffreys Bank Habitat Closure	Existing	Closed to MBTG	X						
Jeffreys Bank Habitat Area (Modified)	New	Closed to MBTG		X	X	X			Updated area encompassing shallow, hard-bottom areas
Cashes Ledge Habitat Closure	Existing	Closed to MBTG	X						
Cashes Ledge Habitat Area (modified)	New	Closed to MBTG		X	X	X			Western boundary moved east as compared to current area, possible extension to the north and south, as well
Ammen Rock Habitat Area ²	New	Closed to all fishing gears		X	X	X	X		Small subset of current and modified Cashes Ledge habitat areas
Fippennies Ledge Habitat Area	New	Closed to MBTG		X	X				
Platts Bank Habitat Area	New	Closed to MBTG		X	X				

¹ The configuration of the area in and around SBNMS (Stellwagen Bank National Marine Sanctuary) simply encompasses mapped hard bottom-boulder ridge habitats and is currently a placeholder for a forthcoming proposal from SBNMS. This option will require further development.

² Boundaries of this area have not yet been determined by the PDT, but will be based on kelp forest area mapped by McGonigle et al 2011

2.1 No Action Alternative

Currently, the primary mechanism for reducing the adverse effects of fishing on EFH across various fisheries is a set of area closures that apply on a year-round basis to mobile, bottom-tending gears. Specifically, this includes all types of trawls and all types of dredges.

- Six habitat closed areas were implemented via Amendment 13 to the Multispecies FMP. These included five that lie within existing groundfish rebuilding closures: Closed Area I, Closed Area II, Nantucket Lightship Closed Area, Western Gulf of Maine Closed Area, and Cashes Ledge closed area, and one additional habitat closure on Jeffreys Bank. A portion of the Nantucket Lightship Habitat Closure lies outside of the rebuilding closure on Nantucket Shoals. Amendment 15 to the Atlantic Sea Scallop FMP (approved June 2011) implements a matching set of habitat closures in the scallop fishery management plan.
- Mobile bottom tending gears are also restricted from the GRAs implemented via Tilefish Amendment 1 (generally, waters shallower than approximately 300 meters in and around Lydonia, Oceanographer, Veatch, and Norfolk Canyons). Note that Veatch and Norfolk Canyons are not shown on the map below.
- Both Lydonia Canyon and Oceanographer Canyon are closed to vessels fishing on a monkfish day at sea.

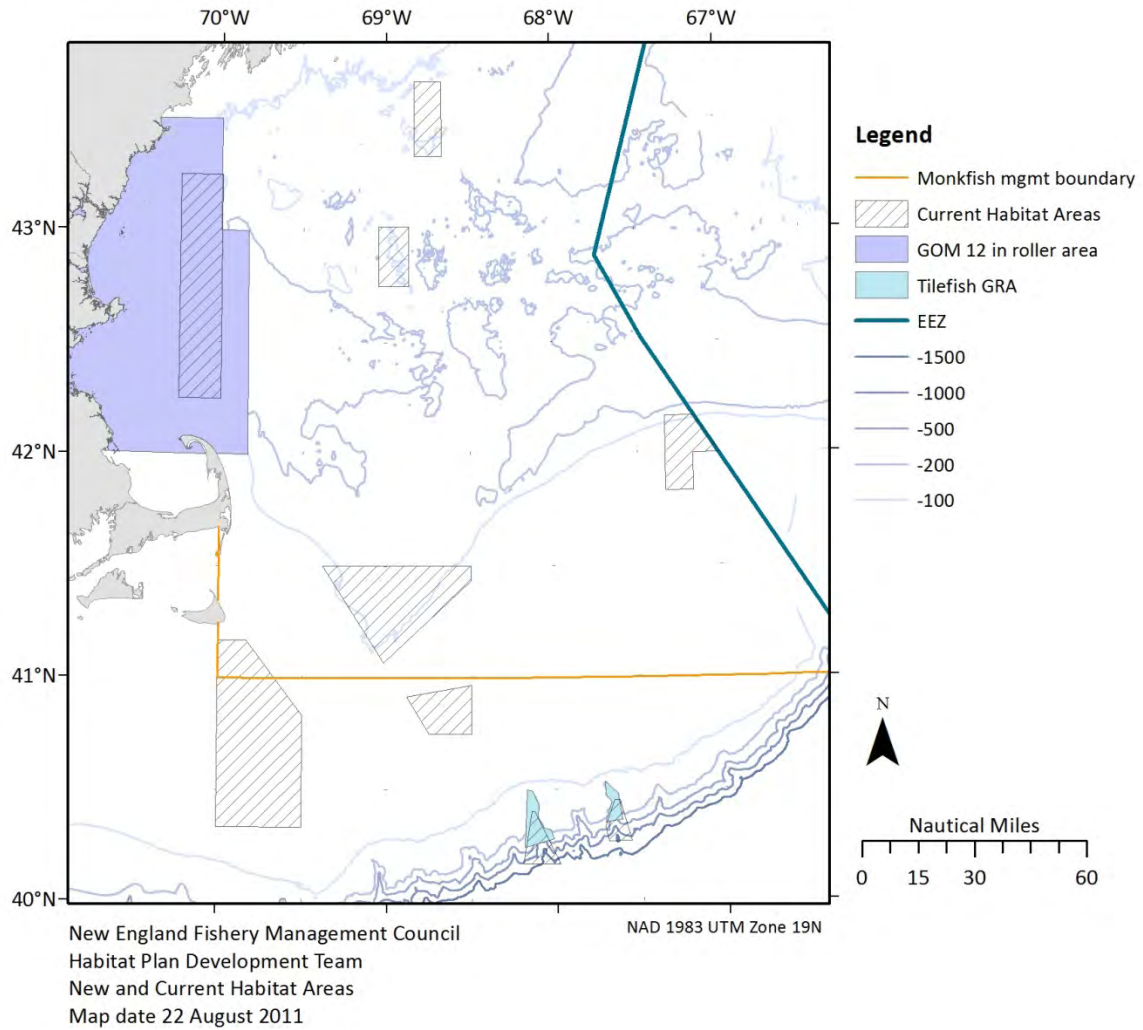
Current gear modification measures are also included in this alternative as a component of status quo habitat management:

- A maximum ground gear size of 12 inches applies in the inshore GOM
- A maximum groundgear size of 6 inches applies in the southern monkfish management area

That the only regional measure similar to a maximum ground cable size is that in the northern shrimp fishery, where ground cable length is capped at a total of 25m. This fishery is managed by ASMFC, not NEFMC, although current habitat closed area restrictions on the use of trawl gears do apply to shrimp trawls.

Map 2 – No-Action Alternative. Additional tilefish GRAs in Veatch and Norfolk canyons are not shown on the figure.

No Action Alternative



2.2 Alternatives 1-5

Alternatives 1-5 include various combinations of new and modified habitat areas, with restrictions associated with the individual areas that range from closure to all fishing gears to closure to mobile bottom-tending gears only, to gear modification requirements for trawls. Habitat research area recommendations, which require further development, could be included in these packages as well.

Alternative 1: Closures to all gears would be implemented in the Ammen Rock and Northern Edge areas. Closures to mobile bottom-tending gears would be implemented in the Georges Shoal small, Nantucket Shoals, Great South Channel, Cox Ledge, Jeffreys Ledge, including the Jeffreys Ledge Extension, Jeffreys Bank (modified), Cashes Ledge (modified), Fippennies Ledge, and Platts Bank areas. This alternative would also include some kind of habitat management area in and around Stellwagen Bank/Tillies Bank/Wildcat Knoll. Gear modification requirements for trawls would be implemented in the Georges Shoal large area.

Alternative 2: Closures to all gears would be implemented in the Ammen Rock and Northern Edge areas. Closures to mobile bottom-tending gears would be implemented in the Georges Shoal small, Nantucket Shoals, Cox Ledge, Jeffreys Ledge, Jeffreys Bank (modified), Cashes Ledge (modified), Fippennies Ledge, and Platts Bank areas. This alternative would also include some kind of habitat management area in and around Stellwagen Bank/Tillies Bank/Wildcat Knoll. Gear modification requirements for trawls would be implemented in the Great South Channel area.

