DRAFT

Omnibus Essential Fish Habitat Amendment 2
Volume 3:
Spatial management alternatives
Environmental Impacts of Spatial Management Alternatives
Cumulative Effects Analysis

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

Updated December 6, 2013
Draft for Council review on December 18, 2013

Note: A number of sections of the impacts analysis have not been written yet; there are placeholders in the text where this is the case. Also, many sections are only partially completed and additional discussion will be added later. As time permits, additional analyses may be provided before the Council meeting. The forthcoming decision document will highlight which areas of the DEIS (all volumes) are incomplete and need to be drafted prior to initial submission.

1 Contents: Volume 3

1.1 Table of contents

1.2 Tables

1.3 Figures

1.4 Maps

2 Spatial management alternatives

While the Essential Fish Habitat and Habitat Area of Particular Concern designations are more administrative in nature, this section of the amendment outlines alternatives that designate spatial management areas, within which fishing activities would be restricted on the basis of gear type (Table 1). Three sets of areas are proposed: (1) year-round habitat protection areas, (2) seasonal spawning protection areas, and (3) dedicated habitat research areas. There are spatial overlaps between the three sets of areas, and there are various fishing restrictions possible within each type of area, so the final distribution of fishing effort restrictions will depend on which areas and measures are selected in combination.

Table 1 – Types of spatial management alternatives that effect fishing activities

Alternative type	Year round or seasonal	Which areas comprise the action alternatives?	Type of restrictions (generally)	Rationale
Habitat protection	Year round, long term	Modified versions of existing habitat management areas in groundfish and scallop FMPs, new areas developed through SASI analysis and groundfish hotspot analysis.	Mobile bottom-tending gears – prohibit their use, or allow dredges and require gear modifications for trawls only. Option to exclude hydraulic clam dredges from the restriction if all mobile bottom-tending gears are prohibited.	Minimize adverse effects of fishing on highly structured seafloor habitats to protect the areas ability to shelter fish and fish prey, some areas focus on encompassing habitats for juvenile large mesh multispecies in particular
Spawning protection	Seasonal, long term	Existing rolling and year round closures, redesignated as spawning areas	Closed to gears capable of catching groundfish, with exemptions as appropriate. Option to include recreational groundfishing in the restriction.	Avoid capture of fish during their spawning season, prevent disruption of spawning activity
Habitat research	Year round, triggered sunset provision	Subsets of existing habitat management areas, or new habitat management areas	At minimum, prohibit use of mobile bottom-tending gears. Stellwagen area maintains no-action restrictions and also includes a reference area that would further restrict recreational groundfish catch.	Create opportunity for research that investigates the relationship between habitat, fishing, and fish productivity

The amendment includes action alternatives designed to address specific goals and objectives, and related no action spatial management alternatives, which consist of combinations of current areas and measures that currently fulfill similar purposes to their corresponding action alternatives. The intent of the action alternatives in each category is explicit – either year round protection of vulnerable habitats from fishing gear effects or seasonal protection of spawning fish. The action alternatives are not designed to reduce fishing mortality per se. The original rationales behind the areas that constitute the no action alternatives are often not as well defined. Furthermore, the existing management areas currently produce multiple benefits, which may not relate well to the original purpose of the designations.

2.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats

The alternatives in this section were designed around two sets of goals and objectives. Some areas were developed through the Habitat Plan Development Team and Habitat Committee process, based on the results of the Swept Area Seabed Impact analyses and related extra-SASI information. The primary goal addressed with these areas was to minimize the adverse effects of fishing on vulnerable seabed habitats, across all areas managed by the Council. Additional areas were later developed by the Closed Area Technical Team and Groundfish Committee, based on an analysis of juvenile groundfish distributions, combined with information about the vulnerability of various stocks and their affinities for vulnerable habitat types. The primary goal addressed with these areas was to improve groundfish productivity, specifically by protecting critical life stages (i.e. juveniles). The SASI approach is detailed in Appendix D, and the results are summarized in the physical/biological habitat portion of the affected environment section. The groundfish distribution analysis is detailed in Appendix E, and the results are summarized in the managed species portion of the affected environment section.

These separate, but complementary, processes were conducted because the Council added goals and objectives specific to groundfish protection later in the amendment's development. Instead of the SASI-based approach which focused more generally on which habitats were most vunerable to fishing gear, the CATT-approach focused more specifically on the critical lifestage of groundfish species that (1) were known to have a strong affinity for those habitats most vulnerable to fishing impacts, and (2) were in the most critical from a stock status standpoint. (See Appendix E for details on the hotspot analysis methods) There were different processes and analyses through which the areas were developed and different goals and objectives within the Amendment that the areas were designed to achieve. However, regardless of the origin of a particular area, the merged sets of areas in each alternative are intended, collectively, to minimize the adverse effects of fishing on Essential Fish Habitats, a requirement of the MSA:

"Fishery Management Plans must describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat" (Magnuson-Stevens Fishery Conservation and Management Act, As Amended Through January 12, 2007)

The Secretarial EFH guidelines (67 FR 2343, January 17, 2002) define 'adverse' as a combination of effects on habitat that are both 'more than minimal' and 'not temporary'. However, determinations about what exactly is meant by minimal and temporary, and about what management measures are practicable, are left to the Council's discretion.

All of the habitat management areas described in this section would be defined on an indefinite, year-round basis, and the fishing restriction measures focus on minimizing impacts associated with mobile bottom-tending gears.

The alternatives in this section are grouped sub-regionally. Alternative 1 for each sub-region (the No Action alternative) consists of mobile-bottom tending gear closures first identified via Northeast Multispecies Amendment 13 as well as the year-round groundfish closures, which were implemented at various times and for various purposes, but restrict some of the same gear types and provide some of the same benefits in terms of minimizing adverse effects on EFH.

Table 2 – Measures in existing groundfish closure areas

Area	Closed to	Exemptions
Cashes Ledge and Western Gulf of Maine Closure Areas	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Charter and party vessels with a letter of authorization; • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls; and • Vessels participating in the mid-water trawl exempted fishery
Nantucket Lightship Closure Area	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Classified as charter, party or recreational vessel, provided that: (A) LOA, (B) Fish species managed by the NEFMC or the MAFMC are not sold, (C) no gear other than rod and reel or handline gear on board, (D) vessel does not fish outside the Nantucket Lightship Closed Area during the period specified by the LOA • Fishing with or using dredge gear designed and used to take surfclams or ocean quahogs • Fishing for scallops within the Nantucket Lightship Access Area
Closed Area I	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Fishing in a Special Access Program • Fishing for scallops within the Closed Area I Access Area

Area	Closed to	Exemptions
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Fishing in a Special Access Program • Tuna purse seine gear outside of the portion of CA II known as the Habitat Area of Particular Concern • Fishing in the CA II Yellowtail Flounder/Haddock SAP or the Eastern U.S./Canada Haddock SAP Program • Transiting the area, provided the vessel's fishing gear is stowed and there is a compelling safety reason • The vessel has declared into the Eastern U.S./Canada Area and is transiting CA II • Fishing for scallops within the Closed Area II Access Area

Alternative 2 for each sub-region is a “no closure” scenario. This was interpreted to mean no year-round habitat management areas; Alternative 2 does not preclude seasonal closures for spawning, or year-round management areas employed for other purposes (e.g. research). The exception to this is the Eastern Gulf of Maine sub-region, where there are no current closed areas. As a result, the No Action and no closure alternatives are combined in this sub-region. Alternatives 3-7 for each sub-region (2-3 for Eastern GOM) consist of combinations of new or modified habitat management areas. In some cases, different alternatives in a sub-region include smaller and larger versions of an area. These are named “Small XX HMA and “Large XX HMA” to distinguish between them; the associated maps clarify which area is included in a given alternative. The areas included in each alternative are summarized in Table 3.

With the exception of the Ammen Rock area (see below), the management measure for each area can be selected from the following four options. Different measures could be selected in each area.

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The Ammen Rock area is proposed as a closure to all fishing, with the exception of lobster trapping; this is the only habitat management area that would be managed in this way. The Ammen Rock area closure would include, but is not limited to, bottom trawls (including shrimp trawls), all types of dredges, demersal longlines, sink gillnets, and traps, with the exception of lobster traps, as well as midwater trawl gear and recreational fishing gear.

Table 3 – Summary of areas included in the various habitat management alternatives

Sub-region	Alternative	Areas included
Eastern Gulf of Maine	1 (No Action, no closure)	None
	2	Large Eastern Maine, Machias
	3	Small Eastern Maine, Machias, Toothaker
Central Gulf of Maine	1 (No Action)	Jeffreys Bank EFH, Cashes EFH, Cashes GF
	2 (no closure)	None
	3	Mod Jeffreys Bank, Mod Cashes, Ammen Rock, Fippennies, Platts
	4	Mod Jeffreys Bank, Mod Cashes, Ammen Rock
Western Gulf of Maine	1 (No Action)	WGOM EFH, WGOM GF
	2 (no closure)	None
	3	Large Bigelow Bight, Large Stellwagen
	4	Large Bigelow Bight, Small Stellwagen, Jeffreys Ledge
	5	Small Bigelow Bight, Small Stellwagen, Jeffreys Ledge
	6	Large Stellwagen
	7	Roller gear areas – current and modified options
Georges Bank	1 (No Action)	CAI and CAII EFH, CAI and CAII GF
	2 (no closure)	None
	3	Northern Edge
	4	Northern Edge and Small Georges Shoal gear modified area
	5	Small Georges Shoal mobile gear closure and Large Georges Shoal gear modified area
Great South Channel/Southern New England	1 (No Action)	NLCA EFH and NLCA GF
	2 (no closure)	None
	3	Extended Great South Channel and Cox Ledge
	4	Great South Channel and Cox Ledge
	5	Nantucket Shoals and Cox Ledge
	6	Alternate version of Nantucket Shoals as a mobile gear closure, alternate version of Great South Channel as a gear modified area

2.1.1 Gulf of Maine

2.1.1.1 *Eastern GOM and the Scotian Shelf*

The habitat management alternatives for the eastern Gulf of Maine and Scotian Shelf region include various combinations of four areas: Toothaker Ridge, Small Eastern Maine, Large Eastern Maine, and Machias.

Table 4 – Coordinates for habitat management areas in eastern Maine

Toothaker Ridge HMA		
Point	N Latitude	W Longitude
1	43° 40.0’	69° 15.4’
2	43° 40.0’	69° 07.9’

3	43° 45.4’	69° 07.9’
4	43° 45.4’	69° 00.5’
5	43° 40.0’	69° 00.5’
6	43° 40.0’	68° 45.6’
7	43° 34.6’	68° 45.6’
8	43° 34.6’	68° 53.1’
9	43° 29.2’	68° 53.1’
10	43° 29.2’	69° 00.5’
11	43° 29.2’	69° 07.9’
12	43° 34.6’	69° 07.9’
13	43° 34.6’	69° 15.3’
Small Eastern Maine HMA, * see note B		
Point	N Latitude	W Longitude
1	44° 02.5’	68° 06.1’
2	43° 51.0’	68° 33.9’
3*	43° 56.6’	68° 38.1’
4*	44° 07.6’	68° 10.6’
Large Eastern Maine HMA, * see note B		
Point	N Latitude	W Longitude
1	44° 07.1’	68° 00.2’
2	43° 51.7’	68° 00.0’
3	43° 42.2’	68° 33.1’
4	43° 42.3’	-68° 46.0’
5*	43° 49.0’	-68° 45.9’
6*	43° 55.9’	-68° 41.0’
7*	43° 56.8’	-68° 39.3’
8*	44° 07.1’	-68° 10.8’
Machias HMA, see note A		
Point	N Latitude	W Longitude
1	44° 27.7’	-67° 08.9’
2	44° 28.0’	-67° 27.1’
3	44° 46.0’	-66° 54.8’
A. Western boundary state waters; eastern boundary state waters/EEZ *B. Landward boundary at state waters. Only endpoints provided.*		

2.1.1.1.1 Alternative 1 (No Action, no habitat management areas)

Because there are currently no year-round closed areas in this sub-region, the no action habitat management alternative in the eastern Gulf of Maine and Scotian Shelf region does not include any habitat management areas. If the Council prefers no a habitat management area strategy in this sub-region, the "no action" alternative would be selected. If the Council prefers a strategy with habitat management areas in this sub-region, one of the action alternatives (2 or 3, below), including the associated management measures, would be selected.

2.1.1.1.2 Alternative 2

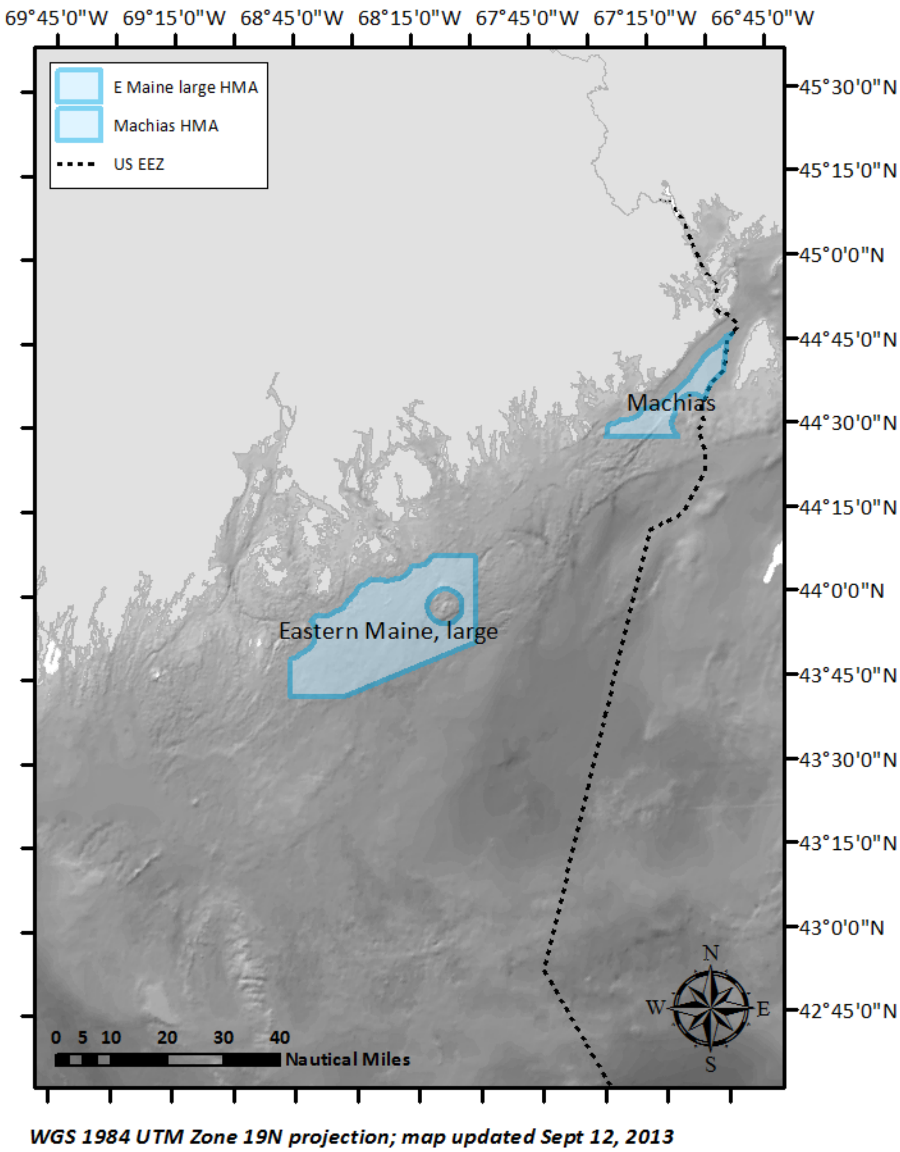
The alternative (Map 1) would designate two new habitat management areas, the Large Eastern Maine Habitat Management Area and the Machias Habitat Management Area, in all FMPs. Measures for both of these areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The Eastern Maine area was designed to minimize the adverse effects of fishing on habitats used by juvenile groundfish, including redfish, alewife, silver hake, white hake, windowpane flounder, winter flounder, and witch flounder. The larger version of the Eastern Maine area included in this alternative includes additional juvenile hotspots compared to the smaller area identified in Alterative 4. Habitats in the Eastern Maine area are vulnerable to fishing impacts, as indicated by the SASI spatial analysis. The Machias area was developed to minimize the adverse effects of fishing on juvenile cod, haddock, and halibut habitats.

Map 1 – Eastern Gulf of Maine/Scotian Shelf Habitat Management Alternative 2



2.1.1.1.3 Alternative 3

This alternative (Map 2) designates three new habitat management areas, the Small Eastern Maine Habitat Management Area, the Machias Habitat Management Area, and the Toothaker Ridge Habitat Management Area. All three areas would be designated in all NEFMC FMPs. Measures for all three of these areas could include:

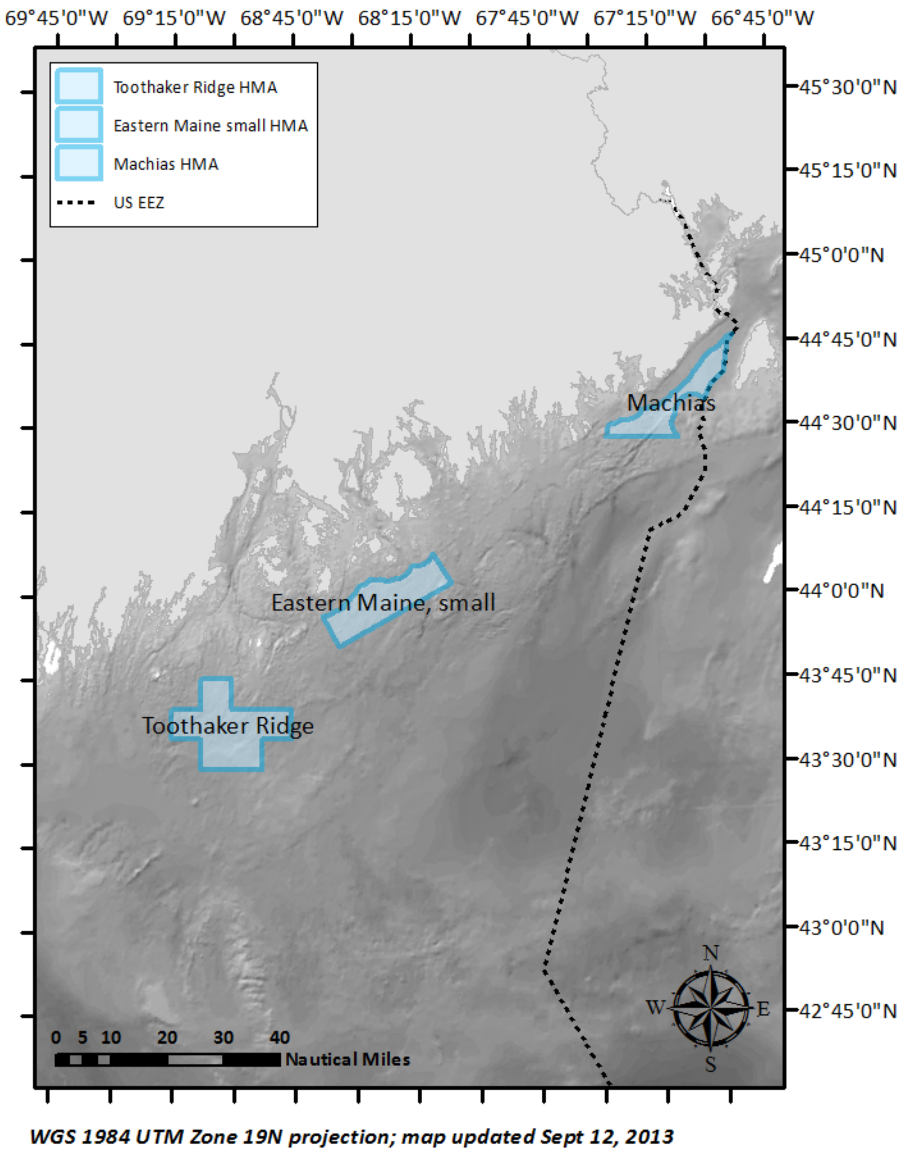
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The Toothaker Ridge area was developed specifically for juvenile groundfish habitat protection, and includes juvenile redfish and witch flounder habitat. The Small Eastern Maine area is expected to protect habitats of similar species as compared to the larger area (i.e. redfish, alewife, silver hake, white hake, windowpane flounder, winter flounder, and witch flounder), but with fewer impacts to industry, which is why the smaller area was combined with the nearby Toothaker Ridge area. The Machias area is the same as in Alternative 3; it was developed to minimize the adverse effects of fishing on juvenile cod, haddock, and halibut habitats.

Map 2 – Eastern Gulf of Maine/Scotian Shelf Habitat Management Alternative 3



2.1.1.2 *Central GOM*

The habitat management alternatives for the central Gulf of Maine region include various combinations of eight areas: Jeffreys Bank (no action), Modified Jeffreys Bank, Cashes Ledge Habitat Closure Area (no action), Cashes Ledge Groundfish Closed Area (no action), Modified Cashes Ledge HMA, Ammen Rock HMA, Fippennies Ledge HMA, and Platts Bank HMA (which is comprised of two sub-areas that would be implemented together).

Table 5 – Coordinates for habitat management areas in the central Gulf of Maine

Jeffreys Bank Habitat Closure Area		
Point	N Latitude	W Longitude

JB1	43° 40’	68° 50’
JB2	43° 40’	68° 40’
JB3	43° 20’	68° 40’
JB4	43° 20’	68° 50’
Modified Jeffreys Bank HMA		
Point	N Latitude	W Longitude
1	43° 31’	68° 37’
2	43° 20’	68° 37’
3	43° 20’	68° 55’
4	43° 31’	68° 55’
Cashes Ledge Habitat Closure Area		
Point	N Latitude	W Longitude
CLH1	43° 01’	69° 03’
CLH2	43° 01’	68° 52’
CLH3	42° 45’	68° 52’
CLH4	42° 45’	69° 03’
Cashes Ledge Groundfish Closure Area		
Point	N Latitude	W Longitude
CL1	43°07’	69°02’
CL2	42°49.5’	68°46’
CL3	42°46.5’	68°50.5’
CL4	42°43.5’	68°58.5’
CL5	42°42.5’	69°17.5’
CL6	42°49.5’	69°26’
Modified Cashes Ledge HMA		
Point	N Latitude	W Longitude
1	43° 01.0’	69° 00.0’
2	43° 01.0’	68° 52.0’
3	42° 45.0’	68° 52.0’
4	42° 45.0’	69° 00.0’
Ammen Rock HMA		
Point	N Latitude	W Longitude
1	42° 55.5’	68° 57.0’
2	42° 52.5’	68° 55.0’
3	42° 52.5’	68° 57.0’
4	42° 55.5’	68° 59.0’
Fippennies Ledge HMA		
Point	N Latitude	W Longitude
1	42° 50.0’	69° 17.0’
2	42° 44.0’	69° 14.0’
3	42° 44.0’	69° 18.0’
4	42° 50.0’	69° 21.0’
Platts Bank HMA 1		

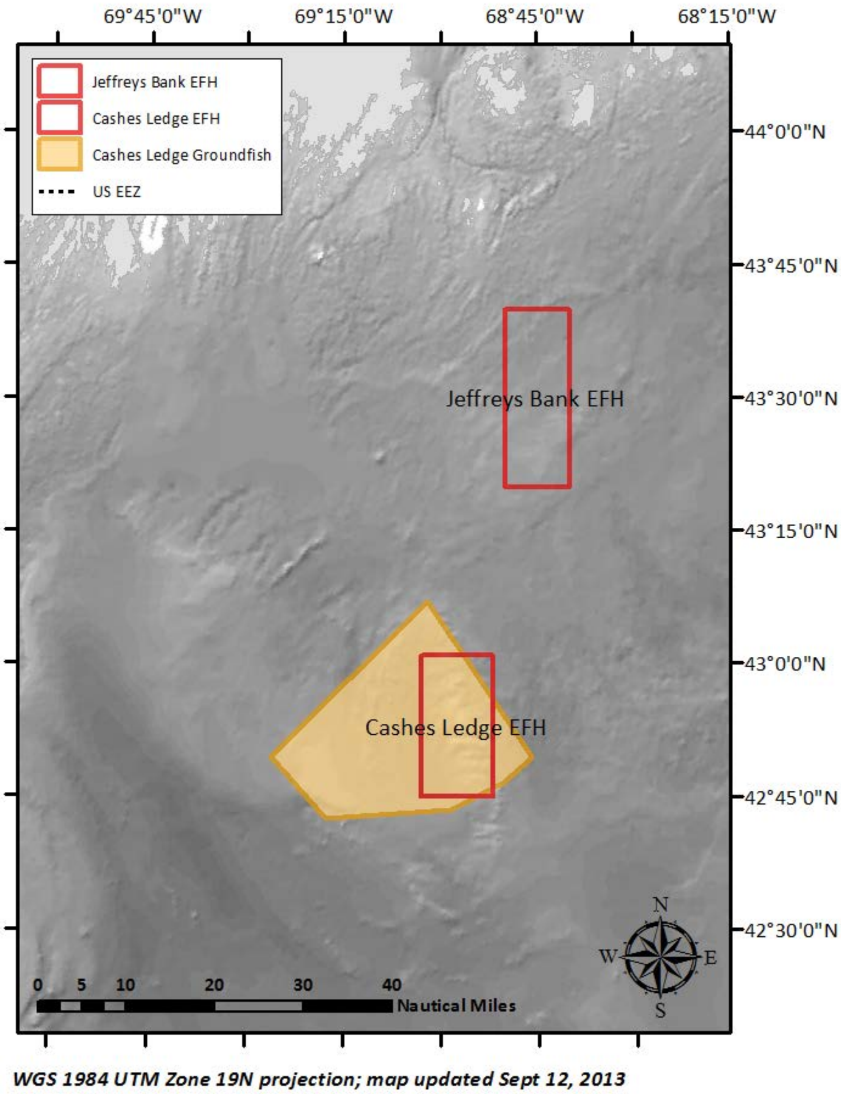
Point	N Latitude	W Longitude
1	43° 13.0'	69° 37.5'
2	43° 10.5'	69° 37.5'
3	43° 10.5'	69° 42.5'
4	43° 13.0'	69° 42.5'
Platts Bank HMA 2		
Point	N Latitude	W Longitude
1	43° 10.5'	69° 32.0'
2	43° 07.5'	69° 32.0'
3	43° 07.5'	69° 37.5'
4	43° 10.5'	69° 37.5'

2.1.1.2.1 Alternative 1 (No Action)

The no action habitat management alternative in the central Gulf of Maine region includes the Jeffreys Bank and Cashes Ledge habitat closure areas. These areas were initially implemented via Amendment 13 to the Northeast Multispecies FMP as areas closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The areas were subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. This alternative also includes the Cashes Ledge Closed Area, which was closed to groundfishing year-round by Secretarial action on May 1, 2002. The Cashes Ledge Closed Area is closed year round to all fishing vessels, with the following exemptions: charter and party vessels with a letter of authorization; vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls; and vessels participating in the mid-water trawl exempted fishery.

Rationale: The habitat closure areas, and also the groundfish closure area, restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the central GOM region.

Map 3 – Central GOM Habitat Management Alternative 1 (No Action)



2.1.1.2.2 Alternative 2 (No habitat management areas)

This alternative would remove the current Cashes Ledge habitat closure area and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.1.2.3 Alternative 3

This alternative (Map 4) would modify the boundaries of the current Jeffreys Bank and Cashes Ledge habitat closures, and designate three new habitat management areas: Ammen Rock, Fippennies Ledge, and Platts Bank (Platts Bank is comprised of two sub-areas). All five of these areas would be designated in all NEFMC FMPs. The Ammen Rock area would be closed to all fishing gears and activities except for lobster trapping. Measures for the other four areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all four areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The current Jeffreys Bank management area encompasses both shallower hard-bottom habitats on the bank (southern portion) and deeper, muddy habitats (northern portion). The modification would change the boundaries to focus on just the southern portion, with an expansion of the area to the east and to the west to incorporate the portion of Jeffreys Bank shallower than approximately 100 m. This better focuses the Jeffreys Bank area on more vulnerable habitat types in order to minimize the adverse effects of fishing on EFH.

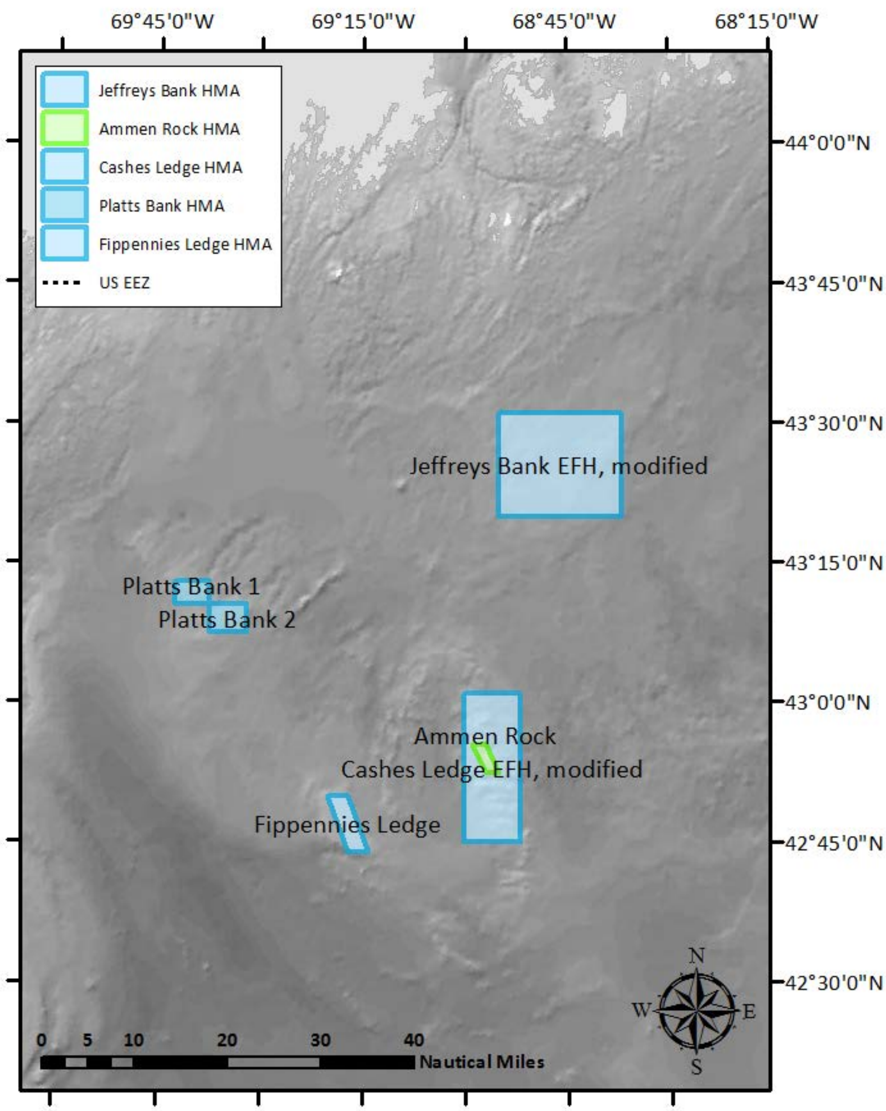
Most of the hard-bottom, shallower habitats on Cashes Ledge are included in the modified, smaller area, including all features shallower than 100 meters. The Ammen Rock pinnacle, which is the shallowest part of Cashes Ledge, represents a particularly unique and vulnerable kelp forest habitat type that would benefit from enhanced levels of protection. Although for an equal amount of area swept fixed gears were estimated to have substantially reduced adverse effects in comparison to trawls and dredges, for some types of benthic features, habitat impacts due to fixed gear use could be significant and long lasting (‘adverse’ effects are both ‘more than minimal’ and ‘not temporary’).

Fippennies Ledge and Platts Bank would be new habitat management areas, although Fippennies Ledge lies within the existing Cashes ledge groundfish closure. Each of these areas is designed to focus on the core, shallow portions of the features. The objective was to protect a representative array of substrate and habitat types while allowing fishing activity along the edges of the features.

None of these areas were identified through evaluation of juvenile groundfish distributions, although the areas contain habitats for redfish on Platts Bank, haddock on Fippennies Ledge, and redfish, plaice, haddock, and silver hake on Cashes Ledge. Designating these habitat management areas is expected to minimize fishing impacts on vulnerable habitats and improve groundfish productivity. Survey sampling on Cashes and Fippennies ledges themselves is extremely limited, so the analysis may not reflect the importance of these habitats to juvenile fish.

This alternative removes the Cashes Ledge groundfish closed area. Portions of the groundfish area not overlapping with habitat area proposals generally contain mud habitat types, which are estimated to be less vulnerable to accumulating adverse effects.

Map 4 – Central GOM Habitat Management Alternative 3



WGS 1984 UTM Zone 19N projection; map updated Sept 12, 2013

2.1.1.2.4 Alternative 4

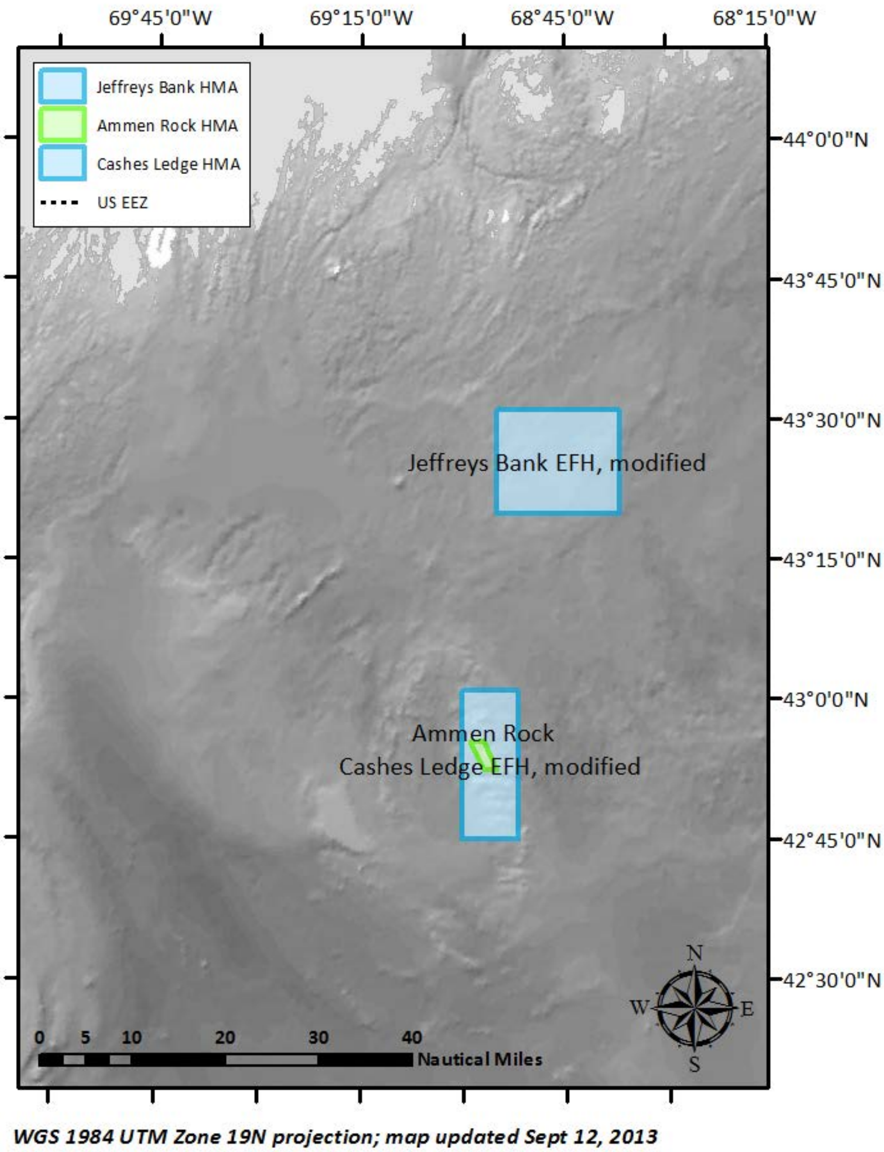
This alternative (Map 5) would modify the boundaries of the current Jeffreys Bank and Cashes Ledge habitat closures, and designate a new habitat management area on Ammen Rock. The Ammen Rock area would be closed to all fishing gears and activities except for lobster trapping. Measures for the modified Jeffreys Bank and Cashes Ledge areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: This alternative includes a subset of the areas proposed via alternative 3, and would not designate the Platts Bank and Fippennies Ledge Habitat Management Areas. This alternative would minimize adverse effects to EFH within some parts of the central GOM region, allowing fishing on other features including Platts Bank and Cashes Ledge. This alternative removes the Cashes Ledge groundfish closed area, since many portions of that area not overlapping with habitat area proposals consist of mud habitat types estimated to be less vulnerable to accumulating adverse effects.

Map 5 – Central GOM Habitat Management Alternative 4



2.1.1.3 *Western GOM*

The habitat management alternatives for the western Gulf of Maine region include various combinations of six areas: Western Gulf of Maine Habitat Closure Area (no action), Western Gulf of Maine Groundfish Closed Area (no action), Jeffreys Ledge HMA, Small Stellwagen HMA, Large Stellwagen HMA, Small Bigelow Bight HMA, and Large Bigelow Bight HMA.

Table 6 – Coordinates for habitat management areas in the western Gulf of Maine

Western Gulf of Maine Habitat Closure Area		
Point	N Latitude	W Longitude
WGM4	43° 15’	70° 15’

WGM1	42° 15’	70° 15’
WGM5	42° 15’	70° 00’
WGM6	43° 15’	70° 15’
Western Gulf of Maine Groundfish Closure Area		
Point	N Latitude	W Longitude
WGM1	42°15’	70°15’
WGM2	42°15’	69°55’
WGM3	43°15’	69°55’
WGM4	43°15’	70°15’
Small Stellwagen HMA		
Point	N Latitude	W Longitude
1	42° 38.0’	70° 07.0’
2	42° 31.0’	70° 07.0’
3	42° 31.0’	70° 02.0’
4	42° 15.0’	70° 02.0’
5	42° 15.0’	70° 15.0’
6	42° 38.0’	70° 15.0’
Small Bigelow Bight HMA		
Point	N Latitude	W Longitude
1*	43° 07.1’	70° 24.4’
2	42° 07.1’	70° 21.6’
3	42° 50.9’	70° 21.1’
4*	42° 50.6’	70° 44.6’
5*	42° 57.1’	70° 41.7’
6*	43° 03.4’	70° 35.9’
7*	43° 07.6’	70° 32.7’
Jeffreys Ledge HMA		
Point	N Latitude	W Longitude
1	43° 13.0’	70° 00.0’
2	42° 44.4’	70° 00.0’
3	42° 44.4’	70° 15.0’
4	42° 55.0’	70° 15.0’
5	42° 55.0’	70° 08.0’
6	43° 09.0’	70° 08.0’
7	43° 09.0’	70° 05.0’
8	43° 13.0’	70° 05.0’
Large Stellwagen HMA		
Point	N Latitude	W Longitude
1	42° 15.0’	70° 00.0’
2	42° 15.0’	70° 15.0’
3	42° 45.2’	70° 15.0’
4	42° 46.0’	70° 13.0’
5	42° 46.0’	70° 00.0’
Large Bigelow Bight HMA		

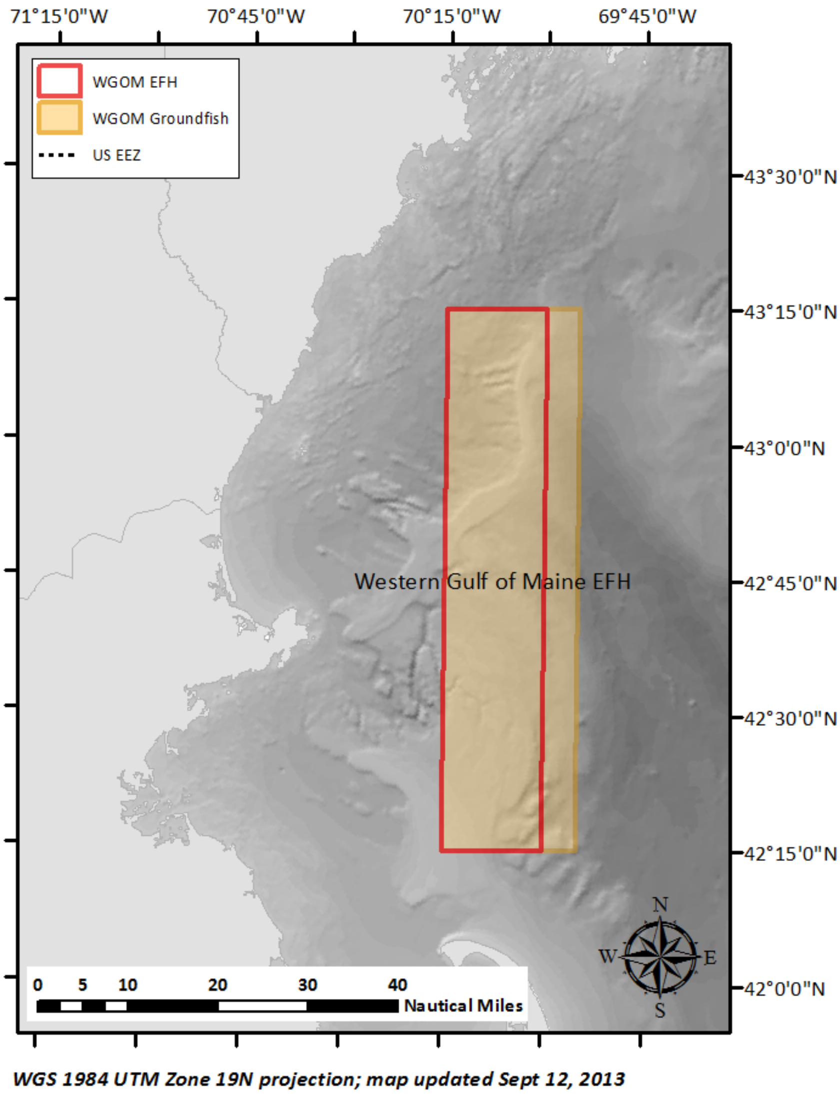
Point	N Latitude	W Longitude
1*	43° 39.2’	69° 45.1’
2	43° 29.1’	69° 45.0’
3	43° 28.9’	70° 07.3’
4	43° 18.1	70° 07.1’
5	43° 18.0’	70° 14.4’
6	43° 07.2’	70° 14.2’
7	43° 07.1’	70° 21.6’
8	42° 50.9’	70° 21.1’
9*	42° 50.6’	70° 44.6’
10*	42° 57.1’	70° 41.7’
11*	43° 03.4’	70° 35.9’
12*	43° 07.2’	70° 33.8’
13*	43° 07.6’	70° 32.7’
14*	43° 09.6’	70° 31.3’
15*	43° 17.3’	70° 29.3’

2.1.1.3.1 Alternative 1 (No Action)

The no action habitat management alternative in the western Gulf of Maine region includes the Western Gulf of Maine habitat closure area. This area was initially implemented via Amendment 13 to the Northeast Multispecies FMP as an area closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The area was subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. This alternative also includes the Western Gulf of Maine groundfish closed area, which was implemented year round in 1998. See Table 9 for information about current restrictions in this area.

Rationale: The habitat closure area and also the groundfish closure area restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the central GOM region.

Map 6 – Western Gulf of Maine Habitat Management Alternative 1 (No Action).



2.1.1.3.2 Alternative 2 (No habitat management areas)

This alternative would remove the current Western Gulf of Maine habitat closure area and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.1.3.3 Alternative 3

This alternative (Map 7) would modify the boundaries of the current WGOM habitat closure to create the Large Stellwagen Habitat Management Area, and designate the Large Bigelow Bight Habitat Management Area. Measures for both of these areas could include:

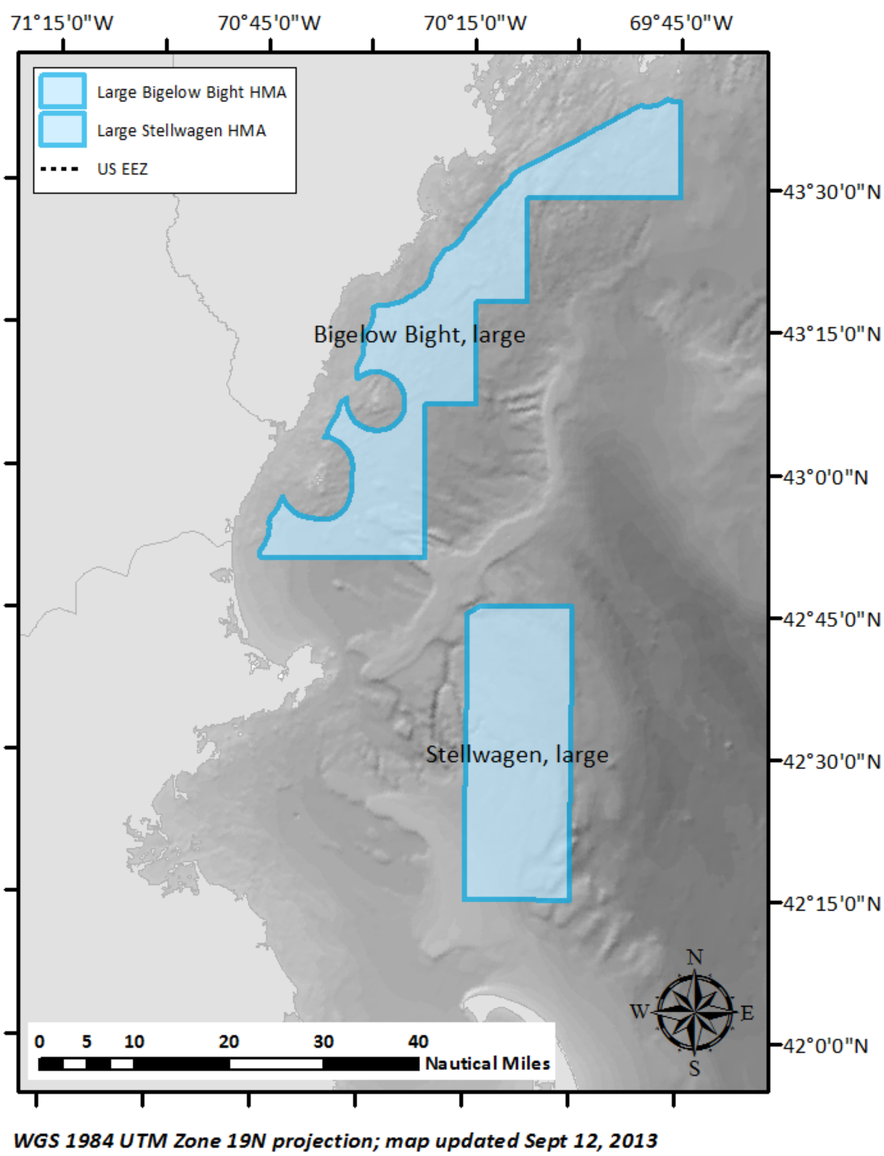
- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western GOM region. The Stellwagen HMA was designed to encompass areas with high-intensity backscatter values from multibeam, which represent coarse sand, gravelly sand, sandy gravel, gravel (including boulder ridges and piles of boulders), and bedrock outcrops (Valentine et al 2005a). Defining a habitat management area in this location and restricting the operation of mobile bottom-tending gears within it would be expected to reduce the accumulation of adverse effects in these particularly vulnerable habitats. The boulder ridges were identified using various types of information including topographic and backscatter data, terrain ruggedness index values, and thousands of video and photographic stations (Valentine et al 2005b). Some of the boulder ridges are quite large, with the largest tens of meters wide and hundreds of meters long, with a maximum height of 18 m (Valentine et al 2005b). The ridges are composed of cobbles and boulders interspersed with voids, and harbor an array of attached organisms as well as various fish species (Valentine et al 2005b, Auster and Lindholm 2005). The SASI vulnerability assessment indicates that cobble and boulder-dominated habitats and their associated geological and biological features have relatively high susceptibility to fishing gear impacts and relatively slow recovery.

The Bigelow Bight area was designed to protect juvenile redfish, alewife, plaice, cod, monkfish, haddock, pout, pollock, red hake, silver hake, white hake, winter flounder, witch flounder, and yellowtail flounder habitats. This alternative includes the Large Stellwagen HMA only and not the Jeffreys Ledge HMA in order to balance the potential economic impacts associated with the larger version of the Bigelow Bight HMA.

Map 7 – Western Gulf of Maine Habitat Management Alternative 3. The Platts Bank areas are not included in this alternative but are shown for reference because they are within the mapped area.