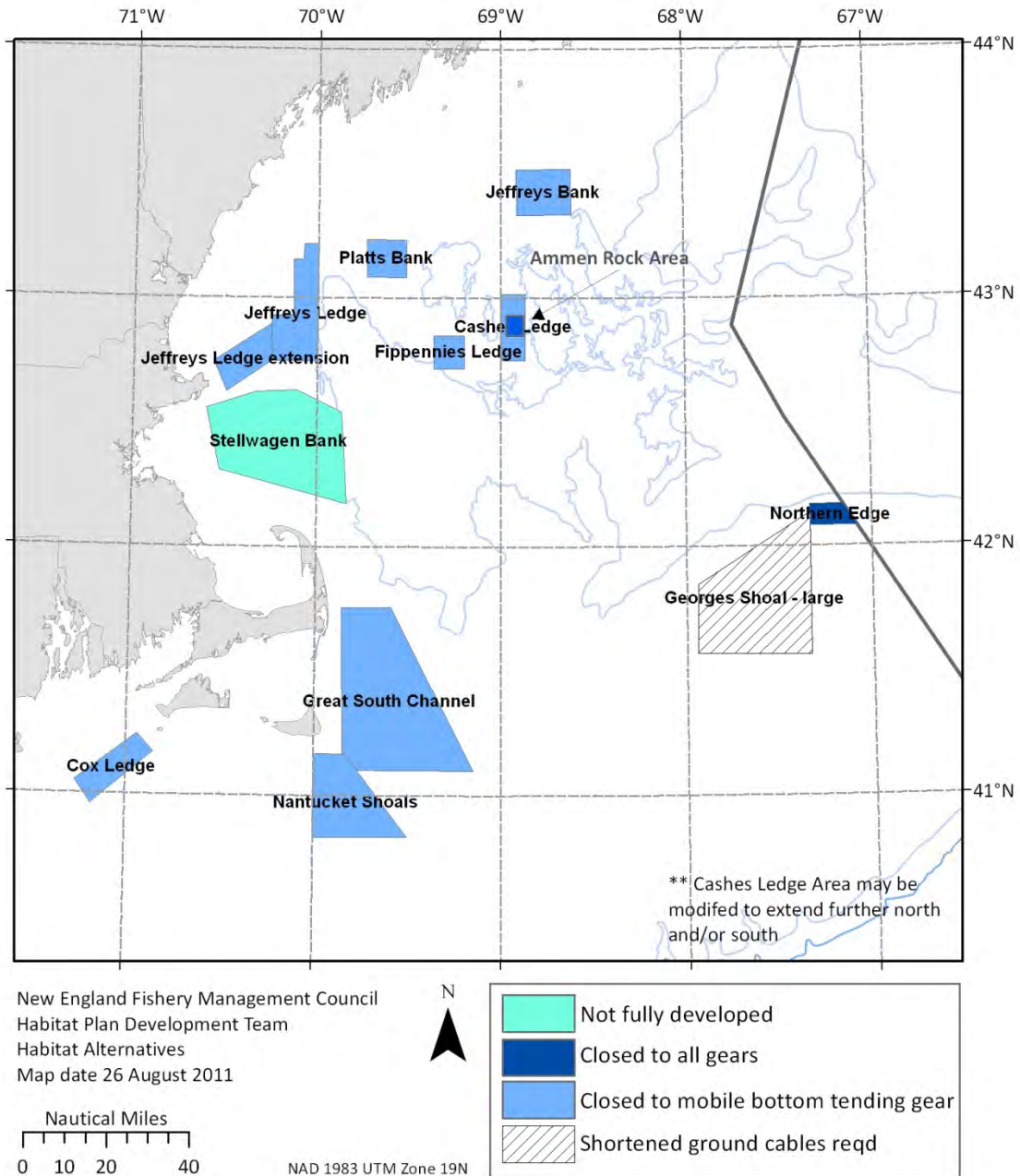
Alternative 3: Closures to all gears would be implemented in the Ammen Rock and Northern Edge areas. Closures to mobile bottom-tending gears would be implemented in the Georges Shoal small, Nantucket Shoals, Jeffreys Ledge, Jeffreys Bank (modified), and Cashes Ledge (modified) areas. This alternative would also include some kind of habitat management area in and around Stellwagen Bank/Tillies Bank/Wildcat Knoll. Gear modification requirements for trawls would be implemented in the Georges Shoal large area and the Great South Channel area.

Alternative 4: Closures to all gears would be implemented in the Ammen Rock and Northern Edge areas. Closures to mobile bottom-tending gears would be implemented in the Nantucket Shoals area. This alternative would also include some kind of habitat management area in and around Stellwagen Bank/Tillies Bank/Wildcat Knoll. Gear modification requirements for trawls would be implemented in the Georges Shoal large and the Great South Channel areas.

Alternative 5: No habitat closures or gear modification areas.

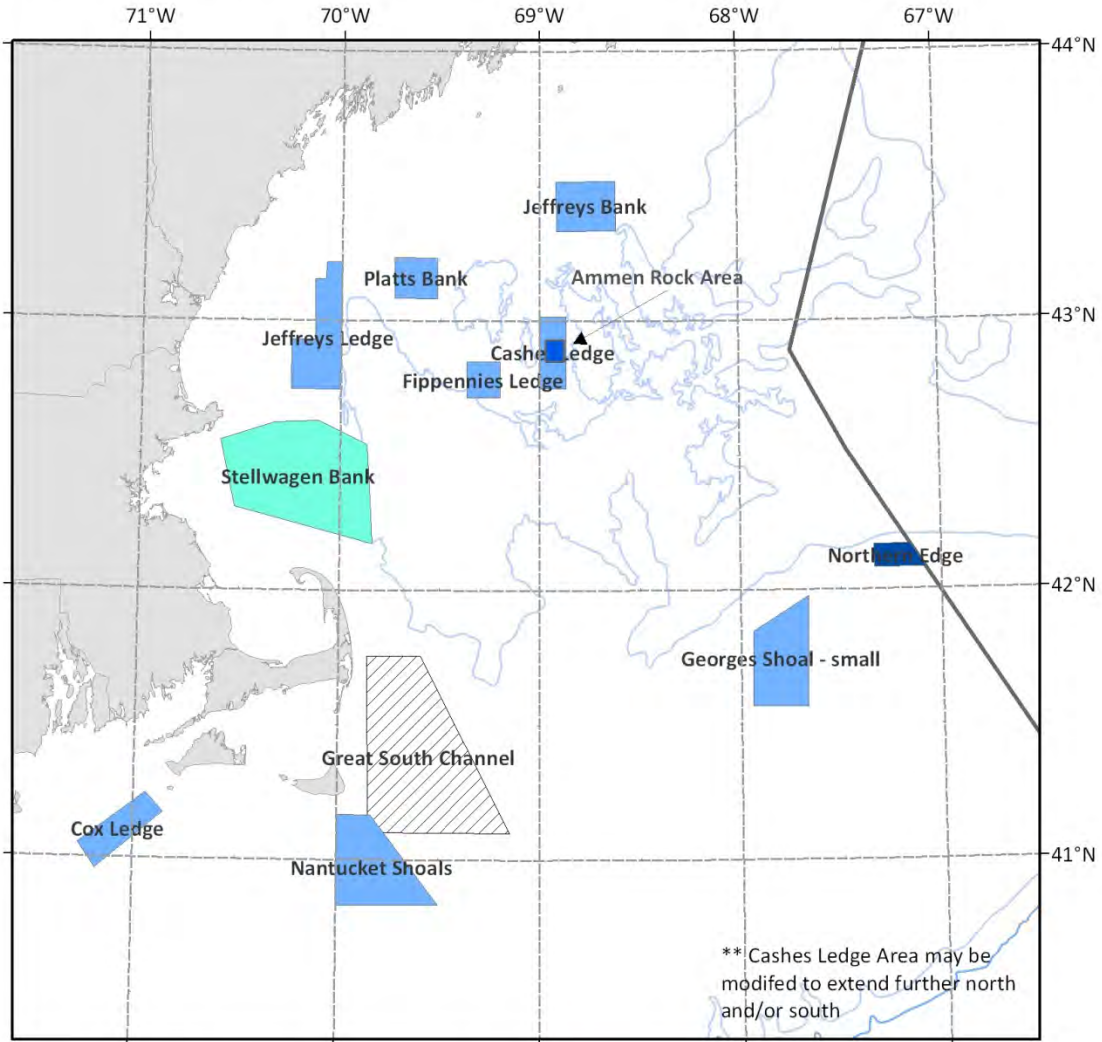
Map 3 - Habitat Alternative 1

Alternative 1

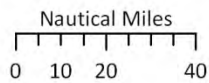


Map 4 - Habitat Alternative 2

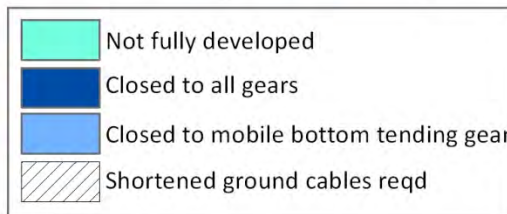
Alternative 2



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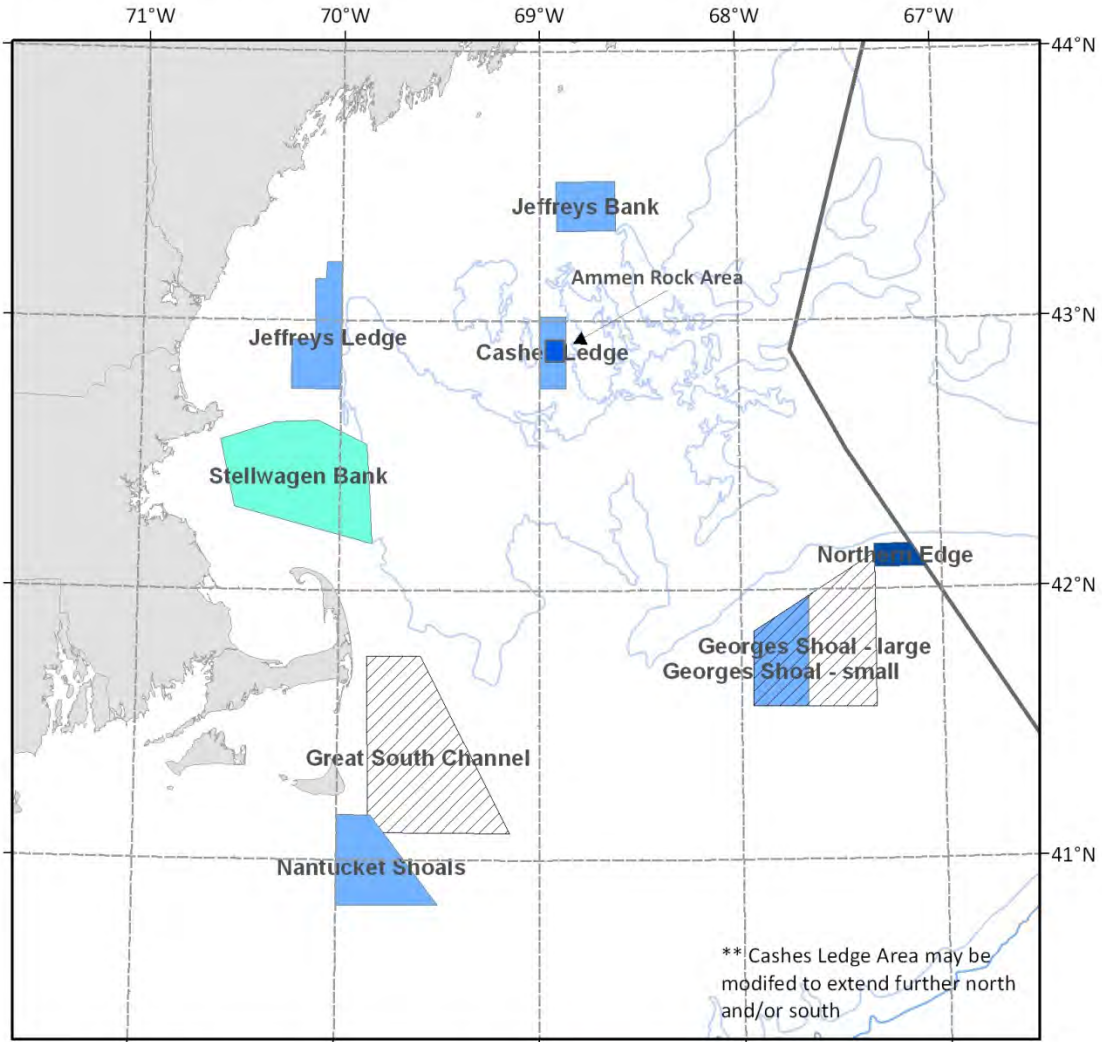