2.1.1.3.4 Alternative 4

This alternative (Map 8) would modify the boundaries of the current WGOM habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Large Bigelow Bight Habitat Management Area. Measures for all three of these areas could include:

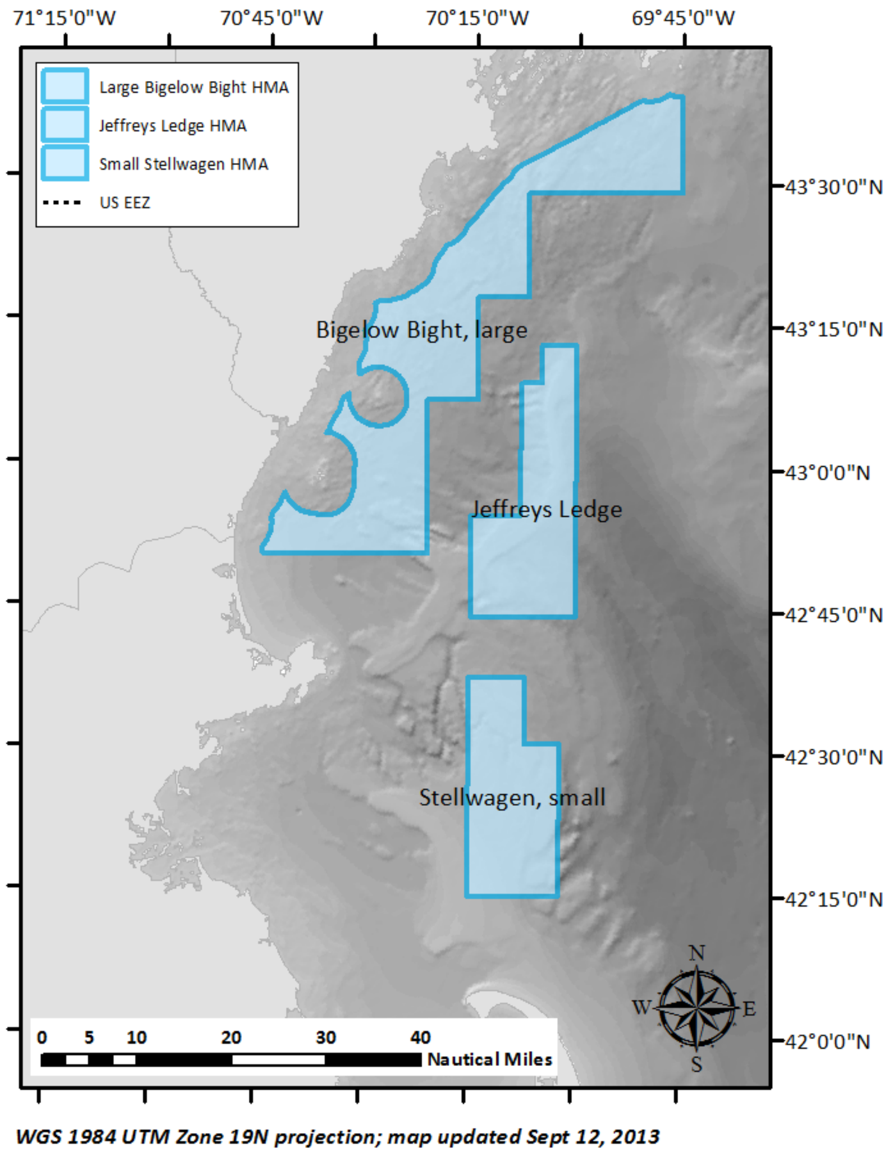
- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or

- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western GOM region. In this alternative, the eastern boundary of the Stellwagen area extends only to the edge of the multibeam sampling area discussed above, not to the current habitat closure boundary, because the existence of vulnerable habitat types is best documented in the areas sampled with multibeam. The northern part of the WGOM habitat area was modified to remove the deeper, muddier habitats in the northwest corner to focus on protection of Jeffreys Ledge itself, which contains complex benthic habitats vulnerable to the impacts of fishing. The Bigelow Bight HMA is as described in Alternative 3.

Map 8 – Western Gulf of Maine Habitat Management Alternative 4.



2.1.1.3.5 Alternative 5

Similar to Alternative 4, this alternative would also modify the boundaries of the current WGOM habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Small Bigelow Bight Habitat Management Area. Measures for all three of these areas could include:

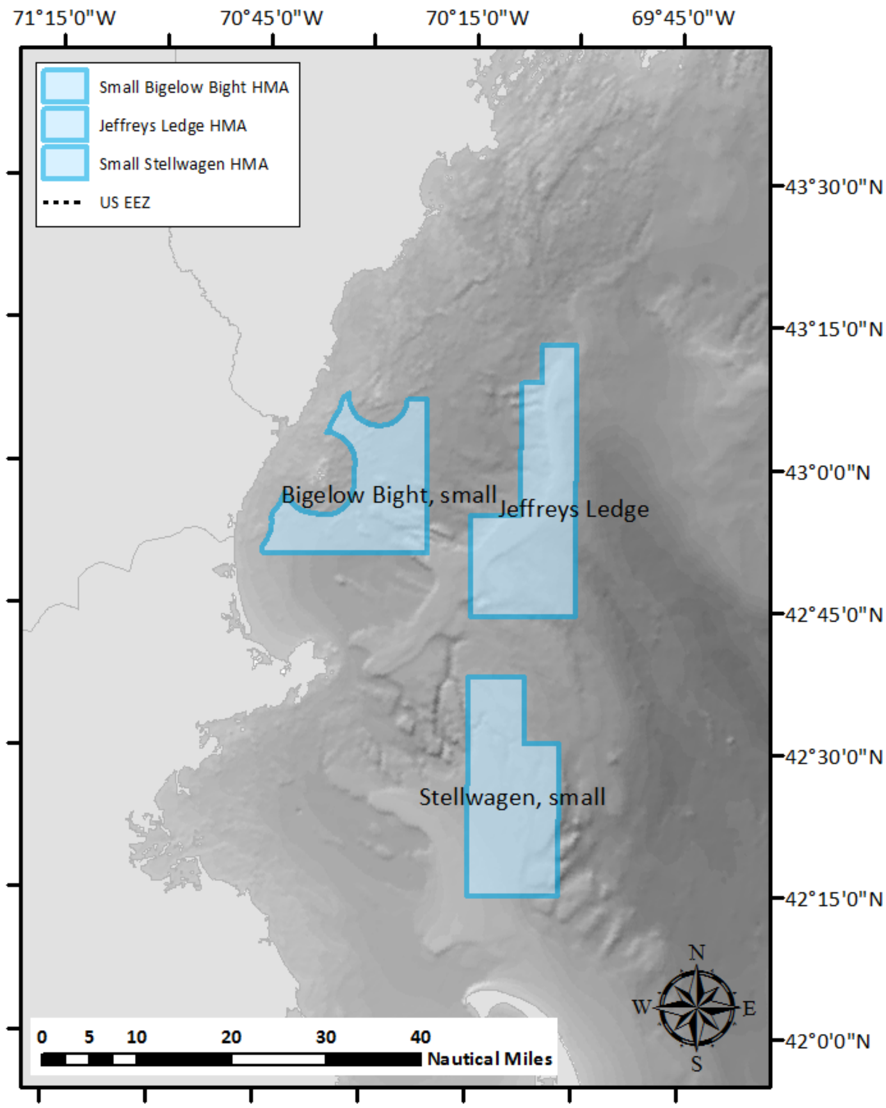
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to all three areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: These areas in combination are intended to reduce the adverse effects of fishing on EFH, including EFH for juvenile groundfish, in the western GOM region. Due to concerns about potential economic impacts associated with the full version of the Bigelow Bight HMA, an alternative, smaller area was developed.

Map 9 – Western Gulf of Maine Habitat Management Alternative 5.



WGS 1984 UTM Zone 19N projection; map updated Sept 12, 2013

2.1.1.3.6 Alternative 6

This alternative (Map 10) would modify the boundaries of the current WGOM habitat closure to create the Large Stellwagen Habitat Management Area. Measures for this area could include:

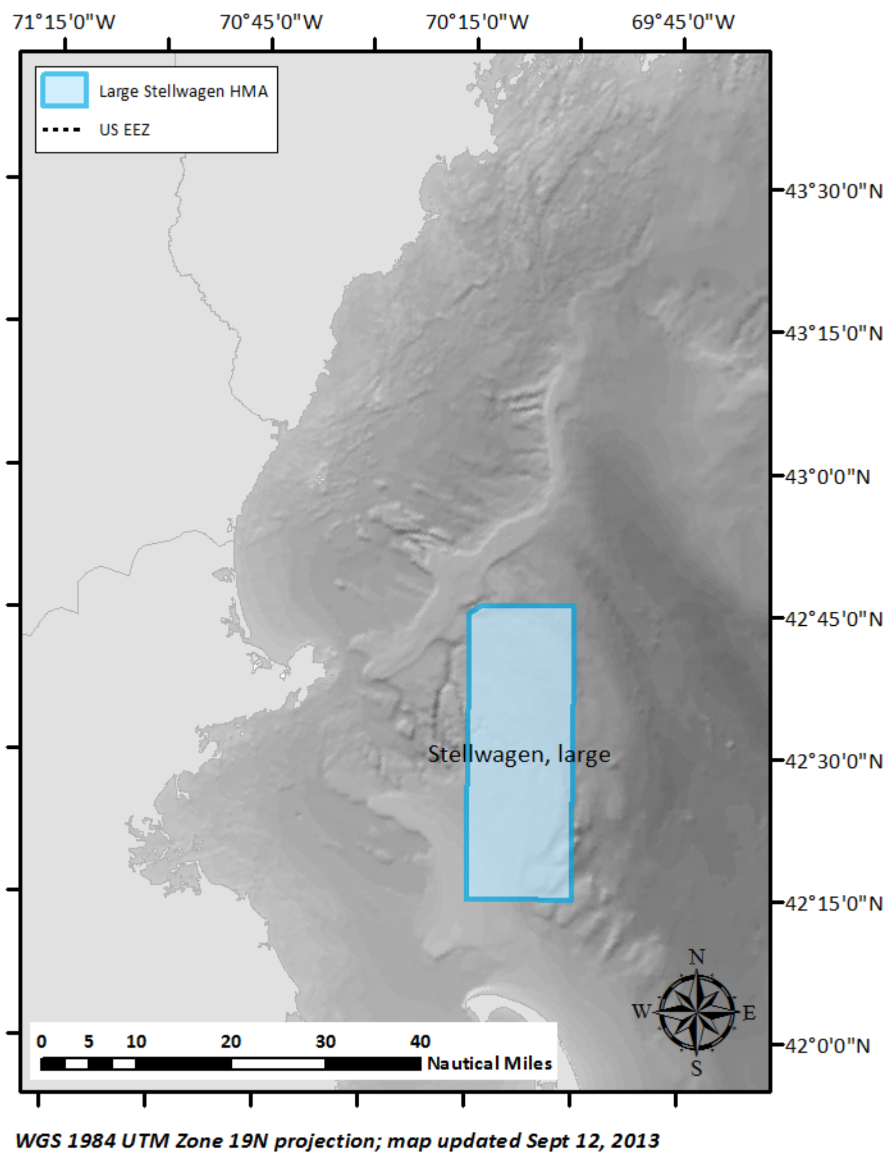
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>

- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: This alternative is a subset of the areas proposed in Alternative 3 and was proposed due to concerns about economic impacts associated with Alternatives 3, 4, and 5. This alternative would minimize adverse effects to EFH within some parts of the western GOM region, but allow fishing in the inshore Bigelow Bight areas and on Jeffreys Ledge.

Map 10 – Western Gulf of Maine Habitat Management Alternative 6.



2.1.1.3.7 Alternative 7

Alternative 7 would implement roller gear size restrictions as a habitat management measure in the WGOM. This alternative can be implemented in addition to any of the other six alternatives.

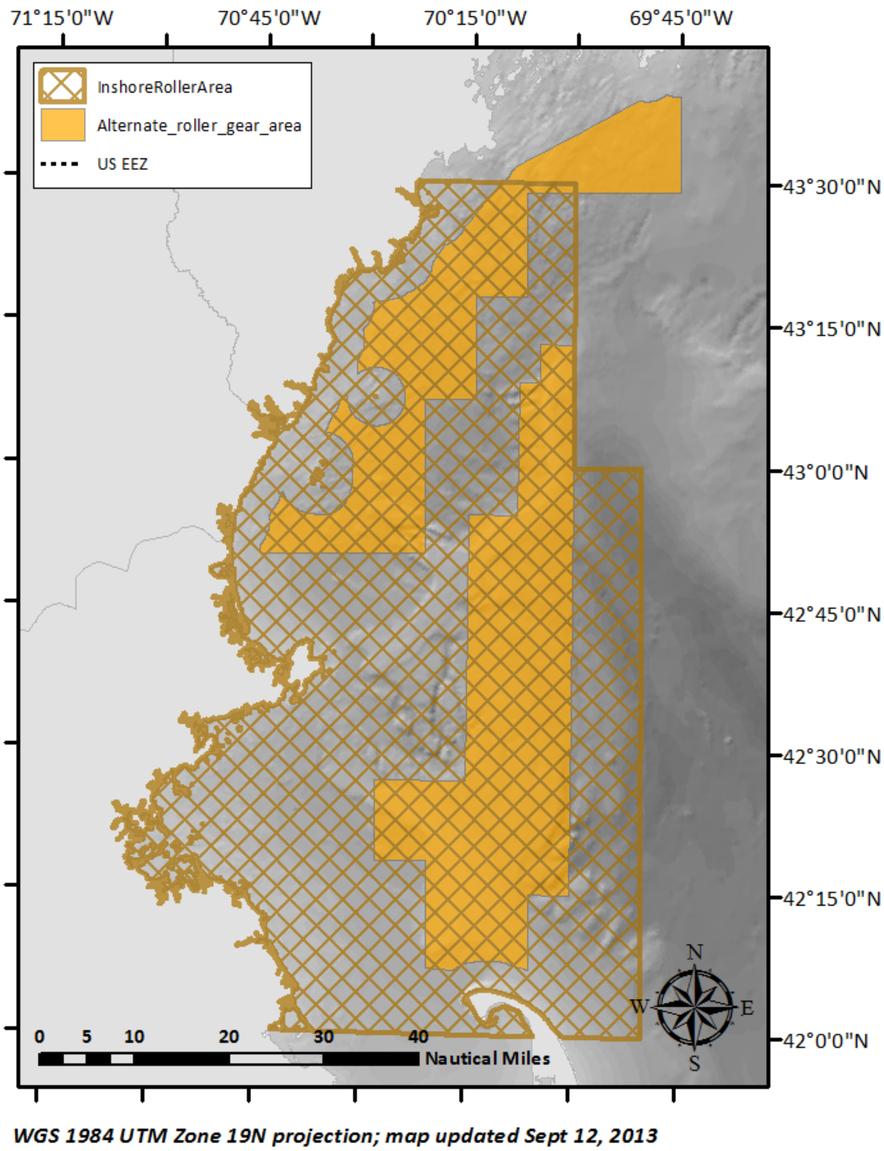
Option 1 would define the current Inshore Roller Gear Restricted Area, which limits trawl roller gear to a maximum diameter of 12 inches, as a habitat management measure.

Option 2 would apply this same restriction to a different set of areas representing the maximum extent of all habitat management areas proposed at the June 2013 Habitat/Groundfish Committee meeting. Both sets of areas are depicted on Map 11.

Because the focus here is on minimizing the adverse effects of fishing on seabed habitats, the roller gear size limit would apply to all bottom trawl gears, even though the current Inshore Roller Gear Restricted Area regulations are limited to vessels fishing on a NE multispecies day-at-sea or sector trip. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: When it was implemented via Framework Adjustment 27 to the NE Multispecies FMP, the Council discussed the inshore roller gear restriction as limiting trawl activity over complex habitat types, although the measure was primarily discussed as a mechanism for reducing mortality on GOM cod. Option 1 would designate this restriction as an adverse effects minimization measure. Option 2 would implement the roller gear restriction as a habitat management measure within all of the WGOM areas identified for adverse effects minimization or juvenile groundfish habitat protection.

Map 11 – Western Gulf of Maine Habitat Management Alternative 7. Existing area option (hatched) and alternate area option (shaded) roller gear areas that could be implemented as habitat management measures in combination with any of the other WGOM alternatives.



2.1.2 Georges Bank and Southern New England

2.1.2.1 *Georges Bank*

The habitat management alternatives for the Georges Bank region include various combinations of seven areas: Closed Area II Habitat Closure Area (no action), Closed Area I N Habitat Closure Area (no action), Closed Area I S Habitat Closure Area (no action), Northern Edge HMA, Closed Area II Groundfish Closed Area (no action), Closed Area I Groundfish Closed Area (no action), Georges Shoal MBTG HMA, Small Georges Shoal Gear Modification Area, Large Georges Shoal Gear Modification Area.

Table 7 – Coordinates for habitat management areas on Georges Bank

Closed Area II Habitat Closure Area		
Point	N Latitude	W Longitude
CIIH1	42° 10’	67° 20’
CIIH2	42° 10’	67° 09.3’
CIIH3	42° 00’	67° 0.5’
CIIH4	42° 00’	67° 10’
CIIH5	41° 50’	67°10’
CIIH6	41° 50’	67° 20’
Closed Area I Habitat Closure Area N		
Point	N Latitude	W Longitude
CI1	41° 30’	69° 23’
CI4	41° 30’	68° 30’
CIH1	41° 26’	68° 30’
CIH2	41° 04’	69° 01’
Closed Area I Habitat Closure Area S		
Point	N Latitude	W Longitude
CIH3	40° 55’	68° 53’
CIH4	40° 58’	68° 30’
CI3	40° 45’	68° 30’
CI2	40° 45’	68° 45’
Closed Area I Groundfish Closure Area		
Point	N. Lat.	W. Long.
CI1	41˚ 30'	69˚ 23'
CI2	40˚ 45'	68˚ 45'
CI3	40˚ 45'	68˚ 30'
CI4	41˚ 30'	68˚ 30'
Closed Area II Groundfish Closure Area		
Point	N. Lat.	W. Long.
CII1	41˚ 00'	67˚ 20'
CII2	41˚ 00'	66˚ 35.8' (1)
G5	41˚ 18.6'	66˚ 24.8' (1)
CII3	42˚ 22'	67˚ 20'
(1) US – Canada maritime boundary		
Northern Edge HMA		
Point	N Latitude	W Longitude
1	42° 12.3’	67° 11.4’
2	42° 00.0’	67° 00.5’
3	42° 00.0’	67° 16.8’
4	42° 09.6’	67° 25.8’
5	42° 11.3’	67° 20.0’
6	42° 12.2’	67° 15.2’
Small Georges Shoal Gear Mod HMA		

Point	N Latitude	W Longitude
1	42° 40.0’	67° 20.0’
2	41° 40.0’	67° 56.0’
3	41° 56.0’	67° 56.0’
4	41° 56.0’	67° 39.7’
Large Georges Shoal Gear Mod HMA		
Point	N Latitude	W Longitude
1	41° 30.1’	66° 34.9’
2	41° 30.0’	68° 10.0’
3	41° 55.1’	68° 09.9’
4	42° 10.3’	67° 09.7’
Georges Shoal MBTG HMA		
Point	N Latitude	W Longitude
1	41° 30.0’	67° 20.0’
2	41° 30.0’	67° 56.0’
3	41° 40.0’	67° 56.0’
4	42° 40.0’	67° 20.0’

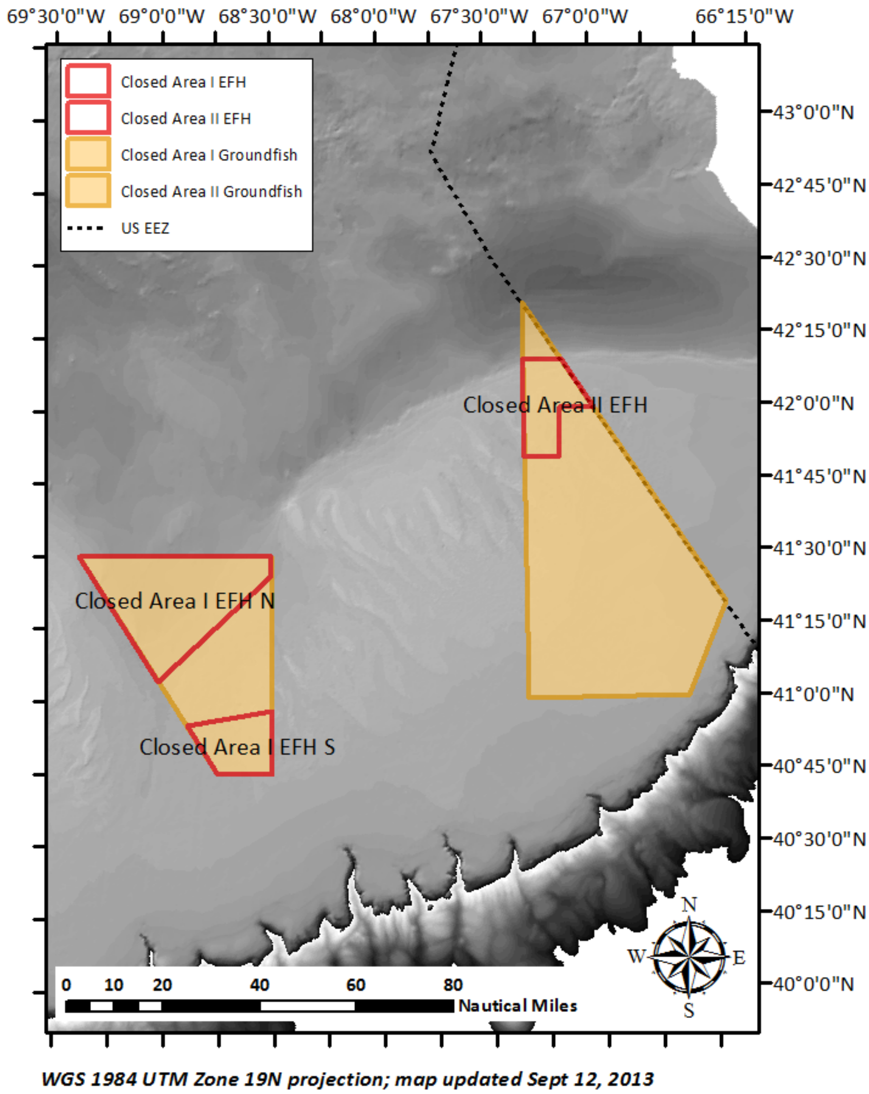
2.1.2.1.1 Alternative 1 (No Action)

The no action habitat management alternative in the Georges Bank region (Map 12) includes the Closed Area I and Closed Area II habitat closure areas. These areas were initially implemented via Amendment 13 to the Northeast Multispecies FMP as areas closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The same areas were subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. Note that between the implementation of Scallop Amendment 10 in 2004 and Amendment 15, a slightly different set of scallop EFH closures was in effect. Also note that the CAII habitat closure area was designated first as a Habitat Area of Particular Concern, a designation which carries no restrictions on fishing.

This alternative also includes the CAI and CAII groundfish closures, which were implemented year round in their present configuration in 1994. See Table 12 for information about current restrictions in these areas.

Rationale: The habitat closure areas, and also the groundfish closure areas, restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the Georges Bank region. Note that some types of mobile gears are currently exempted from some portions of the groundfish closures.

Map 12 – Georges Bank Habitat Management Alternative 1 (No Action)



2.1.2.1.2 Alternative 2 (No habitat management areas)

This alternative would remove the current CAI and CAII habitat closure areas and would not designate any additional habitat management areas in the region. This alternative would not affect the HAPC designation.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.2.1.3 Alternative 3

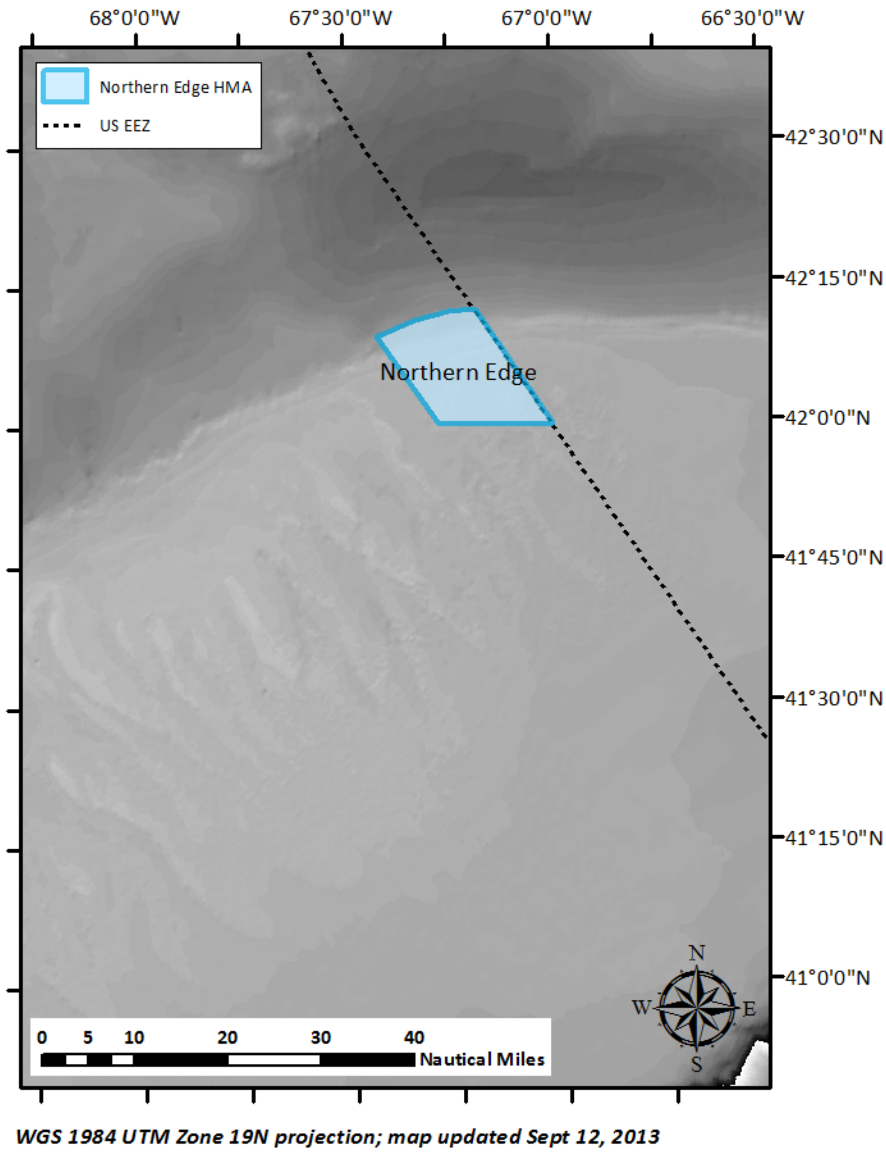
This alternative (Map 13) would remove the current CAI habitat closure areas and would modify the CAII habitat closure to create the Northern Edge Habitat Management Area, and implement it in all NEFMC FMPs. Measures for the Northern Edge area could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The Northern Edge HMA encompasses cobble habitats with associated epifauna that are vulnerable to the adverse effects of fishing, so designation of this area would minimize the adverse effects of fishing on EFH. The area and adjacent areas were identified in the LISA cluster analysis. The northern, deeper part of the area contains juvenile haddock and cod habitats, although high cod catches per tow in the area are more historic than recent. Thus, protection would be expected to increase productivity of these stocks. The proposed area is smaller than the current CAII habitat closure area and shifted to the north, so it could provide increased fishery access for the scallop fishery, if the CAII groundfish area is converted to a seasonal spawning area only.

Map 13 – Georges Bank Habitat Management Alternative 3.



2.1.2.1.4 Alternative 4

This alternative (Map 14) would remove the current CAI habitat closure areas from the multispecies and sea scallop regulations and would modify the CAII habitat closure to create the Northern Edge Habitat Management Area, and implement it in all NEFMC FMPs. Measures for the Northern Edge area could include:

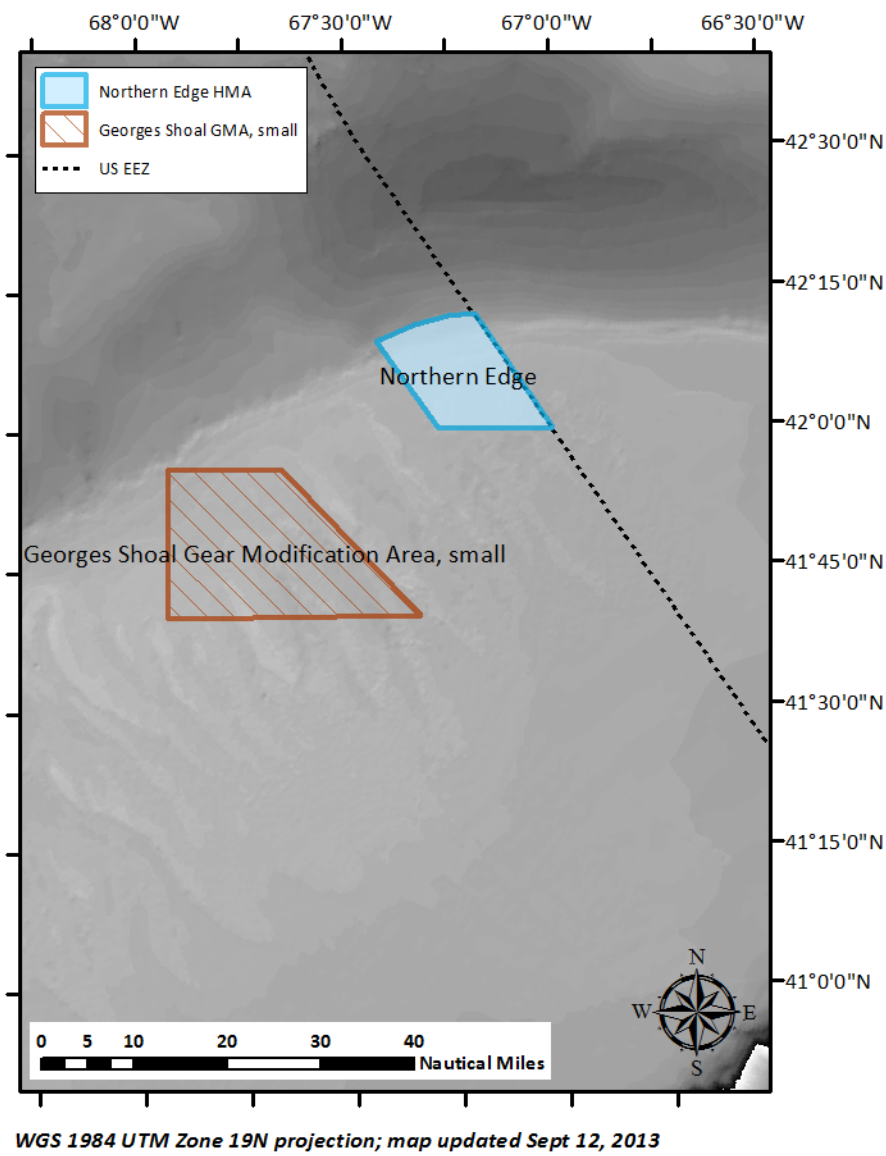
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

In addition, this alternative would establish the Small Georges Shoal Gear Modification Area (GMA), which would mandate either the no ground cable or the raised ground cable trawl gear restrictions (Options 3 and 4, above). The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The Northern Edge HMA is discussed above. The Small Georges Shoal GMA could provide additional habitat benefits via reduced area swept by requiring modified ground cables, although the size of this benefit would depend on tradeoffs between decreased catch rates and increased fishing time when using the modified gear.

Map 14 – Georges Bank Habitat Management Alternative 4. The hatched Georges Shoal GMA is only being considered for ground cable modifications.



2.1.2.1.5 Alternative 5

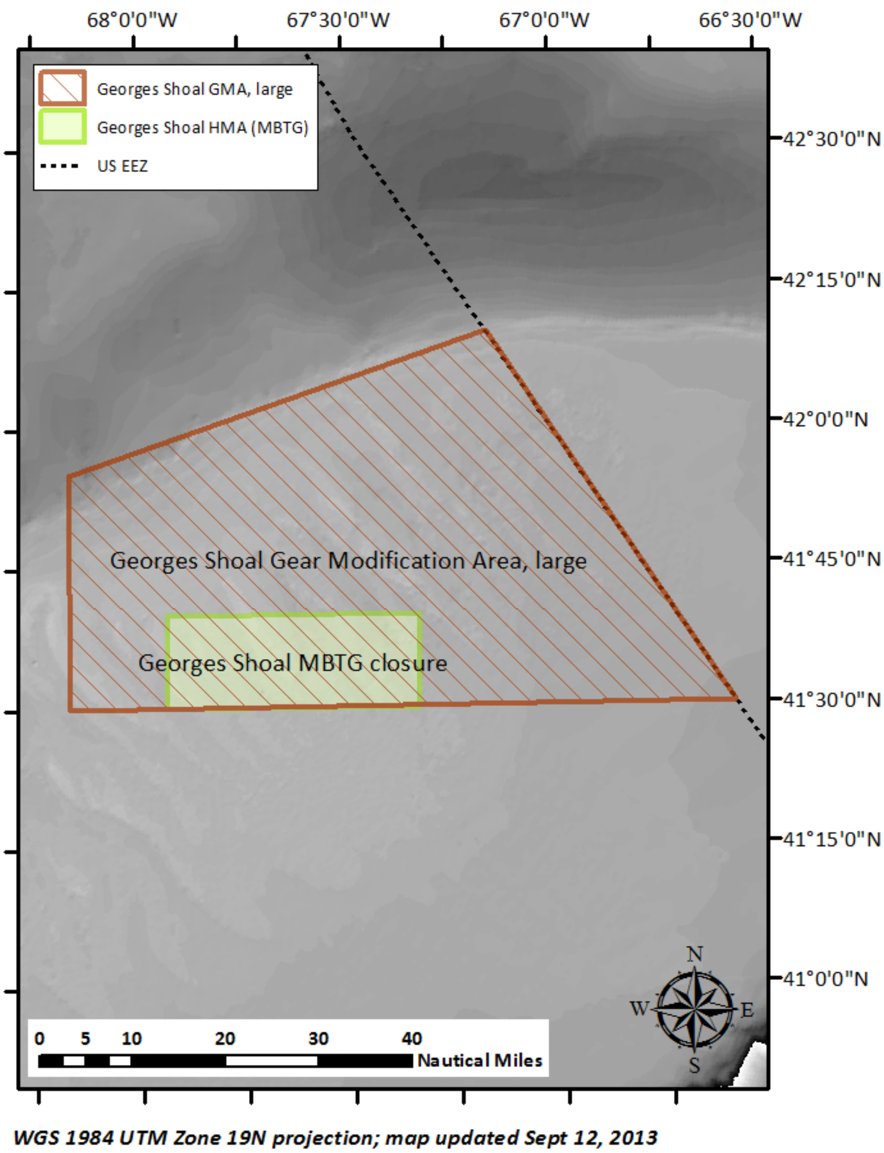
This alternative (Map 15) would remove the current CAI and CAII habitat closure areas from the multispecies and sea scallop regulations. This alternative would establish the Georges Shoal mobile-bottom tending gear HMA, and close it to mobile bottom-tending gears. In addition, this alternative would establish the Large Georges Shoal Gear Modification Area (GMA), which would mandate either the no ground cable or the raised ground cable trawl gear restrictions:

- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: This alternative does not create a smaller habitat area on the northern edge, and therefore would provide the greatest flexibility in terms of access to fishing grounds, aside from Alternative 2. The larger Georges Shoal GMA could provide habitat benefits via reduced area swept by requiring modified ground cables, but as above, this size of this benefit would depend on tradeoffs between decreased catch rates and increased fishing time when using the modified gear.

Map 15 – Georges Bank Habitat Management Alternative 5. The hatched Georges Shoal GMA is only being considered for ground cable modifications, while the Georges Shoal HMA shown in green is only being considered as a mobile bottom-tending gear closure.



2.1.2.2 *Great South Channel and Southern New England*

The habitat management alternatives for the Great South Channel and Southern New England region include various combinations of seven areas: Nantucket Lightship Habitat Closure Area (no action), Great South Channel HMA, Extended Great South Channel HMA, Great South Channel Gear Modification Area, Nantucket Shoals HMA, Extended Nantucket Shoals HMA, and the Cox Ledge HMA (which is comprised of two sub-areas that would be implemented together).

Table 8 – Coordinates for habitat management areas in the Great South Channel and Southern New England

Nantucket Lightship Habitat Closure Area		
Point	N Latitude	W Longitude
NLH1	41° 10′	70° 00′
NLH2	41° 10′	69° 50′
NLH3	40° 50′	69° 30′
NLH4	40° 20′	69° 30′
NLH5	40° 20′	70° 00′
Nantucket Lightship Groundfish Closure Area		
Point	N. lat.	W. long.
G10	40°50′	69°00′
CN1	40°20′	69°00′
CN2	40°20′	70°20′
CN3	40°50′	70°20′
Great South Channel HMA		
Point	N Latitude	W Longitude
1	41° 30.3′	69° 31.0′
2	41° 0.00′	69° 18.5′
3	41° 51.7′	69° 18.5′
4	41° 51.6′	69° 48.9′
5	41° 30.2′	69° 49.3′
Extended Great South Channel HMA		
Point	N Latitude	W Longitude
1	41° 44.9′	69° 49.5′
2	41° 30.3′	69° 31.0′
3	41° 30.0′	69° 25.2′
4	40° 58.0′	69° 12.9′
5	40° 58.0′	69° 18.5′
6	40° 51.7′	69° 18.5′
7	40° 51.6′	69° 48.9′
Great South Channel Gear Mod HMA		
Point	N Latitude	W Longitude
1	41° 30.0′	69° 23.0′
2	41° 02.9′	69° 00.0′
3	40° 50.0′	69° 00.0′
4	40° 50.0′	69° 30.0′
5	41° 30.0′	69° 30.0′
Nantucket Shoals HMA		
Point	N Latitude	W Longitude
1	41° 30.2′	69° 30.0′
2	40° 51.5′	69° 30.0′
3	40° 51.5′	69° 53.5′
4	41° 30.2′	69° 53.5′

Extended Nantucket Shoals HMA		
Point	N Latitude	W Longitude
1	40° 50.0’	70° 00.0’
2*	41° 11.4’	69° 60.0’
3*	41° 25.7’	69° 60.0’
4*	41° 29.3’	69° 60.0’
5*	41° 29.5’	69° 60.0’
6*	41° 30.2’	69° 57.5’
7	41° 30.0’	69° 30.0’
8	40° 50.0’	69° 30.0’
*State waters boundary		
Cox Ledge HMA 1		
Point	N Latitude	W Longitude
1	41° 05.0’	71° 03.0’
2	41° 00.0’	71° 03.0’
3	41° 00.0’	71° 14.0’
4	41° 05.0’	71° 14.0’
Cox Ledge HMA 2		
Point	Latitude	Longitude
1	41° 12.0’	70° 55.0’
2	41° 07.5’	70° 55.0’
3	40° 07.5’	71° 01.0’
4	41° 12.0’	71° 01.0’

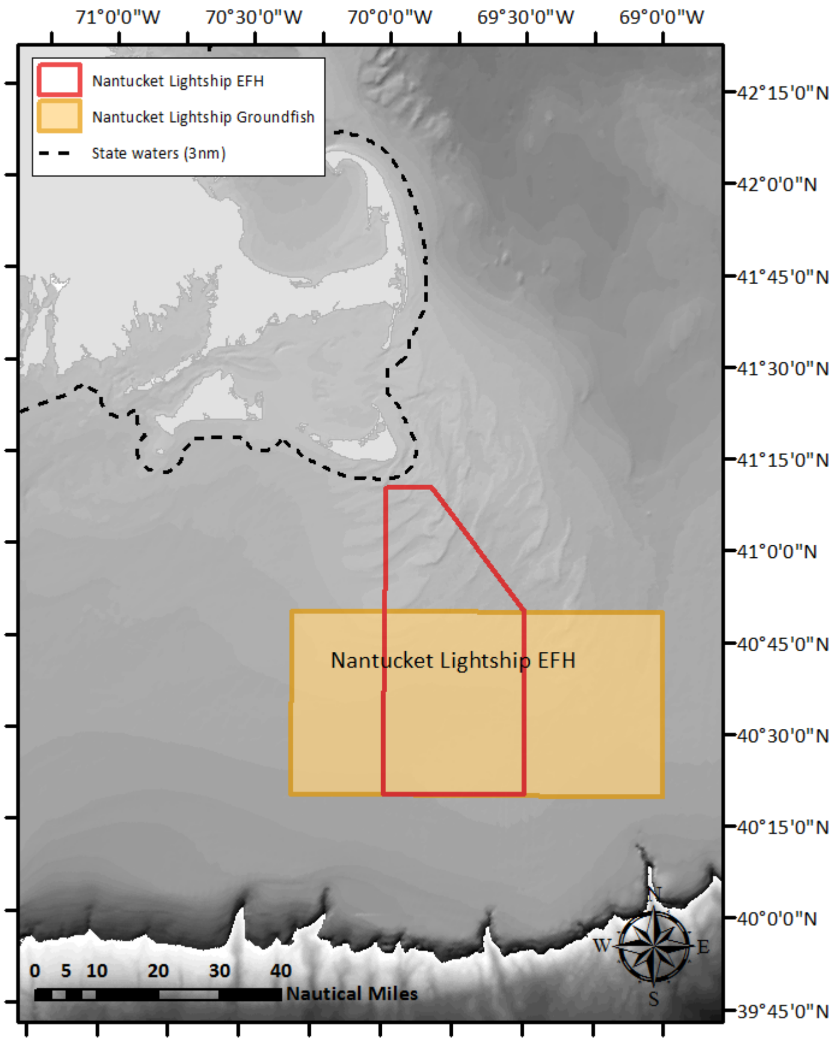
2.1.2.2.1 Alternative 1 (No Action)

The no action habitat management alternative in the Great South Channel/Southern New England region includes the Nantucket Lightship Habitat Closure Area (Map 16). This area was initially implemented via Amendment 13 to the Northeast Multispecies FMP as an area closed to all mobile bottom-tending gears, regardless of the FMP under which that effort was managed. The same areas were subsequently implemented via Atlantic Sea Scallop Amendment 15 as a closure to all vessels fishing for scallops. Note that between the implementation of Scallop Amendment 10 in 2004 and Amendment 15, a slightly different set of scallop EFH closures was in effect.

This alternative also includes the Nantucket Lightship Groundfish Closed Area, which was implemented year round in its current configuration in 1994. See Table 12 for information about current restrictions in this area.

Rationale: The habitat closure areas, and also the groundfish closure areas, restrict various types of fishing, including fishing with mobile gears, which reduce the adverse effects of EFH on the seabed in the Great South Channel/Southern New England region. Note that some types of mobile gears are currently exempted from the groundfish closure.

Map 16 – Great South Channel/SNE Habitat Management Alternative 1 (No Action).



WGS 1984 UTM Zone 19N projection; map updated Sept 12, 2013

2.1.2.2.2 Alternative 2 (No habitat management areas)

This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would not designate any additional habitat management areas in the region.

Rationale: One way to reduce the impact of fishing on the seabed is to minimize area swept by bottom tending gears. The rationale behind this alternative is that eliminating area-based restrictions on fishing activity will enable vessels to optimize fishing efficiency, given limitations imposed by Annual Catch Limits and other restrictions, which should reduce area swept and therefore impacts to the seabed.

2.1.2.2.3 Alternative 3

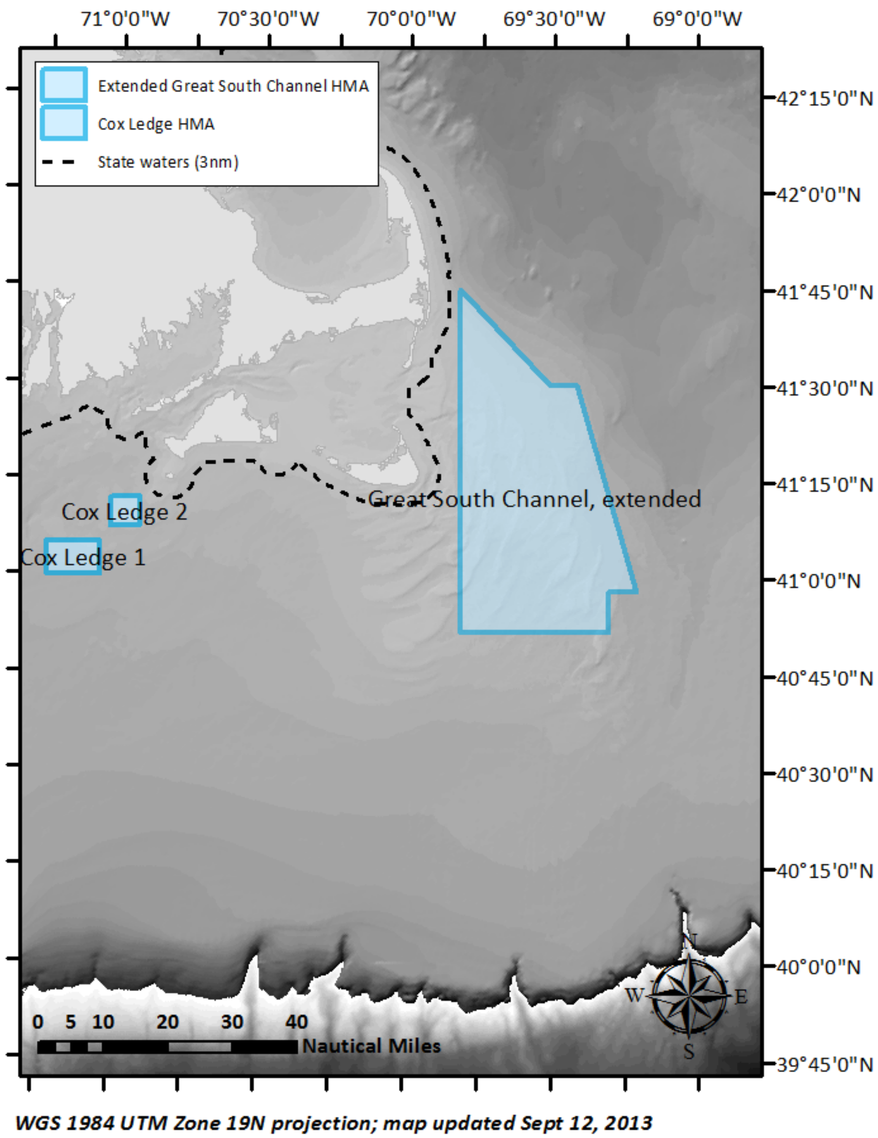
This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel as shown in (Map 17), i.e. the Extended Great South Channel HMA. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Great South Channel and Cox Ledge areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Extended Great South Channel HMA better encompasses cobble- and boulder-dominated habitat types and compared to the existing Nantucket Lightship habitat closure area. This version of the area in particular, which extends the furthest to the east of the any of the HMAs proposed for this region, would provide the best protection for juvenile cod. The central portion of this area was originally suggested by industry and evaluated by the Habitat PDT, which added some of the edge areas to efficiently encompass complex habitats. The easternmost portion was added by the Committee to encompass additional cod habitat. The Cox Ledge areas include vulnerable seabed habitat types.

Map 17 – Great South Channel/SNE Habitat Management Alternative 3.



2.1.2.2.4 Alternative 4

This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north and east in the Great South Channel as shown in (Map 18), which is a subset of the area proposed via Alternative 3. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Great South Channel and Cox Ledge areas could include:

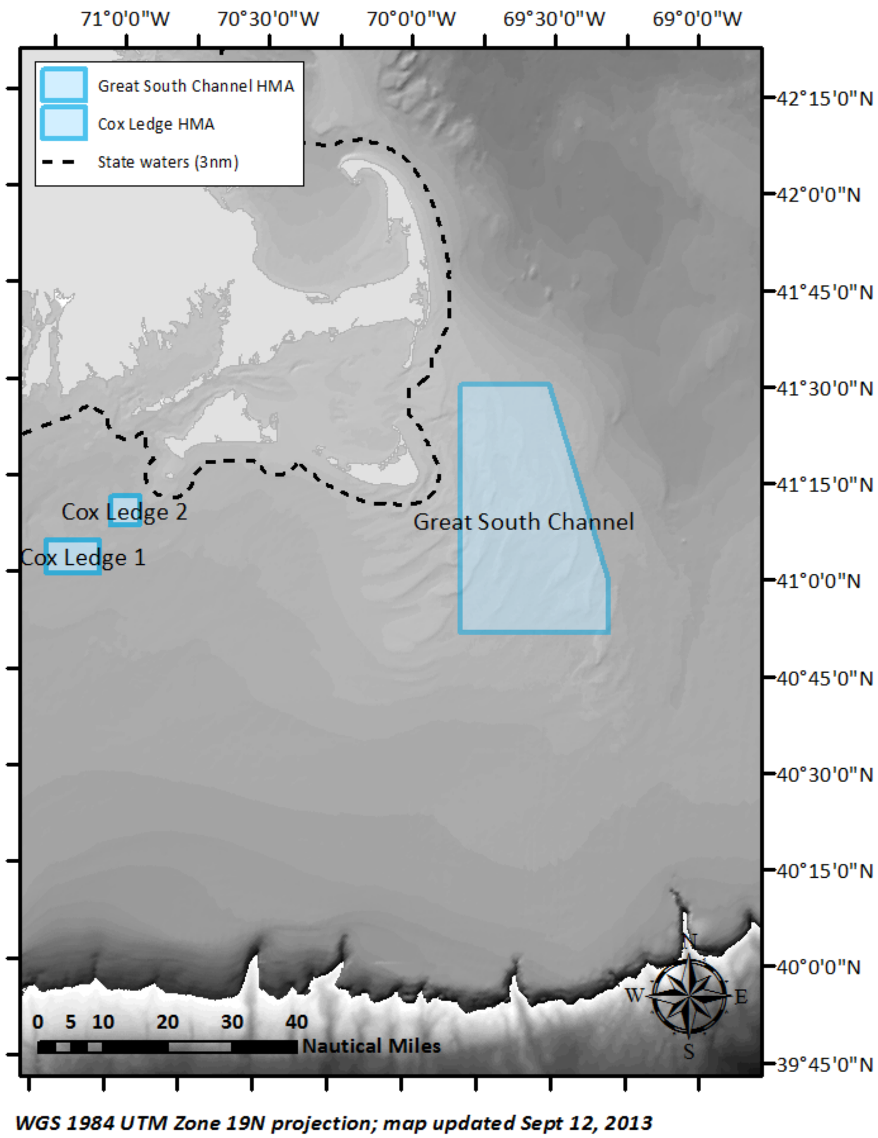
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>

- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Great South Channel area better encompasses cobble- and boulder-dominated habitat types and compared to the existing Nantucket Lightship habitat closure area. This version of the area does not include the northern and eastern portions of the area proposed via Alternative 3, and thus mitigates some concerns raised about fishery access. However, there is much less overlap with juvenile cod. The central portion of this area was originally suggested by industry and evaluated by the Habitat PDT, which added some of the edge areas to efficiently encompass complex habitats. The Cox Ledge areas include vulnerable seabed habitat types.

Map 18 – Great South Channel/SNE Habitat Management Alternative 4.



2.1.2.2.5 Alternative 5

This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals as shown in (Map 19). This Nantucket Shoals area overlaps with the areas proposed via Alternatives 3 and 4, but is generally further to the west. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Nantucket Shoals and Cox Ledge areas could include:

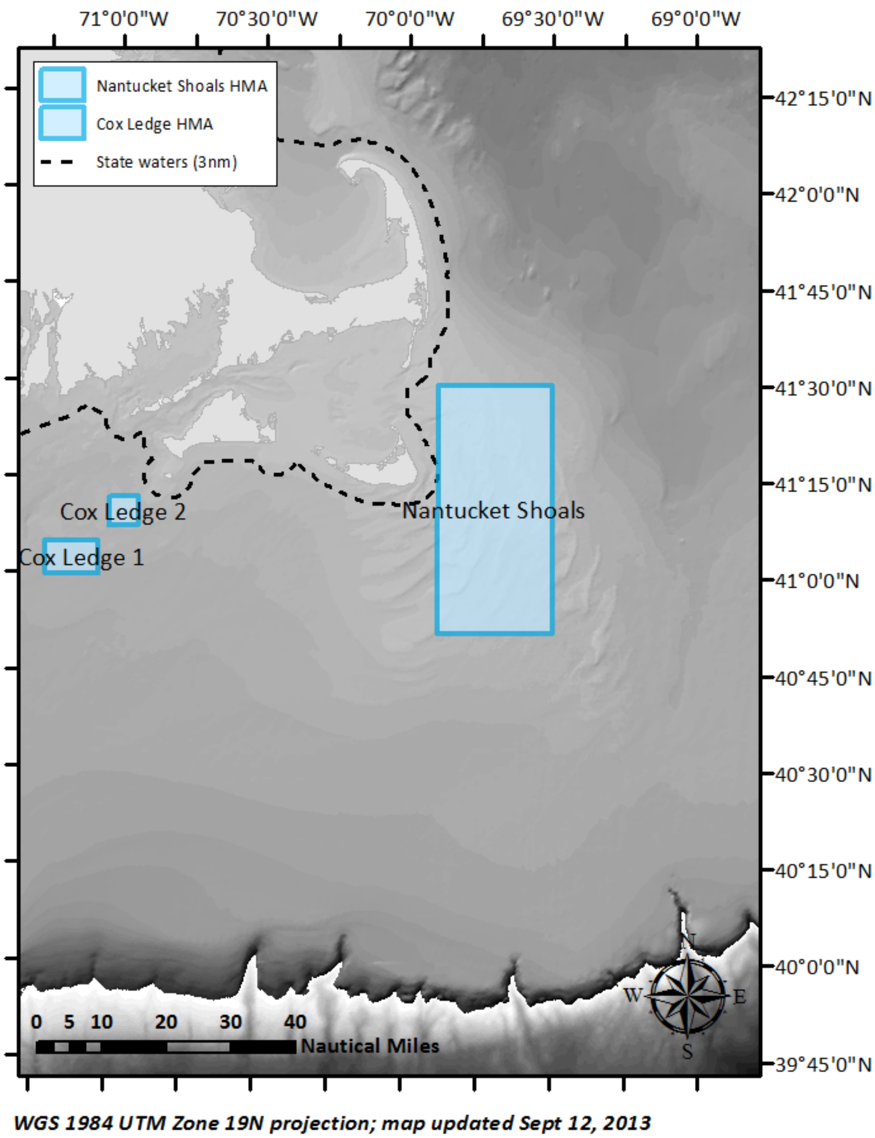
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>

- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, or
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The same management measure need not be applied to both areas. The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The Nantucket Shoals area better encompasses cobble- and boulder-dominated habitat types and compared to the existing Nantucket Lightship habitat closure area, although the western and southern parts are generally sand dominated. This version of the area was suggested by the Committee and developed through discussions with industry, and thus mitigates some concerns raised about fishery access, even as compared to the Great South Channel HMA in Alternative 4. The Cox Ledge areas include vulnerable seabed habitat types.

Map 19 – Great South Channel/SNE Habitat Management Alternative 5.



2.1.2.2.6 Alternative 6

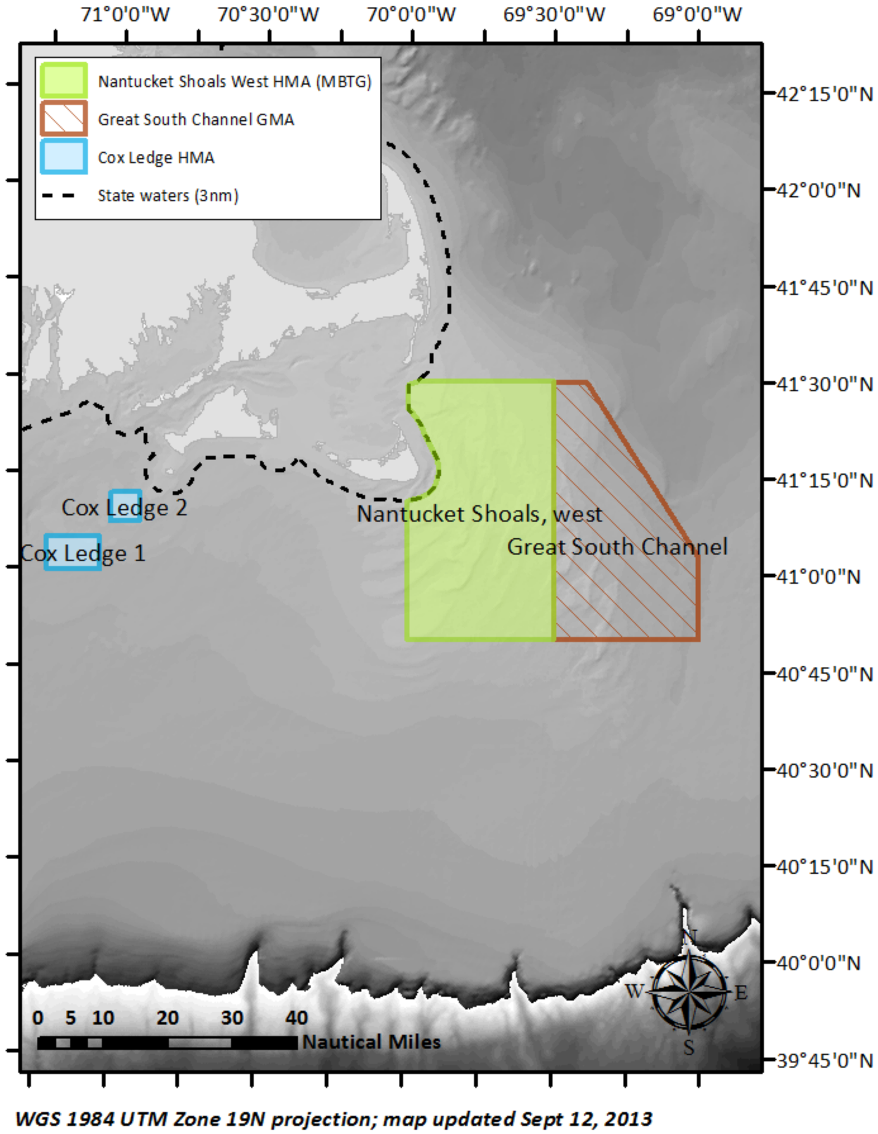
This alternative (Map 20) would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals, which is similar to the area proposed via Alternative 5. This area would be a mobile bottom-tending gear closure (with or without an exemption for hydraulic dredge gears). An additional area further east in the Great South Channel would be designated as a gear modification area, with a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms, or a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. An additional habitat management area (consisting of two sub-areas) would also be designated on Cox Ledge. Measures for the Cox Ledge areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The intent is that fishing restrictions would apply to any fishing activity conducted with the specified gear type, not only to fishing activities managed by NEFMC.

Rationale: The purpose of designating these areas is to minimize adverse fishery effects on EFH. The western area proposed in this alternative is very similar to the Nantucket Shoals area described in Alternative 5, but extends further west to state waters and slightly further south, and is only considered as a closure to mobile bottom-tending gears. Most of these additional areas are likely sand dominated, although they are not especially well sampled from a habitat type or fish distribution standpoint. The eastern area, which includes deeper waters and complex cobble and boulder habitats, would be designated as a gear modification area. As with the Georges Shoal Gear Modification Areas, this area could provide additional habitat benefits via reduced area swept by requiring modified ground cables, although this would depend on tradeoffs between decreased catch rates and increased fishing time. The distribution of juvenile cod in the region overlaps mainly with the eastern gear modification area. The Cox Ledge areas include vulnerable seabed habitat types.

Map 20 – Great South Channel/SNE Habitat Management Alternative 6. The hatched GSC GMA is only being considered for ground cable modifications, while the Nantucket Shoals HMA shown in green is only being considered as a mobile bottom-tending gear closure.



2.2 Alternative to improve groundfish spawning protection

This section describes alternatives designed to meet the following objectives:

- Improved groundfish spawning protection; including protection of localized spawning contingents or sub-populations of stocks
- Improved access to both the use and non-use benefits arising from closed area management across gear types, fisheries, and groups.

These objectives reflect the Council's intent to shift the focus of groundfish area management designations based on mortality reduction to those based on protection of specific attributes that contribute to stock productivity, such as spawning. Similarly, the habitat management spatial alternatives focus in part on protection of habitats that contain concentrations of juvenile groundfish, in order to improve stock productivity.

All of the spawning protection areas described in this section would be defined on a seasonal basis, and the measures focus on limiting the use of gears that are capable of catching groundfish within these areas during the closed seasons, with possible exemptions for recreational groundfish fishing.

2.2.1 Gulf of Maine

2.2.1.1 *Alternative 1 (No Action)*

No Action would retain (1) the Western Gulf of Maine Closure Area and the Cashes Ledge Closure Area, (2) the GOM Rolling Closures Areas that apply to sector and common pool vessels, and (3) the GOM Cod Spawning Protection Area, also known as the Whaleback area (Map 21). Measures for the areas are listed in Table 9, and the coordinates for these areas are listed in Table 10.

Rationale: In addition to the original intended effects related to fishing mortality reduction, these year round and seasonal closures have incidental effects that provide protection for spawning groundfish. The Western Gulf of Maine area was intended to provide incidental protection to spawning cod and haddock in the Gulf of Maine. The Cashes Ledge year round groundfish closed area was intended to provide protection to spawning and resident cod.

Table 9 – Current restrictions in the year round and seasonal closed areas in the Gulf of Maine

Area name	Prohibitions	Exemptions
Western Gulf of Maine and Cashes Ledge Closure Areas	Closed year round to all fishing vessels	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls[1] • Vessels participating in the mid-water trawl exempted fishery
Rolling Closure Areas I-V	Closed to all fishing vessels during the following months: • I – March • II – April* • III – May* • IV – June* • V – October/November *Smaller inshore version is	• Charter and party vessels with a letter of authorization • Vessels fishing with exempted gears: spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, and shrimp trawls • Vessels participating in the mid-water trawl exempted fishery • Vessels fishing under a scallop DAS or in a scallop dredge

[1] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the WGOM and CL groundfish closures

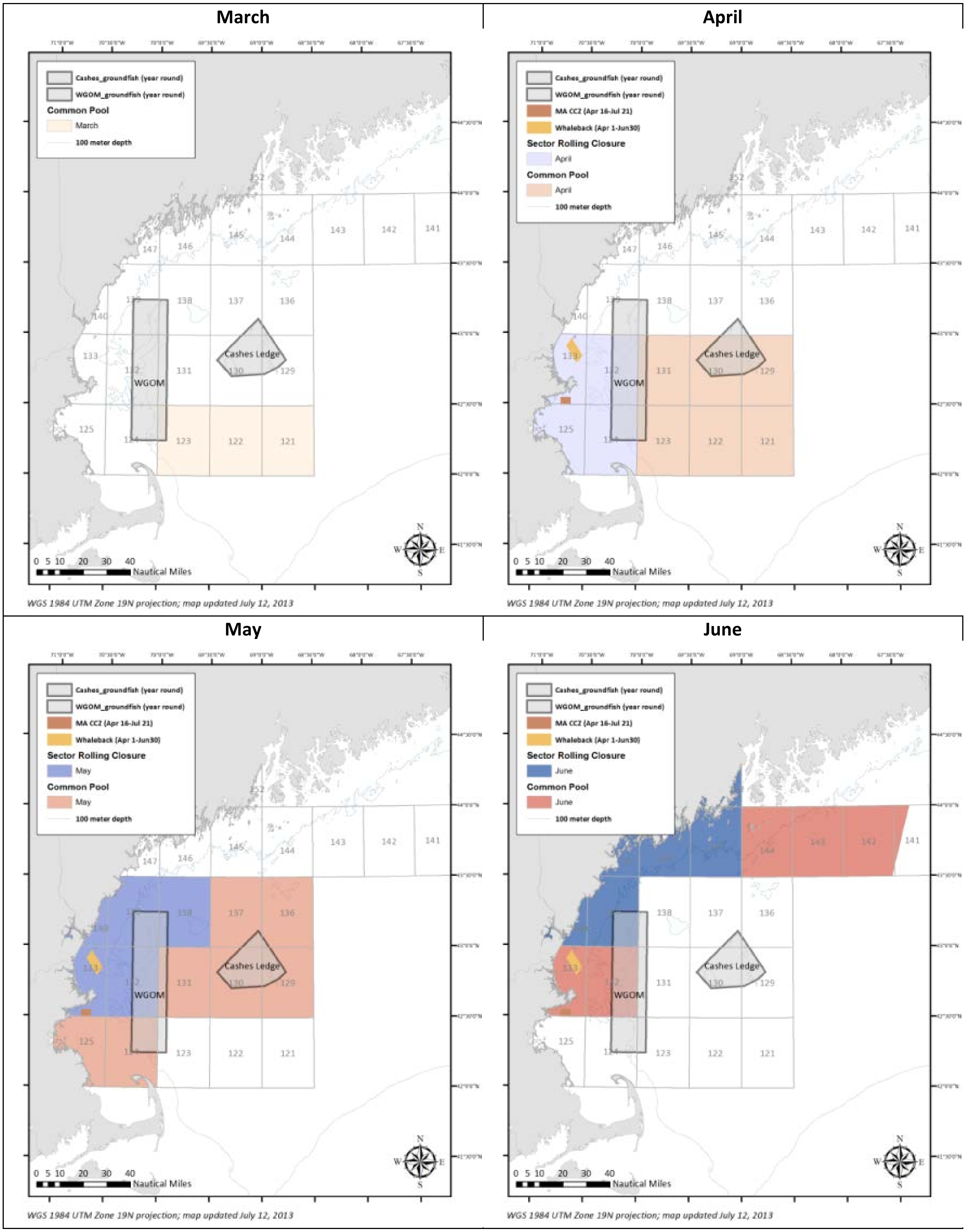
Area name	Prohibitions	Exemptions
	closed to sector vessels	exemption area • Vessels participating in the raised footrope trawl exempted whiting fishery • Sector vessels can fish in areas I and V, and also in the offshore portions of areas II, III, and IV.
GOM Cod Spawning Protection Area	From April through June of each year, no fishing vessel or person on a fishing vessel may enter, fish in, or be in the area, and no fishing gear capable of catching NE multispecies may be used on, or be on board a vessel in the area.	• Vessels that have not been issued a NE multispecies permit and that are fishing exclusively in state waters • Vessels that are fishing with or using exempted gears • Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species (i.e. vessels targeting tuna) • Vessels that are transiting

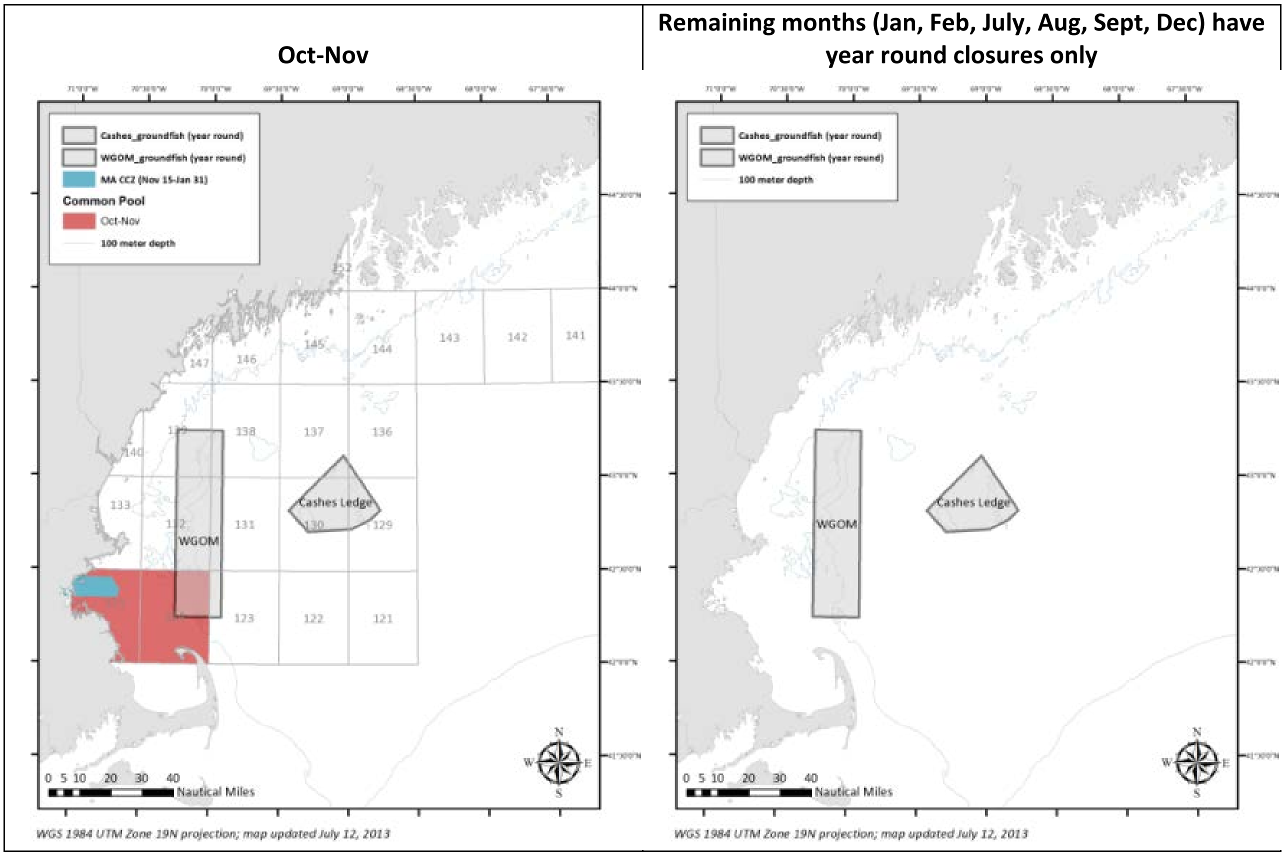
Table 10 – Coordinates for Gulf of Maine year round and seasonal closed areas

Area	Point	Latitude	Longitude
Western Gulf of Maine Closure Area	WGM1	42°15′	70°15′
	WGM2	42°15′	69°55′
	WGM3	43°15′	69°55′
	WGM4	43°15′	70°15′
Cashes Ledge Closure Area	CL1	43°07′	69°02′
	CL2	42°49.5′	68°46′
	CL3	42°46.5′	68°50.5′
	CL4	42°43.5′	68°58.5′
	CL5	42°42.5′	69°17.5′
	CL6	42°49.5′	69°26′
[Common Pool] Rolling closure Area I – March	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM5	42°00′	68°30′
	GM6	42°30′	68°30′
	GM23	42°30′	70°00′
[Common Pool] Rolling closure Area II - April	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM5	42°00′	68°30′
	GM13	43°00′	68°30′
	GM10	43°00′	New Hampshire shoreline
Sector Rolling Closure Area II – April	GM1	42°00′	MA shoreline
	GM2	42°00′	Cape Cod, MA shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod, MA shoreline on the Atlantic Ocean
	SGM1	42°00′	70°00′
	SGM2	43°00′	70°00′
	SGM3	43°00′	New Hampshire shoreline
[Common Pool] Rolling Closure Area III - May	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM4	42°00′	70°00′
	GM23	42°30′	70°00′

	GM6	42°30′	68°30′
	GM14	43°30′	68°30′
	GM18	43°30′	Maine shoreline
Sector Rolling Closure Area III - May	SGM4	42°30′	Massachusetts shoreline
	SGM5	42°30′	70°00′
	SGM6	43°00′	70°00′
	SGM7	43°00′	69°30′
	SGM8	43°30′	69°30′
	GM18	43°30′	Maine shoreline
[Common Pool] Rolling closure Area IV – June	GM9	42°30′	Massachusetts shoreline
	GM23	42°30′	70°00′
	GM17	43°30′	70°00′
	GM19	43°30′	67°32′ or U.S.-Canada maritime boundary
	GM20	44°00′	67°21′ or U.S.-Canada maritime boundary
	GM21	44°00′	69°00′
	GM22	Maine shoreline	69°00′
Sector Rolling Closure Area IV - June	SGM9	43°00′	New Hampshire shoreline
	SGM6	43°00′	70°00′
	SGM10	43°30′	70°00′
	SGM11	43°30′	69°00′
	GM22	Maine shoreline	69°00′
[Common Pool] Rolling closure area V – October and November	GM1	42°00′	Massachusetts shoreline
	GM2	42°00′	Cape Cod shoreline on Cape Cod Bay
	GM3	42°00′	Cape Cod shoreline on the Atlantic Ocean
	GM4	42°00′	70°00′
	GM8	42°30′	70°00′
	GM9	42°30′	Massachusetts shoreline
GOM Cod Spawning Protection Area (April, May, and June)	CSPA1	42°50.95′	70°32.22′
	CSPA2	42°47.65′	70°35.64′
	CSPA3	42°54.91′	70°41.88′
	CSPA4	42°58.27′	70°38.64′
	CSPA1	42°50.95′	70°32.22′

Map 21 – Gulf of Maine Spawning Alternative 1 (No Action)





2.2.1.2 *Alternative 2 Spawning Protection Areas based on Sector Rolling Closures*

This alternative (Map 22) would redesignate the existing rolling closures that currently apply to sector enrolled vessels during April, May, and June as seasonal groundfish spawning protection areas. These closed areas would apply from April to June to all vessels capable of catching groundfish, whether the vessel is in the common pool or enrolled in a sector, with possible exemptions as identified in the options below.

This alternative would also designate the Massachusetts Bay Cod Spawning Protection Area. This area is a subset of the existing October-November common pool rolling closure area, and would be closed from November 1 through January 31 with the same restrictions as the GOM Cod Spawning Protection (Whaleback) Area.

Under this alternative, the March-June common pool rolling closures would be eliminated. The Western Gulf of Maine and the Cashes Ledge groundfish closed areas would be eliminated unless maintained for habitat protection purposes. Overlapping habitat management areas for this region are proposed in sections 2.1.1.2 and 2.1.1.3. The GOM Cod Spawning Protection (Whaleback) Area would be maintained as is.

Two options are proposed; Option A would exempt recreational groundfish fishing from the April, May, and June closures, while Option B would restrict recreational fishing for groundfish in these areas.

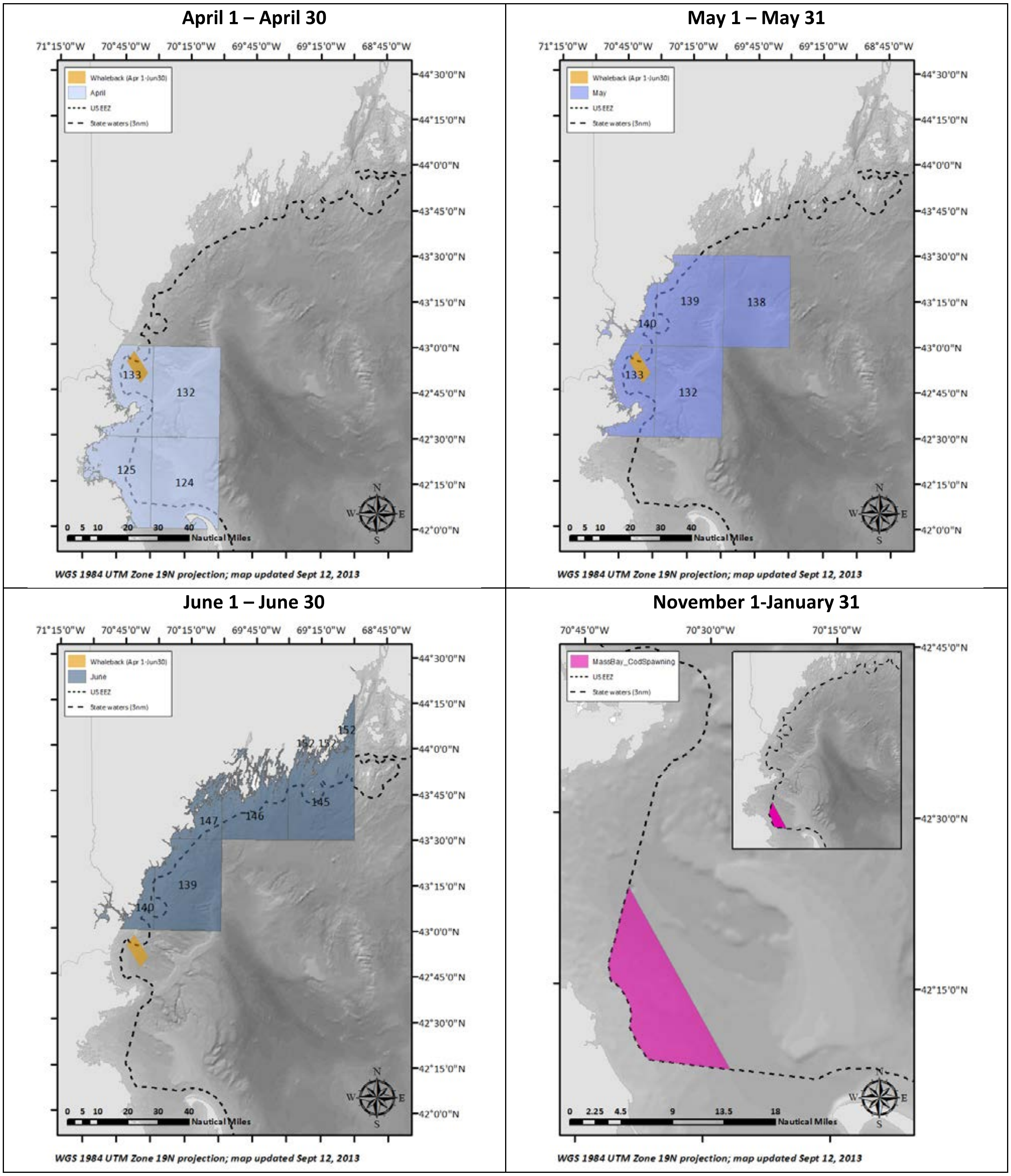
Rationale: New science and published research show a large degree of overlap between the sector rolling closures and groundfish spawning, particularly for cod and haddock. The Council had anticipated developing more precise spawning closure areas based on these data and analyses, but rejected novel area closure boundaries in favor of using a modification of the existing system of areas to meet spawning objectives in the Gulf of Maine. The rolling closures largely overlap identified concentrations of large groundfish and are appear to be sufficiently broad to capture variability in the timing and geographical range of annual spawning activity.

The Massachusetts Bay Cod Spawning Protection Area would protect known aggregations of winter spawning cod, in order to improve productivity of the GOM cod stock.

Table 11 – Coordinates for proposed Gulf of Maine groundfish spawning protection areas. The April, May, and June coordinates are identical to the existing coordinates to seasonal rolling closures that apply to sector-enrolled groundfish vessels.

	April 1 – April 30		May 1 – May 31		June 1 – June 30		Nov. 1 – Jan. 31 (6)	
Point	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
1	42˚ 00'	(1)	42˚ 30'	(1)	43˚ 00'	(4)	42° 23.6’	70° 39.2’
2	42˚ 00'	(2)	42˚ 30'	70˚ 00’	43˚ 00'	70˚ 00'	42° 07.7’	70° 26.8’
3	42˚ 00'	(3)	43˚ 00'	70˚ 00’	43˚ 30'	70˚ 00'		
4	42˚ 00'	70˚ 00'	43˚ 00'	69˚ 30’	43˚ 30'	69˚ 00’		
5	43˚ 00'	70˚ 00'	43˚ 30'	69˚ 30’	(5)	69˚ 00’		
6	43˚ 00'	(4)	43˚ 30'	(5)				
(1) Massachusetts shoreline								
(2) Cape Cod shoreline on Cape Cod Bay								
(3) Cape Cod shoreline on the Atlantic Ocean								
(4) New Hampshire shoreline								
(5) Maine shoreline								
(6) Western boundary at Massachusetts state waters								

Map 22 – Gulf of Maine Spawning Alternative 2. Shaded areas would be closed seasonally as shown. Note difference in scale on the fourth panel; inset map provided for reference.



2.2.1.2.1 Option A: Areas closed to selected commercial fishing gears capable of catching groundfish, with specified exemptions

The April, May, and June spawning areas identified in this alternative (Map 22) would be sequentially closed for one-month periods to all fishing vessels, with the following exemptions, which are the exemptions currently in effect for the GOM rolling closure areas:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Charter and party vessels[2]
- Recreational vessels
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls (with properly configured grates)
- Vessels participating in the mid-water trawl exempted fishery
- Sea scallop dredge gear when under a scallop day-at-sea
- Vessels lawfully in a scallop dredge exemption area
- Vessels participating in the Raised Footrope Trawl Exempted Whiting Fishery

The smaller November 1 – January 31 spawning area and the Whaleback Area from April – June would be closed to all fishing vessels, with the following exemptions (Note these are the exemptions currently associated with the Whaleback Area):

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species or ocean pout
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates

This option would not preempt or change any overlapping state closures in Massachusetts, New Hampshire, or Maine state waters..

Rationale: More specific concentrations of spawning cod have been identified in Massachusetts Bay and the Whaleback Spawning Protection Area, and cod spawning in these areas would be disrupted if the areas are open to recreational fishing. However, other portions of the rolling closures have cod spawning, but specific areas have not yet been identified and it is not clear that

[2] Charter and party vessels may fish in the GOM RCAs provided they have a Letter of Authorization (LOA) from the Regional Administrator to enter or fish in these areas (additional requirements also apply).

recreational fishing would disturb more widely distributed spawning activity, so recreational fishing would be allowed in the larger April, May, and June closures.

2.2.1.2.2 Option B: Areas closed to selected commercial fishing gears capable of catching groundfish, with specified exemptions, and recreational groundfish fishing

The April, May, and June spawning areas identified in this alternative would be sequentially closed for one-month periods to all fishing vessels, including recreational and charter/party fishing, with the following exemptions:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates
- Vessels participating in the mid-water trawl exempted fishery
- Sea scallop dredge gear when under a scallop day-at-sea
- Vessels lawfully in a scallop dredge exemption area
- Vessels participating in the Raised Footrope Trawl Exempted Whiting Fishery

The smaller November 1 – January 31 spawning area would be closed to all fishing vessels with the following exemptions, which are the exemptions associated with the Whaleback Area:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Charter/party or recreational fishing vessels, provided that pelagic hook and line gear is used, and there is no retention of regulated species or ocean pout
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates

Similar to Option 1, this option would not preempt or change any overlapping state closures in Massachusetts, New Hampshire, or Maine state waters. The GOM Cod Spawning Protection Area (Whaleback Area) (Map 22) would continue to be closed to commercial and recreational fishing vessels between April 1 and June 30

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce.

2.2.2 Georges Bank and Southern New England

2.2.2.1 *Alternative 1 (No Action)*

No Action would retain the existing year round closed areas on Georges Bank and in Southern New England, specifically Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area, and the May Georges Bank Seasonal Closure Area (Map 23). Measures for these areas are summarized in Table 12 and coordinates for these areas are shown in Table 13.

Rationale: In addition to the original intended effects, these year round and seasonal closures have incidental effects that provide protection for spawning groundfish. Closed Area I and Closed Area II in particular were originally designed to protect cod and haddock spawning activity, although year round protection is unnecessary for this purpose.

Table 12 – Restrictions in the year round and seasonal closed areas on Georges Bank and in Southern New England

Area name	Prohibitions	Exemptions
Nantucket Lightship Closure Area	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Classified as charter, party or recreational vessel, provided that: (A) LOA, (B) Fish species managed by the NEFMC or the MAFMC are not sold, (C) no gear other than rod and reel or handline gear on board, (D) vessel does not fish outside the Nantucket Lightship Closed Area during the period specified by the LOA • Fishing with or using dredge gear designed and used to take surfclams or ocean quahogs • Fishing for scallops within the Nantucket Lightship Access Area
Closed Area I	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Tuna purse seine gear; review to ensure no impacts on regulated multispecies • Fishing in a Special Access Program • Fishing for scallops within the Closed Area I Access Area

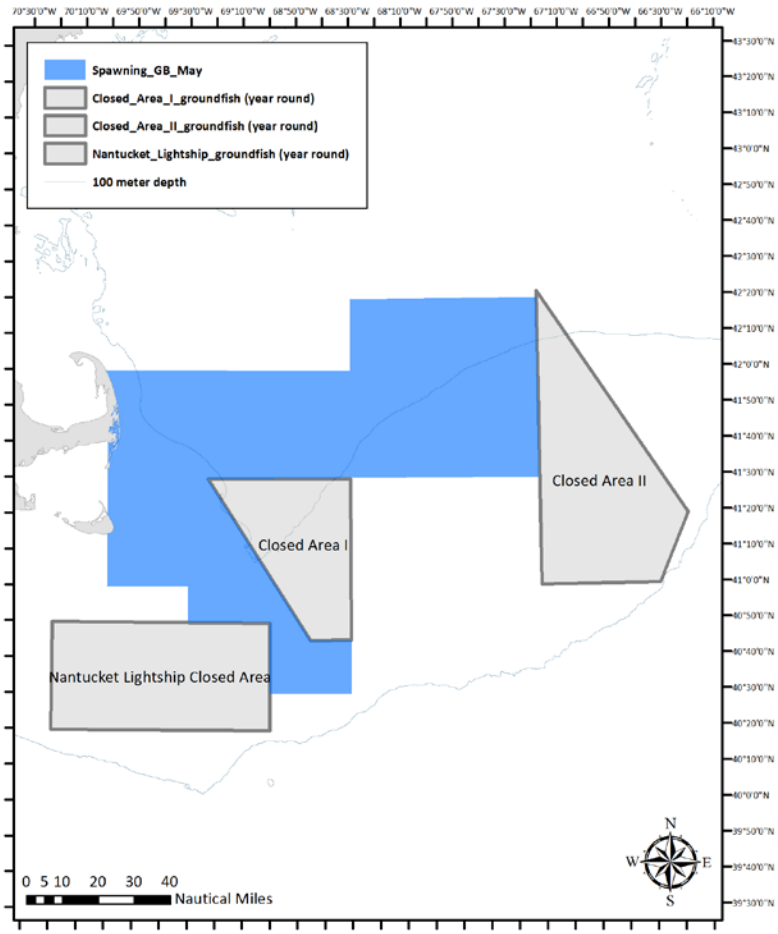
Area name	Prohibitions	Exemptions
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Pot gear for lobsters or hagfish • Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear • Pelagic midwater trawl gear, with bycatch limits • Fishing in a Special Access Program • Tuna purse seine gear outside of the portion of CA II known as the Habitat Area of Particular Concern • Fishing in the CA II Yellowtail Flounder/Haddock SAP or the Eastern U.S./Canada Haddock SAP Program • Transiting the area, provided the vessel's fishing gear is stowed and there is a compelling safety reason • The vessel has declared into the Eastern U.S./Canada Area and is transiting CA II • Fishing for scallops within the Closed Area II Access Area
GB Seasonal Closure	From May 1-May 31, no fishing vessel or person on a fishing vessel may enter, fish, or be in the area	• Exempted gears - spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets pound nets, pots and traps, purse seines, midwater trawls, surfclam/quahog dredge gear, pelagic hook and line, pelagic longline, single pelagic gillnets, shrimp trawls • Charter/party or recreational vessels; • Fishing with dredge gear under a scallop DAS, and provided that the vessel complies with the NE multispecies possession restrictions for scallop vessels, or when lawfully fishing in the Scallop Dredge Fishery Exemption Areas • Fishing in the CA I Hook Gear Haddock Access Area • Fishing under the restrictions and conditions of an approved sector operations plan • Fishing under the provisions of a Northeast multispecies Handgear A or B permit

Table 13 - Latitude and longitude coordinates of areas included in the no action Georges Bank groundfish spawning alternative.

Closed Area I - Year round		
Point	N. Lat.	W. Long.
CI1	41˚ 30'	69˚ 23'
CI2	40˚ 45'	68˚ 45'
CI3	40˚ 45'	68˚ 30'
CI4	41˚ 30'	68˚ 30'
Closed Area II - Year round		
Point	N. Lat.	W. Long.
CII1	41˚ 00'	67˚ 20'
CII2	41˚ 00'	66˚ 35.8' (1)
G5	41˚ 18.6'	66˚ 24.8' (1)
CII3	42˚ 22'	67˚ 20'
Nantucket Lightship Closed Area - Year round		
Point	N. lat.	W. long.
G10	40°50′	69°00′
CN1	40°20′	69°00′
CN2	40°20′	70°20′

CN3	40°50′	70°20′
Georges Bank Seasonal Closure - May 1 – May 31		
Point	N. Lat.	W. Long.
1	42˚ 00'	(2)
2	42˚ 00'	68˚ 30'
3	42˚ 20'	68˚ 30'
4	42˚ 20'	67˚ 20'
5	41˚ 30'	67˚ 20'
6	41˚ 30'	69˚ 23'
7	40˚ 45'	68˚ 45'
8	40˚ 45'	68˚ 30'
9	40˚ 30'	68˚ 30'
10	40˚ 30'	69˚ 00'
11	40˚ 50'	69˚ 00'
12	40˚ 50'	69˚ 30'
13	41˚ 00'	69˚ 30'
14	41˚ 00'	70˚ 00'
15	(2)	70˚ 00'
(1) US – Canada maritime boundary		
(2) Northward to its intersection with the shoreline of Massachusetts		

Map 23 – Georges Bank Spawning Alternative 1 (No Action). Areas are closed year-round (grey) and seasonally (blue) to gears capable of catching groundfish, with various exemptions.



WGS 1984 UTM Zone 19N projection; map updated July 12, 2013

2.2.2.2 *Alternative 2 Spawning Protection Areas using Closed Area I and Closed Area II*

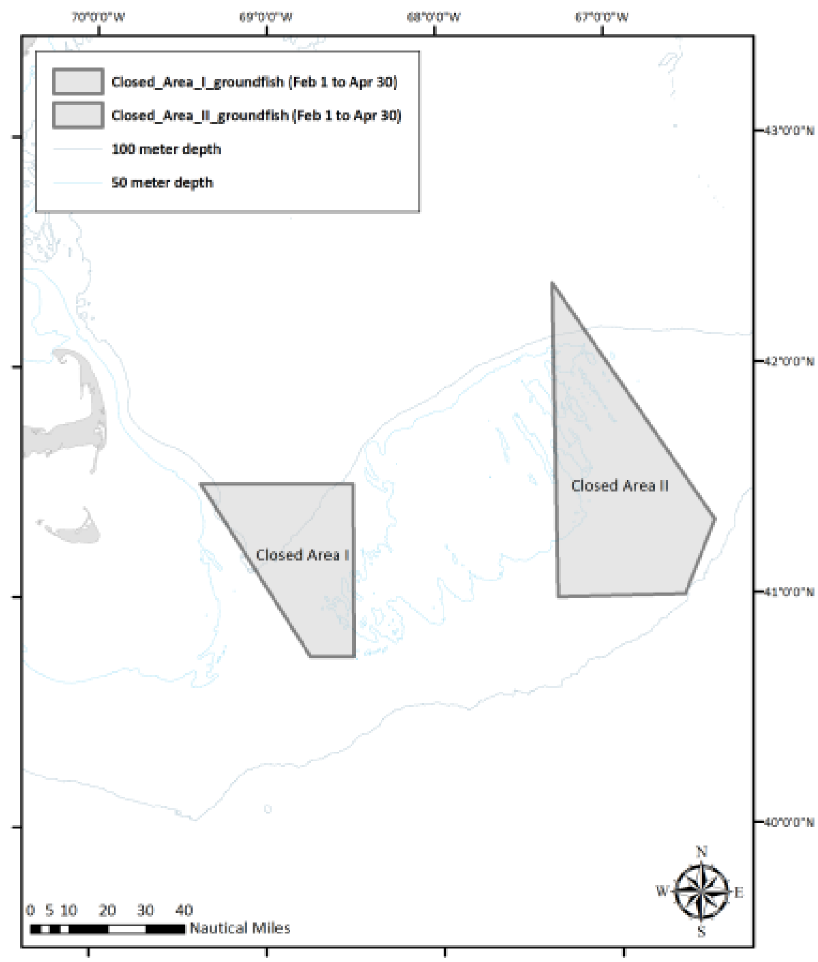
This alternative would retain as spawning closures Closed Area I and Closed Area II (Table 14) during the months of February, March, and April (Map 24). Under this alternative, the Nantucket Lightship groundfish closed area would be eliminated and the Georges Bank Seasonal Closure Area would be eliminated. The options consider closures to just commercial gears (Option A) or commercial and recreational gears (Option B).

Table 14 – Coordinates of proposed Georges Bank groundfish spawning protection areas, Alternative 2. These are identical to the existing coordinates for CAI and CAII.

	Closed Area IN February 1 – April 30		Closed Area II February 1 – April 30	
Point	N. Lat.	W. Long.	N. Lat.	W. Long.
1	41˚ 30'	69˚ 23'	41˚ 00'	67˚ 20'
2	40˚ 45'	68˚ 45'	41˚ 00'	66˚ 35.8' (1)
3	40˚ 45'	68˚ 30'	41˚ 18.6'	66˚ 24.8' (1)
4	41˚ 30'	68˚ 30'	42˚ 22'	67˚ 20'

5	41˚ 30'	69˚ 23'	41˚ 00'	67˚ 20'
(1) US – Canada maritime boundary				

Map 24 – Georges Bank Spawning Alternative 2. Areas closed February 1-April 30 to vessels using gears capable of catching groundfish.



WGS 1984 UTM Zone 19N projection; map updated July 15, 2013

2.2.2.2.1 Option A: Areas closed to selected commercial fishing gears capable of catching groundfish

Closed Areas I and II would be closed during February, March, and April to all fishing vessels with the following exemptions:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Charter and party vessels
- Recreational vessels

- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Vessels participating in the mid-water trawl exempted fishery
- Vessels participating in the Cultivator Shoals or Raised Footrope Exempted Whiting Fishery

Rationale: This alternative would exempt charter, party, and recreational vessels. Although cod spawn in these areas, specific locations have not yet been identified and it is not clear that recreational fishing would disturb more widely distributed spawning activity. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. Whiting vessels are exempted from these restrictions because they fish in specific exemption areas that are narrowly defined spatially and temporally.

2.2.2.2.2 Option B: Areas closed to selected commercial fishing gears capable of catching groundfish and recreational groundfish fishing

Closed Areas I and II would be closed during February, March, and April to all fishing vessels with the following exemptions:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates
- Vessels participating in the mid-water trawl exempted fishery
- Vessels participating in the Cultivator Shoals or Raised Footrope Exempted Whiting Fishery

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. Whiting vessels are exempted from these restrictions because they fish in specific exemption areas that are narrowly defined spatially and temporally.

2.2.2.3 *Alternative 3 Spawning Protection Areas using Closed Area I and Closed Area II*

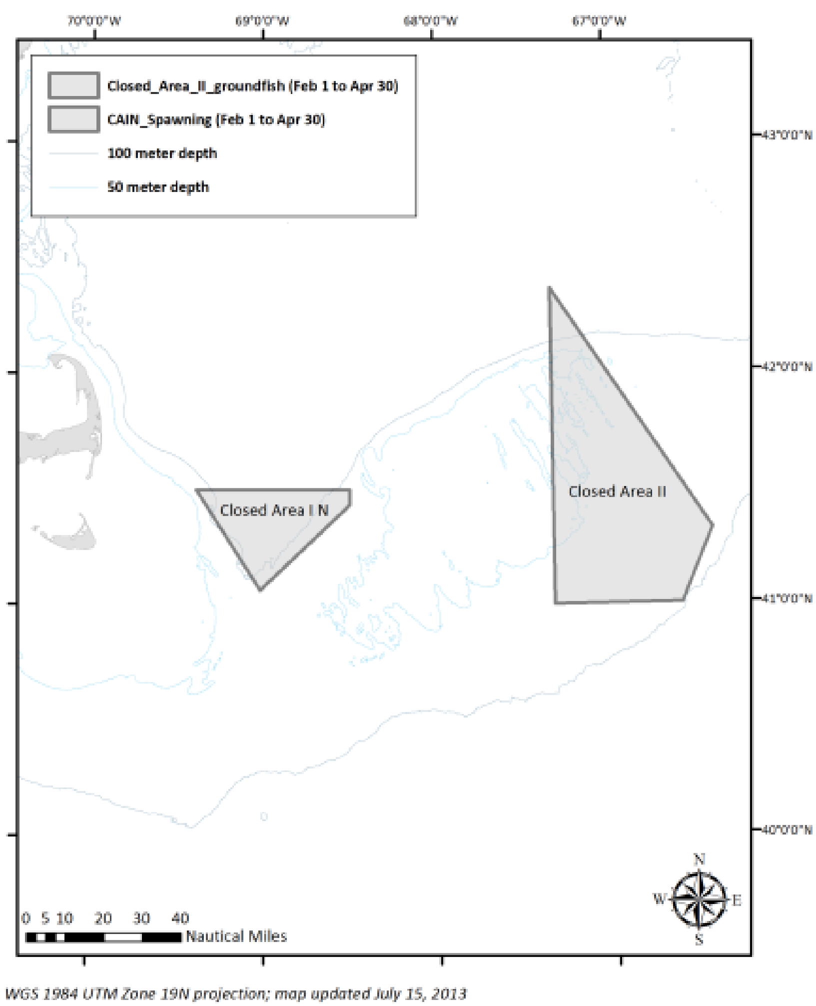
This alternative would retain as spawning closures the northern part of Closed Area I and Closed Area II (Table 11) during the months of February, March, and April (Map 24Map 24). Under this alternative, the Nantucket Lightship groundfish closed area would be eliminated and the Georges

Bank Seasonal Closures Area would be eliminated. The options consider closures to just commercial gears (Option A) or commercial and recreational gears (Option B).

Table 15 – Coordinates of proposed Georges Bank groundfish spawning protection areas. These are identical to the existing coordinates for CAIN Habitat Closure Area and CAII.

	Closed Area IN February 1 – April 30		Closed Area II February 1 – April 30	
Point	N. Lat.	W. Long.	N. Lat.	W. Long.
1	41˚ 30'	69˚ 23'	41˚ 00'	67˚ 20'
2	41˚ 30'	68˚ 30'	41˚ 00'	66˚ 35.8' (1)
3	41˚ 26'	69˚ 30'	41˚ 18.6'	66˚ 24.8' (1)
4	41˚ 04'	69˚ 01'	42˚ 22'	67˚ 20'
5	41˚ 30'	69˚ 23'	41˚ 00'	67˚ 20'
(1) US – Canada maritime boundary				

Map 25 – Georges Bank Spawning Alternative 3. Areas closed February 1-April 30 to vessels using gears capable of catching groundfish.