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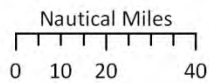


Map 5 - Habitat Alternative 3

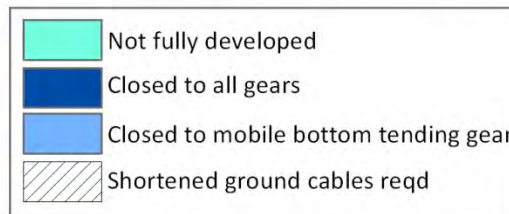
Alternative 3



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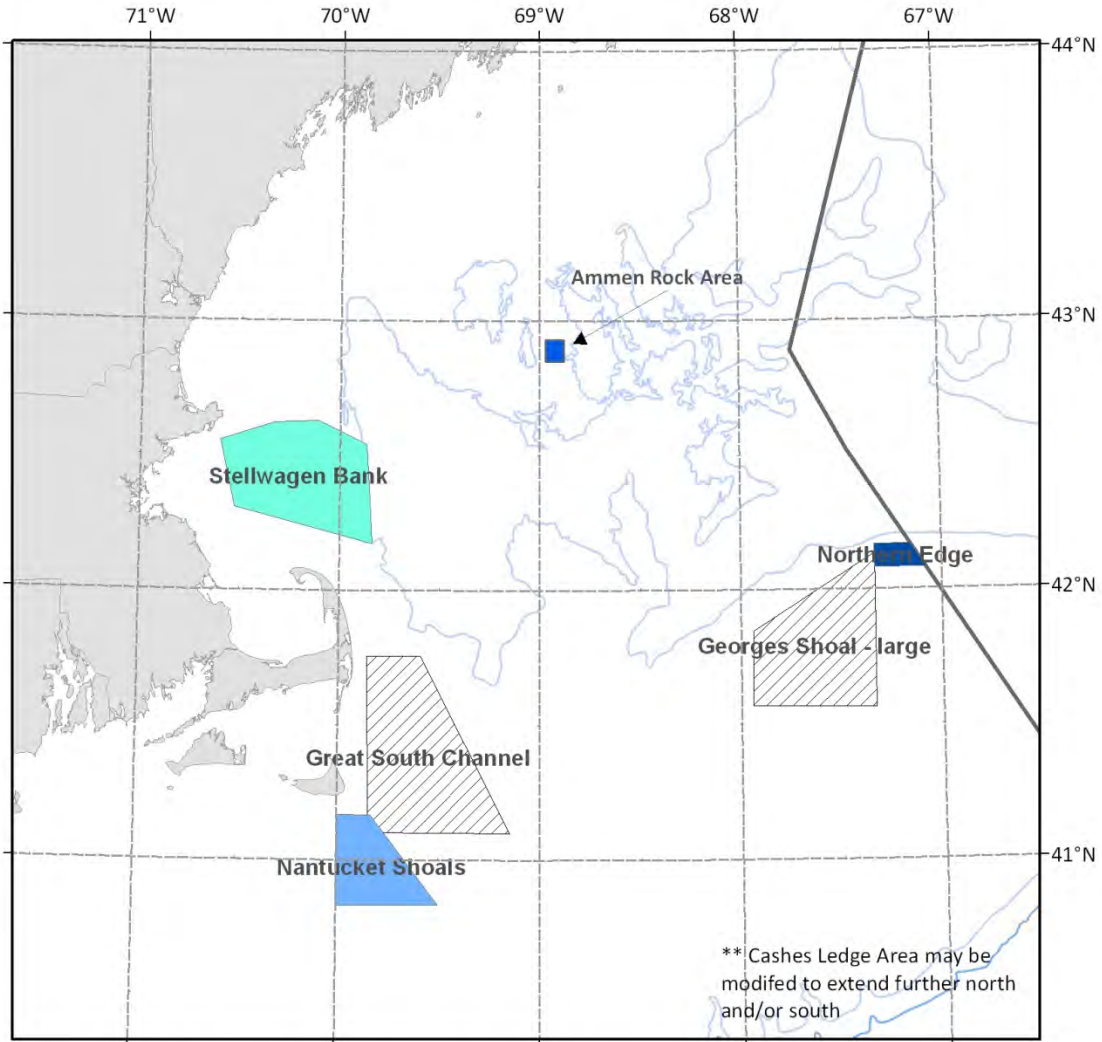


NAD 1983 UTM Zone 19N

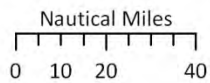


Map 6 – Habitat Alternative 4

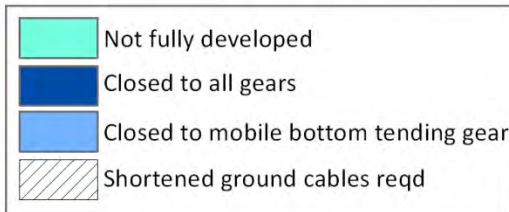
Alternative 4



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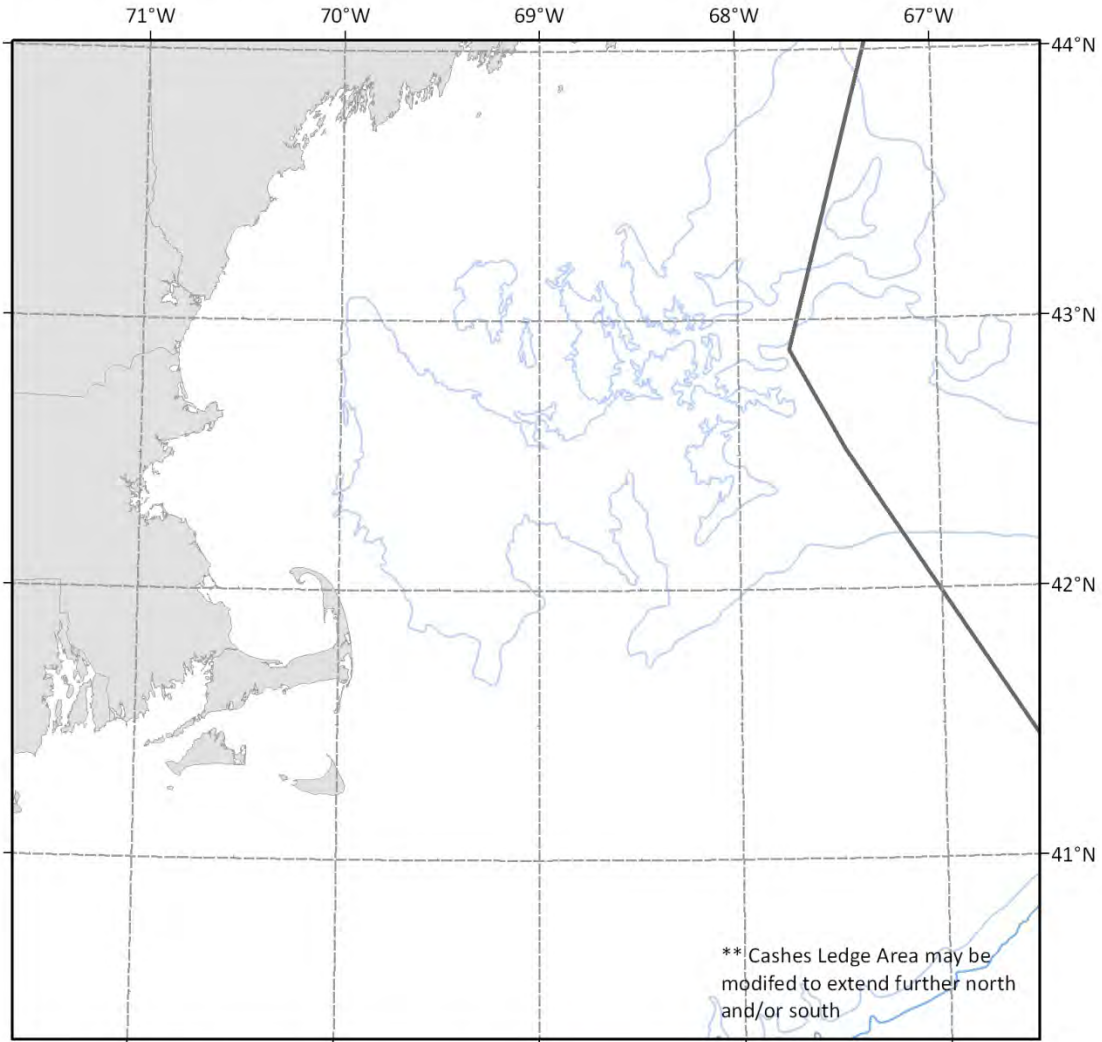


NAD 1983 UTM Zone 19N

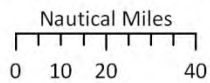


Map 7 – Habitat Alternative 5

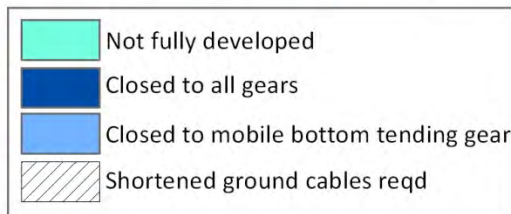
Alternative 5



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Map date 26 August 2011



NAD 1983 UTM Zone 19N



3.0 Individual area-based options

Based on the results of the Vulnerability Assessment, areas with gravel substrates and complex associated biological and geological structures tend to be most vulnerable to the effects of fishing gears. SASI model $Z_{realized}$ outputs indicate the generic otter trawl gear category contributes the most to adverse effects in the region. Thus, as of the last Committee meeting on July 21, the PDT recommends that, as a primary objective, the Committee focus on protection of gravel habitats from the effects of trawling. The PDT generated a list 'vulnerable areas', using the SASI model trawl Z_{∞} outputs that clustered using the LISA (Local Indicators of Spatial Association) method as a starting point. At the Committee's direction, the PDT further developed options to minimize adverse effects in these 'vulnerable areas'. Options are grouped by location. To facilitate public input about these areas, coordinates are listed in the following table. Note that errors in coordinates sent out in August 22 have been corrected in this version. Also, the area boundaries and the table below will be 'cleaned up' as areas move forward in the process.

Table 2 – Coordinates for habitat areas in degrees, decimal minutes. Points are in clockwise order starting in the upper right of each polygon shown in the figure above. Note that the configuration of the area in SBNMS simply encompasses mapped hard bottom-boulder ridge habitats, and is intended as a place holder for a forthcoming proposal from SBNMS. Note also that the Ammen Rock area is not precisely drawn and requires further refinement. The intention is for the area to encompass the kelp forest habitats located in the shallow waters of Cashes Ledge.

Jeffreys Bank:

Point	Longitude	Latitude
1	-68° 37.0'	43° 31.0'
2	-68° 37.0'	43° 20.0'
3	-68° 55.0'	43° 20.0'
4	-68° 55.0'	43° 31.0'

Cashes Ledge:

Point	Longitude	Latitude
1	69° 00.0'	43° 01.0'
2	68° 52.0'	43° 01.0'
3	68° 52.0'	42° 45.0'
4	69° 00.0'	42° 45.0'

Platts Bank:

Point	Longitude	Latitude
1	-69° 31.2'	43° 13.8'
2	-69° 31.2'	43° 04.8'
3	-69° 43.8'	43° 04.8'
4	-69° 43.8'	43° 13.8'

Fippennies Ledge

Point	Longitude	Latitude
1	-69° 12.0'	42° 51.0'
2	-69° 12.0'	42° 43.2'
3	-69° 22.2'	42° 43.2'
4	-69° 22.2'	42° 51.0'

Jeffreys Ledge

Point	Longitude	Latitude
1	-70° 00.0'	43° 13.0'
2	-70° 00.0'	42° 44.6'
3	-70° 15.0'	42° 44.6'
4	-70° 15.0'	42° 55.8'
5	-70° 08.0'	42° 55.8'
6	-70° 08.0'	43° 09.2'
7	-70° 04.6'	43° 09.2'
8	-70° 04.6'	43° 13.0'

Jeffreys Ledge Extension

Point	Longitude	Latitude
1	-70° 15.0'	42° 53.8'
2	-70° 15.0'	42° 44.7'
3	-70° 29.5'	42° 37.3'
4	-70° 33.8'	42° 44.6'

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Stellwagen Bank

Point	Longitude	Latitude
1	-69° 51.6'	42° 32.4'
2	-69° 50.4'	42° 10.2'
3	-70° 31.8'	42° 18.6'
4	-70° 36.0'	42° 33.6'
5	-70° 19.8'	42° 37.2'
6	-70° 06.6'	42° 37.8'

Northern Edge

Point	Longitude	Latitude
1	-67° 09.3'	42° 10.0'
2	-67° 04.7'	42° 05.0'
3	-67° 20.0'	42° 05.0'
4	-67° 20.0'	42° 10.0'

Great South Channel

Point	Longitude	Latitude
1	-69° 35.6'	41° 45.5'
2	-69° 08.9'	41° 05.9'
3	-69° 50.7'	41° 06.2'
4	-69° 51.5'	41° 45.3'

Nantucket Shoals

Point	Longitude	Latitude
1	-69° 50.0'	41° 10.0'
2	-69° 30.0'	40° 50.0'
3	-70° 00.0'	40° 50.0'
4	-70° 00.0'	41° 10.0'

Georges Shoal (two areas)

Small Area

Point	Longitude	Latitude
1	-67° 39.8'	41° 58.7'
2	-67° 40.2'	41° 34.2'
3	-67° 56.2'	41° 50.8'
4	-67° 56.2'	41° 34.2'

Large area:

Point	Longitude	Latitude
1	-67° 20.0'	42° 08.1'
2	-67° 20.0'	41° 34.2'
3	-67° 56.2'	41° 50.8'
4	-67° 56.2'	41° 34.2'

Cox Ledge

Point	Longitude	Latitude
1	-70° 56.4'	41° 14.4'
2	-70° 51.0'	41° 10.2'
3	-71° 10.8'	40° 57.6'
4	-71° 16.2'	41° 03.0'

3.1 Options for Gulf of Maine offshore banks and ledges

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). Notable offshore banks and ledges include Jeffreys Bank, Cashes Ledge, Fippennies Ledge, and Platts Bank.

3.1.1 Jeffreys Bank

3.1.1.1 Sub-option A: Maintain current Jeffreys Bank habitat closed area (status quo)

There has been a habitat area closed to all mobile bottom tending gear on Jeffreys Bank since 2004. This area includes both shallower hard bottom habitats and deeper mud habitats. This option would maintain the status quo Jeffreys Bank habitat closure in the multispecies and scallop FMPs.

3.1.1.2 Sub-option B: Adjust the boundaries of the Jeffreys Bank habitat closed area and close to mobile bottom tending gear

This option would change the boundaries of the current Jeffreys Bank habitat closure, and close the updated area to mobile bottom tending gear. The goal of the updated area would be to more closely encompass the shallower hard bottom habitats. The boundaries mapped below were developed by drawing a regular shape around the 100 m contour.

3.1.2 Cashes Ledge

Cashes Ledge is one of the most prominent examples of the GOM 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 $2.12-2.45 \times 10^6$ m³ (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).

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.

There has been a habitat closed area on Cashes Ledge since 2004, and a larger year-round groundfish rebuilding closure on Cashes Ledge since 2002.

3.1.2.1 Sub-option A: Maintain current Cashes Ledge habitat closed area (status quo)

This option would maintain the current habitat closure on Cashes Ledge.

3.1.2.2 Sub-option B: Adjust the boundaries of the Cashes Ledge habitat closed area and close to mobile bottom tending gear

This option would change the boundaries of the current Cashes Ledge habitat closure, moving the western boundary to 69° W longitude, and close the updated area to mobile bottom tending gear.

3.1.2.3 Sub-option C: Establish a smaller habitat management area on Ammen Rock only, and close to all gear types

This option would establish a new habitat management area on Ammen Rock, which is a small pinnacle on Cashes Ledge that contains kelp forest habitats. The area would be closed to all types of fishing gear. The intention is that this option could be combined with one of the larger Cashes Ledge habitat areas described above.

3.1.3 Establish a habitat management area on Fippennies Ledge and close to mobile bottom tending gear

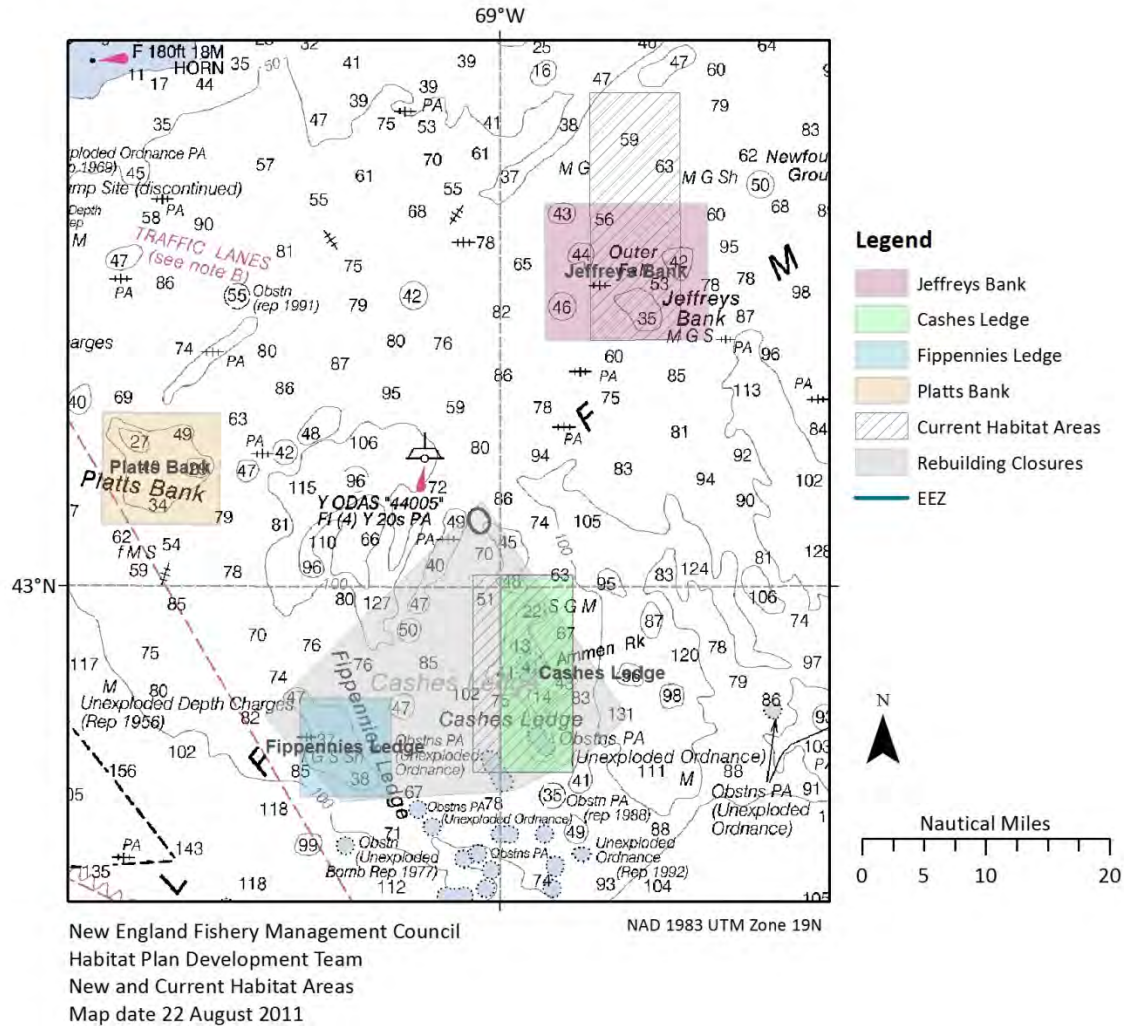
This option would establish a new habitat management area on Fippennies Ledge, which is a shallow ledge in the Gulf of Maine that lies within the Cashes Ledge Mortality Closure and to the west of the Cashes Ledge Habitat Closure, and close the area to mobile bottom tending gear. Fippennies Ledge has been closed to fishing by gear capable of catching groundfish since the Cashes Ledge Mortality Closure was implemented, first as a seasonal closure and then as a year round closure in 2002.