2.2.2.3.1 Option A: Areas closed to selected commercial fishing gears capable of catching groundfish

The northern part of Closed Area I and all of Closed Area II would be closed during February, March, and April to all fishing vessels with the following exemptions:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Charter and party vessels
- Recreational vessels
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates)
- Vessels participating in the mid-water trawl exempted fishery
- Vessels participating in the Cultivator Shoals or Raised Footrope Exempted Whiting Fishery

Rationale: This alternative would exempt charter and party and recreational vessels. Although cod spawn in these areas, specific locations have not yet been identified and it is not clear that recreational fishing would disturb more widely distributed spawning activity. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. Whiting vessels are exempted from these restrictions because they fish in specific exemption areas that are narrowly defined spatially and temporally. The northern portion of CAI was identified by the Council as an area that might contain the majority of CAI spawning activity, so this alternative is smaller in terms of areal coverage as compared to Alternative 2.

2.2.2.3.2 Option B: Areas closed to selected commercial fishing gears capable of catching groundfish and recreational groundfish fishing

The northern part of Closed Area I and all of Closed Area II would be closed during February, March, and April to all fishing vessels with the following exemptions:

- Vessels that are transiting
- Vessels that do not have a federal NE multispecies permit and are fishing exclusively in state waters
- Vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surfclam/quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, shrimp trawls with properly configured grates
- Vessels participating in the mid-water trawl exempted fishery
- Vessels participating in the Cultivator Shoals or Raised Footrope Exempted Whiting Fishery

Rationale: Groundfish spawning protection areas should be closed to all gears and fisheries capable of catching and in particular targeting groundfish. In addition to commercial vessels, recreational fishermen can quickly target concentrations of spawning cod and haddock, which if there are enough vessels is likely to disrupt spawning and remove actively spawning fish before they have had the opportunity to successfully reproduce. Scallop dredge vessels would be restricted under this alternative as they catch various species of groundfish and could disrupt spawning activity. Whiting vessels are exempted from these restrictions because they fish in specific exemption areas that are narrowly defined spatially and temporally. The northern portion of CAI was identified by the Council as an area that might contain the majority of CAI spawning activity, so this alternative is smaller in terms of areal coverage as compared to Alternative 2.

2.3 Alternatives to designate Dedicated Habitat Research Areas

One goal of this amendment is to minimize the adverse effects to essential fish habitat to the extent practicable. To date, existing knowledge from the region as well as from across the world has been used to develop general ecological assumptions about designating EFH as well as produce specific management measures to minimize adverse effects.

In order to better inform managers about trade-offs associated with minimization of adverse effects, the PDT developed the Swept Area Seabed Impact (SASI) approach, including a spatial model combining habitat maps, habitat vulnerability estimates, and fishing effort data. This approach was intended to aid in identifying areas throughout the region that are most vulnerable to each type of commercial fishing gear. While a clear step beyond previous efforts, the model rests on a set of general assumptions that are not necessarily equally applicable in all habitats and in all sub-regions. There is a clear need to test these assumptions and to improve the utility of the model with empirical studies from across the region. Further, there is a critical need to improve our understanding of the linkages between habitat and the productivity of managed species (and their prey) in order to better target management and conservation actions.

One approach to address information needs is to designate Dedicated Habitat Research Areas (DHRAs) in concert with Habitat Management Areas. These DHRAs would be the focus of research activities to provide information to managers, improve understanding of the ecological effects of fishing across a range of habitats, and ultimately improve model forecasts and inform future habitat management. An important aspect about DHRAs is that they would allow coordinated research and build upon past studies and baselines. The current ad hoc nature of fish habitat and gear effects research has minimized potential synergies and potentially reduced the amount of information of use to managers.

Under DHRA Alternative 1 (No Action), no DHRAs would be designated. If one or more of the action alternatives in this section (Alternatives 2, 3, and 4) are selected, the Council would designate up to three separate DHRAs in Gulf of Maine and Georges Bank locations. Any combination of these alternatives could be selected. In all cases, the DHRAs overlap with other management areas that currently exist or are proposed in this amendment. The structure of the alternatives in this document implies that DHRA designations would be considered as separate but overlapping management area designations, potentially with different restrictions on fishing activity than the habitat or spawning areas that they overlap with. Alternative 5, if selected, would implement a sunset provision for all of the designated DHRAs, and presumably for any future DHRAs as well.

All of the dedicated habitat research areas described in this section would be defined on a year-round basis, with the possibility of a sunset provision after three years. The measures restrict certain types of fishing to create appropriate reference conditions in the research area, in order to facilitate scientific study.

Research agenda for designated DHRAs

The Council identified a set of priority research questions that the DHRAs should address. Identifying the questions is a critical first step in designing research areas in appropriate habitats with a statistically valid range of treatments. The questions are based on four broad focus areas: gear impacts, habitat recovery, natural disturbance, and productivity.

- **Impacts:** These questions address the differential susceptibility and recovery of habitats by gear type, and gear contact with the seabed.
- **Recovery:** These questions focus on recovery models, patch size effects, and effort-response issues.
- **Natural disturbance**: These questions address the difference between natural and fishing disturbance.
- **Productivity:** These questions address productivity by habitat type.

Gear impacts

How do different types of bottom tending fishing gear (e.g., trawl nets, dredges, hook and line, traps, gillnets, longlines) affect the susceptibility and recovery of physical and biological characteristics of seabed habitat, and how do these impacts collectively influence key elements of habitat including spatial complexity, functional groups, community state, and recovery rates and dynamics?

In order to study the impact of different fishing gears and variable intensities of fishing on biological and geologic characteristics of habitat, it is necessary to design management experiments. The potential redesign of the existing closures in the region provides an ideal opportunity to examine this question because the existing habitat closures most likely approach habitat undisturbed by fishing impacts in the region. Thus, allowing prescriptive fishing efforts inside a portion of these closures and comparing effects to undisturbed control areas will provide insight into how each gear type impacts the susceptibility and recovery of habitat features. In order to design ideal habitat impact studies, it is important to have adequate replication of areas, in other words, a number of areas that can be studied simultaneously to understand variation in processes across space and time. This will require characterization of key habitat components in order to identify sub-areas that are appropriate to incorporate into a study design. Having a number of areas available for study also allows for a before-after-control-impact (BACI) design, which is important in order to prove with high statistical power that any particular effect is due to fishing activity, rather than other sources of habitat disturbance (e.g. storms).

Each DHRA would therefore ideally include: (1) previously closed areas that are opened to fishing under controlled circumstances, (2) previously open areas that close to fishing (3) previously open areas that remain open, and (4) previously closed areas that remain closed. This design will allow researchers to study both susceptibility to specific fishing activities and recovery dynamics when fishing disturbance is removed.

These questions aim in part to address some key assumptions in the SASI model and outstanding questions about habitat impacts:

- How accurate are the susceptibility and recovery scores for biological and geological components derived in the SASI model?
- How accurate are the assumptions in SASI model about the cumulative impacts of each gear type (e.g. multiple passes)?
- Has SASI correctly identified the most vulnerable habitats?
- Are the differences in magnitude of impact among gear types correct?
- Have we significantly over- or under-estimated the impacts of particular gear types?

Are our estimates of gear contact with the bottom accurate? Can we develop trawl gear that minimizes contact on the bottom, thereby reducing the potential for gear impacts?

SASI 'rewards' fishing gear types that have less contact with the seabed by assigning a lower contact index value to those gear types. This results in lower area swept estimates that enter the model in each time step and thus lower estimates of adverse effects that result from that type of fishing. For example, imagine two vessels fishing with the same size trawl and doors but one fishes with a raised footrope sweep and the other fishes with a rockhopper sweep. While the contact of the doors and ground cables are assumed to be similar for both types of gear, seabed contact of the sweep was assumed to be much lower for the raised footrope gear. Thus, if the vessels fish for the same amount of time/distance in the same area, the adverse effects associated with the raised footrope are estimated to be less by the model.

Clearly, this example is an oversimplification, and different types of fish occur on different habitats with varying vulnerability to fishing gear. However, if contact indices can be better specified, SASI provides a way to estimate the magnitude reduction in adverse effects to EFH that would be associated with substitution of reduced impact gears for those gears currently in use. Further research in this subject area could also improve estimates of fixed gear seabed contact, which are presently highly uncertain.

Evaluating gear contact with the seabed and developing lower impact gears will require gear technology scientists to work with fishermen.

Habitat Recovery

What recovery models (e.g., successional vs. multiple-stable states) are operant in the region and how resilient are seafloor habitats to disturbance? In other words, how do seafloor habitats recover, and are there thresholds after which habitats have achieved an alternate state and are no longer capable of recovering to their previous undisturbed condition?

This critical question addresses our underlying assumptions about fishing effects. We often assume that seafloor communities recover in a successional manner; i.e., if we stop the impacts, the habitat recovers to a previously unimpacted state. Although we know this happens in some areas, there are research results that suggest that other community models are at play in other areas. In terms of measuring 'success' of management measures intended to promote habitat recovery, it is important to be able to distinguish between habitats that have experienced some recovery but require more time to achieve full recovery, vs. habitats that have experienced some recovery, but look different ecologically than they did prior to disturbance. Habitats that have recovered to a different state than they were in originally may nonetheless provide similar functional value for managed and ecosystem component species.

Do "small" fishing-caused disturbances surrounded by unimpacted habitat recover more quickly and exhibit greater resilience in contrast to "large" fishing-caused disturbances embedded with small unimpacted patches?

In other words, how does the size of a habitat management area vs. the intensity of fishing influence habitat recovery and resilience (see Auster and Langton 1999 for a discussion of this issue)? Answers to this question relate directly to understanding how management strategies focused on maximizing CPUE relate to habitat impacts.

When a particular area is fished for the first time vs. subsequent efforts, are these impacts equal per unit effort? Or, is the first pass over an area much more detrimental? Conversely, is there a tipping point beyond which the habitat is no longer capable of recovering?

Answers to this question can help define management strategies for the region. If first pass impacts are most critical in some habitat types, there is a stronger argument for setting areas aside entirely in order to protect habitats from damage. If long-term, cumulative effects are the bigger issue, than the management strategy might be different, and be aimed at controlling but not eliminating fishing in vulnerable habitats. This question will require setting up research areas in the closures and controlling the level of fishing allowed in each to examine the impacts of the first versus subsequent units of effort on the susceptibility and recovery of key habitat components.

Natural Disturbance

In the absence of fishing, what are the dynamics of natural disturbance (e.g., major storm events) on seafloor habitat (especially biological components) across five major grain size classes (mud, sand, coarse sand-granule, pebble-cobble, boulder) and across oceanographic

regimes? In areas where natural disturbance is high, are signals of the impacts of fishing masked?

This requires reference areas closed to all fishing, and spatially replicated within each major oceanographic setting (Gulf of Maine, Georges Bank, Southern New England, Southern Mid-Atlantic). We need to know what seafloor habitat and communities look like in the absence of any fishing impacts in order to evaluate the role of natural disturbance combined with fishing effects.

Productivity

How does the productivity of managed species (and prey species) vary across habitat types nested within the range of oceanographic and regional settings? And how does this productivity change when habitats are impacted by fishing gear? Do durable mobile bottom tending gear closures increase fish production? Why are highly productive areas (e.g. Stellwagen Bank) so productive?

This is probably the most important habitat-related question from a fisheries management standpoint. This question extends beyond the current modeling capacity of SASI, but addresses a key limitation of SASI, specifically that it only addresses impacts to habitat and assumes that all habitat is EFH. Integrating SASI-derived habitat vulnerability with a better understanding of which habitats influence the productivity of managed species will greatly enhance management efforts. Without this integrated effort, management actions based solely on reducing impacts may actually focus efforts on habitats that are more vulnerable but less important as EFH.

A gradient of impacts to particular habitat types, focused in impact treatment areas, allows assessment of variation in the role of habitat in population responses. In other words, comparisons of fished to unfished areas will reveal how fished species respond to changes in biological and geological components of habitat. Addressing these questions requires comparisons of closed areas that are opened vs. closed areas that remain closed.

<u>Design and implementation elements common to all DHRAs</u>

Dedicated Habitat Research Areas would be a new type of management area designation for the Council, so there are a number of design and implementation elements to think through.

Area design and fishing impact treatments

While a before-after control-impact design was recommended as the ideal, the three DHRAs proposed in this amendment would be control-impact designs. These two approaches are contrasted in Table 16.

Table 16 – Comparison between before-after control-impact and control-impact designs

A before-after control-impact design could produce results that:	A control-impact design will:
• Will separate the effects of fishing from	• Limit all comparisons of recovery to the

environmental variability and species interactions. • Address effects of timing (season) and size (spatial footprint) of impacts. • Address the potential for multiple states of recovery • Identify the effects of particular types of gear and levels of effort on habitats in multiple states of recovery. • Determine how fish production is affected by seafloor habitats in multiple states and different trajectories of recovery.	single state existing within the current closed areas • Address effects of timing (season) and size (spatial footprint) of impacts • Identify the effects of particular types of gear and levels of effort • Determine how fish production is affected by seafloor habitats • The control-impact approach would fail to take advantage of a unique opportunity to advance our knowledge of the potential benefits of closed areas (recovery dynamics, gear specific impacts and relationships to fish productivity).

Another consideration related to DHRA design is how fishing impacts treatments will be implemented. Three approaches were discussed during development of the amendment:

1. General closure of research areas with all impact treatments as research fishing,
2. General closure of research areas with impacts coming from some kind of limited access fishery in specified fishing treatment areas, or
3. Open fishery access specified fishing treatment areas.

All three DHRAs in this amendment follow the first approach. Specifically, fishing effort would be contracted or arranged specifically by project scientists to occur in particular areas using specific gears. This decision means that the Council would not need to specify treatment areas within a particular DHRA at the time of DHRA designation, but rather, that the location of study sites and treatments would be determined by researchers using the DHRA. This approach also helps to ensure that fishing effort occurs in the locations desired and at the magnitude desired. There would be lower administrative costs at the front end because specification of levels of fishing activity is left to the researchers. However, this requires researchers to invest the greatest amount of resources in designing the fishing impact.

One potential cost of a research fishing approach is that it might be hard to generate effort that is of sufficient magnitude to replicate a commercial fishery impacts. There might be gaps in impacts if funding is limited, which could be an issue in long-term impacts studies. Also, researchers would need to figure out how to fund the activities and whether the fish could be landed and if so they would need to come out of the fishery's overall allocation, or if vessels would need to agree to use DAS or quota to cover the trips.

It will be important for the Council to understand how the DHRAs are being used. Coordination and oversight will probably need to happen at the Council level on an ongoing basis, perhaps through the Council's Research Steering Committee. NERO will be involved with coordination and oversight to determine where research treatment sites are located and to assure there are no conflicts that would bias results. The Council may wish to request that researchers obtain letters of acknowledgement before conducting research in a DHRA.

2.3.1 Alternative 1 (No Action) – No DHRA designations

Currently there are no DHRAs designated in the region. Under No Action, this would continue and DHRAs would not be designated as part of this amendment.

2.3.2 Alternative 2 – Eastern Maine Dedicated Habitat Research Area

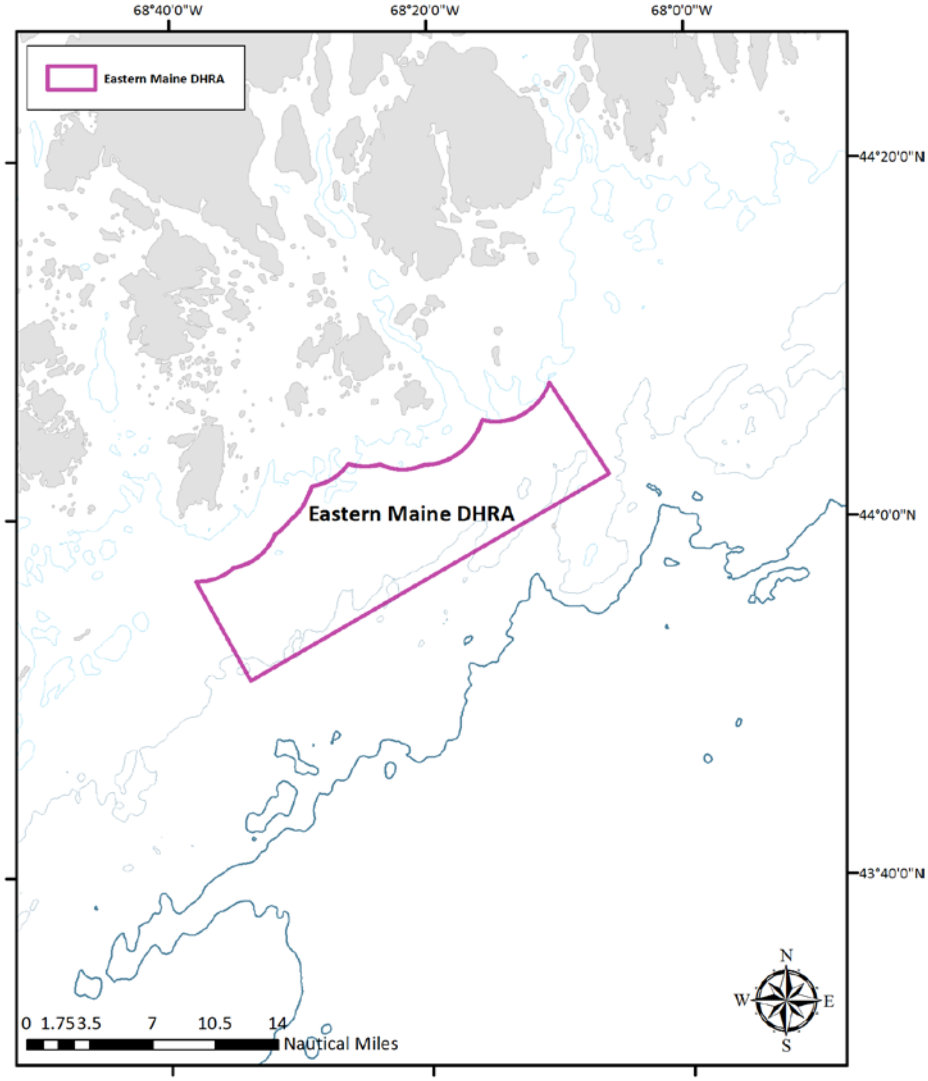
This alternative would designate a Dedicated Habitat Research Area in the eastern Gulf of Maine as shown in Map 26. Measures for this area would be closure to all mobile bottom-tending gear on a year round basis. If the DHRA overlaps with a habitat management area with less restrictive measures, the DHRA measures would take precedence.

Rationale: The purpose of this alternative is to establish a management regime in the eastern Gulf of Maine region that will facilitate the study of:

- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources.

Designation of the DHRA should help to focus research efforts on this location, and streamline the permitting process for those projects where research fishing activities will impact the seabed and a letter of authorization is necessary to conduct research. Relative to present conditions, where groundfish resources are relatively depleted, this region previously supported additional groundfish resources and groundfish fisheries. Dam removal inshore of this area may lead to recovery of prey resources and improved production of managed species via an increase in feeding opportunities. Routine sampling of fishery and prey species in this area could help to identify these ecological linkages.

Map 26 – Eastern Maine Dedicated Habitat Research Area



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

2.3.3 Alternative 3 – Stellwagen Dedicated Habitat Research Area

This alternative would designate a Dedicated Habitat Research Area in the western Gulf of Maine as shown in Map 27. Measures for the entire area would be closure to mobile bottom-tending gear, sink gillnet gear, and demersal longline gear on a year round basis. This alternative includes a reference area that would additionally be closed to recreational and party/charter groundfish fishing. Mid-water and pelagic gears would be permitted. If the DHRA overlaps with a habitat management area with less restrictive measures, the DHRA measures would take precedence.

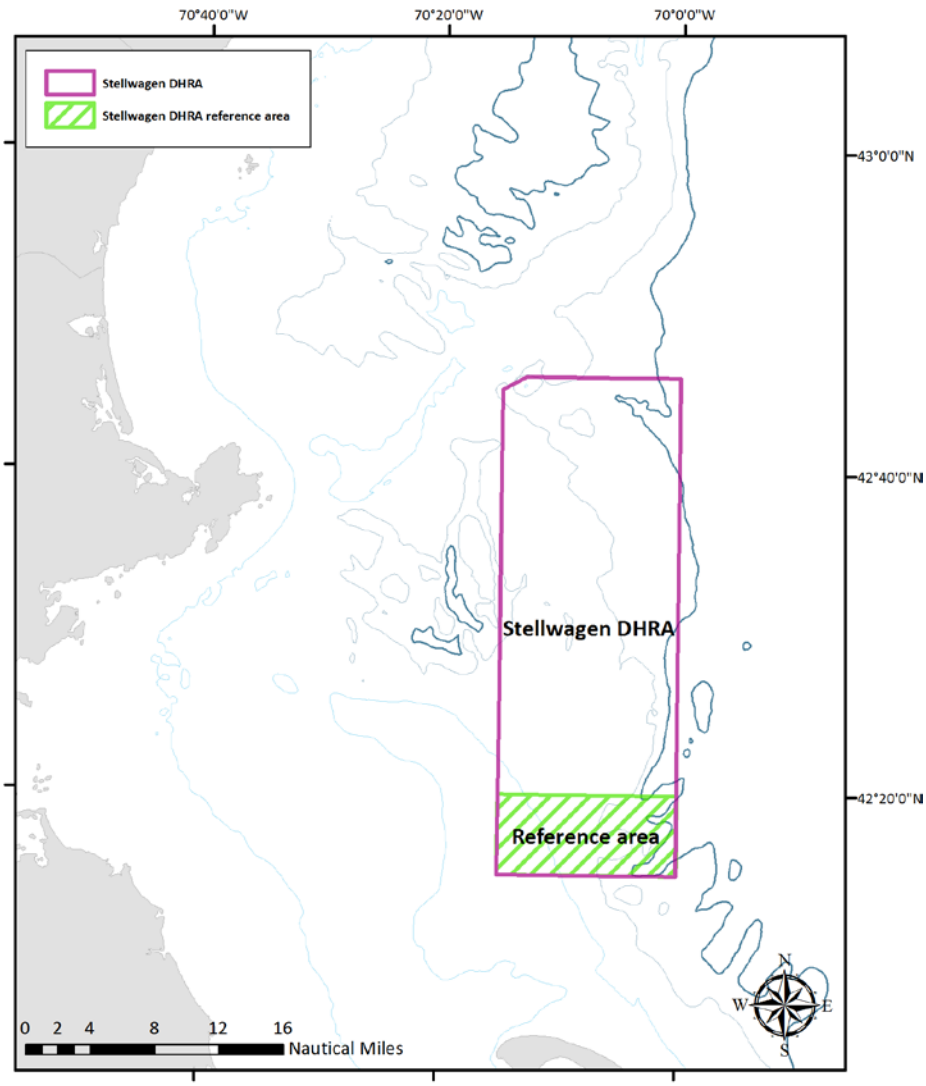
This DHRA would represent a control-impact style design as it lies completely within the existing Western Gulf of Maine habitat closed area. The specific boundaries identified for the area were recommended by an independent ad-hoc working group of fishermen and scientists that are involved with both Stellwagen Bank National Marine Sanctuary and the Council's Habitat Omnibus process, although the boundaries are adopted as a Council management alternative.

Rationale: The purpose of this alternative is to establish a management regime in the western Gulf of Maine region that will facilitate the study of:

- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources.

Designation of the DHRA should help to focus research efforts on this location, and streamline the permitting process for those projects where research fishing activities will impact the seabed and a letter of authorization is necessary to conduct research. The DHRA area contains a wide array of habitat types and species, and there are numerous baseline studies of the area that could be built upon in the future. Stellwagen Bank in general is a highly productive area, and a better understanding as to why this is could improve fisheries management in the Western Gulf of Maine.

Map 27 – Stellwagen Dedicated Habitat Research Area



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

2.3.4 Alternative 4 – Georges Bank Dedicated Habitat Research Area

This alternative would designate a Dedicated Habitat Research Area on Georges Bank as shown in Map 28. Measures for this area would be closure to all mobile bottom-tending gear on a year round basis. If the DHRA overlaps with a habitat management area with less restrictive measures, the DHRA measures would take precedence.

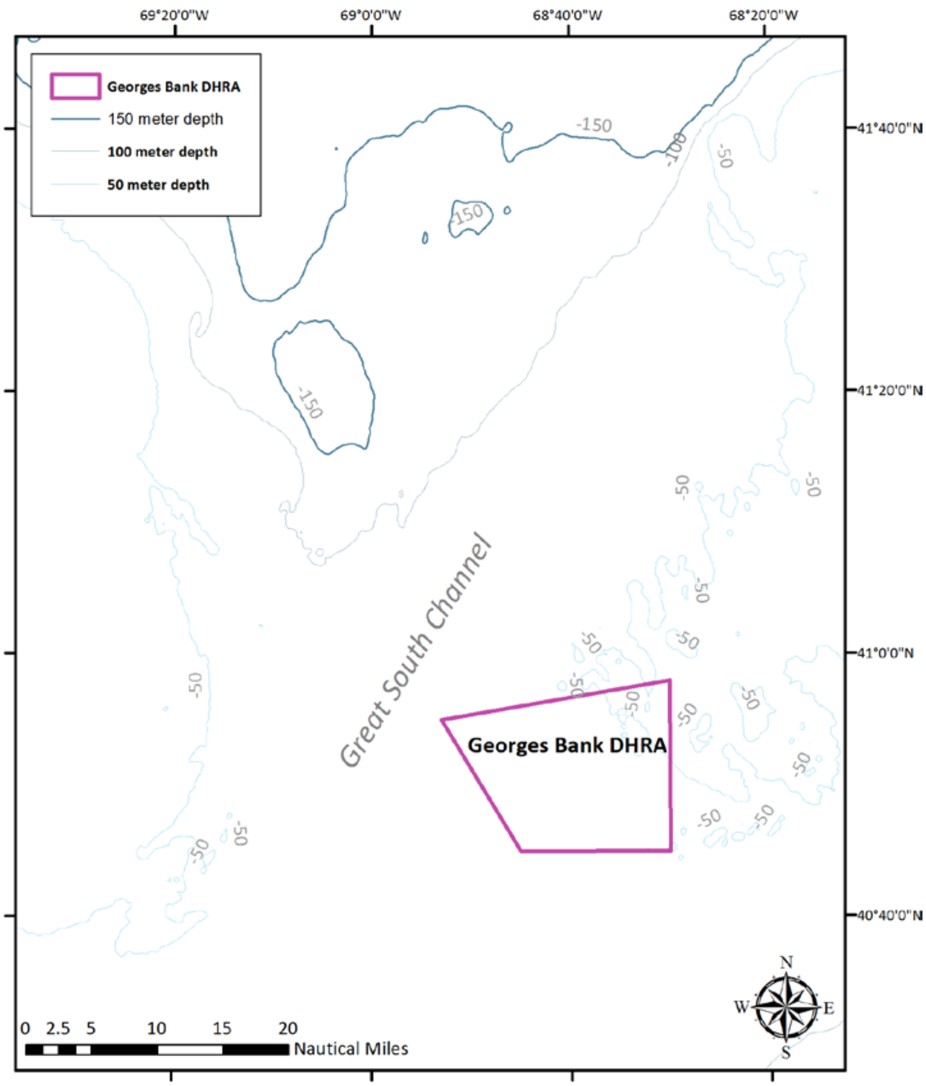
Rationale: The purpose of this alternative is to establish a management regime in the Georges Bank region that will facilitate the study of:

- fishing gear impacts on benthic habitats,
- habitat recovery,

- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources, especially the relationships between scallop distribution, abundance, growth, and seabed type.

Designation of the DHRA should help to focus research efforts on this location, and streamline the permitting process for those projects where research fishing activities will impact the seabed and a letter of authorization is necessary to conduct research.

Map 28 – Georges Bank Dedicated Habitat Research Area



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

2.3.5 Alternative 5 – DHRA sunset provision

This alternative would create a sunset provision for DHRAs that would allow administrative removal without further Council action three years after implementation, if no research had been initiated. This alternative would apply to all DHRAs designated via OA2. Removal would be accomplished by NOAA via rulemaking or some kind of notice, and would be coordinated by the Northeast Regional Office. The following criteria must be met in order for the DHRA to continue after the three-year review:

- ***Documentation of active and ongoing research in the DHRA area, in the form of data records, cruise reports or inventory of samples with analytical objectives focused on DHRA topics outlined in the introduction to section 2.3.***
- ***Documentation of pending or approved proposals or funding requests (including ship time requests) with objectives focused on DHRA topics.***

These criteria would be evaluated using the following approach:

Figure 1 - Flowchart - DHRA evaluation procedure.

1. Is there active research being conducted in the DHRA?

   Yes--> see #2. No --> see #3.

2. Is it anticipated that it will continue beyond this fishing year? *This assumes that NOAA will publish a notice and the change of status would be effective at the start of the next fishing year. This may require a verbal commitment on the part of researchers, rather than letters of support/funding from the funding agency, as agencies are sometime reluctant to make commitments for the next year until their own funding allocations are more certain.*

   Yes --> DHRA remains classified as such. No --> See #3.

3. Is there potential research currently in the permitting process at NERO or other entities, e.g. Stellwagen Bank National Marine Sanctuary? *Note that many types of research can be conducted without a permit or letter of acknowledgment.*

   Yes --> See #6. No --> see #4.

4. Is there potential research currently in the funding process? *Note that in some cases, outside funding may not be required, as the project could be part of an organization's routine operations. Ship time allocation requests could also be used as a marker.*

   Yes --> See #5. No --> see #7.

5. Is there a high likelihood that the project will be funded? *This assessment will be very subjective and is probably not a good indicator, unless for some reason it appears that funding is very unlikely or very likely.*

   Yes --> See #6. No --> see #8.

6. Are the fishing restrictions associated with the DRHA designation an explicit part of the design of the project?

   Yes --> DHRA remains classified as such. No --> see #8.

7. Is there potential research [at some other critical stage in the idea-->funding process]? I.e., is there a coherent research plan or proposal in the pre-submission process? This plan should be responding to a current research funding process or planning process such as ship time allocations, and it should have an actionable timeline.

   Yes-->See #5. No--> See #8.

8. DHRA classification is removed.

Rationale: This alternative responds to concerns that DHRAs might be designated and then remain unused, thereby causing economic hardship to the fishing industry without improving habitat science. This scenario is possible because although the Council has the ability to designate DHRAs and enact fishing restrictions within them, as well as the ability to set research priorities, it does not directly conduct or fund research activities. The intent is that the three year review would evaluate whether appropriate research activities were either ongoing or imminent. Allowing for research activities to be in the planning stage but not yet on the water at the three year mark acknowledges the fact that proposal development, submission, review, and allocation of funds can be a lengthy process.

2.4 Framework adjustments and monitoring

2.4.1 Alternative 1 (No action) – Current list of frameworkable measures and monitoring activities; ad-hoc initiation of framework adjustments

There is extensive language in the fishery management plans developed by NEFMC, and in their implementing regulations, related to framework adjustments and measures that can be implemented or changed via framework adjustment. Generally speaking, the framework-related regulations document procedures for analyzing and implementing annual/biennial/triennial fishery specifications, but other measures are specifically identified in the regulations as candidates for implementation via framework (Table 17). Specifically, the existing regulations allow the Council to initiate a framework adjustment to modify, add, or eliminate various management measures used to regulate the groundfish fishery, including area closures and gear restrictions.

The decision to initiate an area-management-oriented framework adjustment or amendment is currently made on an ad-hoc basis, responding to specific issues, and there is no schedule for evaluating or updating spatial management measures.

Currently, Council-specified research priorities related to spatial management are embedded within plan-by-plan research priority documents, which are updated periodically by Plan Development Teams, Oversight Committees, Advisory Panels, and the Scientific and Statistical Committee. Existing data collection from areas closed to fishing includes regular resource surveys by government vessels, ad hoc tagging programs and other research, and observed fishing trips surrounding closed areas.

Under no action, there would be no changes made to the lists of frameworkable items in NEFMC FMPs, or to the procedures for reviewing the effectiveness of spatial management measures. No additional recommendations would be made regarding research priorities specifically intended to improve the development and evaluation of spatial management measures.

Rationale: The Council could use the existing framework adjustment procedures to respond to new fish habitat science or changing circumstances. According to current policies, a Council decision to initiate a framework adjustment would be weighed against other management priorities. Initiation of this type of framework adjustment would be available regardless of whether the Council selected to add one of the following strategic framework adjustment processes described below.

Existing survey and fishery data collection programs may provide sufficient information to monitor the performance of area-based management possibly in the largest proposed closed areas, although currently conducted research is highly unlikely to sufficiently monitor smaller proposed closed areas. More targeted scientific research may or may not be conducted, depending on scientific interest and available funding. Fishery exemptions for scientific experimentation or data collection might be considered on a case by case basis, but may or may not be approvable.

Table 17 – Measures related to types of alternatives analyzed in OA2 that may be implemented via framework action, by fishery management plan. All citations are from 50 CFR Part 648.

Fishery Management Plan and CFR section	**Frameworkable measures (only the subset of measures relevant to measures discussed in OA2 are included in this table)**
Northeast multispecies (§648.90)	As part of biennial review, the groundfish PDT may include **any of the management measures in the FMP**, including but not limited to: **gear restrictions**, **closed areas**, recreational fishing measures, **describing and identifying EFH, fishing gear management measures to protect EFH, and designating HAPCs within EFH**. In addition, the following conditions and measures may be adjusted through future framework adjustments: **gear requirements to reduce impacts of the fishery on EFH**.
Atlantic sea scallop (§648.55)	The Council's recommendations on adjustments or additions to management measures must include measures to prevent overfishing of the available biomass of scallops and ensure that OY is achieved on a continuing basis, and must come from one of the following categories: modifications to the opening dates of closed areas, size and configuration of rotational management areas, controlled access seasons to

	minimize bycatch and maximize yield, limits on number of area closures, area specific gear limits and specifications, **adjusting EFH closed area management boundaries or other associated measures**, and **any other management measures currently included in the FMP**.
Atlantic herring (§648.206)	Measures that may be changed or implemented through framework action include: gear restrictions or requirements, **measures to describe and identify EFH, fishing gear management measures to protect EFH, and designation of HAPCs within EFH**, and **any other measure currently included in the FMP**.
Skate complex (§648.321)	Measures that may be changed or implemented through framework action, provided that any corresponding management adjustments can also be implemented through a framework adjustment, include **description and identification of EFH, description and identification of HAPCs, measures to protect EFH**.
Monkfish (§648.96) and deep-sea red crab (§648.261)	No measures in framework regulations specifically related to OA2 issues.

2.4.2 Alternative 2 – Planned, strategic framework adjustment and monitoring

This alternative would do three things:

- Specify additional spatial management measures as frameworkable in various NEFMC FMPs,
- Develop a regular, strategic process to review the effectiveness of spatial management measures, and
- Define a series of research priorities related to the review and development of spatial management measures.

First, this alternative would add the following items to the list of frameworkable measures in all NEFMC FMPs:

- Designation or removal of habitat management areas
- Changes to fishing restrictions within habitat management areas

Second, a strategic process would be established that will routinely evaluate the boundaries, scope, characteristics, and timing of habitat and spawning protection areas. The foundation of this process would be a technical review that evaluates the performance of habitat and spawning protection areas. This review will be completed at **10 year intervals** following implementation of area management measures proposed by this amendment. The review and associated written report will be prepared using relevant available science and data to show whether or not the areas are meeting the objectives and advise the Council whether changes are warranted. Development of this technical review and report may be aided through:

- Review of new or previously unreviewed research and data (Council's Research Steering Committee)
- Independent evaluation (e.g. Gulf of Maine Research Institute, University of Massachusetts School for Marine Science and Technology)

- A workshop convened by the NEFMC
- Consultation with Council technical teams
- Peer review by the Council's Scientific and Statistical Committee or the Center for Independent Experts.

This review should consider but is not limited to the following questions:

Juvenile habitat

1. Is juvenile abundance increasing in the area, compared with adjacent open fishing areas?

2. Is overall stock-wide recruitment increasing due to better survival of juvenile fish in closed areas?

3. Is growth of juveniles faster inside the closed areas than elsewhere?

4. Are biotic factors (stomach contents, size at age, prey abundance) of juvenile fish different inside of closed area?

5. Are there stronger associations with habitat types in closed areas than elsewhere?

6. Is natural mortality for juvenile fish different inside closed areas than elsewhere?

7. How long do juvenile fish remain in closed fishing areas?

8. Does performance relative to the metrics listed above vary with closed area size?

Spawning

1. How well does the timing of spawning coincide with the spawning closures?

2. Does fishing actually disrupt spawning activity (apart from the effect of catch removing spawners)?

3. Have the closed areas actually improved stock-wide recruitment?

4. What is the variability of spawning activity (location and timing) over time? Are spawning closures as configured able to protect spawning activity, given this variability?

5. Have new sub-populations of spawners been identified that require specific protection?

Based on this review, the Council may choose to initiate a framework adjustment to adjust spatial management measures.

Third, building on what the Council learned during the review of the performance of existing closed areas and the development of new EFH management in this amendment, the Council would identify and periodically revise research priorities to improve habitat and spawning area monitoring. New types of data to enable a satisfactory review of area management performance include:

- Spawning condition and other life history characteristics (stomach content, size at age, robustness)
- Juvenile fish condition, distribution, and movement
- Changes in prey availability
- Habitat quality (type, structure, cover, and size) associated with high abundance of juvenile fish
- Observation of fish spawning behavior within closed and open fishing areas
- Movement and migration
  - Telemetry tagging
  - Acoustic tagging
- Before-After-Control-Impact comparison of changes in fish biomass and characteristics before and after a closure inside a closed area and in surrounding fished areas
- More intensive egg and larval surveys at various times throughout the year
- Oceanographic information that affects egg and larval dispersion

Many of these data are critical to answering the questions posed above. One concern is that lethal sampling could undermine population improvements in very small management areas.

Funding sources could be developed or promoted by a future management action that include, but are not limited to:

- Research set-asides from annual groundfish ACLs and/or extra landings allocations while conducting fishery impact research in habitat or spawning management areas
- Sector set-asides to fund research that collects information that sectors would use to justify closed or restricted area exemptions
- Experimental fisheries
- Cooperative research
- Enhancement of observer coverage in specific areas (e.g. modify Standardized Bycatch Reporting Methodology sampling allocations)
- More intensive survey sampling in and around closed or gear restricted areas.

Rationale: Management areas and measures may require reconsideration for a variety of reasons. Some habitat and groundfish area restrictions may not produce the results that had been expected, or may require modification to achieve the intended results. Or, habitat and spawning areas may have achieved the intended results, and the area-based fishing restrictions are no longer needed. Alternatively, areas that have achieved the intended results may be deemed as vital and possibly expanded upon. In other cases, new management areas may be warranted.

A regular framework adjustment process would ensure that reevaluation of spatial management performance and effects on groundfish productivity would be conducted in a holistic rather than piecemeal fashion. Regulators, researchers, and fishermen would be on notice that a regular review is planned and that relevant information may be submitted to the Council in a timely manner for review. It also establishes the expectation that habitat and groundfish spawning management via area-based fishery restriction will be periodically reviewed so that the restricted areas that are selected are those areas that provide the greatest potential for protecting essential fish habitat and helping stocks rebuild.

The proposed framework adjustment is not intended to replace the authority for the Council to initiate an ad hoc review of a specific management issue at any time, or to respond to relevant new science that becomes available. It is also not intended as a substitute for the process that would apply to Dedicated Habitat Research Areas (see Section 2.3.5) which is intended to promote habitat research in unfished areas for a period not less than three years.

Current sources of data will likely not be sufficient to monitor the proposed closed areas due to their small sizes. Identification of monitoring and research needs specific to spatial management issues would promote and enhance collection of data and scientific analyses that would inform future decisions. New data would address scientific and information gaps that were encountered during the development of Framework Adjustment 48 to the Northeast Multispecies FMP, when the Council reviewed the performance of existing year round groundfish closed areas, and during the development of this amendment.

The ten year review is suggested because enough time needs to pass to gather sufficient data and information to analyze the effects of area closures and expect statistically significant changes in fish populations. Recent research has suggested that a minimum of three generation times are needed to see population changes due to closed areas (Moffitt et al. 2013), which would be more than 15 years for Atlantic cod. Many types of data used to evaluate of the effectiveness of current closed areas will not be usable for future reviews after implementation of OHA2 due to the relatively small sizes of the proposed closed areas and spatial pattern of current sampling. The current closed area evaluation is heavily based on the NEFSC bottom trawl surveys, which are effective at detecting total population trends, but are unlikely to have sufficient samples at appropriate time scales in the proposed closed areas due to the current stratification and random sampling design of the survey. Thus most questions are likely to not be answerable unless dedicated research is funded and implemented in a timely manner. It is highly unadvisable to open habitat or spawning areas within a few years based on partial data or insufficient sampling. If additional research is conducted with sufficient sampling, some metrics could be evaluated in a shorter time frame, but population level changes will take at least three generation times or more to be detectable for any given species of interest. Caution in including lethal sampling into additional research and monitoring would need to be taken since this sampling itself could impact the effectiveness of the area closures especially in the smaller proposed regions. Visual census approaches (i.e., camera sled, ROV) are applicable for this type of monitoring and there is a rich literature on sampling design and analytical approaches.

3 Considered and rejected spatial management options and alternatives

3.1 Adverse effects minimization and juvenile groundfish

The Habitat Committee, and later in the process, the jointly convened Habitat and Groundfish Committees, considered a large range of area management options to minimize the adverse effects of fishing on EFH and protect juvenile groundfish habitats before arriving at the set of areas analyzed in this document. This section briefly describes the areas considered but rejected. Map 29 depicts the areas developed mainly within the Habitat PDT and Committee process as adverse effects minimization areas. Map 30 depicts the areas developed by the CATT as juvenile groundfish habitat areas.

Eastern/Central Gulf of Maine

Habitat areas on offshore banks and ledges in the Gulf of Maine were identified based on the presence of complex seabed habitats, but boundaries were generally defined using the 100 m contour. This was done because the entirety of the features was not mapped with a sampling device capable of detecting cobble and boulder substrates, so 100 meters and shallower was used a proxy for areas expected to contain more complex and vulnerable seabed habitat types. The Committee requested that the Fippennies Ledge and Platts Bank areas be made smaller to allow for fishing opportunities other than on the most complex habitat areas on the tops of the features.

Based on the juvenile groundfish hotspot analysis, the CATT initially identified a somewhat different set of 100 km^2 grids in the Eastern Maine region, specifically additional areas further east. As development of this area continued, the Committee focused on the western parts of the area that had been identified in the SASI LISA analysis and discussed as a dedicated habitat research area.

Western Gulf of Maine

In February 2012, the PDT developed a range of proposals covering complex habitat areas in the western Gulf of Maine. Four options were presented from which the Committee selected the smaller of the two Stellwagen areas. The original options (SWGOM 2-4) included an extension off the northwestern corner to include Tillies Bank, and an eastern extension to cover Wildcat Knoll. The PDT also identified Gloucester Bank and New Scantum off Jeffreys Ledge. Earlier, in August 2011, the PDT recommended extending the Jeffreys Ledge area to the southwest to cover the part of the ledge feature outside of the existing Western Gulf of Maine closure. In general, the Committee preferred to work with refinements to areas already managed, as opposed to additional areas.

The CATT developed a number of proposals in the western Gulf of Maine as many juvenile groundfish hotspots occurred in this sub-region. The original version of the Bigelow Bight area was more extensive than what is currently included in Alternatives 3-5 for this region, and including some areas in state waters and some additional 100 km^2 grids. The Habitat and Groundfish Committees were extremely concerned about the potential economic impacts associated with designation of this area as an HMA, and they rejected it at their May 2013 meeting. The CATT and PDT refined this area for a subsequent joint Habitat and Groundfish Committee meeting, and the updated versions (larger and smaller) were forwarded to the Council after further review. Two areas in Massachusetts Bay and Cape Cod Bay were also developed by the CATT, and rejected by the joint Habitat and Groundfish Committees due to concerns about economic impacts. A subset of the grids in the Massachusetts Bay area were presented to the Habitat and Groundfish Committees as an extension of the larger of the two Stellwagen areas, but it was not approved for Council consideration. In addition, the committees rejected a large area in the inshore Gulf of Maine, which extended to either 90 meters depth or 15 nm offshore, whichever was less. There were concerns about economic impacts of such an area, and also the Committees determined not to recommend year round habitat management area designations in state waters as a general rule.

Georges Bank

In August 2011 the PDT recommended as an alternative a subset of the existing CAII habitat closure (referred to at the time as the Northern Edge area), but the Committee chose not to move forward with analysis of the option. West of the existing closure, a range of proposals were developed to encompass the various shoals, including Georges Shoal. Part of the Georges Shoal East area was included in a new version of the Northern Edge area, which was approved for analysis as part of Alternatives 3 and 4. Given the development of the new area, Georges Shoal east was no longer necessary. A larger version of the Northern Edge area encompassing more Georges Shoal East area and the existing habitat closure in CAII was rejected by the Committee. Similarly, the Committee recommended an area further to the wet as a gear modification area in May 2013. This area, referred to in Alternative 4 as the Georges Shoal GMA, replaced the Georges Shoal West and Georges Shoal Large Areas.

The CATT developed an area on the northern edge, in deeper water along the edge of the bank. This area was identified on the basis of juvenile haddock. The area was combined with the new version of the Northern Edge area, which was approved for analysis as part of Alternatives 3 and 4. The CATT also developed the Southeast Parts HMA based on the distribution of juvenile haddock hotspots. The joint Habitat and Groundfish Committees rejected this area due to concerns over economic impacts, and based on a discussion of the lower habitat vulnerability of the area such that there is less of a need to minimize fishing impacts on the habitat.

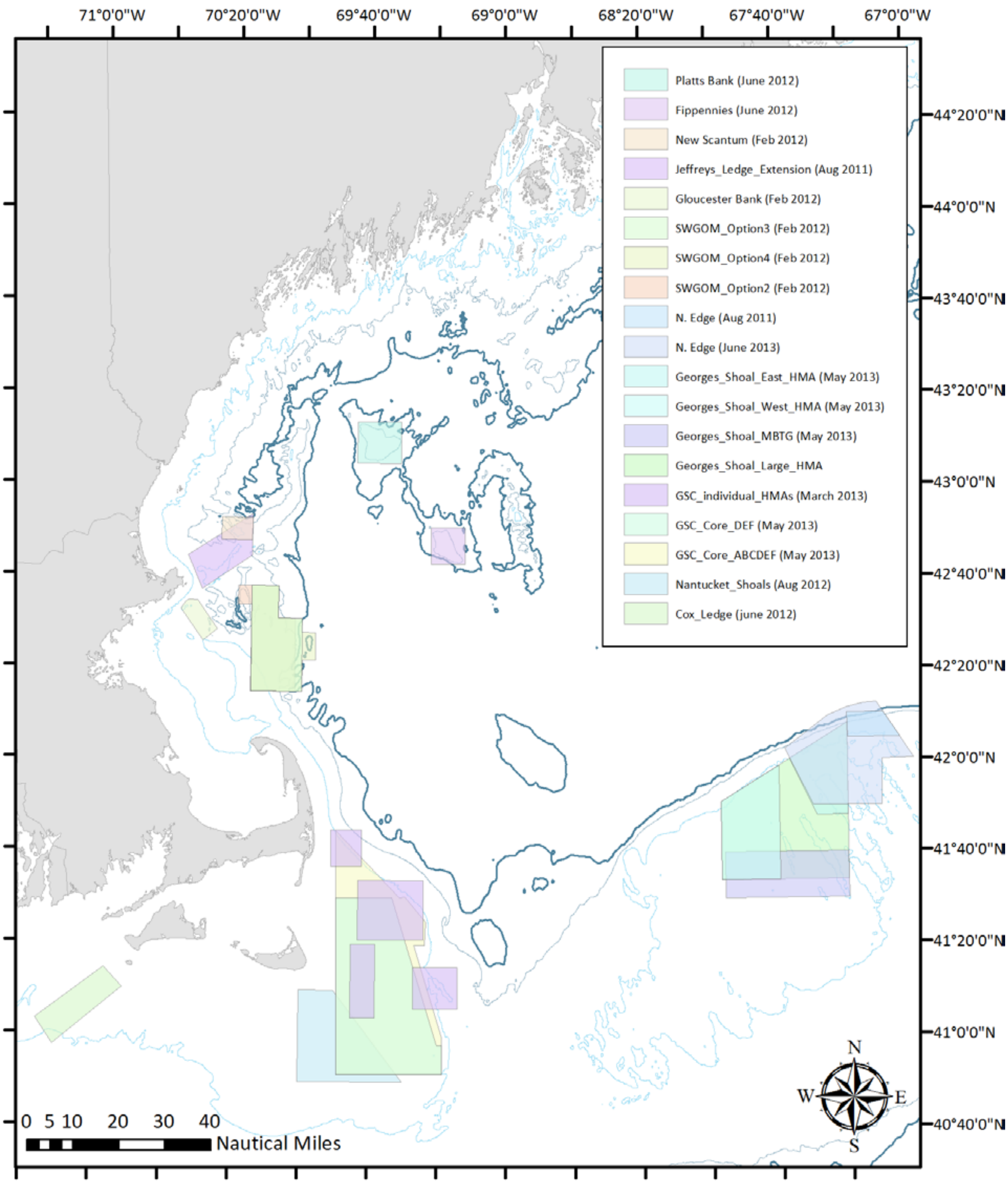
Concerned about the practicability of Georges Bank Habitat Management Alternatives 3 and 4, both NMFS NERO and Council staff (at the Committee's request) developed additional alternatives for the northern edge region that were provided to the joint Habitat/Groundfish Committee (NERO area) and the Council (NERO and staff areas). Both areas removed the southern portion of the Northern Edge area in GB Habitat Alternatives 3 and 4, and were intended to minimize the adverse effects of fishing on EFH in the Georges Bank region while allowing access to fishery resources, including dense concentrations of scallops that are currently within the CAII Habitat Closure Area.