3.1.4 Establish a habitat management area on Platts Bank and close to mobile bottom tending gear

Platts Bank is a shallow bank in the Gulf of Maine that is currently open to fishing. This option would establish a habitat management area on Platts Bank and close it to mobile bottom tending gear. Platts Bank contains gravel habitats vulnerable to fishing gear impacts.

Map 8 - Options for GOM offshore banks and ledges. Note that the Cashes Ledge Area boundary may be adjusted to the north and/or south.

Gulf of Maine offshore banks and ledges



3.2 Options for the western Gulf of Maine

3.2.1 Maintain the WGOM habitat closed area (status quo)

This option would maintain the WGOM habitat closed area in both the multispecies and scallop FMPs. The WGOM mortality closure was implemented temporarily in 1998 and then extended indefinitely. The WGOM habitat closure, which was implemented in 2004 via Amendment 13 to the Multispecies FMP, overlaps the western portion of WGOM mortality closure. Mobile bottom-tending gears (i.e. trawls and dredges) are excluded from the WGOM habitat closure in an effort to minimize the adverse effects of fishing on habitat.

The WGOM habitat and groundfish rebuilding closures encompass parts of Jeffrey's Ledge, Stellwagen Bank, Tillies Bank, and Wildcat Knoll, as well as deeper, muddy areas. Specifically, within the western Gulf of Maine, 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.

3.2.2 Eliminate the WGOM habitat closed area

This option would eliminate the WGOM habitat closed area from the groundfish and scallop FMPs.

3.2.3 Adjust the boundaries of the WGOM habitat closed area to create the Jeffreys Ledge habitat area and close to mobile bottom tending gear

Jeffreys Ledge is a shallow ledge in the Gulf of Maine that lies within the northern portions of the Western Gulf of Maine (WGOM) Habitat and Mortality Closures, extending west beyond the closure boundaries towards Cape Ann, Massachusetts. Note that all of Jeffreys Ledge is within the current inshore GOM 12-inch roller gear area). This option would create a habitat management area on Jeffreys Ledge and close the area to mobile bottom tending gear. This area was designed to leave the northwestern portion of the current WGOM habitat closure open to fishing, given concerns about shrimp fishery access to that location.

3.2.3.1 Sub-option A: Extend the Jeffreys Ledge habitat management area to the west and close to mobile bottom tending gear

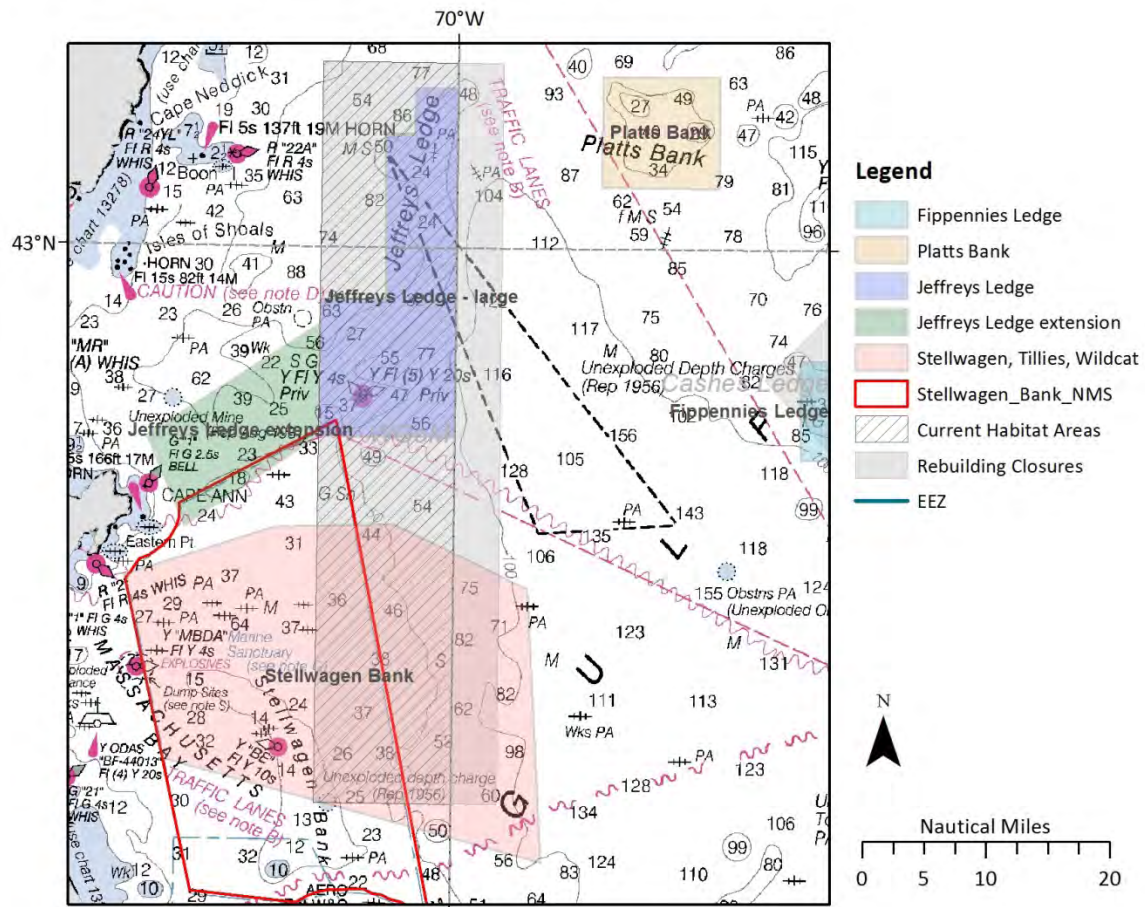
This option is similar to above, but would create a larger habitat area closed to mobile bottom tending gear. There are known boulder ridge habitats in the extension area.

3.2.4 Create a habitat management area/dedicated habitat research area on Stellwagen Bank/Tillies Bank/Wildcat Knoll

Stellwagen Bank National Marine Sanctuary (SBNMS) staff, in collaboration with the NEFSC and the headquarters office of National Marine Sanctuaries, have developed a research area proposal (Sanctuary Ecological Research Area) for SBNMS. While the Council regulates fishing activities in SBNMS, the Sanctuary does have its own management plan that contains goals and objectives for long and short-term management of the area. The PDT concurs with SBNMS' assessment that waters in or around SBNMS are an appropriate location for a research area, and recommends that the committee review the proposal developed by SBNMS, and use that proposal as a starting point for development of a SBNMS DHRA/habitat management area alternative for inclusion in the Omnibus Amendment.

Map 9 – Western Gulf of Maine and surrounds

Western Gulf of Maine and surrounds



New England Fishery Management Council
 Habitat Plan Development Team
 New and Current Habitat Areas
 Map date 22 August 2011
 NAD 1983 UTM Zone 19N

3.3 Options for CAII and surrounds

3.3.1 Maintain current CAII habitat closed area (status quo)

This option would maintain the CAII habitat closed area in both the multispecies and scallop FMPs (blue hatched area in Map 10).

3.3.2 Eliminate CAII habitat closed area

This option would eliminate the CAII habitat closed area from both the multispecies and scallop FMPs.

3.3.3 Adjust the boundaries of the CAII habitat closed area to create the Northern Edge habitat area and close to all gear types

This option would modify the current CAII habitat closed area by shifting the southern boundary north. The new Northern Edge habitat area would be closed to all fishing gear. The boundaries of this area are based on an area of 'pristine' habitat identified by repeated USGS surveys of the area. This location contains a greater abundance of complex structural epifauna as compared to the remainder of the current habitat closed area.

3.3.4 Establish a habitat management area on Georges Shoal

Georges Shoal is a location in the Northeast Region where grid cells highly vulnerable to trawl gear clustered in the SASI LISA analysis. This area contains a relatively large amount of gravel seabed, which is vulnerable to the adverse effects of fishing. The PDT identified vulnerable habitat areas on Georges Shoal based on the locations of gravel outcrops as identified by Harris and Stokesbury 2010, which analyzed the distribution of sediments on Georges Bank based on video survey data (their data are included in the SASI model base grid). Based on the Committee's input, the PDT developed two sub-options for Georges Shoal. These two options could be used separately, or combined together. The previous 'vulnerable areas' are identified on the map for reference.

3.3.4.1 Sub-option A: Establish a larger habitat management area on Georges Shoal and restrict use of trawl gears to shortened ground cable lengths

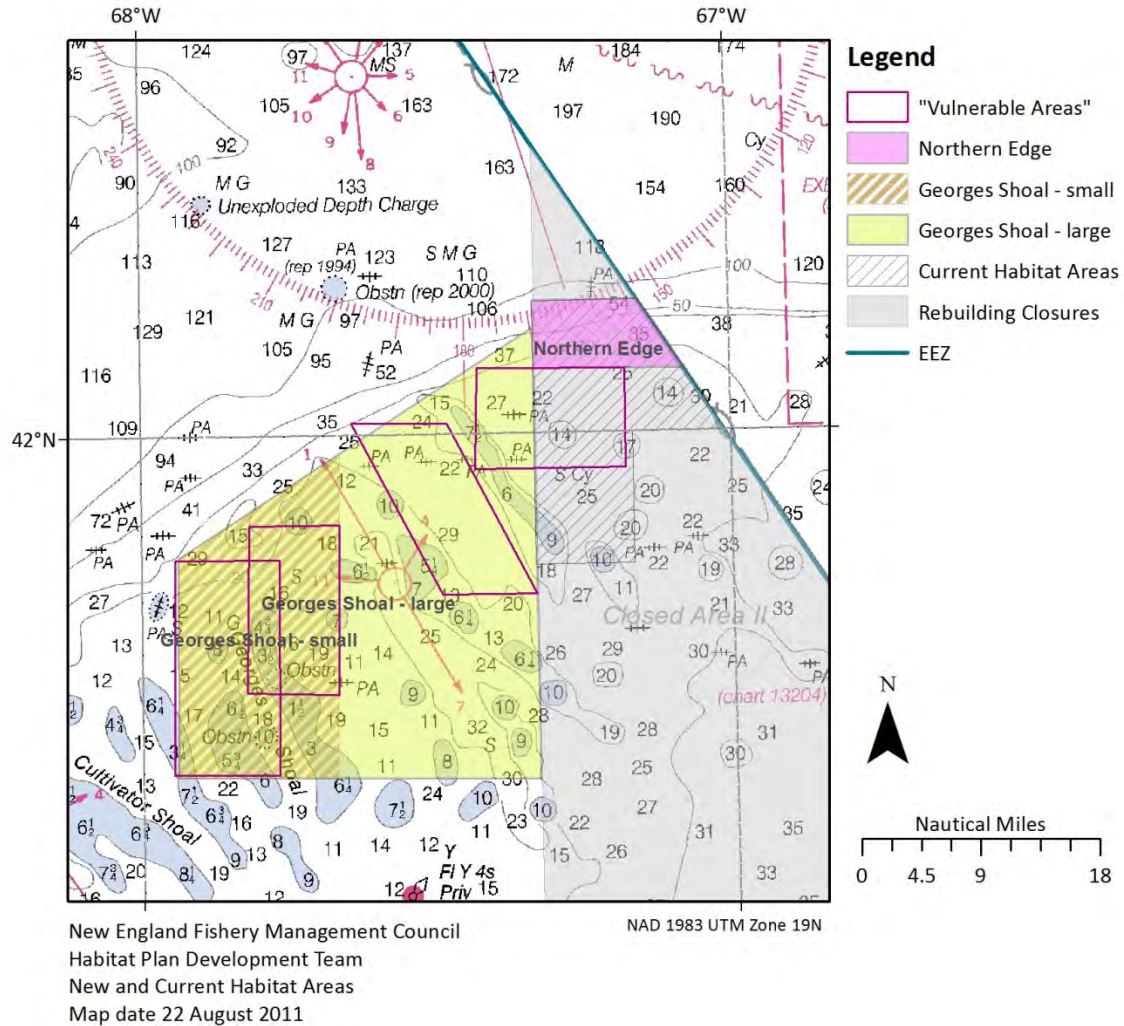
This option would create a larger habitat management area on Georges Shoal, and limit the length of ground cables that trawlers can use within the management area.

3.3.4.2 Sub-option B: Establish a smaller habitat management area on Georges Shoal and close to all mobile bottom-tending gears

This option would create a smaller habitat management area on Georges Shoal, encompassing the two westernmost vulnerable areas presented to the Committee in July, and close the area to mobile bottom-tending gears.

Map 10 – Options for CAI and surrounding areas. “Vulnerable areas” are provided for comparison the the updated area boundaries.

CAI and Surrounds



3.4 Options for CAI and surrounds

The following options are for the CAI habitat closed areas, as shown in Map 11. Note that this section does not include research areas, which require further development by the PDT.

3.4.1 Maintain existing CAI habitat closed areas (status quo)

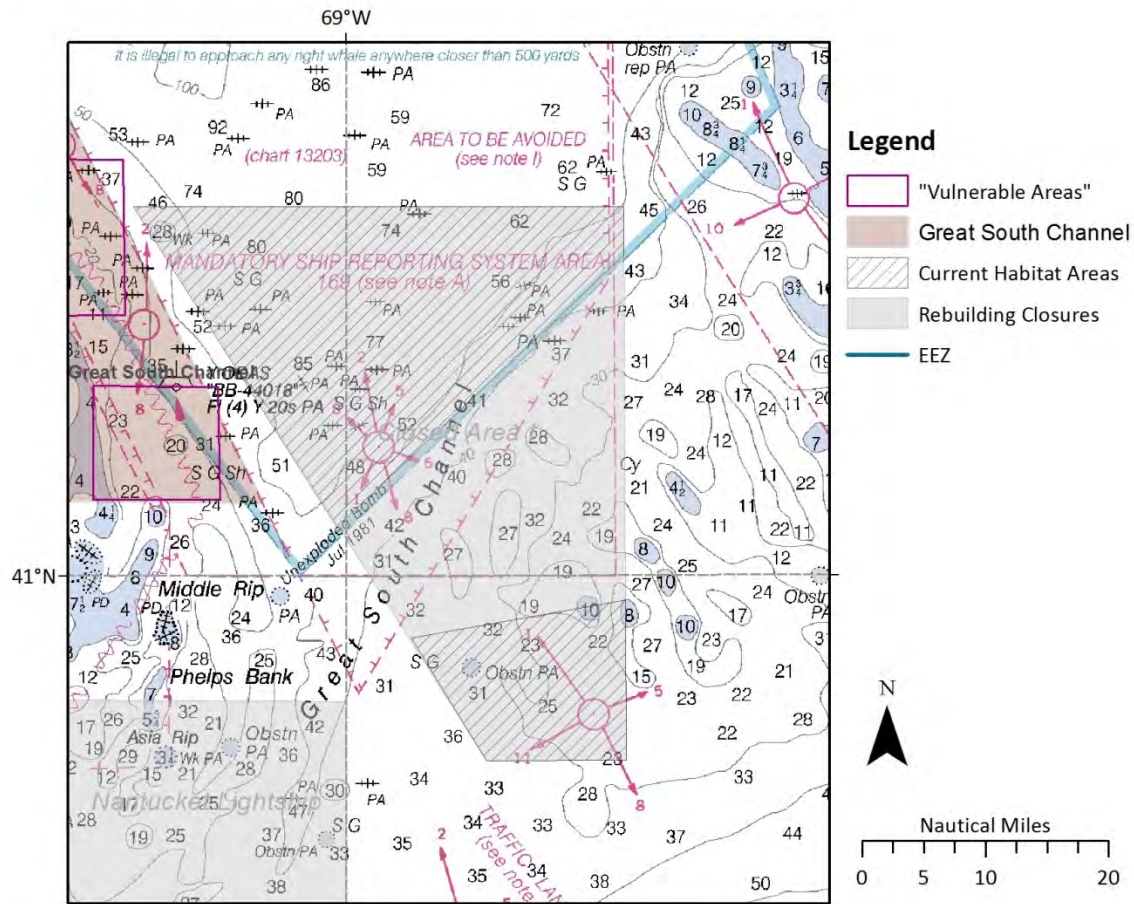
This option would maintain the CAI habitat closed area in both the multispecies and scallop FMPs.

3.4.2 Eliminate CAI habitat closed areas

This option would eliminate the CAI habitat closed area from both the multispecies and scallop FMPs. Note that the CAI habitat closed area is comprised of two non-contiguous areas, CAI-N and CAI-S, and that this option would eliminate both areas.

Map 11 - Options for CAI and surrounds

CAI and Surrounds



New England Fishery Management Council
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3.5 Options for Great South Channel and Southern New England

3.5.1 Maintain existing NLCA habitat closed area (status quo)

This option would maintain the NLCA habitat closed area in both the multispecies and scallop FMPs.

3.5.2 Eliminate NLCA habitat closed area

This option would eliminate the NLCA habitat closed area from both the multispecies and scallop FMPs.

3.5.3 Modify the NLCA habitat closed area to create the Nantucket Shoals habitat area, and close to mobile bottom tending gear

This option would adjust the boundaries of the current NLCA habitat closed area to form the Nantucket Shoals habitat area, and keep the area closed to mobile bottom tending gear. This location has relatively poor sampling compared to surrounding areas, which could explain why it did not cluster in the SASI analysis. However, it is a location containing gravel substrates that are known to be important to species such as juvenile cod. For this reason, the PDT felt it was appropriate to include for further analysis, especially given that the area is part of a current habitat closure.

3.5.4 Establish a habitat management area in the Great South Channel

The Great South Channel is one of the areas where grid cells highly vulnerable to trawl gear clustered in the SASI LISA analysis. This area contains a relatively large amount of gravel seabed, which is vulnerable to the adverse effects of fishing. Vulnerable habitat areas were identified in the Great South Channel based on the locations of gravel outcrops as identified by Harris and Stokesbury 2010, which analyzed the distribution of sediments on Georges Bank based on video survey data. These areas are currently open to fishing.

3.5.4.1 Sub-option A: Close to mobile bottom tending gear

This option would close the Great South Channel area to mobile bottom tending gear.