Great South Channel and Southern New England

In the Great South Channel, the PDT originally identified four discrete habitat management areas corresponding with concentrations of cobble habitat. A larger area combining all four boxes was also suggested, but it was probably too extensive in size to be practicable, and the Habitat Committee did not give it much consideration. Later in the process, the Committee requested development of a single area that provided similar protection for cobble and boulder habitats. A number of variations were recommended in March 2013. Two of those approved by the Committee for further analysis (GSC core + ABCDEF and GSC core + DEF) were later rejected and substantially similar areas were included in the range of alternatives approved for analysis by the Council in June 2013 (see Great South Channel Alternatives 3 and 4).

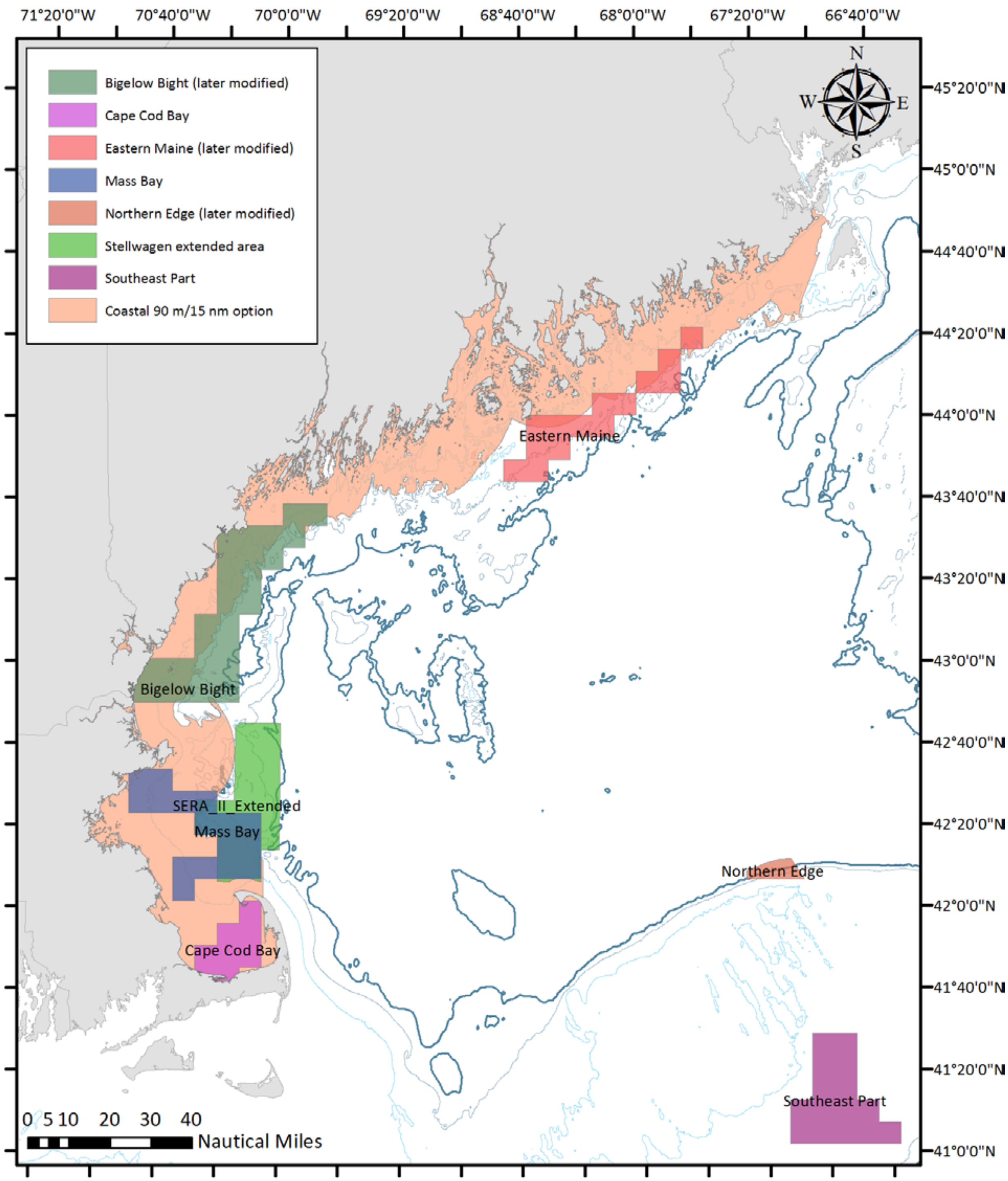
In a similar fashion to the revisions of the original Fippennies and Platts areas, the original Cox Ledge area was reduced in size to focus on areas with documented cobble habitat.

Map 29 – Considered and rejected adverse effects minimization habitat management areas



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

Map 30 - Considered and rejected juvenile groundfish habitat management areas



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

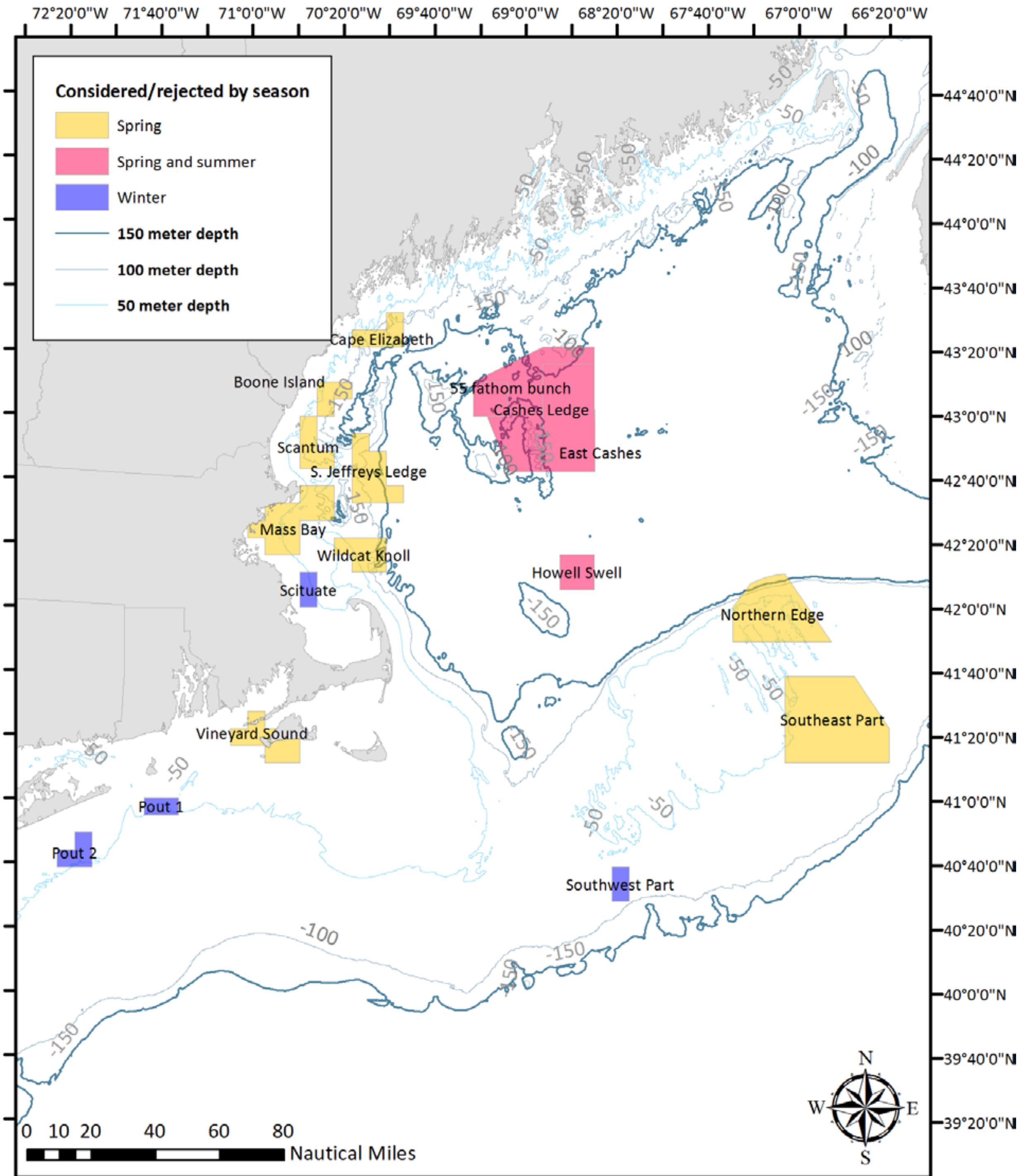
3.2 Spawning

During the development of alternatives for this amendment, the Council's Closed Area Technical Team (CATT) reviewed relevant literature and conducted several types of analysis (see Appendix 6) to identify concentrations of large mature groundfish. It also examined the consistency of these areas with maturity condition of regulated groundfish caught on seasonal surveys. Using this information, the CATT proposed consideration of several areas in the Gulf of Maine and on Georges Bank for closure during seasons when groundfish were known to spawn (Map 31). The information was integrated over all regulated groundfish species based on several relevant factors, heavily weighted toward those species that were at low abundance, overfished, and therefore deemed to be vulnerable to reductions in productivity through fishing on spawning fish.

Many areas were rejected by the Council due to practicality concerns and belief that the areas identified by concentrations (or hotspots) of large mature fish in the survey data were not representative of spawning locations. The Council intends to collect and examine more information about spawning timing and locations to develop new spawning protection areas in a future NE Multispecies FMP management action.

The Georges Bank Seasonal (May) Closure Area was removed from the action spawning alternative in September 2013 at the recommendation of the Habitat/Groundfish Committee.

Map 31 – Areas of 100 km^2 blocks identified by the CATT as having concentrations of large mature groundfish to be considered as seasonal spawning closures.



WGS 1984 UTM Zone 19N projection; map updated July 19, 2013

3.3 Dedicated Habitat Research Areas

The PDT discussed Dedicated Habitat Research areas, or DHRAs, as a system of areas, with multiple designations per region. This would have allowed for comparison of research results among areas, to confirm ecological patterns and allow for stronger inferences to be made and applied to other similar habitats. However, the Habitat Committee felt that a much smaller number of areas should be designated. One of their objectives was to base DHRA designations on habitat management area boundaries, so some areas were not forwarded on to them for that reason.

The PDT discussed the following areas as potential DHRAs, but did not develop them in detail or recommend them to the Committee for the reasons noted:

- Fippennies Ledge and Platts Bank – both are relatively small in size. This meant that the treatment areas associated with fishing impact research would likely include much of the HMA, which runs counter to the objective of minimizing adverse effects within the HMA boundaries.
- Wilkinson and Jordan Basins – there is no nexus to current or proposed management areas, with the exception of small coral zones under development in Jordan Basin as part of the deep-sea coral amendment.
- The southeast parts of Georges Bank – this area has been fished since 1999 by scallop dredge vessels as part of a rotational access program.
- The northern part of the Nantucket Lightship habitat closure – at the time, it appeared unlikely to continue as a habitat management area.
- Georges Bank canyons – not appropriate to some of the objectives, such as fishing impact studies, or comparisons of high vs. low energy habitats
- Fingers area (Southern New England) - no nexus to proposed or current management areas.
- Cox Ledge – not recommended because the proposed HMAs on Cox Ledge and 19 Fathom Bank are approximately 27 mi^2 and 55 mi^2, so the treatments areas associated with fishing impact studies would likely impact much of the HMA. In addition, Cox Ledge and 19 Fathom Bank are currently open to all types of fishing, so there is not the possibility for a currently closed and reopened to fishing disturbance treatment, or a closed-closed reference area.
- The New York Bight – there is no nexus to current or proposed NEFMC habitat management areas. Also, at their June 2012 meeting, the NEFMC Habitat Committee discussed forwarding any recommendations about Southern New England/Mid-Atlantic areas that are within the MAFMC region to the MAFMC for their consideration.

These areas were forwarded to the Committee by the PDT but were rejected at the Habitat Committee level:

- Jeffreys Bank
- Cashes Ledge – relatively further offshore, less practical
- Jeffreys Ledge
- Great South Channel

- Northern Edge – relatively further offshore, less practical. Concern about fishery impacts.

As noted above, the Committee felt that a smaller set of areas was more appropriate, so they focused their recommendations on the three areas with industry support.

4 Environmental impacts of spatial management alternatives

There are three types of spatial management alternatives in this document: habitat protection, spawning protection, and dedicated habitat research area designation. These alternatives identify areas within which certain types of fishing activity, by gear type, would be restricted on either an annual or seasonal basis. Measures within Habitat Management Areas (HMAs) and Dedicated Habitat Research Areas (DHRAs) would be implemented year round, while measures within Spawning Management Areas (SMAs) would be implemented seasonally.

This section describes the impacts of these spatial management alternatives on the valued ecosystem components (VECs) identified in the affected environment section of the EIS. Impacts of alternatives related to framework adjustment procedures and monitoring are also evaluated in section 4.4. The analyses are presented by type of management alternative (habitat, spawning, research, framework/monitoring) and then by valued ecosystem component (i.e. physical and biological environment, managed species, human communities and the fishery, protected resources). Within this outline, the discussion of the impacts of the alternatives is organized by region to correspond with the structure of section 2. While the analytical approach and assumptions vary according to alternative type and VEC, some general issues and assumptions common to all alternative type/VEC combinations are described below.

The overall approach for the impacts analysis is to identify the attributes of the various areas that make up each alternative, and then use these attributes, or metrics, to evaluate the impacts of each alternative on the valued ecosystem component in question. Within the sub-region (habitat alternatives) or region (spawning alternative), impacts are compared between each alternative and the no action alternative, and between action alternatives. Metrics include seabed habitat type and vulnerability, fish abundance and hotspots, revenue by gear type, etc. In some cases, the analyses describe these metrics at the alternative level, and in other cases, the analyses describe these metrics at the area level. To be clear, most of the alternatives consist of combinations of individual management areas.

One overarching issue that complicates development of the impacts analyses is that the purposes for the action alternatives do not always map directly to the original rationale for the areas and measures that make up the no action alternatives. In particular, the year round groundfish closed areas (Closed Areas I and II, Nantucket Lightship, Western GOM, Cashes Ledge) are included in the no action habitat management alternatives and the no action spawning alternatives, but they were primarily designated to meet mortality reduction objectives, which is not an objective of this amendment. Thus, the analyses will address how the action alternative areas and measures meet the purpose and need of this amendment relative to how well the no action areas and measures meet the purpose and need of this amendment. This is different that an evaluation of how well the no action areas perform relative to their original intended purpose.

Another overarching issue is that it is difficult to specify with any certainty how fishing effort will shift in response to alternative spatial management scenarios. However, the impacts of any alternative are directly related to the displacement of fishing effort that results from any particular management area or combination of areas. The analyses in this section will attempt to estimate how fishing effort may shift under the various alternative scenarios, and assess the costs and benefits of such shifts. These estimates are challenging to make for a few reasons. First, some of the areas into which effort could shift as a result of the alternatives in this amendment have been closed for many years to certain types of fishing, in some cases for about 19 years. Because fisheries characteristics and stock abundance have changed so much since these closures went into effect, data describing previous effort distributions in these areas may be of little use to predict future effort distributions. Effort distribution data available have changed since 1994 as well; vessel trip reports (VTR), at-sea observer data, and vessel monitoring system (VMS) data were first collected in 1993, 1996, and 2000, respectively, so historical spatial distributions of fishing effort are poorly specified relative to current effort distributions. Nonetheless, these older data may provide insight into possible effort shifts. For example, VTR and observer data clearly show an abundance of gillnet effort on Jeffreys Ledge prior to the implementation of the WGOM closure area in 1998. In some cases, the current distributions of a stock may provide the best insight as to possible future distributions of fishing effort, which is the approach taken with the sea scallop-related analyses.

General approach to the analysis of economic impacts

The economic analysis is comprised of four main components. The first step of the analysis uses Vessel Trip Reports (VTR) to identify the magnitude and composition of fishing revenues in areas currently open to fishing but being considered for area management in the Omnibus Amendment in each sub-region. The second analysis uses the more explicit spatial data contained in the Vessel Monitoring System (VMS) polls to refine the estimate of fishing effort in area alternatives currently open to fishing, for those boats currently utilizing the VMS system. The third component analyzes recreational revenue currently being generated in each of the areas being considered for management. The fourth analysis looks at observer hauls adjacent to currently closed areas to assess the types of benefits and effort shift that might be expected with a reopening of these areas. The Scallop PDT has also conducted an additional analysis to understand the benefits of area management alternatives within Georges Bank, primarily around scallop biomass in the Great South Channel and the northern edge of Closed Area II. What follows is a brief introduction to the approaches used.

Given that the Omnibus Amendment has the potential to affect all federally managed FMPs through area management, it is important to develop as complete a picture as possible of the spatial distribution of fishing effort. The only datasets approaching a census of spatial fishing locations for federally managed fisheries within New England and the Mid-Atlantic are the self-reported VTR and Clam logbook data. Within these datasets individuals report a single spatial position that looks to represent the totality of fishing conducted on a trip. For purposes of reporting these trips are defined as a single statistical area/gear combination, with individuals required to report a new VTR whenever either the gear or statistical area fished changes. Previous studies have identified that the self-reporting underreports these switches in gear and statistical area (Palmer XXXX). Furthermore, given that commercial fishing trips can be quite long, a single spatial point is unlikely to adequately represent the actual footprint of fishing on any given trip. Because of this, the CATT/Habitat PDT developed a statistical approach in order to better represent the footprint of fishing associated with the self-reported spatial data point.

The New England Fishery Observer Program (NEFOP) and At Sea Monitoring (ASM) databases record the spatial potion of haul/set beginning and end points. Fishermen file VTRs regardless as to whether they are carrying observers or not. By joining the observed haul positions with the VTR data, the cumulative distribution function (cdf) of the distance between observed hauls and self-reported VTR points can be estimated. Furthermore, this cdf can be modeled as a function of variables that are reported on all VTRs. This means that the model estimates the probability that all the hauls associated with a trip fall within a given distance from the self-reported VTR location, as a function of variables that would be expected to influence the actual footprint of fishing. For example, it is likely that longer trips have hauls dispersed across larger geographical areas when compared to shorter trips. This in turn means that the VTR locations are less and less representative of the spatial footprint of a trip's fishing activity as trips increase in length. The model can then be used to estimate confidence intervals for the fishing footprint of each and every VTR point in the database, regardless of whether it was observed through the ASM and NEFOP programs. This allows for a more realistic spatial footprint of trips to be represented, which in turn provides a better understanding of the fishing occurring in areas being considered for area management.

The cdf was estimated using a three parameter gamma distribution, which outperformed alternative specifications including log-normal and exponential functions, as determined by Akiaki's Information Criterion. Gear type and days absent explain a large portion of the variability in reporting accuracy, as would be expected, while the area fished (Mid-Atlantic versus New England) has a small but significant effect on the estimated spatial footprint of a VTR trip. The parameter estimates were then used to estimate the 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentile confidence intervals for all the VTR points from calendar years 2005 to 2012.

In order to assess the relative impact of area management alternatives, these confidence intervals were linked to trip-level gross revenues, generated from the VTR reported landings using a monthly average price at the four-digit NESPP4 species code (species plus market category). This revenue was then attributed spatially assuming a uniform distribution for each confidence interval (25 percent of the revenue generated from each trip was attributed to that trip's 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentile rings respectively). Although still an abstraction from reality, the distribution of revenue from a trip based on the statistical analysis of that trip's spatial footprint is more realistic than, and thus an improvement over, attributing all of a trip's revenue to a single point. Areas where fishing is known not to occur, for example on land, or bottom trawl effort within existing habitat management areas, were erased from the spatial footprint of a given trip. Finally, revenue was attributed to each area management alternative by taking the percentage of the confidence interval rings falling within a given alternative, on a trip-level basis.

The spatial analysis conducted with the VTR provides a high level overview of the types, and relative magnitude, of fishing occurring in management alternatives currently open to fishing. However, a more refined spatial dataset exists in the form of VMS. Records and Demarest (2013) estimated a logit model which assesses a conditional probability of fishing, based off of characteristics of the trip (including vessel size and primary gear used on trip) and VMS poll (including imputed speed, depth, depth change, and distance to known fishing hotspots). This model can then be used to assess the probability-weighted effort associated with each VMS poll. In the second component of the Omnibus Amendment's Economic impact analysis, a more refined analysis of the fishing effort within the boundaries of area management alternatives currently open is conducted using this approach for trips monitored by VMS and classified as

Limited Access Scallop fishery, the General Category Scallop fishery, Shrimp Trawl fishery, and Bottom Trawl fishery. It is important to note that this approach classifies a trip based off of the primary gear/landed fish combination and is thus not a full census of trips which could be attributed to each FMP. However, the approach is necessary in order to avoid the double-counting of effort.

Recreational fishing was assessed using VTR data. Unlike the treatment of the commercial data, recreational VTR was analyzed using the traditional inside/outside approach. This means that if a VTR latitude/longitude position falls within an area of interest, the entirety of that report's gross revenue is attributed to that area. Although the caveats to this type of analysis previously highlighted still apply, recreational trips are not subject to observer monitoring, and thus a more rigorous analysis of their spatial footprint is not possible at this time. The revenue itself is generated as a function of the number of anglers reported to have fished on the VTR, since revenue in the recreational fishery is a function of the number of paying customers on a given fishing trip. Average revenue per paying angler was estimated for each state from which recreational trips embarked, using NOAA's Marine Recreational Information Program (MRIP) data. A value for a trip was then generated by multiplying the state-specific average revenue per paying customer by the number anglers reported to have fished on the VTR.

Current management areas are subject to varying exclusions, exemptions, and regulations. Thus, it is not enough to just look at what fishing is currently being conducted within their waters. Instead, observer data from both the ASM and OBDBS programs from the waters adjacent to current closures were used in order to assess the net benefits expected to arise from the management alternatives under consideration. The sample analyzed consisted of all haul and set beginning and end points falling within a ten nautical mile buffer of currently closed areas. Monthly average revenues by species were estimated at the haul/set level, taking care not to double-count the observations. All species contributing > 5% of a haul's revenue in a single month are then reported, in order to understand the potential for seasonal changes in species importance to a given gear type. The dominant species within these areas are then analyzed for their likelihood of generating additional benefits to fishermen, under the assumption that species composition within closed areas is similar to adjoining waters.

General considerations related to analysis of social impacts

The need to assess social impacts emanating from federally mandated fishing regulations stems from National Environmental Protection Act (NEPA) and MSA mandates that the social impacts of management measures be evaluated. NEPA requires the evaluation of social and economic impacts in addition to the consideration of environmental impacts. National Standard 8 of the MSA demands that "Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of over fishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities" (16 U.S.C. §1851(2)(8)). The analysis that follows provides a context for understanding possible social impacts resulting from the proposed measures in the Habitat Omnibus Amendment 2.

It is important to note that the current interpretation of National Standard 8 requires the Council to consider the importance of fishery resources to affected communities and provide those communities with continuing access to fishery resources, but it does not allow the Council to compromise the conservation objectives of the management measures. *Sustained participation* is interpreted as continued access to the fishery within the constraints of the condition of the resource. The long-term conservation and rebuilding of stocks often require that limits be placed on particular gears and/or the harvest of specific stocks. Thus, the law interprets National Standard 8 only as a consideration of continued overall access to fishery resources and not as a guarantee that fishermen will be able to use a particular gear type, harvest a particular species of fish, fish in a particular area, or fish during a certain time of the year.

The need to measure, understand and mitigate the social impacts of fisheries policy is an essential part of the management process. Managers have an obligation to consider how policy changes affect the human context of the fishery, including the direct and indirect impacts on the safety, wellbeing, quality of life, fishery dependence, culture and social structure of communities. These impacts can be felt at the individual, family and community level which can make measuring and considering them difficult as the impact variables are typically differentially distributed. There is general consensus however, as to the types of impact to be considered; the section of the human environment where the impacts may be felt; likely social impacts; and the steps to enhance positive impacts while mitigating negative ones (ICPGSIA, 2003).

A fundamental difficulty exists in attributing social change to specific factors such as management regulations when communities or other societal groups are constantly evolving in response to numerous additional external factors, such as market conditions and technology. Increasingly important influences in coastal communities include demands for recreational uses of the waterfront and tourism. Certainly, management regulations influence the direction and magnitude of social change, but attribution is difficult with the tools and data available. Attribution is particularly difficult considering the dynamic and fluid nature of fishing communities. As a result, while this assessment focuses generally on the social impacts of the proposed fishing regulations, it is recognized that external factors are also influencing change, both positive and negative, in the affected communities. In many cases, these factors contribute to a community's *vulnerability* and ability to adapt to new or different fishing regulations.

Broadly defined, social impacts that need to be considered are the "social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society" (Burdge and Vanclay 1995). Identifying possible social impact variables is a topic of much debate but the development of standard definitions for a set of the most common and consequential social impacts are underway. The current National Marine Fisheries Service "Guidelines for Social Impact Assessment," provides some assistance in defining relevant social factors/variables. It is suggested that the following five social factors/variables should be considered when comparing the preferred management alternative to the alternatives not selected:

- The *Size and Demographic Characteristics* of the fishery-related work force residing in the area; these determine demographic, income, and employment effects in relation to the work force as a whole, by community and region.
- The *Attitudes, Beliefs and Values* of fishermen, fishery-related workers, other stakeholders and their communities; these are central to understanding behavior of fishermen on the fishing grounds and in their communities.
- The effects of proposed actions on *Social Structure and Organization*; that is, changes in the fishery's ability to provide necessary social support and services to families and communities.
- The *Non-Economic Social Aspects* of the proposed action or policy; these include life-style issues, health and safety issues, and the non-consumptive and recreational uses of living marine resources and their habitats.
- The *Historical Dependence on and Participation* in the fishery by fishermen and communities, reflected in the structure of fishing practices, income distribution and rights. (NMFS, 2007)

Longitudinal data describing these social factors region-wide and in comparable terms is limited, though the new surveys currently being implemented will begin to alleviate this. For this amendment the "guidelines" document provides a range of variables to consider when predicting potential social impacts. It should also be noted that the academic literature on the subject has provided multiple lists of potential social variables, but it also cautions that such lists should not be considered "exhaustive" or "a checklist" (ICGPSIA, 1994; Vanclay, 2002; Burdge, 2004).

This DEIS considers and evaluates the effect management alternatives may have on people's way of life, traditions, and community. These social impacts may be driven by changes in fishery flexibility, opportunity, stability, certainty, safety, and/or other factors. While it is possible that the social impacts of some measures under consideration will be experienced solely by one community group or another; rather, it is likely that some impacts will be experienced across communities, fisheries, gear sectors, and vessel size classes.

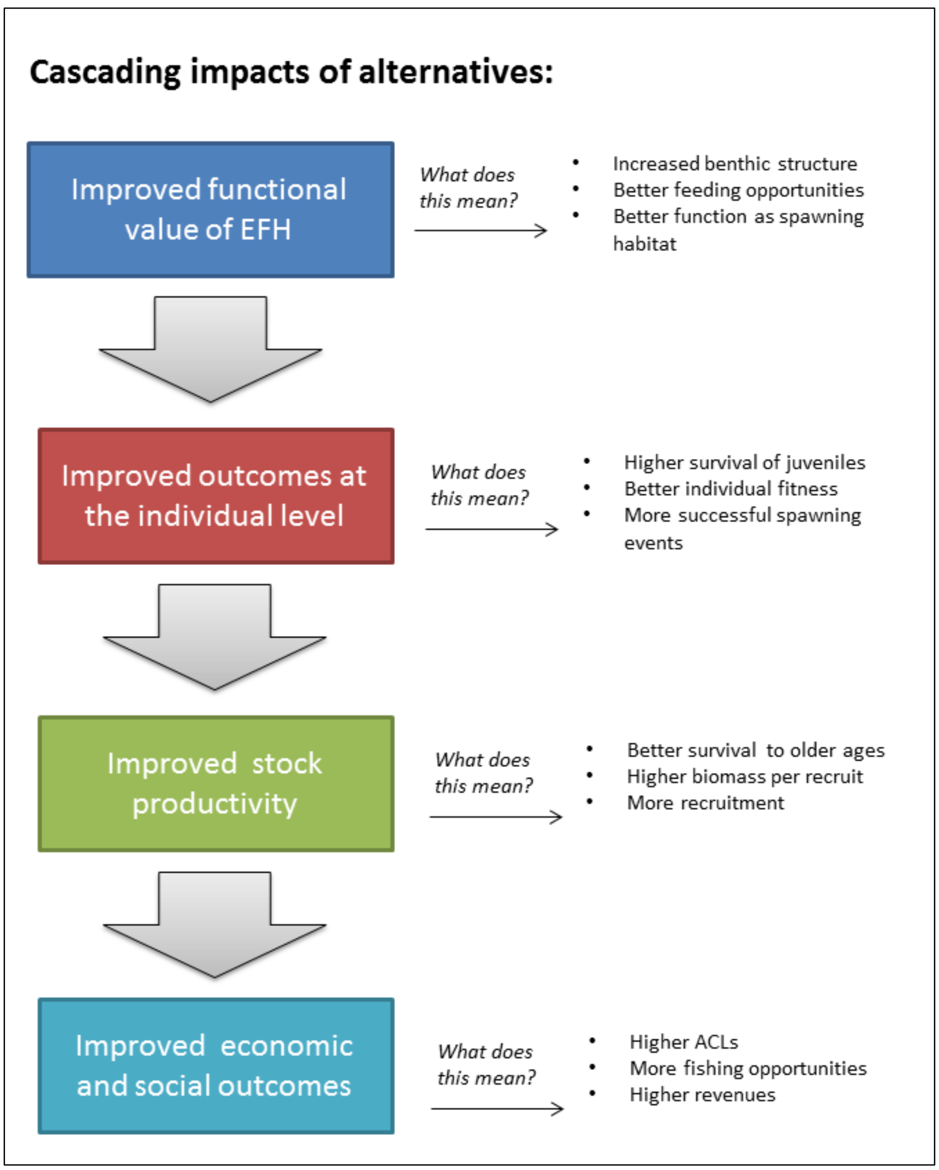
While some management measures tend to produce certain types of social impacts it is not always possible to predict precise effects when there are multiple overlaying management measures such as in this proposed action. There is also a wide variation in the acceptance of area closures among stakeholders based on the intended goals (reduce bycatch, protect spawning aggregations, protect EFH etc.) of a possible closure and its duration (temporary, seasonally recurring, or permanent) (Pita et al. 2011). The difficulty in defining the social impacts of closed areas is inextricably tied to their variability and how they are perceived by stakeholders (Pomeroy et al. 2007).

Also changes to the human environment often occur in small, incremental amounts and the character of a particular impact can be hidden by the gradual nature with which it occurs. As such there is high uncertainty in the relative strengths of the impacts. Therefore the discussion of social impacts for alternatives will indicate the likely directional impacts of specific measures e.g., positive, negative, or neutral. The analysis is generally qualitative in nature because of the limitations of determining effects over the large geographic areas under consideration.

4.1 Alternatives to minimize the adverse effects of fishing on EFH and improve protection of juvenile groundfish habitats

The impacts of the habitat management alternatives on the various VECs are closely linked, and are expected to accrue over various timescales. These management alternatives were developed with the amendment's goals and objectives in mind. These include minimizing the adverse effects of fishing on EFH, and improving productivity of groundfish resources, among others (see Volume 1). Minimizing the adverse effects of fishing on EFH is important because it is a requirement of the Magnuson-Stevens Act, but the reason for doing so is that improving the functional value of a fish's habitat should improve survival and fitness. This should improve the stock overall, which should improve economic and social outcomes (Figure 2).

Figure 2 - Linkages between VECs and impacts



Information relating managed species of fish to the habitats they occupy and the functional value of those habitats in enhancing resource productivity is crucial in order to identify habitat management measures that will minimize the adverse effects of fishing to the extent practicable. The productivity of an exploited resource population is a function of recruitment, the process by which younger age groups that are below harvestable size are added to the population, and growth. Natural processes that increase the number of small fish that reach a size at which they enter, or recruit to, the exploited population and/or the rate at which they reach the size at recruitment, build stock biomass and enable higher catches. Mortality caused by natural processes reduces the numbers and biomass of fish that can be harvested. Recruitment is affected by a number of factors, including the number and sizes of spawning fish, the feeding success of young fish, predation, and environmental variables such as temperature and the availability of suitable habitat that affect the survival of eggs, larvae, and pre-recruit age groups of fish.

Because it is affected by so many factors, it is very difficult to quantify the link between recruitment and habitat protection. There are many cases in which large year classes of fish are produced and sustain exploited populations for years once they reach harvestable sizes without any clear explanation as to what processes caused such high survival of the early life history stages. However, because recruitment is a function of growth and survival, information that demonstrates that the survival and/or growth rates of juvenile fish are higher in certain habitat types serves to identify habitats that would benefit from conservation measures designed to minimize the adverse effects of fishing. If recruitment rates increase as a result of habitat protection measures implemented in this amendment, the productivity of managed species with life stages that rely heavily on benthic habitat for their survival and growth can be expected to increase.

There are a number of studies demonstrating the importance of complex bottom habitats in providing optimum conditions that enhance the survival of recently-settled and older juvenile fish. Complex, highly-structured benthic habitats are relatively rare in continental shelf waters and are used by many species to reduce predation risk and provide food (Caddy 2008, 2013). If suitable habitats are limited, or if the abundance of juveniles that rely on these critical habitats exceeds the amount of suitable habitat that is available, ecological “bottlenecks” to recruitment are created. Fishing gears and practices that reduce the quality and quantity of suitable habitat for these species can be expected to reduce recruitment rates and stock productivity.

Atlantic cod have been the subject of a considerable amount of research in the Northwest Atlantic aimed at defining the affinity of different life stages with complex bottom habitats and the effect of habitat type on growth and survival, particularly for the younger age groups. Several studies in U.S. and Canadian waters have shown that cod move into deeper water as they grow (refs). A number of field studies conducted in shallow water show that survival rates of juvenile cod were higher in more structured habitats (e.g., in vegetation or rocky reefs and on cobble bottoms) where they find refuge from predators (Linehan et al. 2001, Tupper and Boutilier 1995). In one of these studies, growth rates were also higher in vegetated habitats. Laboratory experiments performed in habitat types of varying complexity with and without predators present have confirmed that juvenile cod, especially young-of-the-year juveniles, survive better in more structured habitats where they are less susceptible to predation (Lindholm et al. 1999, Borg et al. 1997, Gotceitas et al and other refs). Lindholm et al. (2001) used a dynamic model to link patterns in habitat-mediated survivorship of post-settlement juvenile cod with spatial variations in habitat complexity.

In deeper water, Lough et al. (1989) used a submersible and trawl survey data to show that recently-settled cod and haddock were found primarily on a large pebble-gravel deposit in the northeastern edge of Georges Bank at depths of 70-100 meters. They hypothesized that the gravel habitat favors their survival through predator avoidance and may be essential to the recruitment success of the Georges Bank gadid population. In a follow-up paper, Lough (2010) used 1986 and 1987 estimates of pelagic juvenile abundance to estimate settlement mortality rates of 3 to 8% per day. Because the juveniles were much more abundant in 1987 than in 1986, but recruitment at age 1 in both years was similar, he concluded that the mortality of demersal juveniles was much higher in 1987 and that the limited gravel on the northern edge of the bank area may represent a survival bottleneck.

Evidence that complex habitats enhance the survival of juvenile fish in other habitat types is provided by research done in sandy bottom habitats in the Mid-Atlantic Bight. Here, structure is provided by bedforms (sand waves) of varying heights and biogenic structure such as tubes, shell beds, or pits. Similar habitat types exist on Georges Bank and in southern New England and in areas of sandy sediment in the Gulf of Maine. Diaz et al. (2003) found more fish associated with larger bedforms that had some biogenic structure. Proximity of complex and simple habitats was important in providing refuge from predators in more complex habitats during the day and foraging opportunities in simpler habitats at night. Such diel patterns of habitat use would be expected to enhance survival and growth. Scharf et al. (2006) exposed prey species of fish (winter flounder, scup, and black sea bass) to predation in habitats of varying complexity in the laboratory and showed that survival increased with greater habitat complexity (bare sand, shell, and sponge). Significant species x habitat interactions implied that the impact of reduced seafloor complexity may be more severe for some species than for others.

The habitat management alternatives analyzed in this section consist of groups of areas designed to minimize the adverse effects of fishing on seabed habitats. A number of the areas were developed based on juvenile groundfish distribution hotspots, while others were based on the distribution of specific habitat types vulnerable to fishing. Existing areas that make up the no action alternative are either closed to gears capable of catching groundfish, with exemptions (the existing groundfish closure areas), or closed to mobile bottom-tending gears (the existing habitat closure areas). For the action alternatives, the Council can select from four different possible fishing restriction measures in developing a proposed action:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>

- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at 30 fathoms per side. Use of dredges would be permitted.

The exception to this is the Ammen Rock area, which would be closed to almost all types of fishing, and the areas that have just Option 1 and 2 or just Option 3 and 4.

A few general assumptions are made in the analyses relative to how fishing effort will be resdistributed, depending on whether option 1, 2, 3, or 4 is selected.

If option 1 is selected, all mobile bottom-tending gear use would be displaced from the area. For some of the areas, this would represent a continuation of measures already in place, but for other areas, these gears would be newly excluded. Mobile bottom-tending gears would include bottom otter trawls used to target groundfish, scallops, and shrimp, including small mesh trawls. Mid-water trawls would not be excluded. Mobile bottom-tending gear also includes all scallop dredges, regardless of size/width, and all clam dredges, both hydraulic and dry dredges.

If option 2 is selected, fishing with hydraulic clam dredges would be permitted, but other types of mobile bottom-tending gear would be prohibited, including dry clam dredges. The assumption is made that fishing effort by any bottom-tending trawls or non-hydraulic dredges would be displaced from any areas currently fished by these gears.

A possibility with options 1 and 2 is that vessels could switch to using fixed gears to catch the same species. However, this is likely very expensive, and might require acquisition of a new fishing vessel.

If option 3 or 4 is selected, a few different outcomes are possible. One possibility is that trawl vessel operators would choose fish in an area using the modified gear type if the trawl gear restriction is enacted, with similar numbers and distributions of trips and tows as in previous years, subject of course to changing catch limits and other restricitons. Another possibility is that vessel operators will fish less in the area after the gear modification is required, because the modified gear requirements compromise operations in some way (e.g. efficiency is reduced). Another possibility is that trawl operators will outfit themselves with the modified ground cables and use them in all areas they fish, to avoid the need to switch back and forth, such that the impacts of the modified gears would extend to other areas of the region.

It is very difficult to assess which outcome is most likely, and an individual operator's choice may depend on the characteristics of their vessel, as well as the amount of fishing they normally do within any areas currently open to them.

Maine and Massachusetts shrimp trawl vessels are likely already compliant with options 3 and 4 based on current regulations:

- Maine – The maximum length of the bottom legs of the bridle of any shrimp trawl net shall not exceed 15 fathoms of uncovered bare wire.

- Massachusetts **–** It is unlawful for any vessel to fish for shrimp with a net having: i. more than 90 feet between the trawl doors and trawl wings, including the ground cables, bridles, and legs. ii. bottom legs of other than bare or uncovered wire or chain.

Each sub-region also includes a no habitat management area alternative. This would mean that mobile bottom-tending gears would not be restricted on the basis of benthic habitat conservation in that sub-region, although they might be restricted as part of a spawning management area restriction, seasonally or year-round, depending on the spawning alternative selected. Even without habitat management areas, some areas may still be lightly fished by mobile bottom-tending gears because they are difficult to fish with these gears. However, it is difficult to know to what extent complex seabed habitats are self-protecting because they are not fishable. This is true of areas that are currently open to MBTG where benthic habitat types are patchy, but the resolution of habitat characterization data and/or fishing effort data are fairly coarse, and it is especially true of areas currently closed to MBTG where there is no data on patterns of fishing in relation to habitat type. The assumption under this no-closure alternative is that MBTG vessels would fish within a sub-region in a way that balances available fishing quota for species found in the area, operating costs, and responds to market factors including prices.

Beyond the distribution of MBTG effort, another consideration for options 2, 3, and 4 that allow some types of mobile bottom-tending gear use is that the use of these gears may influence the distribution of commercial fixed gear effort, or recreational fishing effort. Patterns of effort by fixed vs. mobile gear type are likely to vary in an open area or area where some MBTG can be used vs. within an area where MBTG are completely prohibited, but fixed gears and/or recreational fishing are allowed.

4.1.1 Physical and biological environment

The impacts of the various habitat management alternatives on the physical and biological environment are evaluated using the Swept Area Seabed Impact (SASI) approach. This introductory section explains how the SASI results are used to understand the impacts of the various habitat management alternatives proposed in this amendment.

A major premise of the Swept Area Seabed Impact (SASI) approach is that the overall magnitude of the adverse effects of fishing on habitat is related to the total amount of contact between fishing gear and the seabed. Thus, if fishing can be done in such a way as to minimize seabed contact, it will help to reduce the magnitude of adverse effects. There are a few different ways to minimize seabed contact: reduce the overall amount of fishing, fish in areas with higher catch per unit effort (CPUE), such that the same amount of fish can be caught with less fishing time, and thus less seabed contact, or use gear types that have less seabed contact.

The SASI analysis concluded that: (1) mobile bottom-tending gears have a greater per unit area impact than fixed bottom-tending gears, and (2) they have a greater overall magnitude of impacts, combining the fact that individual mobile gear fishing events contact more of the seabed than individual fixed gear fishing events with the overall amount of effort by mobile vs. fixed gears. **Due to the much greater magnitude of mobile vs. fixed bottom-tending gear impacts, eliminating mobile bottom-tending gear use in an area should reduce the adverse effects of**

fishing on seabed habitats significantly. Thus, the habitat management options generally focus on mobile bottom-tending gears.

Within habitat management areas, complete closure to all mobile bottom-tending gears (**Option 1**) is one type of measure that can be used to achieve adverse effects minimization objectives. **Setting aside issues surrounding the redistribution of fishing effort, in terms of protecting vulnerable seabed habitats from the adverse effects of fishing, the greatest <u>local</u> reduction in adverse effects to the seabed will be achieved if all bottom-tending fishing is prohibited from the area.** This is the measure employed in all of the existing habitat closure areas (JB, CL, WGOM, CAII, CAI, NLCA).

Similarly, **Option 2** would enact a complete closure to all mobile bottom-tending gears, but allow an exemption for hydraulic clam dredges. The rationale for this exemption is that hydraulic dredges can only be used in sands and fine gravels, which are less vulnerable to the adverse effects of fishing as compared to cobble- and boulder-dominated habitats. **Cobble- and boulder-dominated habitats are patchily distributed amongst sand- and granule-pebble-dominated areas in the SASI habitat map, so the assumption is that hydraulic clam dredges, if exempt from HMA restrictions, would be operating in the sand and fine gravel patches intermixed between areas dominated by cobble and boulder.** While it might be possible to define the boundaries of HMAs so that they cover cobble-boulder areas and avoid sand and granule-pebble areas, this is somewhat difficult to achieve in practice due to the patchiness of the substrate distribution. Thus, a compromise is to allow gears that could only fish in the sand- and granule-pebble-dominated parts of the HMA to continue to operate there. While hydraulic clam dredges are exempted from the year-round groundfish closure areas based on the rationale that they have limited bycatch of groundfish, they are not exempted from any of the current habitat closure areas. Note that in some areas, a hydraulic clam dredge exemption would make no difference in terms of habitat impacts because there are few clams and no clam fishing effort.

In addition to the fact that they cannot be used on certain habitat types, the per-trip area swept for hydraulic clam dredges is relatively low as compared to the per trip area swept for scallop dredges and otter trawls. Thus, the overall area swept by hydraulic dredges is low relative to other mobile bottom-tending gears.

However, over sand- and granule-pebble-dominated seabed types, the per unit area impact of hydraulic clam dredges is high relative to scallop dredges and otter trawls, and hydraulic dredge impacts were estimated to be greater in low energy areas than in high energy areas, due to longer estimated recovery times for geological and biological features in low energy environments. Thus, the seabed impacts associated with a hydraulic dredge exemption would be higher in low energy HMAs as compared to high energy HMAs, given similar levels of fishing effort. This does not account for the relative distribution of clams and clam fishing effort between high and low energy areas; both the clams and clam effort tend to be concentrated in high energy areas where recovery would be somewhat more rapid.

Options 3 and 4 would allow mobile bottom-tending gear use, but restrict ground cable configuration and length (Option 3) or prohibit ground cable use (Option 4).

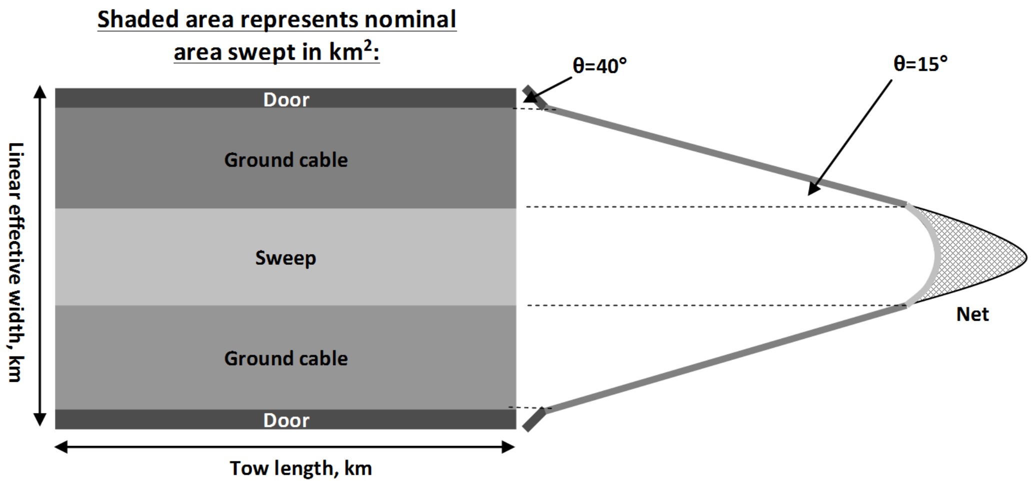
Ground cables are defined as wire ropes extending along the seabed between the trawl doors and the bridles or net; they serve to herd fish and increase the area of seabed fished (swept) by the trawl. Ground cable diameter can be increased be passing the wires through rubber disks (cookies) or rollers as show in Figure 3; this modification is designed to assist passage of the ground cables over the seabed. Ground cables are typically constructed from steel wire rope (twisted), often with small diameter rubber disks (cookies) compressed together along the entire cable length. There are some reports that a few fishermen use chain as an alternative to wire rope. Cable diameter ranges from $^{9}/_{16}$ inch to ¾ inch, with 1¾ to 3 inch diameter cookies (2 inch to 2 $^{3}/_{8}$ inch cookies are commonly used).

Figure 3 – Ground cable with cookies

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 obstructions that can catch or damage the gear. Some fishermen do not vary ground cable length much under different circumstances as changes in cable length may affect 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, nor is it known under which circumstances fishermen make such a change.

In comparison with the sweep and the doors, ground cables are the longest element of bottom trawl gear and thus they contribute the greatest proportion of area swept for a given fishing event (Figure 4 shows the relative contribution of each gear element to the effective width of the gear). **Thus, shortening their length and/or reducing their contact with the seabed provides a mechanism to reduce gear width, <u>assuming that the total length of the tow does not change.</u>**

Figure 4 – Schematic of trawl gear (top down view) showing the relative contribution of doors vs. ground cables vs. sweep to gear width/area swept. Not to scale.



Given some straightforward assumptions about angle of attack, and holding all else constant, it is possible to estimate the reductions in linear effective gear width that could result from shortened cable lengths. In addition, gear contact with the seabed may be reduced if ground cables are raised above the seabed with elevating disks. This also provides a mechanism to reduce area swept. However, in order to understand if there is a **net benefit** for use of these types of gear modifications to minimize total area swept, other information is needed:

- **What is the cable length/configuration/catchability trade-off for target species?**
  - If catchability is reduced with shortened cables, how does tow length/duration increase to compensate to achieve the same total catch? Would gear modifications lead to a net increase in area swept, and thus EFH adverse effects, within restricted areas because modified ground cables catch fewer fish?
  - How does this relationship vary by species?
  - What other changes might be made to the way the gear is rigged or fished to allow fishermen to compensate for reduced ground cable lengths?

- **What will the distribution of effort look like after the ground cable restrictions are implemented?**
  - Will reduced catchability cause vessels to fish elsewhere, thereby minimizing adverse effects within the area?
  - Can target species within the ground cable area be captured using other gear types instead of trawls, e.g. gillnets or longlines?
  - Is the target species readily available in other locations?

- **What is the effect of area size on the enforceability of ground cable length limit measures?**

- **Does the ground cable length cap represent a significant reduction?**
  - 45 fathom limit is close to a typical maximum size

- No ground cables represents a much greater % reduction
- These changes may be easier to make on some vessels as compared to others.

In terms of enforceability, there may be lessons in the way that the multispecies exemption areas are regulated. For example, exemption areas that allow the use of small mesh, have strict stowage requirements for small mesh nets when transiting other areas, and require vessels to carry letters of authorization. There are also strict possession and landings limits for non-target multispecies.

Past changes to fishing gears have been authorized following extensive field trials of the new gear type to determine how target and non-target species catches are affected. There is one good example of ground cable changes made in the North Pacific where habitat protection was one of the primary management objectives. Scientists and fishermen in the Bering Sea have examined the habitat and bycatch related benefits and costs to industry of ground cable changes (Rose et al. 2009, Rose et al. 2010). The wire ground cables (called sweeps in the North Pacific) were raised off the seabed by adding cookies of various sizes at various spacing intervals. They examined changes in the catch of target and incidental species and found that seafloor contact could be reduced with relatively low associated losses in catch. As of 2011, Bering Sea flatfish trawlers must use the reduced contact gear.

While there are some lessons that can be taken from the Bering Sea work, there are limits in terms of applying this work to our situation in the Northeast. Specifically, the Bering Sea flatfish trawl fishery operates primarily on mud and sand substrates, and prior to the new regulations, most vessels used cables made of coated wire. Here, the habitat management areas include a mix of sand, granule-pebble, cobble, and boulder-dominated areas, and cable construction appears to be about 50/50 bare wire vs. cookies, according to the observer data examined for Georges Shoal and the Great South Channel. Chains, rollers, and rockhoppers are also reported as ground cable materials.

Also, it is not clear whether widely spaced elevating disks would allow the gear to pass over the types of geological and biological structures found in the proposed habitat management areas. The Bering Sea study (Rose et al 2009) found that the sweeps with disks only contacted the seabed at the disk positions, whereas the bare wire sweeps raised sediments clouds along their length, but they note that the structure-forming seafloor organisms of the eastern Bering Sea are generally 'small and flexible' and that elevating the cables by a few centimeters would not prevent contact with larger organisms. Similar experiments in the Northeast would be required to provide the knowledge necessary to fully gauge the net effect of gear modifications on EFH.

Two pilot studies have been conducted in the Northeast region and the results of one of the studies were provided to the PDT. A 6-day, May 2013 paired vessel study in Ipswich Bay compared standard ground cables with ground cables of the same length that used the elevating disks, as proposed by Option 3. Five one-hour tows were made each day, and the modified ground cables were moved from vessel to vessel on a daily basis. Six species were caught in sufficient numbers to statistically analyze differences in catch rates between the two nets. Three species, witch flounder, American plaice, and yellowtail flounder, were caught at significantly lower rates with the modified (disk elevated) ground cables. Three other species, silver hake, winter skate, and winter flounder, showed no significant difference in catchability between the two nets. Total catch was significantly higher with the standard net. Given the observed catch rates, the preliminary study report estimated that total fishing time would need to be about 18% higher to maintain the same catch with the modified ground cables as compared to the standard cables. While it appears that the modified cables raise the gear off the seabed somewhat, it is not clear that this reduction in contact would compensate for the necessary increase in tow length. It is important to note that this study should be regarded as a pilot project, and the results should not be extrapolated overmuch to other areas, vessel sizes, habitat types, or species.

In summary, the size and direction of changes in adverse effect estimates could be calculated using applications of the SASI model, but only if effort distribution is well understood and changes in area swept can be estimated pre- and post- gear modification. **Because the effect of ground cable modifications on species catchability, and therefore on area swept, is not well understood, it is very difficult to say with any certainty that there would be a habitat benefit of requiring ground cables with elevating disks in habitat management areas.** However, the pilot study does indicate that the modified ground cables can at least be used by regional fishing vessels, and the 45 fathom length limit per side is not expected to be particularly constraining, given that many vessels use shorter cables. Overall, Option 3 likely has negative impacts on seabed habitats as compared to Options 1 and 2, but this assessment is uncertain.

The impacts of the option to eliminate ground cables entirely (Option 4) may be somewhat different. Comments made during informational interviews indicated that this requirement would be less constraining for smaller vessels than larger ones, because smaller vessels already use relatively short cables. Shrimp vessels in particular already appear to comply with this restriction, based on their gear requirements. It is possible that under a no-ground cable requirement, some effort would simply be displaced into other areas. Overall, it is not possible to determine the effect of a no ground cable measure on catchability, and therefore on overall swept area and adverse effects. Thus, it is not possible to quantify, or really even qualify, the impacts of option 4 as compared to options 1 and 2.

This tables and figures below summarize habitat vulnerability and habitat type by management area. These results can be used to evaluate the impacts associated with habitat management measures. Table 18 shows the minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). A grid was considered overlapping if its center point (centroid) fell inside the management area.

These results are shown graphically on the following figures:

- Figure 5 – Eastern GOM, one panel per area
- Figure 6 – Central GOM, one panel per area
- Figure 7 – Western GOM, one panel per area
- Figure 8 – Western GOM, single panel for all areas
- Figure 9 – Georges Bank, one panel per area
- Figure 10 – Georges Bank, single panel for all areas
- Figure 11 – Great South Channel and Southern New England, one panel per area

The figures are kernel density plots, which show a smoothed distribution of trawl vulnerability scores by area and are similar to histograms. Note that the scale on the horizontal (X) axis varies by region. A density plot cannot be created when there is only a single grid cell overlapping a particular management area, so a few panels are blank.

Mobile gear results are the focus of this section, because these gears were estimated to have a greater impact on seabed habitats as compared to fixed gears, and as such are the focus of adverse effects minimization management measures.

Table 18 – Summary of vulnerability results by habitat management area. Units are km^2.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	Max	*N*	Min	Max	*N*	Min	Max	*N*
Eastern GOM									
Habitat Management Area									
Eastern Maine, small	48.1	114.4	*7*	48.0	115.6	*5*	147.9	156.1	*6*
Eastern Maine, large	41.8	114.4	*21*	48.0	115.6	*5*	147.9	156.1	*11*
Machias	44.5	53.6	*9*	46.0	56.0	*8*	108.1	157.3	*9*
Toothaker Ridge	41.9	52.3	*7*				142.6	156.5	*6*
Central GOM									
EFH closure									
Cashes Ledge EFH	49.7	61.2	*3*				133.5	148.1	*3*
Jeffreys Bank EFH	47.9	75.3	*8*				134.5	155.3	*7*
Groundfish closure									
Cashes Ledge GF	42.1	61.2	*15*				132.6	148.1	*7*
Habitat Management Area									
Jeffreys Bank EFH, modified	59.1	75.3	*4*				134.5	140.4	*4*
Cashes Ledge EFH, modified	49.7	61.2	*3*				133.5	148.1	*3*
Ammen Rock	61.2	61.2	*1*				145.2	145.2	*1*
Fippennies Ledge	52.9	52.9	*1*				139.1	139.1	*1*
Platts Bank	63.0	63.0	*1*	65.2	65.2	*1*	142.0	142.0	*1*
Western GOM									
EFH closure									
Western Gulf of Maine EFH	46.4	61.6	*22*	49.3	52.7	*3*	120.7	148.5	*18*
Groundfish closure									
Western Gulf of Maine GF	46.4	61.6	*33*	49.3	52.7	*3*	120.7	148.5	*19*
Habitat Management Area									

Bigelow Bight, large	43.0	69.1	*27*	44.5	70.3	*18*	110.0	159.9	*27*
Bigelow Bight, small	45.5	57.2	*9*	47.1	55.3	*5*	110.0	154.8	*9*
Jeffreys Ledge	48.3	61.6	*7*				134.3	148.5	*6*
Stellwagen, large	46.4	55.8	*12*	49.3	52.7	*3*	120.7	140.7	*12*
Stellwagen, small	46.4	50.8	*8*	49.3	52.7	*3*	120.7	140.7	*8*
Inshore Roller Gear Restricted Area	42.4	69.1	*100*	44.5	70.3	*48*	108.0	156.9	*83*
Alternate Roller Gear Restricted Area	43.0	69.1	*55*	44.5	70.3	*30*	108.0	159.9	*54*
Georges Bank									
EFH closure									
Closed Area I EFH N	43.9	48.6	*18*				107.1	120.9	*14*
Closed Area I EFH S	44.8	48.7	*5*	47.7	51.7	*5*	107.9	113.5	*5*
Closed Area II EFH	48.3	57.2	*6*	50.7	59.4	*6*	119.2	126.4	*6*
Groundfish closure									
Closed Area I GF	43.9	51.4	*37*	47.0	54.1	*18*	107.1	120.9	*33*
Closed Area II GF	41.7	57.2	*75*	47.4	59.4	*65*	106.5	133.3	*73*
Habitat Management Area									
Georges Shoal Gear Modification Area, large	44.2	72.7	*76*	46.6	75.9	*74*	106.9	133.1	*76*
Georges Shoal Gear Modification Area, small	44.7	72.7	*9*	46.7	75.9	*9*	110.0	129.4	*9*
Georges Shoal MBTG closure	44.2	58.3	*10*	46.6	61.1	*10*	108.0	114.3	*10*
Northern Edge	46.5	57.2	*6*	51.2	59.4	*4*	120.3	132.4	*6*
Southern New England									
EFH closure									
Nantucket Lightship EFH	44.4	50.0	*31*	47.1	52.4	*31*	107.2	133.6	*31*
Groundfish closure									
Nantucket Lightship GF	42.2	49.2	*66*	46.3	51.8	*62*	107.2	136.0	*65*
Habitat Management Area									
Cox Ledge	47.0	48.3	*3*	48.8	50.7	*3*	109.1	111.9	*3*
Great South Channel	44.4	63.2	*26*	47.1	65.5	*26*	108.3	119.2	*26*
Great South Channel Gear Modification Area	44.7	63.6	*20*	47.7	66.1	*19*	109.6	122.8	*20*
Great South Channel, east	44.4	63.6	*34*	47.1	66.1	*34*	108.3	122.8	*34*
Nantucket Shoals	44.4	63.2	*22*	47.1	65.5	*22*	107.3	119.2	*22*
Nantucket Shoals, west	44.4	63.2	*29*	47.1	65.5	*29*	107.3	119.2	*29*

Figure 5 – Distribution of vulnerability scores for trawl gear displayed as density plots. Each panel shows a different management area. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. Within this region, the Machias and Toothaker Ridge areas have very similar and somewhat lower vulnerability scores that are more narrowly distributed, while both Eastern Maine areas contain some higher scores.

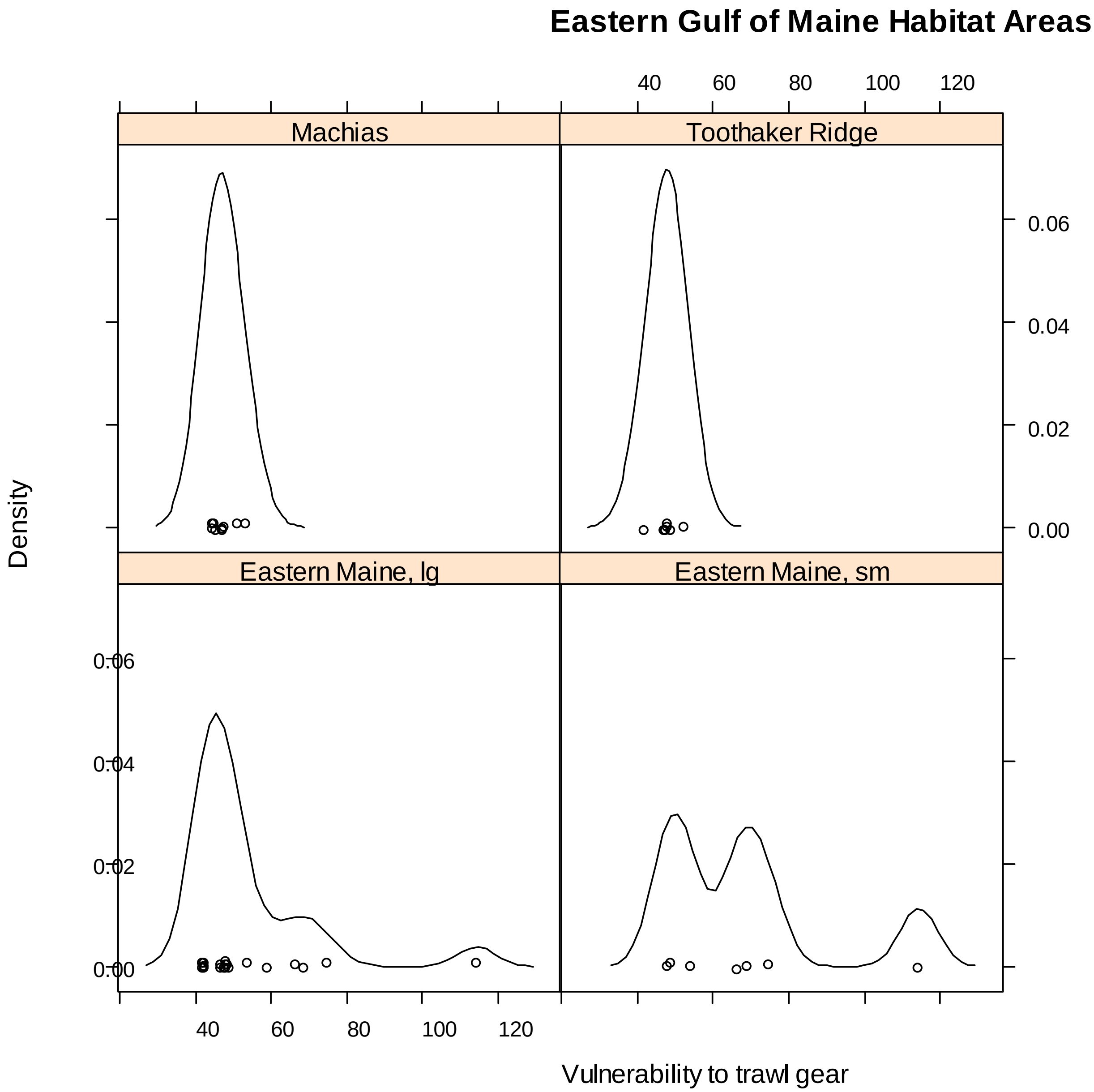


Figure 6 – Distribution of vulnerability scores for trawl gear displayed as density plots. Each panel shows a different management area. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. No curve is shown for areas where there is only a single overlapping SASI grid. Within this region, Cashes Ledge Groundfish has the lowest vulnerability scores, the Cashes Ledge EFH and modified EFH areas have somewhat higher vulnerability scores, and the Jeffreys Bank EFH and EFH modified areas have the highest scores.

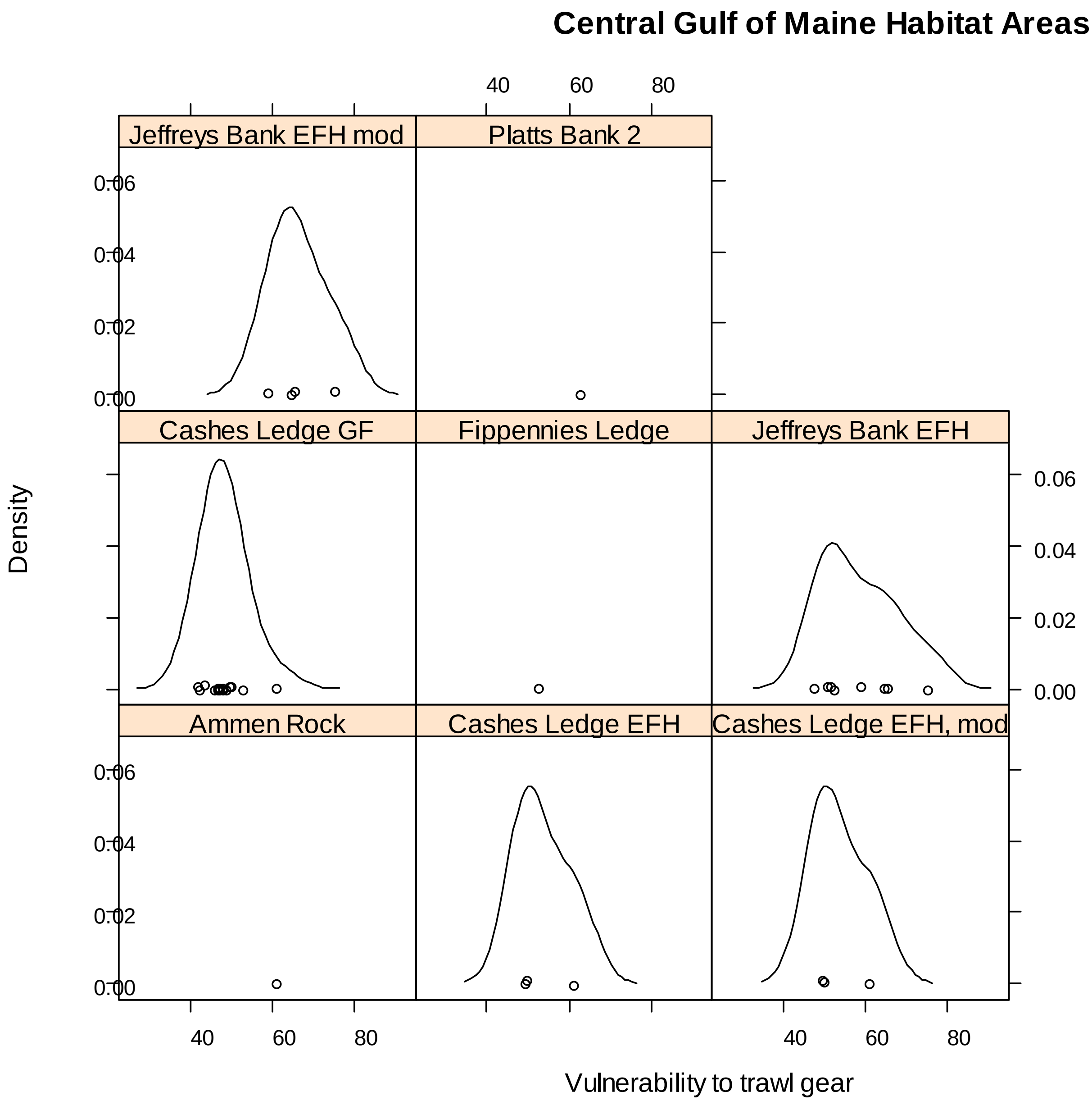


Figure 7 – Distribution of vulnerability scores for trawl gear displayed as density plots. Each panel shows a different management area. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. The distributions are easier to compare using the single panel on the following page.

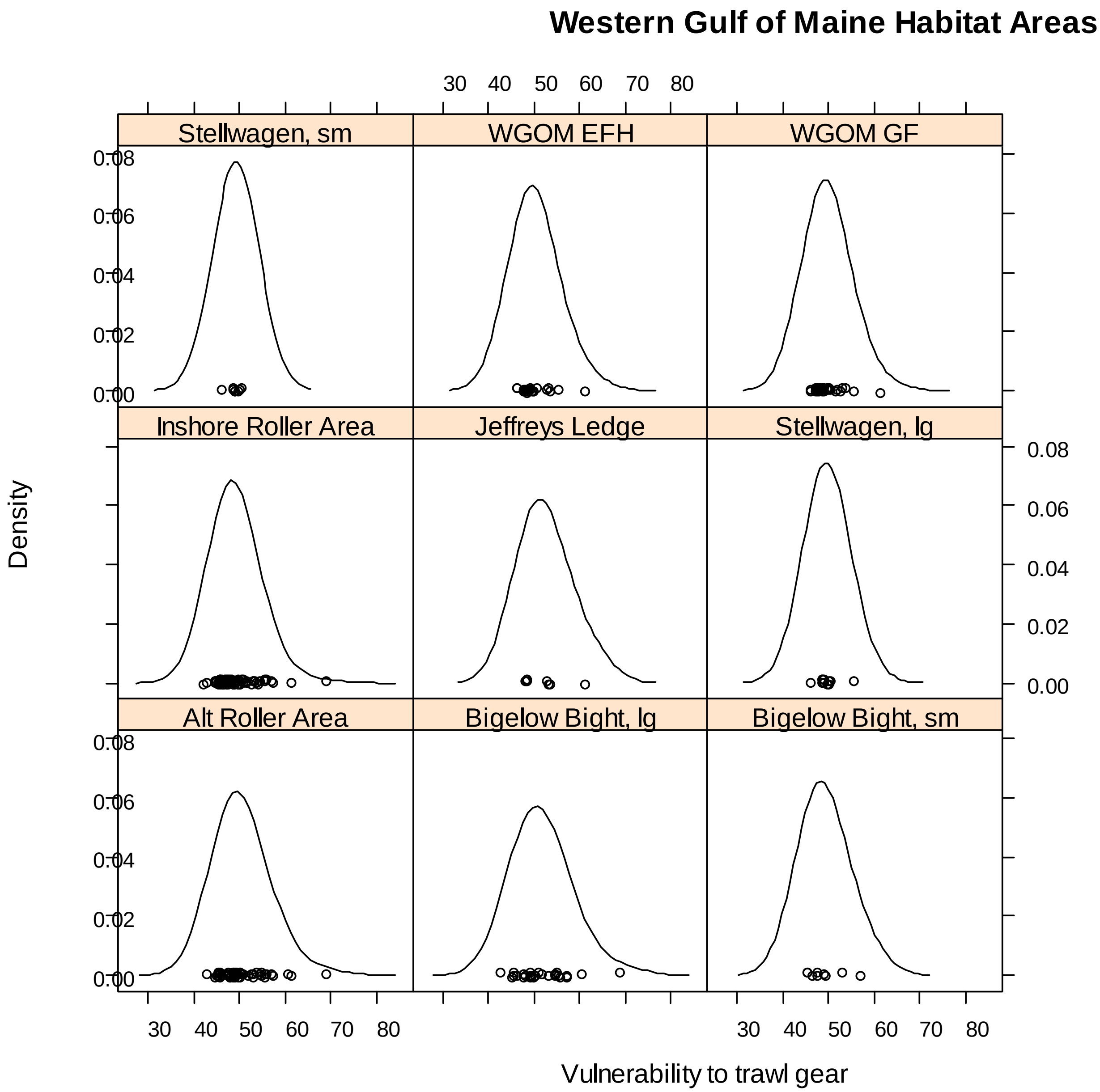


Figure 8 – Distribution of vulnerability scores for trawl gear displayed as density plots, with all western Gulf of Maine areas compared on a single panel. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. The highest density of high vulnerability scores occurs in the Jeffreys Ledge Area.

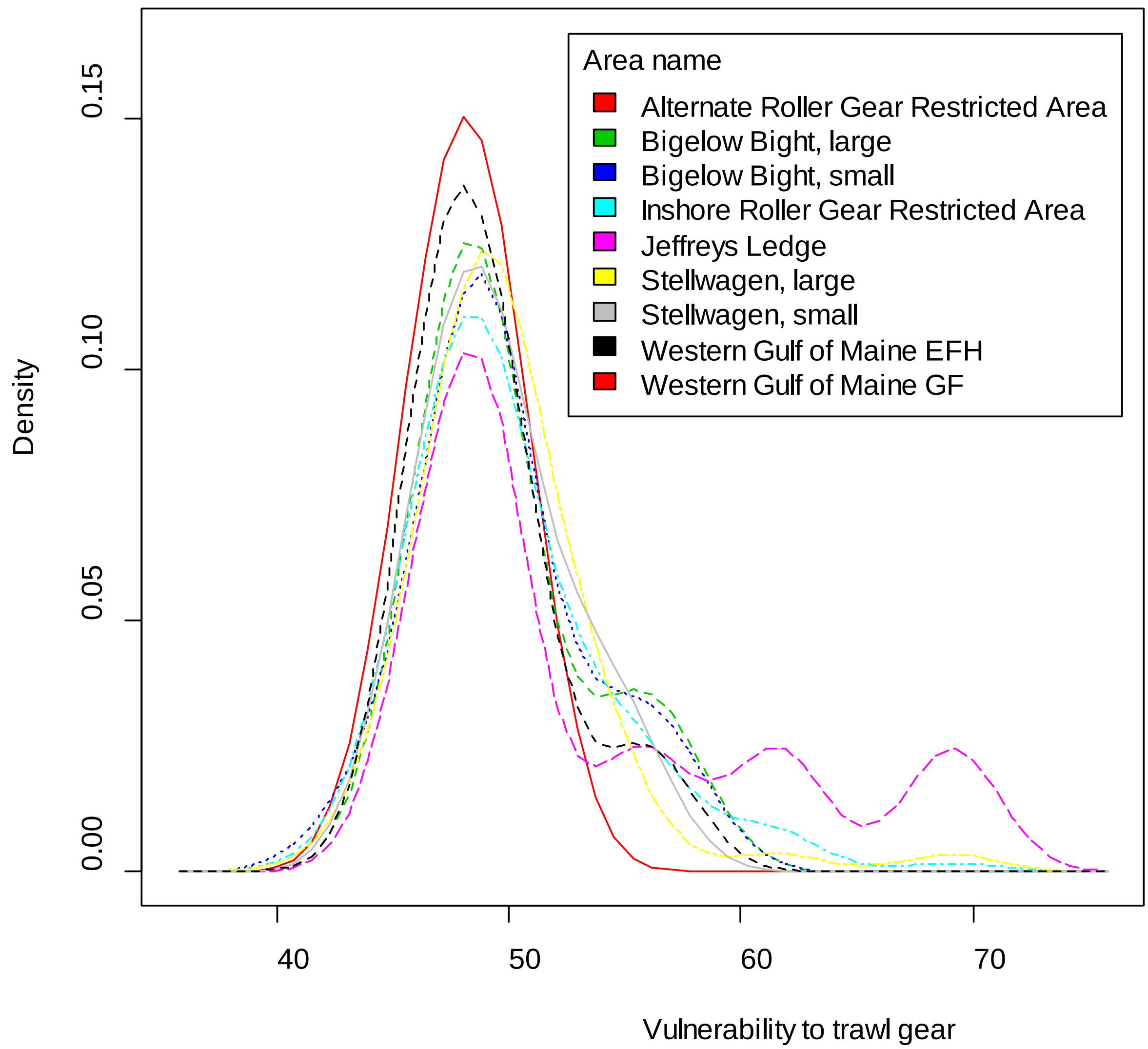


Figure 9 – Distribution of vulnerability scores for trawl gear displayed as density plots. Each panel shows a different management area. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. The distributions are easier to compare using the single panel on the following page.

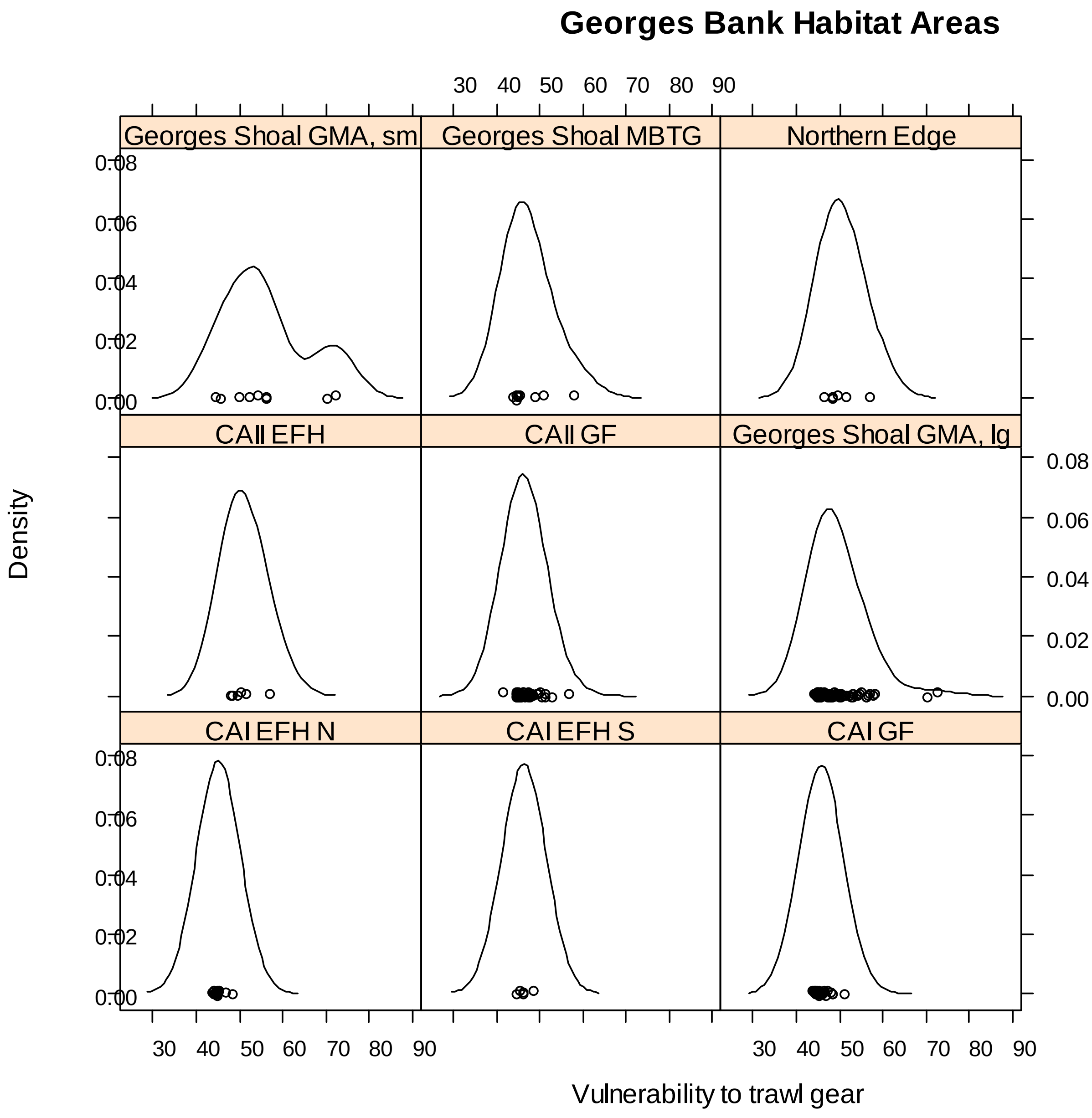


Figure 10 – Distribution of vulnerability scores for trawl gear displayed as density plots, with all Georges Bank areas compared on a single panel. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.

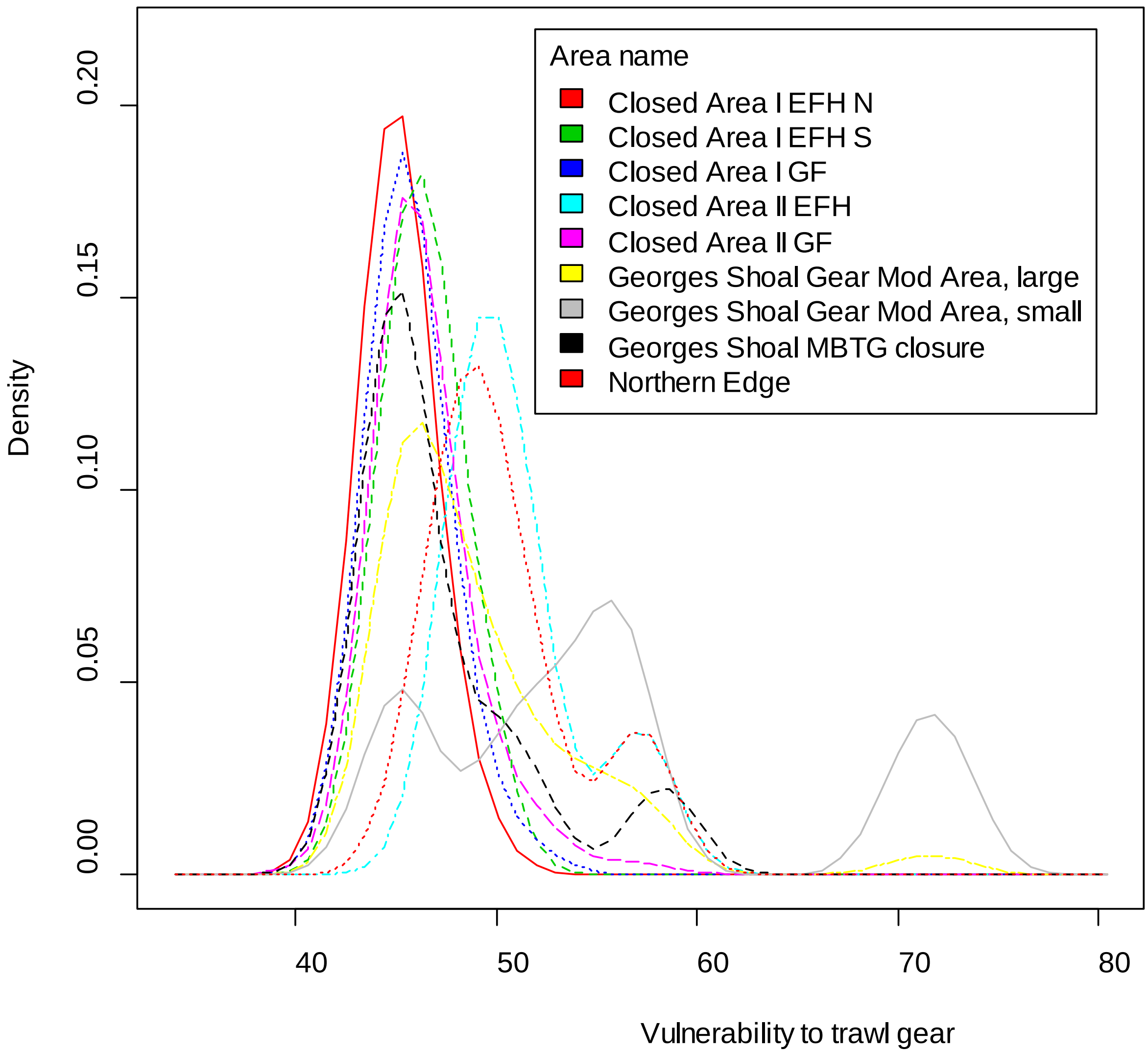


Figure 11 – Distribution of vulnerability scores for trawl gear displayed as density plots. Each panel shows a different management area. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores. In this region, the Cox Ledge areas have very low sample sizes. The Nantucket Lightship EFH and Groundfish areas tend to have lower vulnerability scores. Scores in the various Great South Channel (GSC) and Nantucket Shoals areas are fairly similar in their distribution, and are shifted to the right (higher vulnerability to trawl gear) as compared to the two Nantucket Lightship areas.

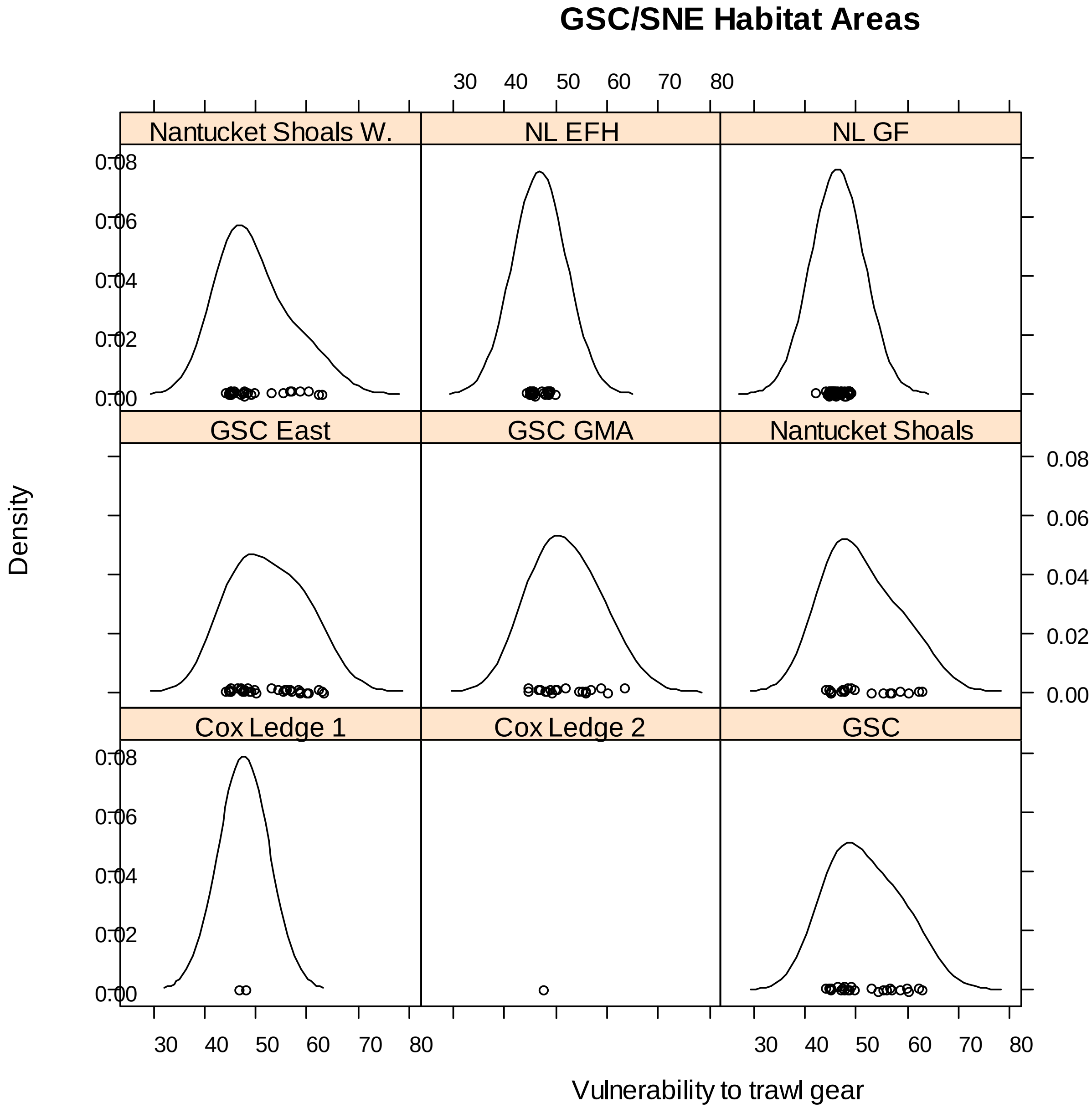


Table 19 – Summary of substrate distribution, data quality, and total size of habitat management areas. Percentages indicate the coverage by area of Substrate and data support values are listed in the text.

Area name, type, and region (number of overlapping unstructured grids)	Energy										Data support							Area, km^2
	Low energy					High energy					Low	Moderate			High			
	M	S	G	C	B	M	S	G	C	B	1	2	3	4	5	6	7	
Eastern GOM																		
Habitat Mgmt Area																		
Eastern Maine, large (112)	85%		8%	7%								38%	54%	8%				1697
Eastern Maine, small (50)	59%		19%	21%								26%	64%	10%				529
Machias (48)			27%			34%	34%	3%	1%			8%	79%	13%				322
Toothaker Ridge (8)	79%		21%								50%	50%						748
Central GOM																		
EFH closure																		
Cashes Ledge EFH (90)	36%	29%	22%		9%					4%		11%	10%	14%	2%	40%	22%	392
Jeffreys Bank EFH (35)	41%	20%	21%	14%	5%						3%	9%			14%	66%	9%	504
Groundfish closure																		
Cashes Ledge GF (188)	65%	20%	10%		3%					1%	1%	11%	7%	8%	4%	43%	27%	1428
Habitat Mgmt Area																		
Ammen Rock (14)		7%		7%	7%		8%		7%	65%						29%	71%	14
Cashes Ledge EFH, modified (86)	37%	22%	25%		11%					4%		10%	10%	15%		41%	23%	335
Fippennies Ledge (41)		40%	32%	11%	16%									5%		37%	59%	41
Jeffreys Bank EFH, modified (39)	9%	36%	20%	13%	22%							3%			31%	59%	8%	521
Platts Bank (54)		34%	15%	9%	14%		11%	5%	5%	8%						65%	35%	63
Western GOM																		
EFH closure																		
Western Gulf of Maine EFH (848)	33%	43%	13%	1%	1%	1%	5%	1%	1%	1%		6%	50%	35%		6%	3%	2256
Groundfish closure																		
Western Gulf of Maine GF (876)	39%	36%	16%	1%	1%	1%	4%	1%	1%	1%		8%	49%	34%		6%	3%	2941
Habitat Mgmt Area																		
Bigelow Bight, large (471)	53%	8%	13%	4%		2%	7%	10%	4%			3%	90%	7%				1696
Bigelow Bight, small (146)	56%	8%	16%	3%		1%	8%	6%	2%			5%	86%	8%				560
Jeffreys Ledge (158)	36%	26%	18%	3%	2%	4%	4%	2%	3%	2%		13%	36%	9%		29%	13%	714
Stellwagen, large (639)	10%	70%	11%	1%			7%	1%				2%	52%	44%		1%	1%	1185
Stellwagen, small (540)	2%	68%	14%				13%	3%					47%	51%		1%	1%	650
Inshore Roller Gear Area (3480)	42%	25%	11%	1%		2%	12%	5%	1%			3%	43%	46%		3%	4%	8384
Alternate Roller Gear Area (2376)	31%	29%	11%	2%		1%	17%	5%	2%			2%	39%	50%		3%	6%	4107

Area name, type, and region (number of overlapping unstructured grids)	Energy										Data support							Area, km^2
	Low energy					High energy					Low	Moderate			High			
	M	S	G	C	B	M	S	G	C	B	1	2	3	4	5	6	7	
Georges Bank																		
EFH closure																		
Closed Area I EFH N (607)		4%				2%	82%	12%				4%	6%	1%	3%	34%	51%	2028
Closed Area I EFH S (263)							92%	7%	1%				3%	2%		60%	35%	617
Closed Area II EFH (1175)	1%	1%					32%	53%	12%					3%		11%	86%	650
Groundfish closure																		
Closed Area I GF (2628)		2%				1%	81%	14%	2%			1%	2%	1%	1%	28%	67%	4063
Closed Area II GF (2904)		5%	1%			1%	84%	8%	2%				3%	2%	1%	49%	45%	6832
Habitat Mgmt Area																		
Georges Shoal Gear Mod Area, large (3876)	1%	3%				1%	65%	19%	9%				3%	5%	2%	39%	50%	6930
Georges Shoal Gear Mod Area, small (538)							49%	26%	24%				5%	20%	1%	62%	12%	1050
Georges Shoal MBTG closure (212)						1%	78%	16%	5%				28%	19%	12%	35%	6%	946
Northern Edge (949)	2%	8%					26%	51%	12%					1%		2%	96%	436
Southern New England																		
EFH closure																		
Nantucket Lightship EFH (603)	3%	32%				1%	62%	2%	1%			5%	23%	3%	3%	54%	11%	3354
Groundfish closure																		
Nantucket Lightship GF (3509)	12%	28%				2%	54%	3%				1%	2%	1%	1%	22%	73%	6066
Habitat Mgmt Area																		
Cox Ledge (37)						6%	73%	6%	6%	8%		24%	22%		6%	48%	1%	199
Great South Channel (1518)							60%	22%	16%	2%			16%	12%		52%	20%	2545
Great South Channel Gear Mod Area (1656)							52%	31%	14%	2%			4%	6%		62%	29%	2328
Great South Channel, east (2186)							54%	27%	17%	2%			12%	11%		53%	24%	3334
Nantucket Shoals (1134)							68%	19%	12%	1%		1%	26%	15%		42%	15%	2319
Nantucket Shoals, west (1244)							74%	15%	9%	1%		2%	29%	15%		39%	14%	2936

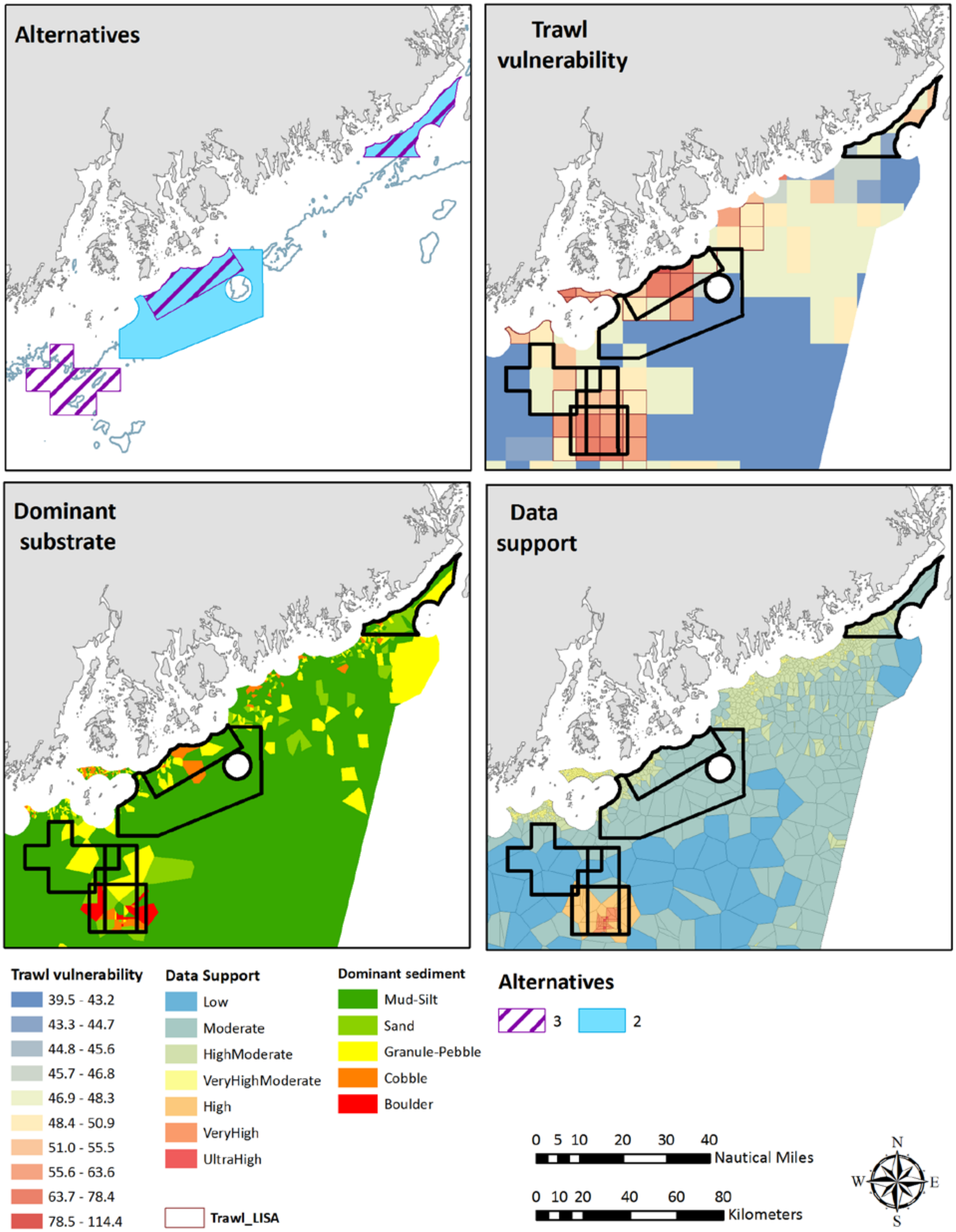
4.1.1.1 *Gulf of Maine*

The Gulf of Maine habitat management alternatives are broken into three sub-regions for decision making and analysis.

4.1.1.1.1 Eastern GOM

There are three habitat management alternatives for the Eastern Gulf of Maine sub-region: (1) no action/no HMAs, (2) Machias, Eastern Maine Large areas, and (3) Machias, Eastern Maine Small, and Toothaker Ridge areas. For alternatives 2 and 3, each area could have any one of the four options. Options 1 and 2 are functionally equivalent in this region because there is no hydraulic clam dredging, although there is dredging with toothed clam dredges in this part of the Gulf of Maine. Clockwise from the upper left panel, Map 32 shows the alternatives, seabed vulnerability to trawl gear, data support, and dominant substrate distribution. Other figures referred to in the discussion can be found above and in Volume 1 (Affected Environment).

Map 32 – SASI dominant substrate, data support, and vulnerability outputs (trawl gear) for the Eastern Gulf of Maine region.



4.1.1.1.1.1 Alternative 1 (No action/no Habitat Management Areas)
Under this alternative, mobile bottom-tending gear fishing would continue in the area without any restrictions. There would be no specific protection provided for benthic habitats through limits on the use of these gears.

4.1.1.1.1.2 Alternative 2
Options 1 and 2 are expected to reduce the adverse effects of fishing on the seabed in the identified areas, and improve habitat protection relative to no action. The impacts of Options 3 and 4 are uncertain but likely slightly negative if catch efficiency declines with the modified gear. Both of the Eastern Maine areas cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 32, Table 19). Based on these substrate distributions and the SASI vulnerability results (trawl vulnerability panel in Map 32) , the Eastern Maine Large area is less efficient at encompassing vulnerable habitats as compared to the Eastern Maine Small area that is part of Alternative 3 (vulnerability results are summarized in Table 18, and plotted in Figure 5). Although the absolute amount of complex habitats encompassed could be larger, the additional areas covered by the Eastern Maine Large area as compared to the Eastern Maine Small area generally consist of less vulnerable seabed types. However, this assessment is uncertain because data quality in this region is relatively poor (data support panel in Map 32). The Machias area appears to also contain rocky substrates, but currents along the seabed in this area are high, and the area is classified as high energy (Table 19). According to the SASI vulnerability assessment, this means habitats in the Machias area are likely somewhat less vulnerable to accumulating adverse effects of fishing (again, vulnerability results are summarized in Table 18, and plotted in Figure 5).