3.5.4.2 Sub-option B: Establish trawl gear ground cable modification requirements

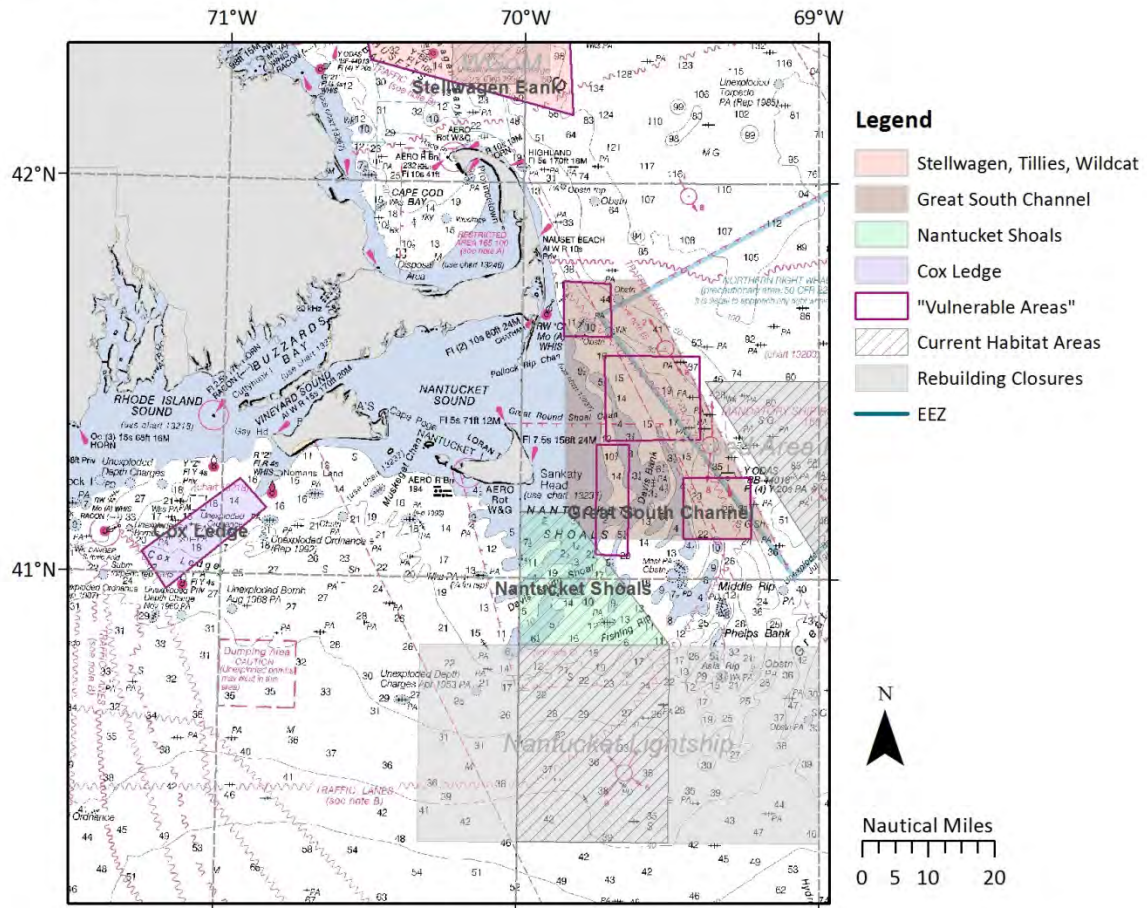
This option would establish trawl gear ground cable length limits in the Great South Channel area.

3.5.4.3 Establish a habitat management area on Cox Ledge and close to mobile bottom-tending gear

Cox's Ledge is currently open to fishing. This option would establish a habitat management area on Cox Ledge and close the area to mobile bottom-tending gear.

Map 12 – Great South Channel and Southern New England. The previously specified ‘vulnerable areas’ are included for comparison purposes.

Great South Channel and Southern New England



New England Fishery Management Council
 Habitat Plan Development Team
 New and Current Habitat Areas
 Map date 22 August 2011

NAD 1983 UTM Zone 19N

4.0 Analysis of options and alternatives

The following summary tables characterize important information about each alternative combination as well as the individual options. The tables summarize area size, vulnerability (Z_{∞}), data support, energy, average profits by gear type, and the relationship between profits and vulnerability (e). These data are outputs of the Swept Area Seabed Impact (SASI) model; the model specification document contains additional detailed information about how these values were calculated (see http://www.nefmc.org/habitat/sasi_info/110121_SASI_Document.pdf).

Vulnerability - Z_{∞}

Vulnerability is independent of the density of fishing effort, and relates to mix of seabed features inferred to a particular location based on its substrate and energy characteristics. The model estimates Z_{∞} values at the structured/regular 100 km² grid cell level, so mean values reported for each area are averaged across the 100 km² grid cells that lie within or overlap an area's boundary. Vulnerability is specific to a particular gear type. In all tables below, the Z_{∞} values reported are for trawl gears. Z_{∞} is reported in km² units, and larger values indicate that the area in question is estimated to be more vulnerable to a particular gear type, in this case, trawl gear. For comparison purposes, the area specific table (Table 7) includes the mean Z_{∞} estimate for the entire model domain. Detailed methodology for calculating the Z_{∞} values is in the SASI summary document.

Quasi-uncertainty bounds for Z_{∞} values are presented in addition to the mean values to convey a sense of how much the values would be likely to change if the model is not specified properly (in other words, if the vulnerability assessment used to determine the susceptibility and recovery parameters is either too conservative or not conservative enough). Sensitivity analyses, outlined in the SASI document referenced above, determined that the model outputs varied the most in response to changes to assumed seabed feature recovery values. Thus, the high and low uncertainty measures reported in this document were calculated by re-running the SASI model with different recovery assumptions, as follows:

Table 3 – Assumptions made when calculating lower bound Z_{∞} estimates

Recovery score	Base case values	Short duration/lower bound assumption values
0	< 1 year	1
1	1-2 years	1
2	2-5 years	2
3	> 5 years	5

Table 4 – Assumptions made when calculating upper bound Z_{∞} estimates

Recovery score	Base case values	Long duration/upper bound assumption values
0	< 1 year	1
1	1-2 years	3
2	2-5 years	20
3	> 5 years	50

Data support

Data support is a measure of the substrate data quality in the SASI model base grid that underlies a particular location. Data support is a combination of the possible sediment types that could have been detected in a cell, based on the sampling device used, and the distance between adjacent samples. The distance between samples translates directly into unstructured grid cell size because of the cell-definition techniques used to develop the model grid (i.e. the Voronoi approach). For each unstructured grid cell, the lowest data support score of 0 corresponds with sampling devices only capable of detecting mud, sand, or granule-pebble, plus very large cell size of 100 km² or greater. Conversely, a score of 6 refers to cells where all five sediment types could be sampled, and the grid cell size is less than 1 km². Mean data support values reported for each area are averaged across the unstructured grid cells that lie within or overlapped with each area’s boundary.

Table 5 – SASI Data Support Scoring Criteria

Data support score	Sediment types sampled	Cell size
0	Sampling devices capable of detecting grain sizes mud through granule-pebble.	Very large – greater than 100 km ²
1	Sampling devices capable of detecting grain sizes mud through granule-pebble.	Large – between 10 km ² and 100 km ²
2	Sampling devices capable of detecting grain sizes mud through granule-pebble.	Medium – between 1 km ² and 10 km ²
3	Sampling devices capable of detecting grain sizes mud through granule-pebble.	Small – less than 1 km ²
4	Sampling device(s) capable of detecting all grain sizes from mud-boulder.	Large – between 10 km ² and 100 km ²
5	Sampling device(s) capable of detecting all grain sizes from mud-boulder.	Medium – between 1 km ² and 10 km ²
6	Sampling device(s) capable of detecting all grain sizes from mud-boulder.	Small – less than 1 km ²

Energy

Energy values presented here can range from 0 to 1, as they are averages across the unstructured grid cells that lie within each area’s boundary, and two values are possible for an unstructured grid cell, 0 (low), or 1 (high). Criteria for ‘low’ and ‘high’ are presented in the SASI document. Thus, an average energy score approaching 1 indicates an area where almost all of the underlying grid cells were classified as high energy,

while a score close to 0 indicates an area where almost all cells were classified as low energy.

Net revenue (X) and practicability ratio (e)

Net revenues (X) are reported by gear type:

- Fixed or static gears include traps, demersal longlines, and sink gillnets, as described in the SASI document.
- Trawl includes generic otter, shrimp, squid, or raised footrope, as described in the SASI document.
- Dredge includes general category and limited access scallop, but not hydraulic dredges, due to data limitations.

Mean net revenues (revenues minus operating costs) as reported in the tables are calculated by summing annual net revenues across all structured 100km² grid cells in an area, and then averaging across all years (1996-2010). In all cases, the grid cells within the area and overlapping with area boundaries were used. This is done even for areas that are currently open to fishing, to use a consistent method across all areas. Values are in 1000s of dollars per year.

Practicability ratios, or *e* values, are also reported by gear type. These ratios provide a single measure that compares the sum of all current and future habitat impacts (Z_{net}) associated with fishing events to the revenues associated with those same fishing events. The *e* values presented here are weighted averages, i.e. they are based on the sum of all Z_{net} in km² within an area across all years, divided by the sum of all revenues in that area across all years:

$$e_{weighted} = \frac{\sum Z_{net}}{\sum X}$$

A low *e* ratio indicates that the habitat impacts associated with fishing with that gear type in that location are low as compared to the revenues associated with fishing with that gear type in that location. Fixed gears tend to have low ratios. Conversely, a high *e* ratio indicates that the habitat impacts associated with that fishing gear in that area are relatively large in comparison with revenues associated with fishing with that gear type in that location.

Table 6 – Summary information about Z_{∞} , data support, and energy for each alternative. Z_{∞} is reported for trawl gears. No Action Plus refers to No Action plus the current groundfish rebuilding closures

Model run	Total area covered km ²	Sum Z_{∞}	Mean	<i>StDev</i>	Lower	<i>StDev lower</i>	Upper	<i>StDev upper</i>	Mean data	<i>StDev data</i>	Mean	<i>StDev</i>
			Z_{∞}	Z_{∞}	bound Z_{∞}	bound Z_{∞}	bound Z_{∞}	bound Z_{∞}	support	support	energy	energy
No Action	119209	4622.41	0.48	<i>0.045</i>	0.31	<i>0.254</i>	1.05	<i>1.173</i>	3.5	<i>1.53</i>	0.59	<i>0.462</i>
No Action Plus	152600	10762.40	0.47	<i>0.036</i>	0.31	<i>0.246</i>	1.01	<i>1.097</i>	3.8	<i>1.57</i>	0.63	<i>0.457</i>
Alt 1	6994	3608.65	0.51	<i>0.072</i>	0.32	<i>0.239</i>	1.13	<i>1.120</i>	3.3	<i>1.40</i>	0.63	<i>0.450</i>
Alt 2	6605	3442.71	0.51	<i>0.074</i>	0.32	<i>0.239</i>	1.13	<i>1.110</i>	3.4	<i>1.40</i>	0.65	<i>0.451</i>
Alt 3	5489	2836.23	0.50	<i>0.059</i>	0.32	<i>0.238</i>	1.12	<i>1.099</i>	3.4	<i>1.44</i>	0.69	<i>0.439</i>
Alt 4	4144	2084.84	0.49	<i>0.052</i>	0.31	<i>0.234</i>	1.05	<i>0.945</i>	3.8	<i>1.39</i>	0.95	<i>0.182</i>

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Table 7 – Summary information about Z_{∞} , data support, and energy for each area individually. Z_{∞} is reported for trawl gears.