Therefore, Alternative 2, either Option 1 or Option 2, is expected to have a positive impact on seabed habitats overall, and relative to no action. Alternative 2, either Option 3 or Option 4, is expected to have a negative to neutral impact on seabed habitats overall and relative to no action, due to uncertainty about the net benefits of ground cable modification measures. Alternative 2 may have fewer positive impacts on seabed habitats than Alternative 3 because although the Eastern Maine area in Alternative 2 is larger, the more offshore portions of this area are expected to be somewhat less vulnerable to mobile bottom-tending gear fishing impacts and the alternative provides no protection for the habitats and species within the Toothaker Ridge area.

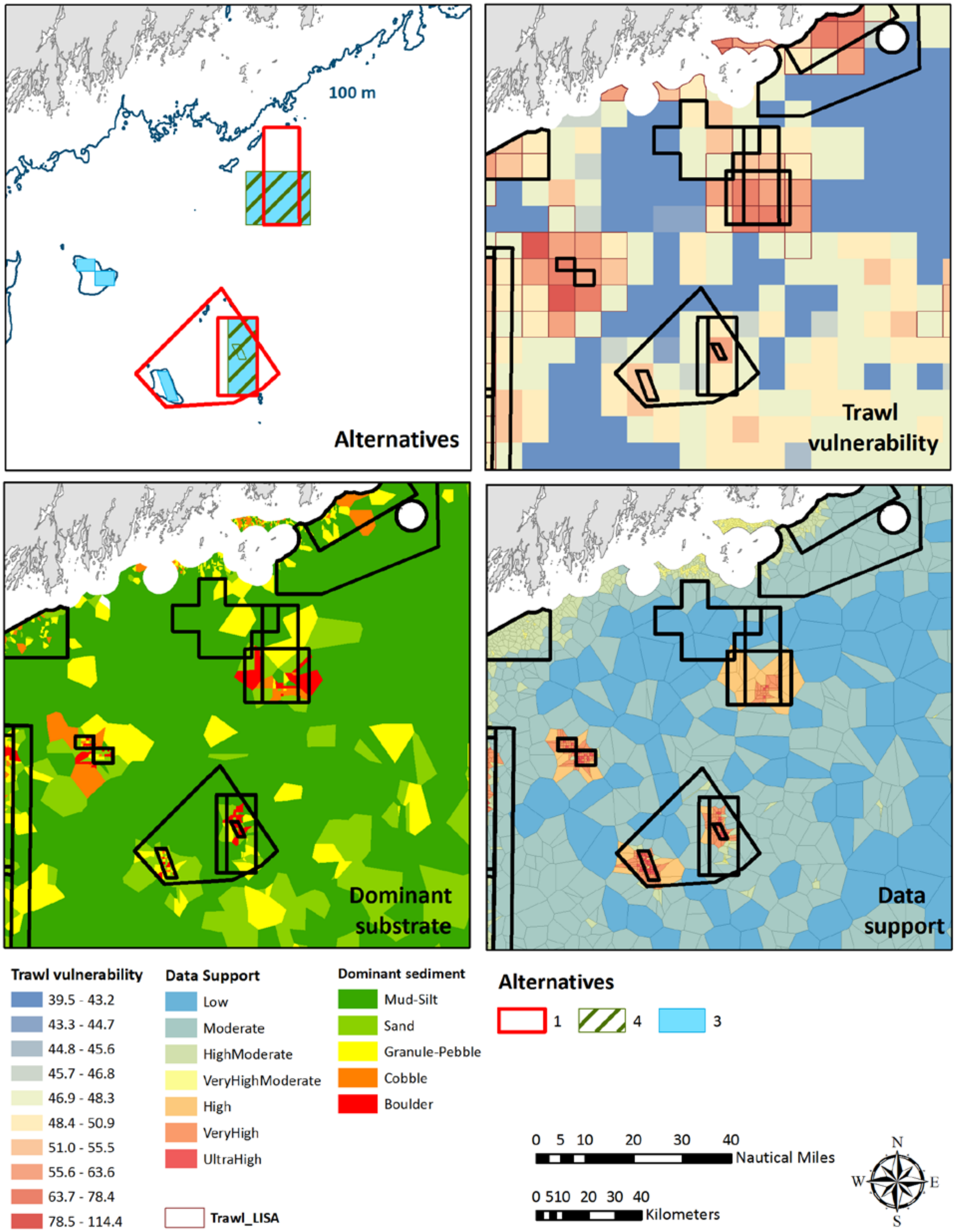
4.1.1.1.1.3 Alternative 3
Similar to Alternative 2, Alternative 3 with Options 1 or 2 restrictions would be expected to reduce the adverse effects of fishing on the seabed in the identified areas, and improve habitat protection relative to no action. The impacts of Options 3 and 4 are uncertain. The Eastern Maine Small area that is part of this alternative more efficiently overlaps with highly vulnerable habitats identified by the SASI approach. Inclusion of the Toothaker Ridge area with Option 1 or 2 fishing restrictions would improve seabed habitat protection in the sub-region, although it appears that the habitat type within the Toothaker Ridge area is relatively less vulnerable and consists mainly of mud-dominated areas. However, data quality for Toothaker is relatively low, and does not include sampling that could detect cobble and boulder substrates, so our understanding of seabed characteristics in this area is very uncertain.

Therefore, Alternative 3, either Option 1 or Option 2, is expected to have a positive impact on seabed habitats overall, and relative to no action. Alternative 3, either Option 3 or Option 4, is expected to have a negative to neutral impact on seabed habitats overall and relative to no action, due to uncertainty about the net benefits of ground cable modification measures. As noted in the previous section, Alternative 3 may have a greater positive impact on seabed habitats as compared to Alternative 2.

4.1.1.1.2 Central GOM

There are four habitat management alternatives for the Central Gulf of Maine sub-region: (1) no action Cashes Ledge and Jeffreys Bank Habitat Closure Areas and no action Cashes Ledge Groundfish Closed Area, (2) no HMAs, (3) modified Cashes Ledge, Ammen Rock, modified Jeffreys Bank, Fippennies Ledge, and Platts Bank and (4) modified Cashes Ledge, Ammen Rock, and modified Jeffreys Bank. For alternatives 3 and 4, each area except Ammen Rock, which would be closed to all fishing, could have any one of the four options. Options 1 and 2 are functionally equivalent in this region because there is no hydraulic clam dredging in this part of the Gulf of Maine. Clockwise from the upper left panel, Map 33 shows the alternatives, seabed vulnerability to trawl gear, data support, and dominant substrate distribution. Other figures referred to in the discussion can be found above and in Volume 1 (Affected Environment).

Map 33 – SASI dominant substrate, data support, and vulnerability outputs (trawl gear) for the Central Gulf of Maine region.



4.1.1.1.2.1 Alternative 1 (No action)

The three no action areas encompass a mix of shallower hard substrate areas containing granule-pebble, cobble, and boulder-dominated habitats on top of Cashes Ledge, Fippennies Ledge, and Jeffreys Bank, as well as deeper muddy habitats between Cashes and Fippennies Ledges and north of Jeffreys Bank (Table 19, Map 33). In the shallow, relatively hard bottomed areas where sampling of all substrate types was possible with video, data support is relatively higher (lower right panel of Map 33). The deep mud habitats were sampled at a relatively low rate, and data support was classified as low or moderate (Map 33). However, the substrate classifications are relatively accurate according to general knowledge of sediment distributions in the Gulf of Maine, i.e. the areas around the shallow ledge and bank features are predominantly muddy, and the ledges and banks themselves are relatively gravelly; it is the distribution of grids in the sediment map (dominant substrate panel of Map 33) that is imprecise. Further, some of the large granule pebble, cobble, and boulder grids at the edges of Platts Bank and Jeffreys Bank have an influence on the vulnerability results (trawl vulnerability panel of Map 33, Table 18, Figure 6). Thus, the ledge and bank features do contain habitat types highly vulnerable to fishing, but the actual spatial distribution of high vulnerability grids and the scores within those grids are not especially meaningful.

Alternative 1 has positive impacts on seabed habitats overall. These positive impacts may or may not be more positive than those associated with Alternatives 3 and 4, depending on the Council's objectives. Specifically, the no action areas encompass a broader mix of habitat types (i.e. they include deeper mud habitats) as compared to the habitat management areas comprising Alternatives 3 and 4. Thus, if the Council agrees that a more general approach to seabed habitat protection is warranted, this is best accomplished by selecting Alterative 1. Alternatives 3 and 4 provide a more targeted approach towards protected hard bottom areas dominated by gravel substrates.

4.1.1.1.2.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

4.1.1.1.2.3 Alternative 3

Alternative 3 is the most efficient alternative for encompassing the greatest amount of vulnerable seabed. The modified versions of the Cashes Ledge and Jeffreys Bank areas included in this alternative, and in Alternative 4, were designed specifically to focus on areas shallower than approximately 100 m depth that were known to contain gravel substrates. The Habitat PDT identified 100 m as the depth at which the shallow gravel habitats transition to soft sediment types. This depth was used throughout the Gulf of Maine to help identify boundaries of habitat management areas when the substrate map was relatively poorly resolved (i.e. low data support).

Alternative 3 would have a positive impact on seabed habitats overall, and a slightly positive to slightly negative impact relative to no action, depending on the Council's objectives.

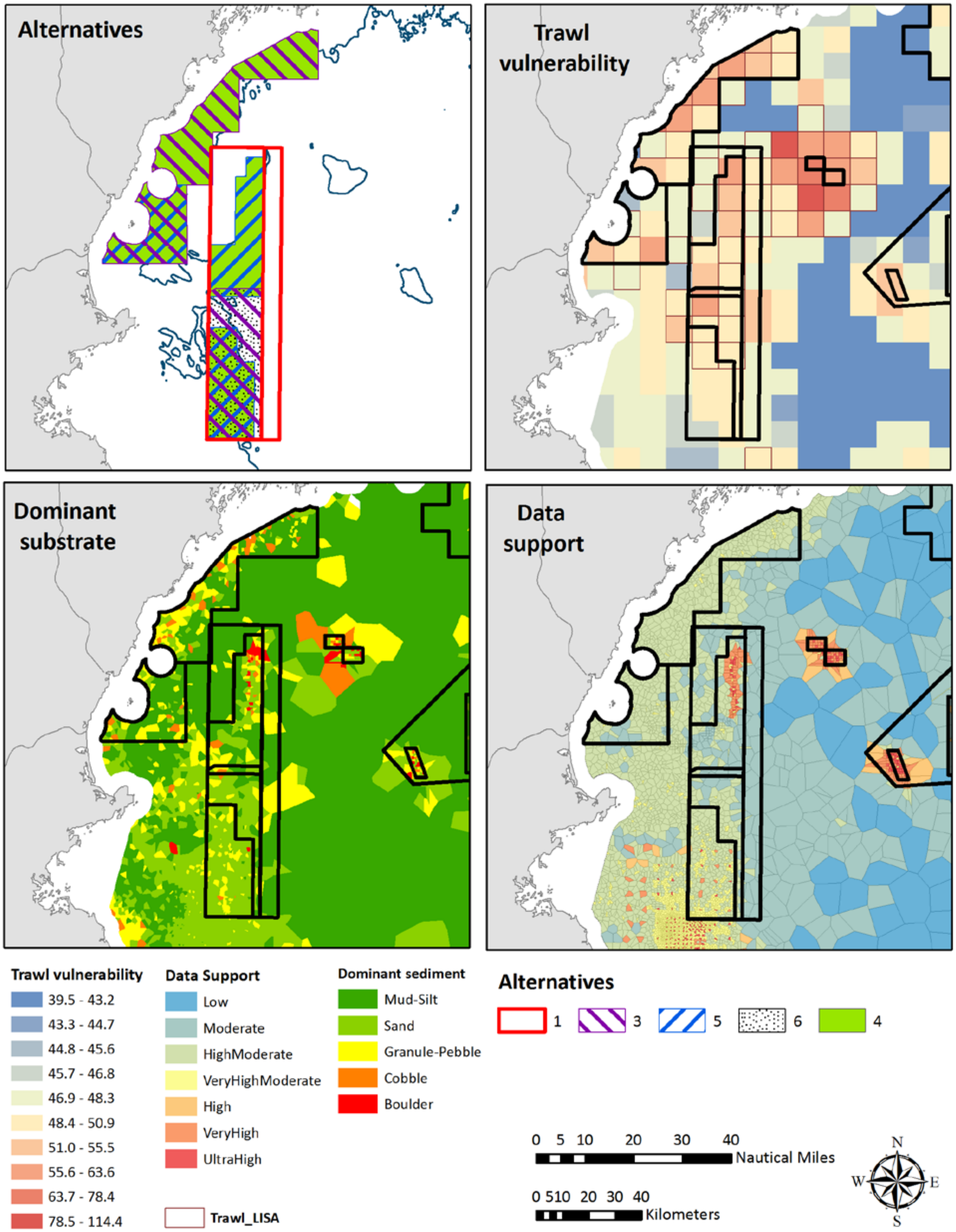
4.1.1.1.2.4 Alternative 4

Alternative 4 areas also efficiently encompass vulnerable seabed types, but the alternative does not provide any protection for Fippennies Ledge or Platts Bank. Alternative 4 would have a positive impact on seabed habitats overall, and a slightly negative impact relative to no action, depending on the Council's objectives, as discussed above.

4.1.1.1.3 Western GOM

There are seven habitat management alternatives for the Central Gulf of Maine sub-region: (1) no action Western Gulf of Maine Habitat Closure Area and no action Western Gulf of Maine Groundfish Closed Area, (2) no HMAs, (3) Stellwagen Large HMA and Bigelow Bight Large HMA, (4) Stellwagen Small HMA, Jeffreys Ledge Small HMA and Bigelow Bight Large HMA, (5) Stellwagen Small HMA, Jeffreys Ledge Small HMA and Bigelow Bight Small HMA, (6) Stellwagen Large HMA, and (7a/b) which would implement roller gear restrictions as a habitat management measure and could be combined with one of the other alternatives. For alternatives 3-6, each area could have any one of the four options. Options 1 and 2 are functionally equivalent in this region because there is no hydraulic clam dredging in this part of the Gulf of Maine. Clockwise from the upper left panel, Map 34 shows the alternatives, seabed vulnerability to trawl gear, data support, and dominant substrate distribution. Other figures referred to in the discussion can be found above and in Volume 1 (Affected Environment).

Map 34 – SASI dominant substrate, data support, and vulnerability outputs (trawl gear) for the Western Gulf of Maine region.



4.1.1.1.3.1 Alternative 1 (No action)
The overlapping habitat and groundfish closure areas that comprise this alternative encompass the eastern part of Stellwagen Bank and most of Jeffreys Ledge, as well as smaller features including Tillies Bank and Wildcat Knoll. The existing management areas are generally low energy, except for the tops of Stellwagen Bank and Jeffreys Ledge, and include a mix of sediment types. The areas are predominantly mud and sand, with about 15% of the area dominated by granule-pebble, and small fractions of cobble- and boulder-dominated areas (Table 19, Map 34). Because the eastern sliver of the Western Gulf of Maine Closed Area that does not overlap with the Western Gulf of Maine Habitat Closure Area tends to be deeper and generally muddy, the habitat closure on average contains coarser sediments than the groundfish closure. Data support values are moderate in this region, with only about 9% of the areas mapped with a sampling gear capable of detecting cobble and boulder sediments. This may mean that cobble and boulder habitat types are under-represented.

Vulnerability estimates are moderate to high for these and other management areas in this region relative to other locations not proposed for habitat management. However, it is difficult to distinguish between the various management areas on the basis of vulnerability scores. This is due to overlaps between the various management areas in this sub-region, the relatively coarse 100 km^2 resolution of the vulnerability grid, and the overall moderate level of data support in the underlying substrate distribution.

The fishing restriction measures associated with these no action areas are sufficient for protecting the complex seabed habitats in the areas from the impacts of the most damaging gear types, i.e. mobile bottom-tending gears. In addition, fixed bottom tending gears capable of catching groundfish are also excluded because of the groundfish closure. Fixed gears have a much lower magnitude of impact on the seabed, so these restrictions provide an incremental benefit to seabed habitats as compared to the mobile bottom-tending gear restrictions associated with the habitat closure area.

Overall, the no action alternative in the Western Gulf of Maine sub-region has positive impacts on seabed habitats. The eastern sliver of the Western Gulf of Maine Closed Area that does not overlap with the Western Gulf of Maine Habitat Closure Area is a candidate for sector exemptions; if this area is fished by sectors with mobile bottom-tending gears it will be somewhat less effective as a habitat conservation area.

4.1.1.1.3.2 Alternative 2 (No Habitat Management Areas)
Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

4.1.1.1.3.3 Alternative 3
Alternatives 3, 4, 5, and 6 encompass subsets of the existing WGOM habitat closure area and in some cases additional areas closer to shore (Bigelow Bight small and large).

4.1.1.1.3.4 Alternative 4

To be completed later.

4.1.1.1.3.5 Alternative 5

To be completed later.

4.1.1.1.3.6 Alternative 6

To be completed later.

4.1.1.1.3.7 Alternative 7 (Options A and B)

To be completed later.

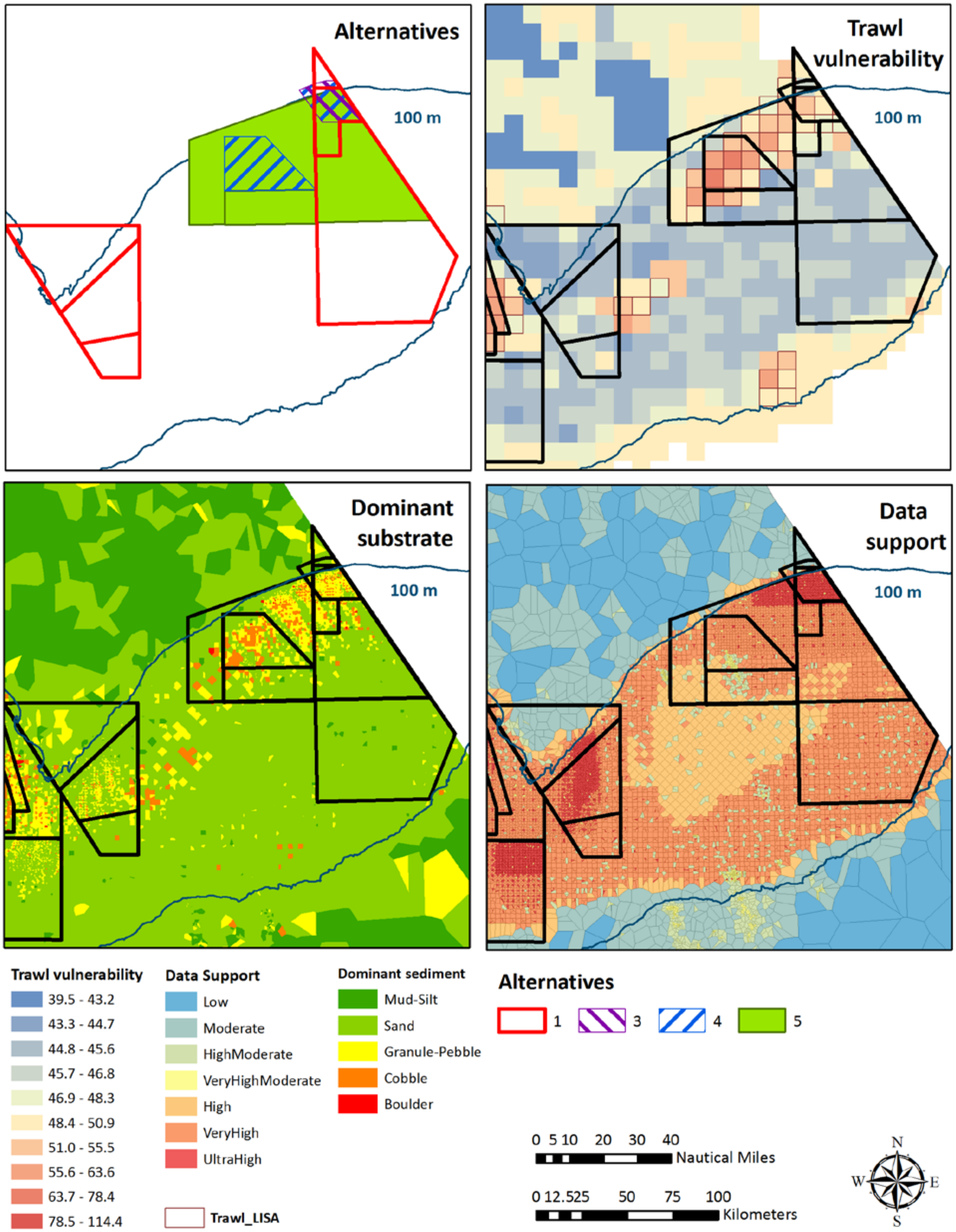
4.1.1.2 *Georges Bank and Southern New England*

The Georges Bank and Southern New England region habitat management alternatives are broken into two sub-regions for decision making and analysis.

4.1.1.2.1 Georges Bank

There are five habitat management alternatives for the Georges Bank sub-region: (1) no action Closed Area I and Closed Area II Habitat Closure Areas and Groundfish Closed Areas, (2) no HMAs, (3) Northern Edge HMA (4) Northern Edge HMA and small Georges Shoal Gear Modification Area, and (5) Georges Shoal HMA as a mobile bottom-tending closure area and large Georges Shoal Gear Modification Area. The Northern Edge area could have any one of the four options; the larger and smaller gear modification areas could have options 3 or 4 only. Clockwise from the upper left panel, Map 35 shows the alternatives, seabed vulnerability to trawl gear, data support, and dominant substrate distribution. Other figures referred to in the discussion can be found above and in Volume 1 (Affected Environment).

Map 35 – SASI dominant substrate, data support, and vulnerability outputs (trawl gear) for the Georges Bank region.



4.1.1.2.1.1 Alternative 1 (No action)

To be completed later. Note that the southern portion of Closed Area II south of 41° 30' is fished with scallop dredges as a scallop access area and also with bottom trawls as part of a groundfish Special Access Program. The area north of 42° 10' is also accessible to otter trawl gear as part of a SAP. Thus, these portions of the closed area provide limited habitat benefits.

4.1.1.2.1.2 Alternative 2 (No Habitat Management Areas)

Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears. Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

4.1.1.2.1.3 Alternative 3

To be completed later.

4.1.1.2.1.4 Alternative 4

To be completed later.

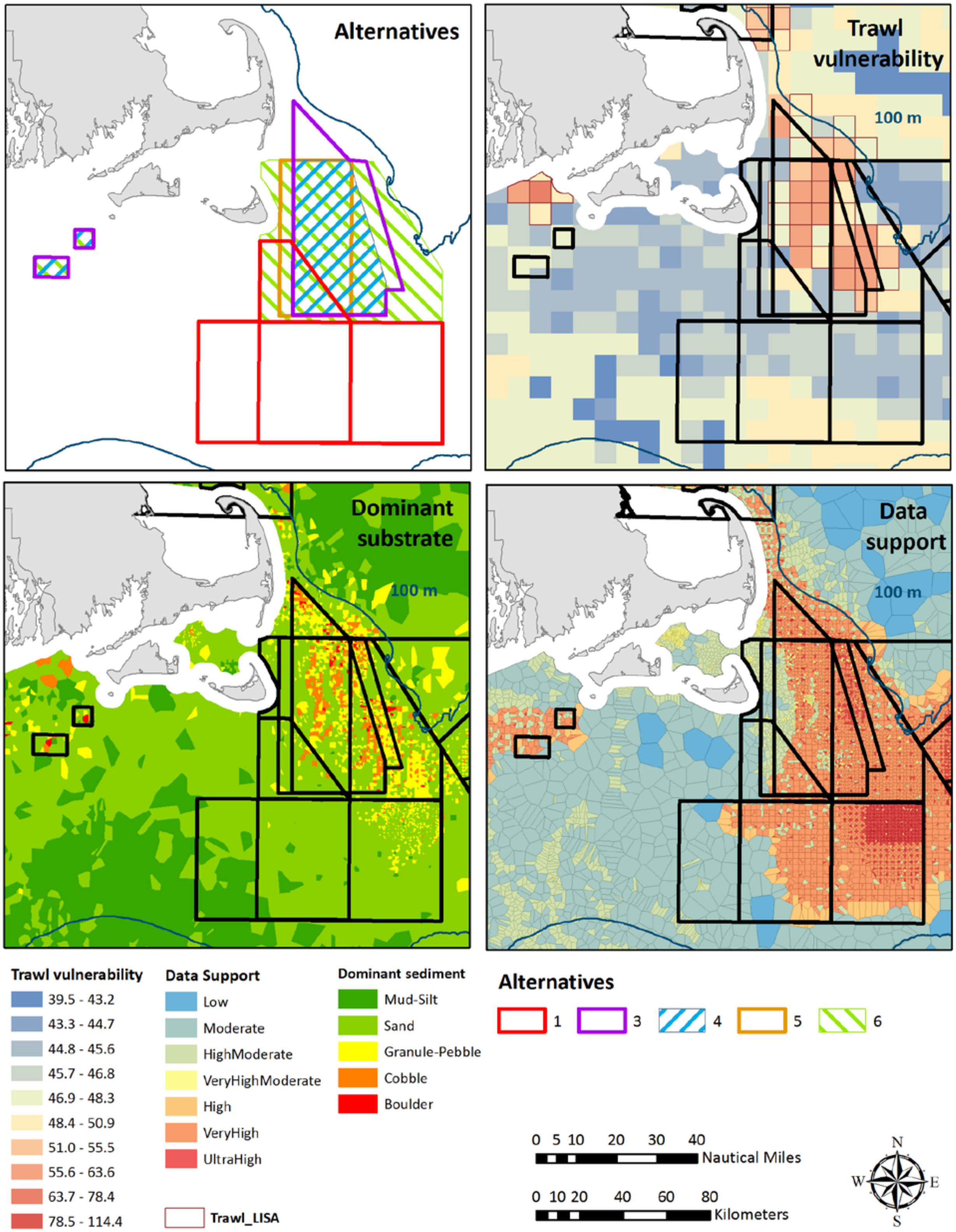
4.1.1.2.1.5 Alternative 5

To be completed later.

4.1.1.2.2 Great South Channel and Southern New England

There are six habitat management alternatives for the Georges Bank sub-region: (1) no action Nantucket Lightship Habitat Closure Area and Groundfish Closed Area, (2) no HMAs, (3) Great South Channel East HMA and Cox Ledge HMA, (4) Great South Channel HMA and Cox Ledge HMA, and (5) Nantucket Shoals HMA and Cox Ledge HMA, and (6) Nantucket Shoal West HMA as a mobile bottom-tending gear closure and Great South Channel Gear Modification Area. Any areas in Alternatives 3, 4, or 5 could have any of the options applied to them. Clockwise from the upper left panel, Map 35 shows the alternatives, seabed vulnerability to trawl gear, data support, and dominant substrate distribution. Other figures referred to in the discussion can be found above and in Volume 1 (Affected Environment).

Map 36 – SASI dominant substrate, data support, and vulnerability outputs (trawl gear) for the Great South Channel and Southern New England region.



4.1.1.2.2.1 Alternative 1 (No action)
To be completed later. Note that the only portion of this alternative currently off limits to mobile bottom tending gear is the habitat closure itself; scalloping is allowed in an access area in the eastern part of the Nantucket Lightship groundfish closed area, and clam dredging is allowed in both the eastern and western portions, just not inside the habitat closure.

4.1.1.2.2.2 Alternative 2 (No Habitat Management Areas)
Under this alternative, there would be no specific protection provided for benthic habitats through limits on the use of mobile bottom-tending gears Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

4.1.1.2.2.3 Alternative 3
To be completed later.

4.1.1.2.2.4 Alternative 4
To be completed later.

4.1.1.2.2.5 Alternative 5
To be completed later.

4.1.1.2.2.6 Alternative 6
To be completed later.

4.1.1.3 ***Species diversity considerations***

Species diversity indices described in the Affected Environment section were summarized by alternative. The average Shannon and Inverted Simpson diversity indexes are calculated for each alternative, using all random and non-random tows from the spring, fall, summer and winter survey data from 2002-2012. These values are then compared with the No Action alternative for the appropriate sub-region. All other factors being equal, the alternative with the highest overall diversity may provide positive benefits to the most species.

Diversity values for each tow were averaged and displayed by habitat management alternative in Table 20 - Table 24. For this part of the analysis, the alternatives with the highest diversity values (75th percentile of each season) for each diversity index were highlighted with a specific color. Groundfish diversity was highlighted in red, regulated diversity in yellow and all species in green. This is to determine which alternative areas are most diverse with respect to groundfish, regulated species and all species year-round. Diversity within the alternative areas and the no action alternative areas are then compared.

Eastern Gulf of Maine

For this part of the analysis, the diversity in Alternative 2 and Alternative 3 areas are compared. The Eastern GOM No Action alternative affects no areas so there are no diversity values. In the spring, groundfish diversity in Alternative 2 areas is greater than in Alternative 3 areas, indicating more positive effects for groundfish species than the other alternatives. Regulated species diversity in areas affected by Alternative 2 is less than Alternative 3 areas. All species diversity is also less in Alternative 2 areas than in Alternative 3 areas. This implies that Alternative 3 areas could have more positive effects for regulated species and all species than Alternative 2 areas.

Groundfish diversity and regulated species diversity in the Eastern GOM is highest in the summer. Groundfish and regulated species diversity in Alternative 2 areas and Alternative 3 areas were among the highest in the region and also equal, implying each alternative's areas would have positive effects on groundfish species. Regulated species diversity in Alternative 2 areas is slightly greater than in Alternative 3 areas implying marginally greater positive benefits on regulated species. All species diversity in Alternative 2 areas is less than in Alternative 3 areas. This means that Alternative 3 areas could have the greatest positive benefits for all species in the Central GOM.

Fall groundfish diversity in areas affected by Alternative 2 and Alternative 3 are nearly equal, yet Alternative 2 areas could have slightly greater positive benefits for groundfish. Regulated species diversity in Alternative 2 areas is less than Alternative 3 areas. All species diversity is also less in Alternative 2 areas than in Alternative 3 areas. This could indicate that Alternative 3 areas would have the greatest positive effects for regulated species and all species in the fall.

Winter groundfish diversity is greater in Alternative 2 areas than in Alternative 3 areas. Regulated species diversity in Alternative 2 areas is among the highest in the region and is greater than regulated species diversity in Alternative 3 areas. All species diversity in Alternative 2 areas is greater than Alternative 3 areas. This implies that Alternative 2 could have the greatest possible effects for all species groups in the winter.

Central Gulf of Maine

The Central GOM No Action alternative affects EFH and Groundfish closures. Alternative 2 affects no areas and has no effect on species diversity. In the spring, the No Action EFH closures could have the largest positive effects on all species groups in the Central GOM. Groundfish diversity is less in Alternative 3 areas than in No Action areas. Regulated species diversity is less in Alternative 3 areas than in No Action. All species diversity in Alternative 3 areas is also less than No Action areas. Diversity of all species groups in Alternative 4 areas are greater than Alternative 3 areas, but is also less than No Action.

Diversity of all species groups in the Central GOM is highest in the summer. The No Action EFH closures in the summer also could have the largest positive effects on all species groups in the summer in the Central GOM. Groundfish diversity in Alternative 3 areas and Alternative 4 areas is equal and also less than diversity in No Action areas. The same applies for regulated species diversity and all species diversity.

In the fall, the No Action EFH closures again could have the largest positive effects for all species groups. Diversity of each species groups is lowest in the Alternative 3 areas. While diversity of each species groups is slightly higher in Alternative 4 areas, it is still less than diversity in the No Action EFH closures.

Overall diversity was lowest in the winter for each species group. Alternative 3 areas have higher diversity of each species group than the No Action EFH closures. Diversity of groundfish, regulated species and all species are highest in Alternative 4 areas and among the highest in the region year-round. This indicates that Alternative 4 areas could have the most positive effects on all species groups in the Central GOM.

Western Gulf of Maine

The Western GOM No Action alternative affects EFH closures, Groundfish closures and Habitat Management Areas. Alternative 2 affects no areas and therefore no species diversity is involved for that alternative. In the spring, diversity of each species group for Alternative 3 areas and Alternative 4 areas are almost equal and greater than the No Action EFH closures. Each species group is also more diverse in Alternative 5 areas. Groundfish and regulated species diversity in Alternative 6 areas are lower than No Action, while all species diversity is higher than No Action. Spring diversity of each species group is highest in the Alternative 7.1 areas, indicating the most potential positive effects for each species group in the Western GOM. Diversity in Alternative 7.2 areas is also higher than the No Action areas.

As with the Eastern and Central GOM, overall diversity appears to be highest in the summer. The No Action Alternative affects EFH closures, groundfish closures and habitat management areas. Diversity for each species group in Alternative 3 areas and Alternative 4 areas are again equal and also higher than the No Action EFH closures, implying more positive effects for each species group than the No Action areas. Groundfish diversity and regulated species diversity are highest in the Alternative 5 areas. This could indicate that Alternative 5 areas would have the most positive benefits for groundfish and regulated species in the Western GOM. All species diversity in Alternative 5 areas is also higher than No Action but not the highest in the season. Overall diversity is higher in Alternative 6 areas than No Action, implying more positive benefits in Alternative 6 areas than No Action. Each species group's diversity is higher in Alternative 7.1 and Alternative 7.2 areas than No Action. All species diversity in Alternative 7.2 areas is also the highest in the season, indicating that those areas could have the most positive benefits for all species.

In the fall, diversity of each species group in Alternative 3 areas and Alternative 4 areas are again equal. Groundfish diversity is higher than in the No Action areas, yet regulated species diversity and all species diversity are both less. Diversity in Alternative 5 areas were among the lowest in the season. Diversity of each species group in those areas is less than in the No Action areas. Overall diversity is higher in Alternative 6 areas than No Action, implying more positive benefits in Alternative 6 areas than No Action. Groundfish and regulated species diversity in Alternative 7.1 areas are less than No Action, yet all species diversity is greater and the highest in the season. Alternative 7.1 areas could have the most positive effects for all species in the summer in the Western GOM. Diversity of each species group is also very low in Alternative 7.2 areas, each lower than in No Action.

Diversity in the No Action EFH areas is lowest in the winter. Overall groundfish diversity is also lowest in the winter. Diversity of each species group in Alternative 3 areas and Alternative 4 areas are again equal and also the highest in the season, implying the most possible positive effects for each species group in the Western GOM in the winter. Diversity of each species group in Alternative 5 areas is also higher than No Action. Groundfish and regulated species diversity is also higher in Alternative 6 areas, while all species diversity is equal. Diversity is lower in Alternative 7.1 areas but is still slightly higher than in No Action areas. Diversity is lowest in Alternative 7.2 areas, yet only all species diversity is lower than the No Action areas.

Georges Bank

The Georges Bank No Action alternative affects EFH and Groundfish closures. Alternatives 2 and 6 affect no areas so no diversity values are included. Overall diversity in Alternative 3 areas is lower than No Action. Spring groundfish, regulated species and all species diversity are highest in Alternative 4 areas, signifying that those areas could have the most beneficial effects for each species group in Georges Bank. Groundfish diversity in Alternative 5 areas is lower than No Action, while regulated and all species diversity is higher.

Groundfish diversity appears to be highest during summer in Georges Bank. Groundfish are slightly more diverse in Alternative 3 areas than No Action, while regulated and all species are less diverse. All species groups are less diverse in Alternative 4 areas than No Action. This could mean that in the summer, Alternative 4 areas have the most positive effects on regulated species and all species. Groundfish diversity is also slightly lower in Alternative 5 areas than No Action, but regulated and all species diversity are higher.

Groundfish and regulated species are less diverse in Alternative 3 areas than No Action, while all species are more diverse. Fall diversity of regulated and all species in Alternative 4 areas than No Action, while groundfish are slightly less diverse. Groundfish diversity in Alternative 5 areas is also higher than No Action, but regulated and all species diversity is lower.

In the winter, none of the areas affected by Alternatives 3 or 4 were sampled. Groundfish and regulated species are more diverse in Alternative 5 areas than in No Action, while all species are less diverse. This still implies that Alternative 5 could have more positive benefits for groundfish and regulated species than No Action.

Great South Channel and Southern New England

The Southern New England No Action alternative affects EFH and Groundfish closures. Alternative 2 affects no areas. In the spring, groundfish diversity is highest in Alternative 3 areas. Regulated species and all species are more diverse in Alternative 3 areas than No Action. Overall diversity in Alternative 4 areas and Alternative 5 areas are higher than No Action. Groundfish and all species diversity are higher in Alternative 6 areas than No Action, yet regulated species diversity is lower.

As in the other analyzed regions, groundfish diversity is highest overall in the summer. Groundfish diversity is slightly higher in Alternative 3 areas than No Action, while regulated and all species diversity are lower. Diversity of groundfish in Alternative 4 areas is relatively equal to No Action areas, while regulated and all species diversity is higher. Groundfish diversity is highest in Alternative 5 areas and regulated species diversity is also lower than No Action. All species diversity in Alternative 5 areas is lower than No Action. Groundfish diversity is tied for highest in Alternative 6 areas, yet regulated and all species diversity is lower than No Action.

The No Action EFH closures appear to have the least positive benefits for groundfish in the fall. Overall diversity is higher in Alternative 3 and Alternative 4 areas than No Action. Groundfish diversity is highest in Alternative 5 areas, yet both regulated and all species diversity are lower than No Action. Diversity of each species group in Alternative 6 areas are higher than No Action. All species diversity within these areas are also the highest of the season.

In the winter, groundfish diversity is lower in Alternative 3 areas than in No Action areas. All species diversity is higher than No Action and regulated species diversity is the highest year-round in the region. Groundfish diversity in Alternative 4 areas is lower than No Action, while regulated and all species diversity are both higher. Groundfish diversity in Alternative 6 areas is lower than No Action, while regulated and all species diversity are higher.

Table 20 - Average diversity indices by status quo and proposed habitat management alternatives in the eastern Gulf of Maine. The 75th percentile of diversity for each species group is highlighted.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Eastern GOM																
No Action	**0**	**0.000**	**0.000**	**0.000**	**0**	**0.000**	**0.000**	**0.000**	**0**	**0.000**	**0.000**	**0.000**	**0**	**0.000**	**0.000**	**0.000**
Alternative 2	44	0.908	0.692	1.611	9	0.999	0.929	1.462	16	0.997	0.788	1.562	4	0.938	0.866	2.063
Alternative 3	26	0.883	0.701	1.632	17	0.999	0.918	1.537	10	0.993	0.845	1.583	2	0.881	0.820	1.952

Table 21 - Average diversity indices by status quo and proposed habitat management alternatives in the central Gulf of Maine. The 75th percentile of diversity for each species group is highlighted.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Central GOM																
No Action																
EFH Closure	29	0.734	0.655	1.454	22	0.995	0.915	1.460	24	0.831	0.628	1.323	16	0.596	0.585	1.281
Groundfish Closure	18	0.593	0.486	1.109	26	0.878	0.795	1.538	12	0.791	0.694	1.513	7	0.169	0.169	0.389
Alternative 2	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000
Alternative 3	40	0.669	0.615	1.386	10	0.963	0.909	1.376	29	0.742	0.598	1.252	29	0.693	0.615	1.340
Alternative 4	35	0.700	0.639	1.446	10	0.963	0.909	1.376	26	0.772	0.614	1.278	28	0.705	0.624	1.361

Table 22 - Average diversity indices by status quo and proposed habitat management alternatives in the western Gulf of Maine. The 75th percentile of diversity for each species group is highlighted.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Western GOM																
No Action																
EFH Closure	109	0.651	0.558	1.234	43	0.913	0.877	1.346	49	0.847	0.715	1.573	44	0.577	0.543	1.143
Groundfish Closure	120	0.669	0.566	1.265	64	0.932	0.893	1.428	63	0.852	0.724	1.588	46	0.580	0.546	1.162
Alternative 2	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000
Alternative 3	146	0.713	0.615	1.363	39	0.980	0.909	1.502	54	0.857	0.669	1.523	51	0.697	0.647	1.416
Alternative 4	140	0.708	0.618	1.364	40	0.965	0.900	1.480	74	0.829	0.657	1.445	59	0.657	0.601	1.338
Alternative 5	90	0.679	0.618	1.343	29	0.957	0.902	1.479	55	0.803	0.667	1.460	43	0.579	0.540	1.179
Alternative 6	59	0.640	0.573	1.261	10	0.945	0.908	1.555	17	0.908	0.802	1.892	23	0.590	0.559	1.143
Alternative 7.1	777	0.773	0.710	1.495	165	0.955	0.896	1.475	452	0.835	0.681	1.548	189	0.616	0.575	1.209
Alternative 7.2	233	0.695	0.623	1.324	47	0.963	0.898	1.489	120	0.809	0.653	1.432	102	0.639	0.598	1.277

Table 23 - Average diversity indices by status quo and proposed habitat management alternatives in Georges Bank. The 75th percentile of diversity for each species group is highlighted.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Georges Bank																
No Action																
EFH Closure	127	0.947	0.528	1.060	179	0.995	0.436	0.805	38	0.873	0.669	1.516	4	0.949	0.662	1.601
Groundfish Closure	377	0.918	0.603	1.177	576	0.993	0.552	0.999	135	0.889	0.633	1.463	11	0.873	0.587	1.329
Alternative 2	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000
Alternative 3	41	0.935	0.365	0.718	62	0.997	0.226	0.459	10	0.771	0.654	1.533	0	0.000	0.000	0.000
Alternative 4	74	0.957	0.550	1.005	85	0.994	0.397	0.732	21	0.871	0.717	1.693	0	0.000	0.000	0.000
Alternative 5	226	0.926	0.622	1.165	248	0.991	0.591	1.077	97	0.941	0.660	1.470	4	0.979	0.745	1.305
Alternative 6	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000

Table 24 - Average diversity indices by status quo and proposed habitat management alternatives in southern New England. The 75th percentile of diversity for each species group is highlighted.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Southern New England																
No Action																
EFH Closure	114	0.821	0.709	1.075	78	0.993	0.772	1.158	106	0.743	0.594	1.079	15	0.982	0.530	1.149
Groundfish Closure	258	0.846	0.677	1.123	198	0.995	0.614	1.024	231	0.779	0.593	1.111	35	0.990	0.580	1.225
Alternative 2	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000
Alternative 3	108	0.984	0.714	1.260	91	0.997	0.550	0.930	48	0.986	0.649	1.469	8	0.907	0.796	1.405
Alternative 4	42	0.970	0.779	1.360	19	0.993	0.805	1.248	36	0.986	0.646	1.435	5	0.917	0.745	1.535
Alternative 5	27	0.965	0.800	1.391	9	0.998	0.761	1.150	27	0.987	0.653	1.432	4	0.940	0.726	1.613
Alternative 6	155	0.982	0.637	1.176	171	0.998	0.548	0.924	62	0.984	0.672	1.503	7	0.939	0.813	1.455

4.1.2 Managed species – impacts on large mesh groundfish stocks and their habitats

This section describes impacts of habitat management measures on large mesh groundfish. These stocks are discussed separately because their conservation is a particular focus of the amendment, and was the subject of a targeted analysis (hotspot analysis). Impacts on other managed species are discussed separately.

The goals and objectives (Volume 1) of this amendment have both a broad focus on all Council-managed species, and a narrower focus on enhancing groundfish productivity. The broader focus is intended to mitigate the adverse gear effects on essential fish habitat of managed species found in the Gulf of Maine, Georges Bank, and Southern New England regions. Reducing adverse effects on vulnerable hard substrates and associated benthic organisms that have longer recovery times is expected to have positive conservation benefits for a variety of managed and unmanaged species, including groundfish.

A specific objective of this amendment is to reduce impacts on critical life stages of groundfish. In terms of habitat protection measures, this critical life stage means age 0/1 fish. Groundfish stocks rely on both highly vulnerable habitat types and lower vulnerability habitat types. Not all hard and vulnerable substrates in the region may be as directly important for groundfish species due to less than optimal conditions, such as temperature, prey availability, and predator abundance. Conversely, habitats that are less vulnerable to the impacts of fishing may be very important to certain groundfish species. Habitat conservation measures intended to reduce impacts on critical life stages of groundfish should focus on the spatial intersection of vulnerable habitat types and groundfish stocks, particularly those species known to rely on complex structured habitats.

The Swept Area Seabed Impact approach and the groundfish hotspot analysis described in Volume 1 were designed to identify locations with vulnerable habitat types and areas occupied by groundfish, respectively. The hotspot analysis was weighted towards species like cod that have a strong affinity for coarse and hard bottom substrates and are overfished and/or at low biomass. Using the SASI and hotspot analysis criteria in combination, the greatest positive impacts for critical life stages of groundfish will be realized by protecting habitats that are vulnerable to fishing and encompass high weighted hotspots values.

It is important to recognize that the size range of groundfish species considered in the hotspot analysis focuses on the smallest fish, age 0/1. Most often, this size range (which varies by stock) is smaller than both the juvenile fish category in the EFH designations (Volume 2) and the size of sub-legal fish caught by commercial and recreational fishing vessels.

Types of impacts on groundfish

Both local and global habitat impacts are evaluated. These local and global effects could change the quality of habitat with which age 0/1 groundfish stocks are associated. The positive impacts of habitat management alternatives will hopefully be evident at the stock level, enhancing productivity and improving sustainable yield. For some stocks that live in muddy or sandy areas and compete with species found in coarse and hard bottom areas protected by a habitat management area, stock productivity may decrease.

The type and classification of potential impacts is summarized in the table below. Stock-level or population-level impacts are discussed generally in the introductory section below. The alternative-by-alternative sections that follow focus on characterization of local habitat impacts, with some discussion of relevant global impacts.

Table 25 – Classification of possible impacts on groundfish habitat and stocks.

Classification of effects	Local impacts on groundfish habitat in the proposed habitat management areas, without considering the effects of potential effort displacement	Global impacts on groundfish habitat in the Gulf of Maine or Georges Bank/Southern New England region, considering the effects of effort displacement and intensified fishing in adjacent areas	Stock-level effects: Impacts on groundfish population and productivity
Positive or beneficial	Quality and quantity of groundfish habitat is expected to improve.	Quality and quantity of groundfish habitat is expected to improve.	Habitat changes are expected to increase stock productivity.
Uncertain	It is unclear how the quality or quantity of groundfish habitat will change.	It is unclear how the quality or quantity of groundfish habitat will change.	It is unclear how habitat change will affect stock productivity
Neutral	Groundfish habitat quality or quantity is not expected to improve or worsen.	Groundfish habitat quality or quantity is not expected to improve or worsen.	Expected effect is not positive or negative
Negative or detrimental	Groundfish habitat quality or quantity is expected to worsen.	Groundfish habitat quality or quantity is expected to worsen.	Habitat changes are expected to decrease stock productivity.

On a local level, a reduction in adverse gear effects within a habitat management area would promote habitat recovery in previously fished areas or continue habitat recovery in currently unfished areas. The greatest benefits are expected to accrue to species that are known to associate with coarse substrates at very young ages. Negative or detrimental local groundfish habitat impacts are not expected to result from the habitat management alternatives, except in existing year round groundfish and habitat closures that are off-limits to mobile bottom-tending gear fishing and re-open to fishing with these gear types.

On a global or regional level, the direction and magnitude of the impacts relates to the effects of the alternatives on habitats inside the proposed habitat management areas as well impacts on neighboring habitats. The impacts to neighboring habitats relate to the potential for fishing effort to shift into adjacent areas or for fishermen to begin using other gears to target groundfish and other species. It is very difficult to evaluate regional impacts without considering the total suite of potential alternatives in the Gulf of Maine or Georges Bank/Southern New England region.

Alternatives that close some areas but leave neighboring areas with vulnerable habitat open to fishing might actually be detrimental to global or regional habitat quality.