Area	Total area covered km ²	Mean Z_{∞}	StDev Z_{∞}	Lower bound Z_{∞}	StDev lower bound Z_{∞}	Upper bound Z_{∞}	StDev upper bound Z_{∞}	Mean data support	StDev data support	Mean energy	StDev energy
Entire domain	-	46.87	3.914	0.31	0.232	0.99	1.034	1.0	1.48	0.2	0.41
Jeffreys Bank Habitat (status quo)	499	0.57	0.104	0.31	0.270	1.31	1.510	2.6	1.70	0.0	0.00
Jeffreys Bank Habitat (modified)	494	0.57	0.084	0.32	0.262	1.29	1.389	2.9	1.15	0.0	0.00
Platts Bank Habitat	293	0.69	0.160	0.34	0.280	1.53	1.495	4.0	1.00	0.1	0.08
Cashes Ledge Rebuilding	1379	0.47	0.041	0.30	0.245	1.04	1.296	2.4	1.41	0.0	0.05
Cashes Habitat (status quo)	313	0.50	0.046	0.32	0.276	1.24	1.530	2.3	1.32	0.0	0.08
Cashes Habitat (modified)	324	0.50	0.046	0.32	0.276	1.24	1.530	2.3	1.32	0.0	0.08
Fippennies Ledge (new)	202	0.50	0.021	0.32	0.277	1.18	1.426	4.5	0.49	0.0	0.00
WGOM Rebuilding	3030	0.49	0.028	0.32	0.261	1.20	1.418	2.1	0.68	0.1	0.24
WGOM Habitat (status quo)	2273	0.49	0.031	0.32	0.263	1.19	1.418	2.3	0.62	0.2	0.27
Jeffreys Ledge Habitat (new)	731	0.51	0.042	0.37	0.239	1.40	1.217	2.1	0.77	0.1	0.16
Jeffreys Ledge Habitat (extension, new)	390	0.47	0.015	0.32	0.241	1.16	1.306	2.0	0.29	0.3	0.30
Stellwagen Bank/Tillies Bank/Wildcat Knoll Habitat (New, placeholder/draft)	2304	0.48	0.018	0.31	0.257	1.10	1.297	2.1	0.63	0.2	0.30
Closed Area II Rebuilding	6920	0.47	0.024	0.31	0.240	0.97	0.966	4.7	0.90	0.9	0.31
CAII Habitat (status quo)	639	0.49	0.032	0.31	0.252	1.08	1.041	5.3	1.09	1.0	0.13
Northern Edge Habitat (modified CAII Habitat)	172	0.50	0.036	0.29	0.259	1.03	1.142	5.1	1.63	0.9	0.19

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Area	Total area covered km ²	Mean Z [∞]	StDev Z [∞]	Lower bound Z [∞]	StDev lower bound Z [∞]	Upper bound Z [∞]	StDev upper bound Z [∞]	Mean data support	StDev data support	Mean energy	StDev energy
Georges Shoal Habitat Large (new)	2369	0.51	0.061	0.36	0.240	1.26	0.963	4.7	0.74	1.0	0.09
Georges Shoal Habitat Small (new)	859	0.53	0.077	0.26	0.248	0.87	0.985	4.3	0.77	1.0	0.05
Closed Area I Rebuilding	3952	0.46	0.035	0.30	0.244	0.94	0.927	4.7	1.01	1.0	0.08
CAI North Habitat (status quo)	1900	0.46	0.038	0.30	0.250	0.93	0.956	4.2	1.17	1.0	0.11
CAI South Habitat (status quo)	622	0.47	0.041	0.30	0.251	0.93	0.945	5.0	0.37	1.0	0.00
NLCA Rebuilding	7314	0.47	0.019	0.31	0.244	0.97	1.036	3.6	1.61	0.7	0.44
NLCA Habitat (status quo)	3401	0.47	0.021	0.31	0.247	0.98	1.057	3.3	1.38	0.6	0.46
Nantucket Shoals Habitat (modified NLCA Habitat)	1042	0.46	0.026	0.29	0.246	0.88	0.924	3.1	1.40	1.0	0.00
Great South Channel Habitat (new)	2930	0.51	0.057	0.32	0.246	1.10	0.997	3.9	1.14	0.9	0.22
Cox Ledge Habitat (new)	416	0.46	0.014	0.30	0.255	0.92	0.953	3.0	1.10	1.0	0.00

Table 8 – Summary of revenue and practicability (e) ratios by gear class for each alternative. Revenues are in 1000s of dollars per year and include adjacent areas.

Alternative	Gear class	Mean revenue	StDev revenue	e ratio
No Action	Dredge	6,380	3044.7	0.064
	Fixed	33,904	10455.8	0.010
	Trawl	37,394	17976.8	0.819
No Action plus	Dredge	31,923	25323.9	0.053
	Fixed	39,442	11590.3	0.009
	Trawl	67,861	33688.4	0.734
Alternative 1	Dredge	10,026	6879.1	0.090
	Fixed	52,846	14517.0	0.006
	Trawl	55,104	23808.2	0.861
Alternative 2	Dredge	9,941	6804.4	0.090
	Fixed	48,126	13528.9	0.005
	Trawl	47,780	22023.0	0.840
Alternative 3	Dredge	9,597	6779.0	0.089
	Fixed	26,214	9368.7	0.004
	Trawl	38,031	19611.2	0.911
Alternative 4	Dredge	9,522	6616.0	0.089
	Fixed	21,600	7619.0	0.005
	Trawl	33,511	17723.3	0.918

Table 9 – Summary of revenue and practicability (e) ratios by gear class for each area individually. Revenues are in 1000s of dollars per year and include adjacent areas.

Area	Gear class	Mean revenue	StDev revenue	e ratio
Jeffreys Bank Habitat (status quo)	Dredge	2	2.3	2.467
	Fixed	246	446.6	0.009
	Trawl	714	449.3	1.453
Jeffreys Bank Habitat (modified)	Dredge	8	.	1.215
	Fixed	343	612.5	0.002
	Trawl	1,914	1043.5	1.628
Platts Bank Habitat	Dredge	0	1.6	1.891
	Fixed	4,842	2312.1	0.004
	Trawl	1,837	1788.3	0.343
Cashes Ledge Rebuilding	Dredge	3	21.5	1.022
	Fixed	5,070	3595.2	0.001
	Trawl	5,178	3324.8	0.509
Cashes Habitat (status quo)	Dredge	-	-	-
	Fixed	2,688	2366.2	0.001
	Trawl	847	593.5	0.305
Cashes Habitat (modified)	Dredge	-	-	-
	Fixed	2,688	2366.2	0.001
	Trawl	847	593.5	0.305
Fippennies Ledge (new)	Dredge	3	21.5	1.022
	Fixed	1,244	1283.5	0.001
	Trawl	975	719.5	0.521
WGOM Rebuilding	Dredge	424	741.3	0.166
	Fixed	25,894	8954.2	0.012
	Trawl	20,479	8705.9	0.735
WGOM Habitat (status quo)	Dredge	422	741.0	0.166
	Fixed	25,163	8686.5	0.012
	Trawl	16,361	6887.6	0.754
Jeffreys Ledge Habitat (new)	Dredge	0	0.5	0.107
	Fixed	10,888	6115.8	0.006
	Trawl	5,214	2683.9	0.685
Jeffreys Ledge Habitat (extension, new)	Dredge	47	65.6	0.301
	Fixed	2,822	1501.0	0.006
	Trawl	3,723	2115.0	0.975
Stellwagen Bank/Tillies Bank/Wildcat Knoll Habitat (New, placeholder/draft)	Dredge	702	938.1	0.190
	Fixed	24,370	6260.0	0.016
	Trawl	38,379	14946.1	0.837
Closed Area II Rebuilding	Dredge	14,425	20614.1	0.036

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Area	Gear class	Mean revenue	StDev revenue	e ratio
	Fixed	2,042	960.3	0.003
	Trawl	20,848	19578.2	0.539
CAII Habitat (status quo)	Dredge	1,425	970.2	0.065
	Fixed	393	347.9	0.000
	Trawl	5,425	3282.1	0.495
Northern Edge Habitat (modified CAII Habitat)	Dredge	557	486.7	0.092
	Fixed	279	302.0	0.000
	Trawl	2,976	2443.0	0.266
Georges Shoal Habitat Large (new)	Dredge	2,065	1267.3	0.098
	Fixed	234	170.7	0.000
	Trawl	14,062	7759.9	0.979
Georges Shoal Habitat Small (new)	Dredge	707	540.6	0.075
	Fixed	641	806.4	0.001
	Trawl	13,400	5331.9	1.155
Closed Area I Rebuilding	Dredge	9,484	9199.1	0.047
	Fixed	5,077	2623.6	0.003
	Trawl	16,232	12157.6	0.935
CAI North Habitat (status quo)	Dredge	2,335	1818.8	0.066
	Fixed	4,916	2645.6	0.003
	Trawl	11,531	9347.8	1.026
CAI South Habitat (status quo)	Dredge	2,050	952.8	0.042
	Fixed	108	157.9	0.004
	Trawl	1,716	2054.8	0.788
NLCA Rebuilding	Dredge	7,588	7403.4	0.085
	Fixed	1,113	493.1	0.003
	Trawl	4,411	4073.3	1.067
NLCA Habitat (status quo)	Dredge	171	242.5	0.019
	Fixed	431	293.3	0.001
	Trawl	971	922.5	1.283
Nantucket Shoals Habitat (modified NLCA Habitat)	Dredge	161	231.8	0.019
	Fixed	184	323.5	0.002
	Trawl	597	663.3	1.382
Great South Channel Habitat (new)	Dredge	8,900	6352.2	0.090
	Fixed	21,164	7574.1	0.005
	Trawl	29,632	16347.2	0.974
Cox Ledge Habitat (new)	Dredge	429	343.5	0.111
	Fixed	4,937	1201.7	0.007
	Trawl	1,650	692.2	0.443