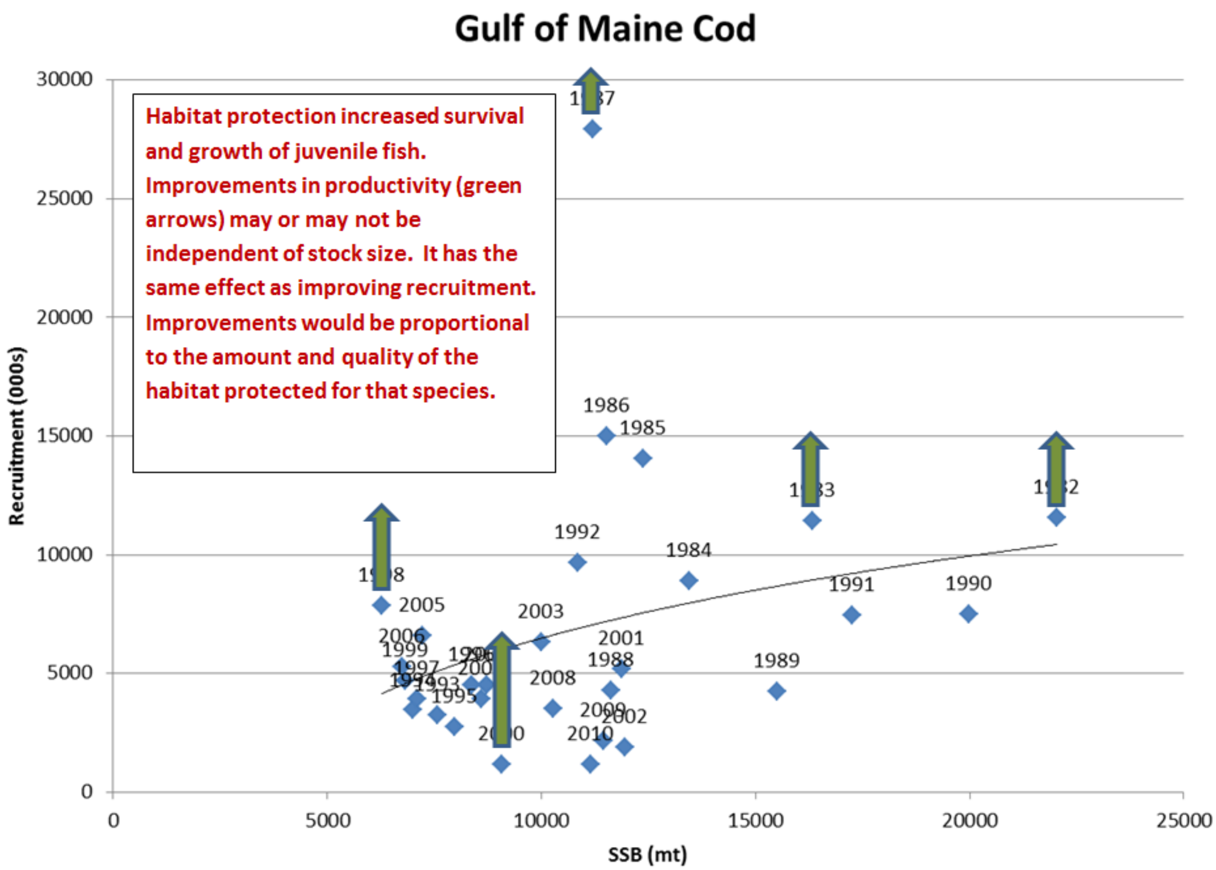
At a stock level, there are many ways to improve productivity of a stock and increase sustainable yield including improving survival and growth of young ages through better habitat, increasing the population of primary prey species, reducing population levels of predators, and reducing fishing mortality from discards. The discussion of impacts in this section focuses on the first of these effects, operating at a population level. When a particular alternative is expected to have a positive or beneficial effect for groundfish, the statement is made with respect to species with age 0/1 fish that are associated with coarse substrates and associated epifauna that are vulnerable to the effects of fishing with mobile bottom-tending gears. A positive or beneficial effect on groundfish habitats is expected to have a positive or beneficial effect on associated groundfish stocks.

Specifically, improvements in habitat quality are expected to translate into improvements in survival and growth of these species. These stock-level effects can be explained using a recruitment/spawning stock biomass conceptual framework. One mechanism by which improved habitat quality may translate into improved stock productivity would be to increase the amount of young fish, or recruits. On a stock/recruit curve, this would be represented by as an increase in the R/SSB slope at the origin. Depending on the degree of density dependence and how the species occupies marginal habitats at higher abundance, the greatest effect should be when stocks are low. Another alternate or complementary mechanism would be that a reduction in gear effects could improve the quality of marginal habitats, allowing young recruits to spread out into improved habitats. This latter response could allow recruitment to increase proportionally to the degree to which relevant habitat improvements are realized.

An example of these potential effects using actual recruitment and spawning stock biomass estimates is illustrated in the figure below. Generally, habitat improvements would increase survival of recruits at all population levels (green arrows shown for four example years). The greatest positive effect (represented by larger green arrows) would be expected when the population (and recruitment) is low, as it has been lately for Gulf of Maine cod. Recruitment in 2010 was the fourth lowest on record. In such a situation, a large amount of better quality essential habitat would allow for better survival and growth.

As a percent change, the expected benefit is more muted at higher population and recruitment levels (represented by smaller green arrows like the 1987 year class, for example). The essential habitat in this case may be fully saturated by the larger number of recruits. Improved habitat in this case may not significantly affect survival. On the other hand, more marginal habitats may become better suited for a given species to expand its range in years when recruitment is good.

Figure 12 – Illustration of potential impacts of habitat improvement on recruitment using actual spawning stock biomass and recruitment estimates for Gulf of Maine cod. (data from NEFSC 2013; http://nefsc.noaa.gov/publications/crd/crd1311/).



Habitat Management Area Restrictions

The particular fishing restrictions employed within the habitat management areas that comprise these alternatives will have a large influence on the expected impacts of the alternatives. With a few exceptions, one of the following restrictions would be selected for each habitat management area. These measures are discussed in other sections of this volume: section 2.1 describes the measures, the introduction to section 4.1 discusses the potential for effort displacement if these measures are implemented, and the introduction to section 4.1.1 discusses how these measures would be expected to influence the direction and magnitude of seabed impacts.

- Maintaining the existing year round groundfish closed area restrictions (closed to all gears capable of catching groundfish, including trawls, gillnets, and longlines) and the existing habitat closure area restrictions (closed to all mobile bottom tending gears including trawls and dredges);
- Closing habitat management areas to all mobile bottom tending gears including trawls and dredges (option 1 in Section 2.1);
- Closing habitat management areas to all mobile bottom tending gears including trawls and dredges, except for hydraulic clam dredges (option 2 in Section 2.1);

- Trawl gear modifications that could limit the length of or restrict the use of ground cables (options 3 and 4 in Section 2.1), with no restrictions on fishing with scallop or clam dredges.

The first measure, a, applies to Alternative 1 (No Action), an alternative that may be chosen for one or more sub-regions. Positive impacts to groundfish habitat may continue if Alternative 1 is selected, although other choices may improve groundfish habitat protection and/or reduce economic cost.

Option 1 – Prohibition on mobile bottom-tending gear fishing

Prohibiting mobile bottom-tending gear fishing (option 1) in habitat management areas that have weighted groundfish hotspots (and to some extent areas without hotspots that host some age 0/1 groundfish and encompass vulnerable substrates) is expected to have a positive local effect on age 0/1 groundfish that are associated with coarse and hard substrates, presuming that those areas have previously been altered by fishing. Areas that overlap existing year round groundfish closed areas would experience a smaller marginal increase in benefits than areas that are now intensively fished. Areas that are currently open but have had no or little fishing are expected to have a neutral or no effect if closed to these gears.

On a regional scale, prohibiting mobile bottom-tending gear fishing may produce positive, neutral, or negative impacts, depending on where and how effort is displaced (see the following section for a more thorough discussion). It is presumed that effort redistribution to use non-mobile gears would reduce regional habitat impacts and be positive for groundfish habitat, although it might have negative consequences for other VECs (such as marine mammals or economics if fishing costs increase). Negative regional habitat impacts may occur when more sensitive areas that currently prohibit fishing with mobile bottom-tending gears open to fishing and are not replaced by areas with equivalent or better groundfish habitat characteristics, represented by the number of hotspots. It is in this context that the evaluation of habitat impacts of the alternatives below are made, compared to Alternative 1 (No Action) in each region.

Option 2 – Prohibition on mobile bottom-tending gear fishing, hydraulic clam dredge exemption

In the Gulf of Maine, options 2 and 3 are expected to have the same impacts because no hydraulic clam dredging occurs offshore in this region. In Georges Bank management areas, the local and regional impacts on groundfish habitat would be less positive under option 2 than if clam dredges were prohibited (i.e. option 1) from fishing in a habitat management area. However, it is known that dredge vessels target clams in areas having sand and/or small gravel and pebbles. Therefore the impact on groundfish habitat in proposed Georges Bank habitat management areas is likely to be marginally negative relative to management measure option 1, but still could be positive relative to Alternative 1 (No Action), assuming that the alternative has better groundfish habitat than existing habitat management areas.

Options 3 and 4 – Gear modifications

Gear modifications could lead to locally positive, neutral (i.e. ineffective), negative, or unknown effects. There are three ways that gear modification areas may directly affect groundfish habitat, influenced by changes in fishing behavior and/or relative catchability.

- Direct reduction of habitat alteration by trawl gear, by reducing area physical interaction with substrates and bottom habitat.
- Changes in fishing time, i.e. area swept. Area swept may increase if the gear is less efficient in catching the target species, or it could decrease if the modified gear is more efficient.
- Changes in fishing behavior or location fished due to changes in fishing costs or the inability of the fishermen to use the modified gear.

Catchability is a measure of the proportion of fish in the path of a net and ground cables that are actually caught by the net. Less than 100% of these fish are caught because fish may escape capture by avoiding or outswimming the oncoming net, by escaping the net through unintentional or designed ‘loopholes’ (i.e. escape panels, raised footrope, sub-optimal ground cables), and by passing through the trawl mesh. If there is a reduction in catchability due to required gear modifications, then vessels might fish longer to catch the target species, which mitigates the direct reduction of habitat alteration..

A gear modification may also lead to changes in fishing behavior. If the modified gear cannot be fished in more rugged bottom dominated by coarse and hard substrates, fishing effort could be redistributed into other habitat types within a proposed gear modification area. This effect is expected to be positive for groundfish habitat. Other fishermen that would normally fish in the proposed area may simply choose not to use the modified gear and fish in other open fishing areas where such gear is not required. This effect could be positive, neutral, or negative depending on the quality of age 0/1 groundfish habitat that exists in the open fishing area.

Due to the potential for fishing time to increase when catchability declines compared to unmodified nets (assuming the gear modification does not actually increase catchability of the net for target species) and allowance of other mobile bottom-tending gear that impact habitat, this management measure applied to any of the proposed habitat management measures is unlikely to have positive impacts on groundfish habitat, unless it substantially reduces the amount of fishing or its location through changes in fishing behavior. Regional impacts on groundfish habitat and on groundfish stocks are either unknown or possibly negative compared to Alternative 1 (No Action).

Effort redistribution

As noted above, regional effort redistribution is expected to influence the magnitude and direction of impacts of the alternatives described in this section. Although the total amount of catch of large-mesh groundfish species is regulated and limited by ABCs, the spatial distribution of fishing effort is important. Two types of effort redistribution are expected in the groundfish fishery, although the magnitude of effort shifts is difficult to quantify.

New habitat management areas are proposed in this amendment (see Section 2.1), which would prohibit or limit fishing using mobile bottom tending mobile gears, including bottom trawls commonly used in the groundfish fishery. The amount of revenue affected by the alternatives is estimated in the economic impacts discussion (Section 4.1.3.1). It is expected that the associated fishing effort will be displaced, usually but not always surrounding the new habitat management area. Some of this fishing effort will be redeployed into year round groundfish closed areas (such as the eastern sliver of the Western Gulf of Maine Area, Closed Area I, Closed Area II, and the Nantucket Lightship Area if they re-open to fishing. Some of this effort may have already been redeployed by sector vessels under Framework 48 regulations (NEFMC 2013).

With this redistribution of groundfish trawl effort, the catch composition will change, making it easier to catch some species and harder to catch others. While there may be some economic benefits that reduce cost to catch groundfish and allow fishermen to catch a higher proportion of the ABC, there will be small or negligible effects on the groundfish stocks. To the extent that fishing effort will be lower in areas with higher amounts of juvenile fish, fishing mortality associated with an ABC level may marginally decline. Alternatively, if fishing effort increases where there is a greater amount of sub-legal fish that are retained by the trawls, fishing mortality associated with an ABC could marginally increase. Eventually, the assessments will detect any changes in size selectivity by the fishery and the ABCs would be adjusted. Other changes in the non-groundfish bycatch in the groundfish fishery may also occur, depending on limits in other fisheries and the overlap in species' distributions with reconfigured open fishing areas.

In areas that are closed to fishing with trawls, but remain open to fishing with gillnets and longlines, there may be a shift towards increased use of non-mobile gears to target groundfish. This shift is more likely occur in inshore, shallower areas, like the Western Gulf of Maine Area. Gillnet use around the Nantucket Lightship Area, Closed Area I, and Closed Area II is not heavy, so significant effort shifts towards gillnets are much less likely in these areas, if one of the action alternatives is approved and re-opens these year round groundfish closed areas.

At present, most of the observed gillnet sets targeting groundfish and monkfish are located in between the southern part of the Western Gulf of Maine and Massachusetts Bay, and other areas on southern Jeffreys Ledge, just inshore of the Western Gulf of Maine Area (map below, at left), but gillnet fishing effort distribution has not always looked as it does now. Before 1998, there was considerable observed fishing effort with gillnets in what later became the Western Gulf of Maine Closed Area and the Western Gulf of Maine Habitat Closure Area (map below, at right).

While economic and other incentives to fish with gillnets may have changed since 1998 and may be different under sector management since 2010, one of the biggest changes during this time was the prohibition on using gillnets in the Western Gulf of Maine Closed Area. All habitat management alternatives except No Action propose to re-open the Western Gulf of Maine Closed Area to fishing with non-mobile gears.

Because total groundfish catch is limited by ABCs, the impact on groundfish catch is expected to be negligible. However, gillnets usually select larger fish like cod than trawls do, so fishing mortality could change (Figure 13 shows the size distribution by gear for trawls and gillnets observed in the Gulf of Maine). Until the ABCs are adjusted for changes in selectivity, shifts in effort from using trawls to using gillnets could reduce fishing mortality and potentially increase stock biomass, at least in the short term. In the longer term, assessments will re-estimate size selectivity and ABCs will be adjusted accordingly. Over the longer term, better selectivity could increase yield-per-recruit and total yield from the fishery for stocks that have better size selectivity using gillnets.

In addition to the existing year round groundfish closed areas and EFH closures, the alternatives in this amendment would close or limit the use of mobile bottom tending gears in new areas. Some of these areas are closer inshore and could attract new or additional gillnet fishing by groundfish vessels, particularly the Large and Small Bigelow Bight Areas and Platts Bank. Although less frequent since 2010, there were substantial amounts of fishing with gillnets in the Scantum Basin off NH and around Platts Bank (see map below at right). While gillnet fishing in these areas is currently allowed, the presence of trawl fishing in these areas could limit the amount of fishing with fixed gears. In a habitat management area that is closed to mobile fishing gears, fishing with fixed gears could increase since the potential for gear loss would be reduced and gillnet catch rates could increase.

Other effects, such as gear conflict with recreational fishing, interactions with marine mammals, and incidental catch of non-groundfish species must be considered since increases in gillnet fishing in the Western Gulf of Maine Area is likely to occur.

Map 37 – Current gillnet effort distribution (left, 2010-2013) compared to historic gillnet effort distribution (right, 1994-1998) before the Western Gulf of Maine closure.

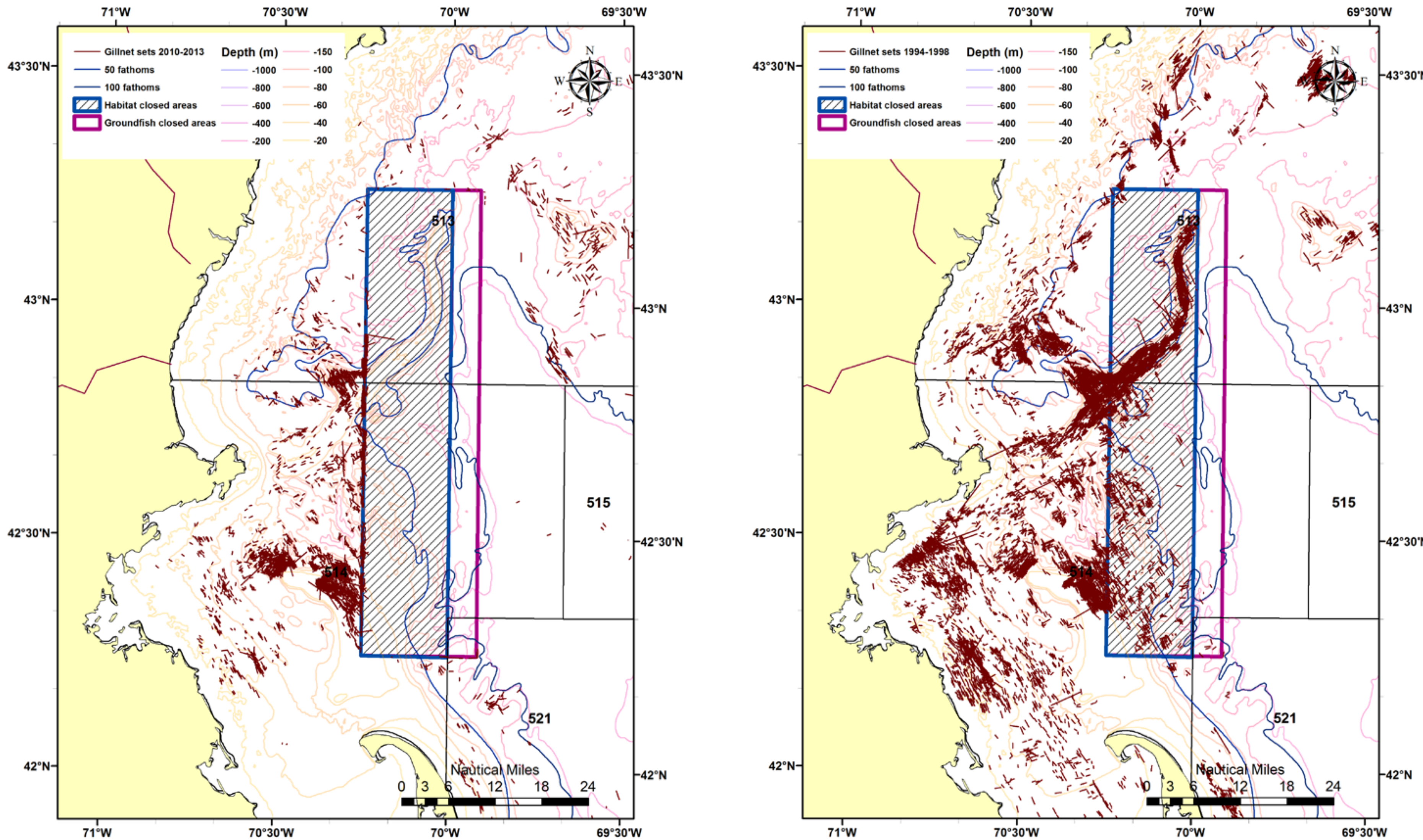
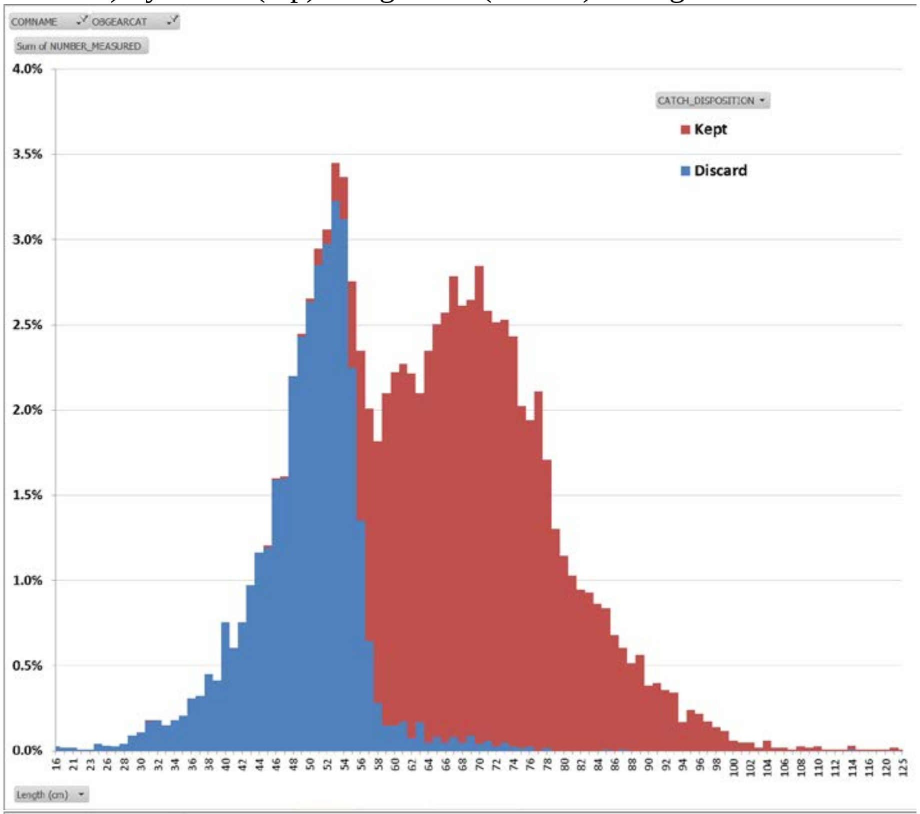
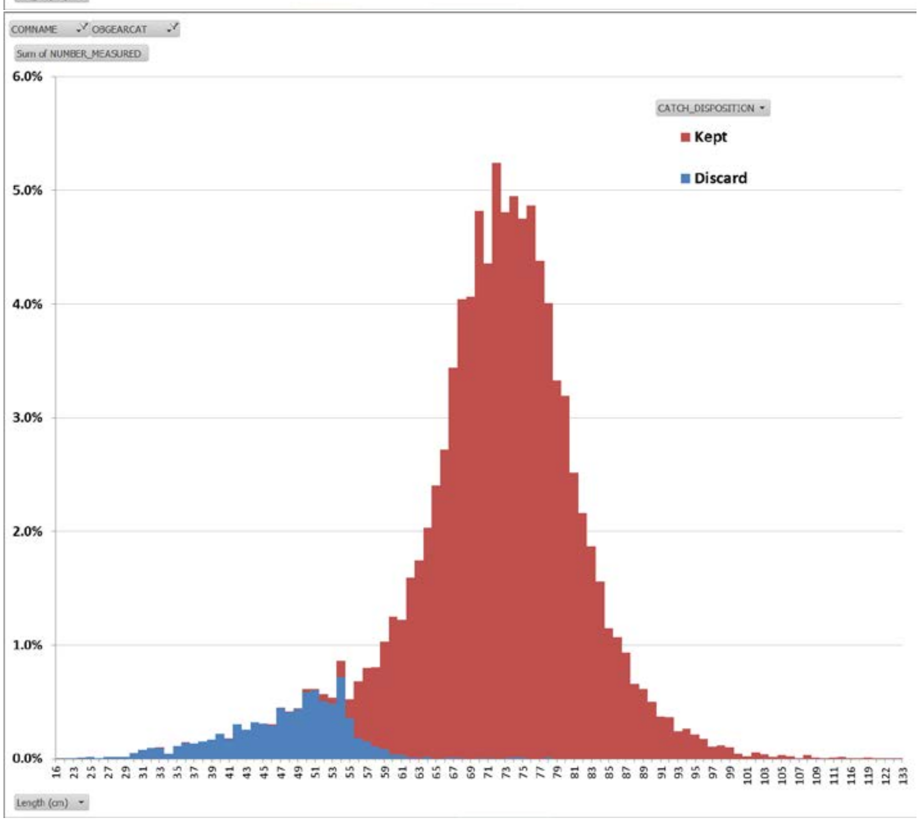


Figure 13 – Length frequency of observed cod catches in the Gulf of Maine (Statistical Areas 511-515) by trawls (top) and gillnets (bottom) during 2010-2013.





Age 0/1 versus large juvenile cod distribution

When evaluating the impacts of the habitat management alternatives on groundfish, it is important to consider the size and age of fish targeted for conservation. Fish size ranges included in the hotspot analysis were selected to encompass age 0/1 fish, and management areas designed around the results of the hotspot analyses therefore are designed to protect these smaller juveniles. These young fish were identified as most reliant on structured bottom habitat for survival and growth. Older, sub-legal, juvenile fish may not derive as much benefit from a habitat management area closure or gear restriction because they are generally less associated with the bottom and are better swimmers with their diet evolving toward consumption of larger fish.

In the case of cod in the Western Gulf of Maine, the age 0/1 fish tend to be more associated with inshore (and generally) shallower areas, particularly in the spring (Map 38). Offshore habitat management areas, such as the Western Gulf of Maine Habitat Closure Area, the Jeffreys Ledge Habitat Management Area, or the Stellwagen Habitat Management Areas (large and small) may benefit older, sub-legal cod, but they may also condense effort inshore where the smaller, younger cod are most abundant. If mobile fishing gear use reduces habitat quality inshore, this could reduce survival and growth of the youngest cod, which are believed to be more dependent on bottom habitat quality.

For cod in the Western Gulf of Maine, there is a notable difference in distribution of age 0/1 cod (<= 25 cm in spring and <= 35 cm in fall) compared to older, but still sub-legal cod <= 55 cm. The age 0/1 cod are distributed more inshore and appear to be more abundant further offshore during both the spring and fall surveys (Map 38). This does not mean that there aren’t cod older than age 1 inshore; however there are relatively fewer in number. This also does not mean that there are not age 0/1 cod further offshore; however they are fewer in number than older, sub-legal fish. The older, sub-legal fish are caught more frequently than then youngest fish in commercial and recreational catches.

This inshore/offshore difference in distribution is not entirely due to depth or temperature (i.e. generally shallower and warmer inshore). There are significant differences in the distribution of younger versus older juveniles by depth, but they are more subtle than it might appear in Map 38. In the spring (Figure 14), abundance of age 0/1 cod appears to be significantly greater than abundance of older, sub-legal cod at depths up to 20 m. The opposite appears to be true at depths greater than 90 m, where the abundance of older sub-legal cod is greater than that of age 0/1 cod. The abundance appears to be not significantly different between these depths, often found in the offshore portions of the Western Gulf of Maine (Map 38). In the spring (Figure 14), there appear to be significantly more 0-25 cm cod only at 7ºC, but not at any other temperature[3]. At temperatures above 9ºC, only sub-legal cod below 25 cm were caught.

In the fall (Figure 15), the relative abundance for these two size categories does not appear to be significantly different, except for depth less than 20 m, where there were very few older sub-

[3] These results should be interpreted with caution, however, due to influences of larger year classes during years when temperature was abnormally high or low.

legal cod in the survey catches. In the fall, there appear to be significantly more 35-55 cm sub-legal cod when the bottom temperature was 6ºC and more 0-35 cm cod when the bottom temperature was above 11ºC.

Figure 14 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 spring surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean.

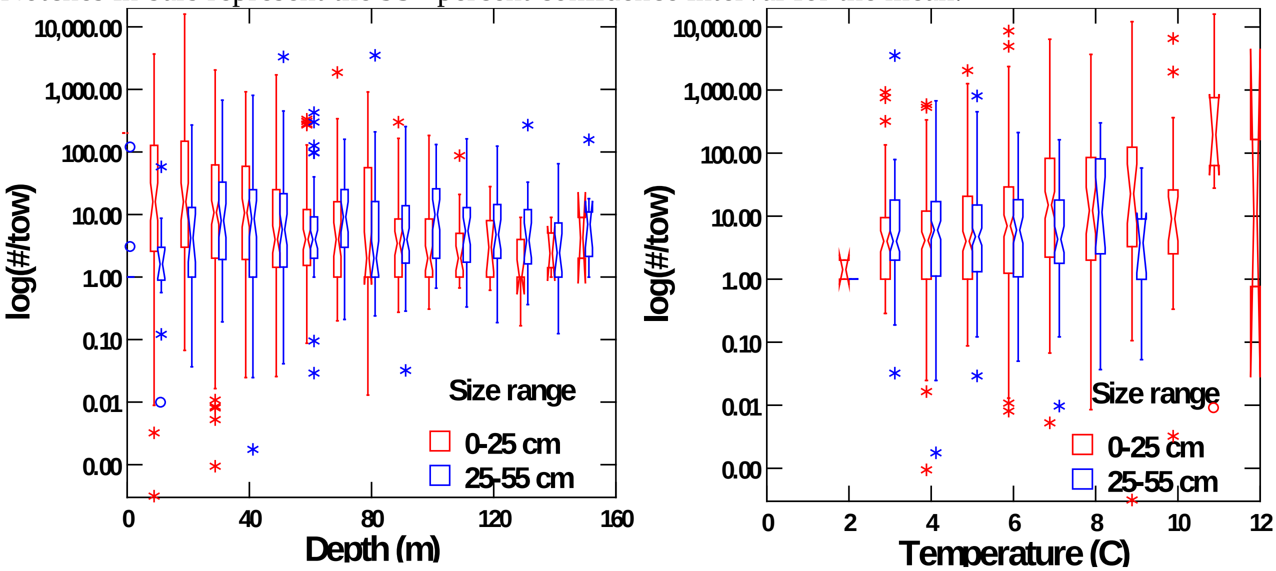
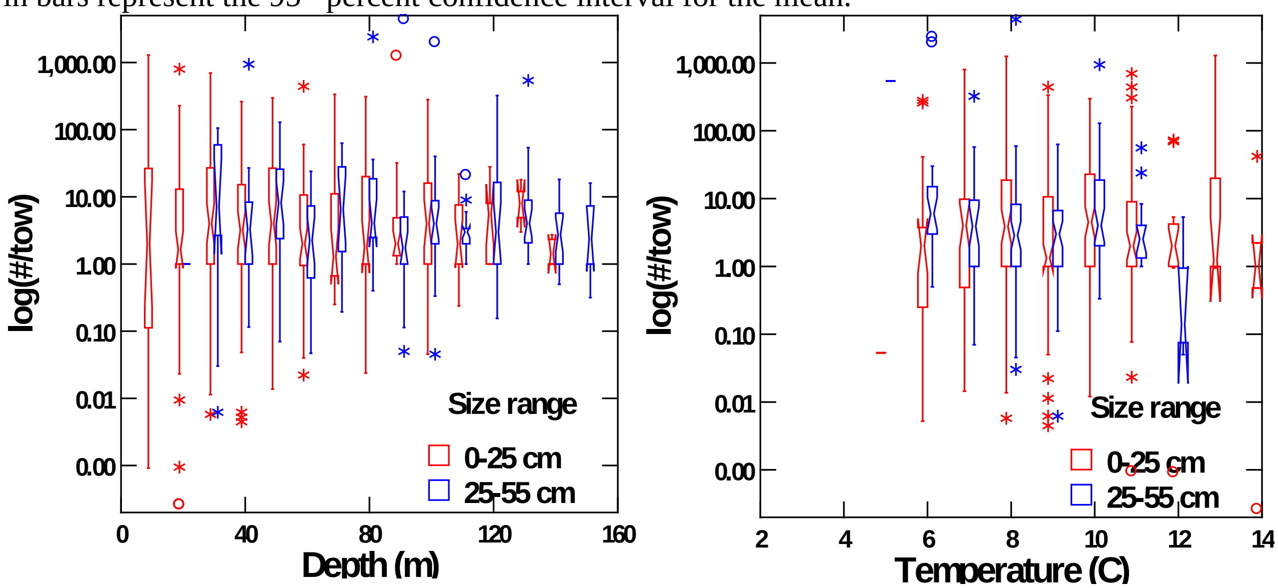
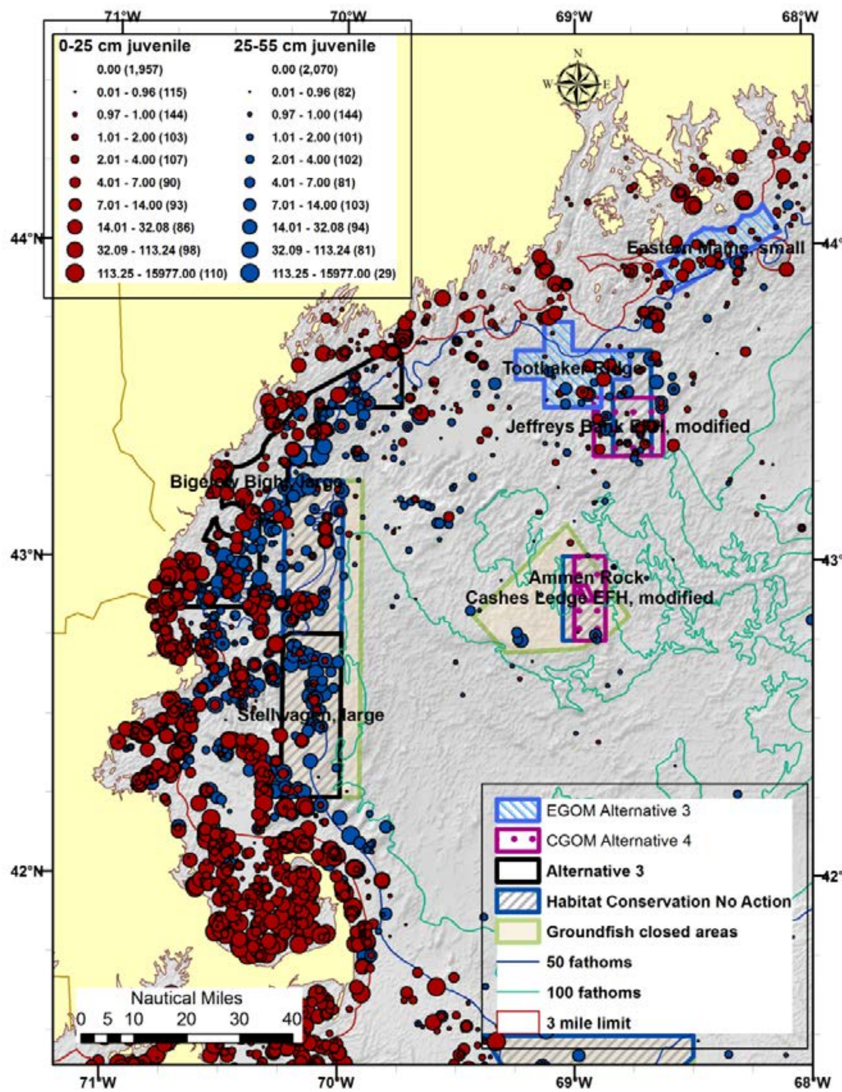


Figure 15 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 fall surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean.

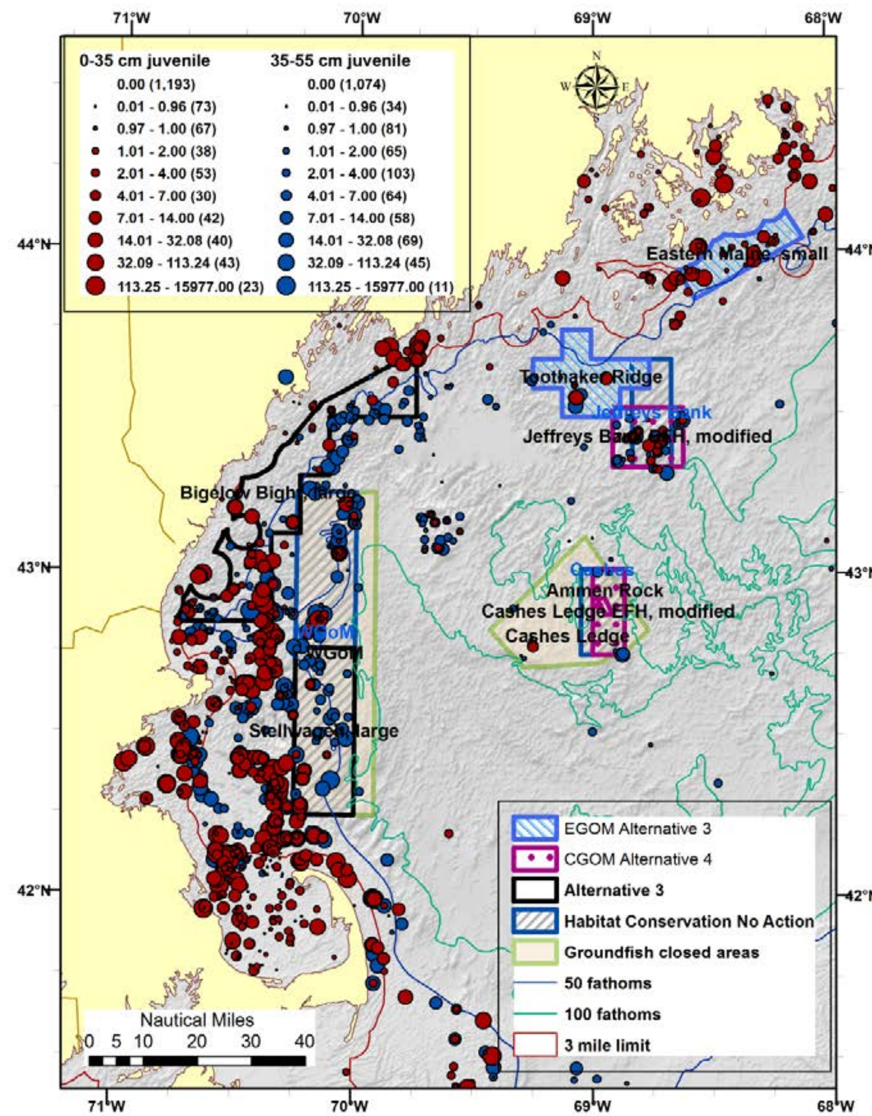


Map 38 – Distribution and overlap of WGOM Alternative 3, EGOM Alternative 3, and CGOM Alternative 4 with sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, ME-NH, and IBS cod surveys.

Spring and summer



Fall and winter



4.1.2.1 *Gulf of Maine*

4.1.2.1.1 No Action

The amount of unweighted and weighted hotspots in each survey season is summarized in the table below, with distribution of the weighted hotspot totals shown in Map 39. Summer and winter hotspots in the Gulf of Maine are low, reflecting the limited amount of survey samples taken there during these seasons [mainly the summer shrimp survey which is restricted to the Western Gulf of Maine off southern Maine (see Map???)].

The total weighted hotspots in the No Action EFH closures in the Gulf of Maine were 288.1 in the spring, 175.8 in the summer, and 386.8 in the fall. During the spring, most of the weighted hotspots occur inshore of and partially overlapping the Western Gulf of Maine EFH closure. Most of the hotspots in Massachusetts, Cape Cod, and Ipswich Bays occur due to the presence of heavily weighted age 0/1 cod. Most of the hotspots off southern Maine and northwest of Jeffreys Bank occur due the presence of heavily weighted American plaice, redfish, and windowpane flounder. Most of the hotspots inshore and southwest of the Western Gulf of Maine EFH closure during the winter are from heavily weighted cod and yellowtail flounder.

Compared to areas outside of the No Action alternative EFH closures and year round groundfish closed areas, there were relatively few groundfish hotspots. In the case of Cashes Ledge, this low amount of hotspots is probably due to low sampling intensity in this specific area, but not elsewhere.

Continuing No Action is unlikely to substantially improve habitat quality associated with age 0/1 large mesh groundfish species. Continuation of No Action (i.e. status quo areas that prohibit the use of mobile bottom-tending gear and year round closures to vessels using gears capable of catching groundfish) are likely to have positive impacts on the groundfish resource, but population level impacts have been so far difficult to detect. No formal BACI analysis of relative changes of biomass in Gulf of Maine closed areas was done in Multispecies Framework Adjustment 48, except for the Western Gulf of Maine Closed Area. Differences in survey CPUE of groundfish species inside and immediately adjacent to closed areas was difficult to detect, although more concentrated fishing activity particularly around the Western Gulf of Maine Closed and Cashes Ledge Closed Areas is evident from the fishery data (see maps in Section ???). The BACI analysis (Kerr et al 2012???) showed that the Western Gulf of Maine Closed Area had positive effects on biomass of winter flounder in the closed area, but not for other species including cod and haddock.

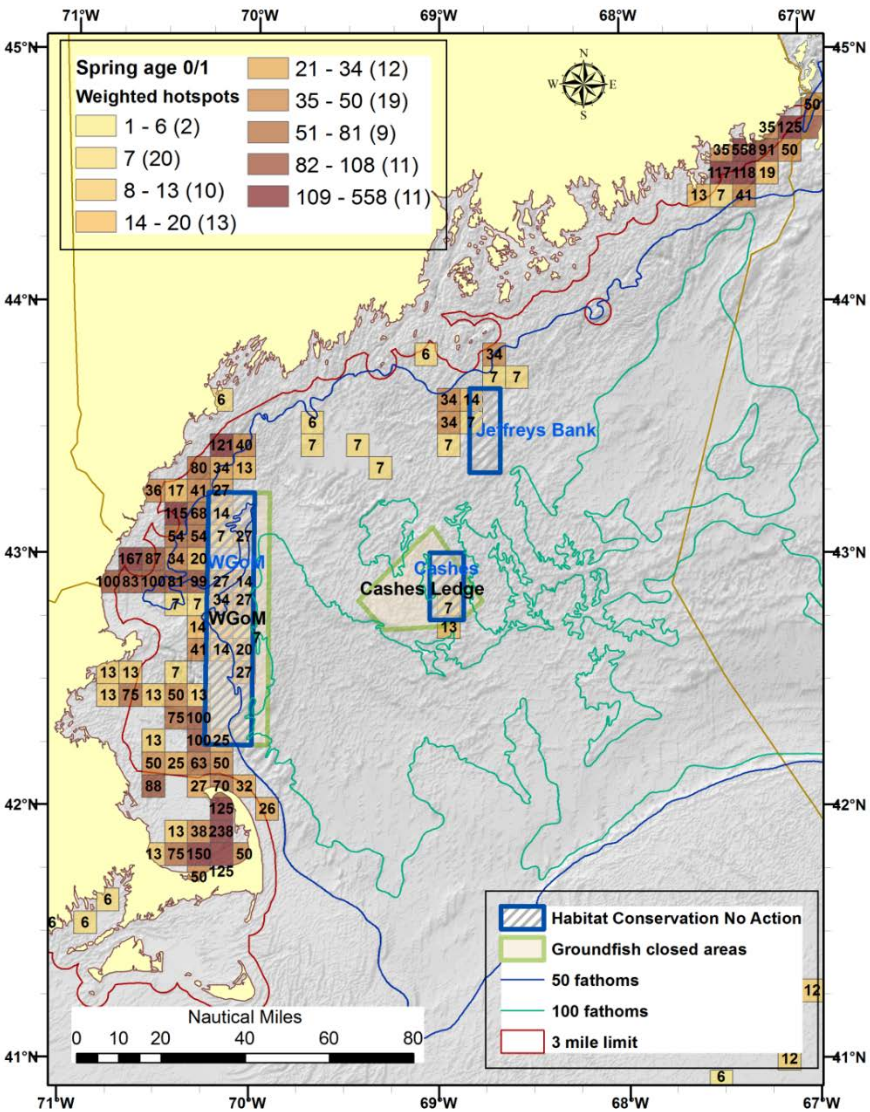
Despite these results, it is still however possible that the existing groundfish and EFH closed areas have a positive impact on the groundfish resource. The effects on groundfish survival and growth while in the closed areas may be realized by the fishery operating outside the boundary of the closed areas, not necessarily showing up as a biomass buildup in the closed area or a measureable increase of productivity for the stock as a whole.

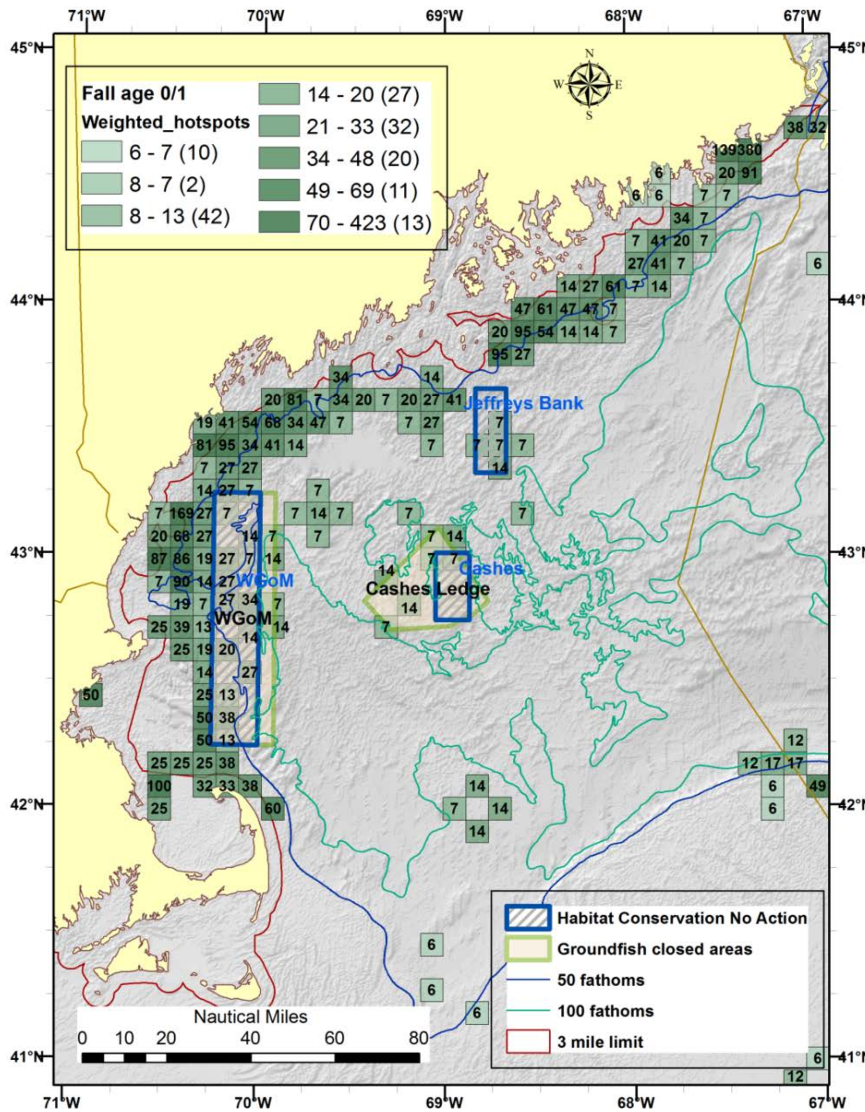
Therefore, based on this reasoning and the evidence at hand, the impacts of the No Action alternative in the Gulf of Maine is slightly positive.

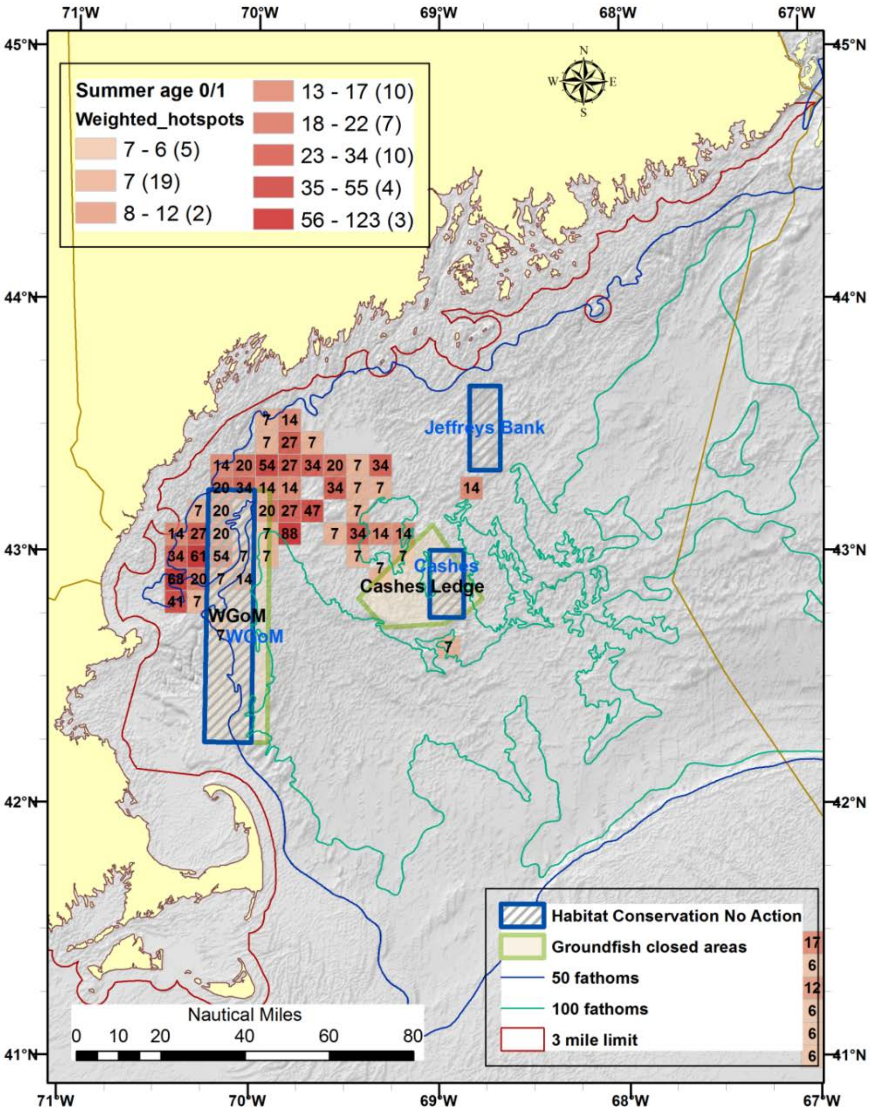
Table 26 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Gulf of Maine.

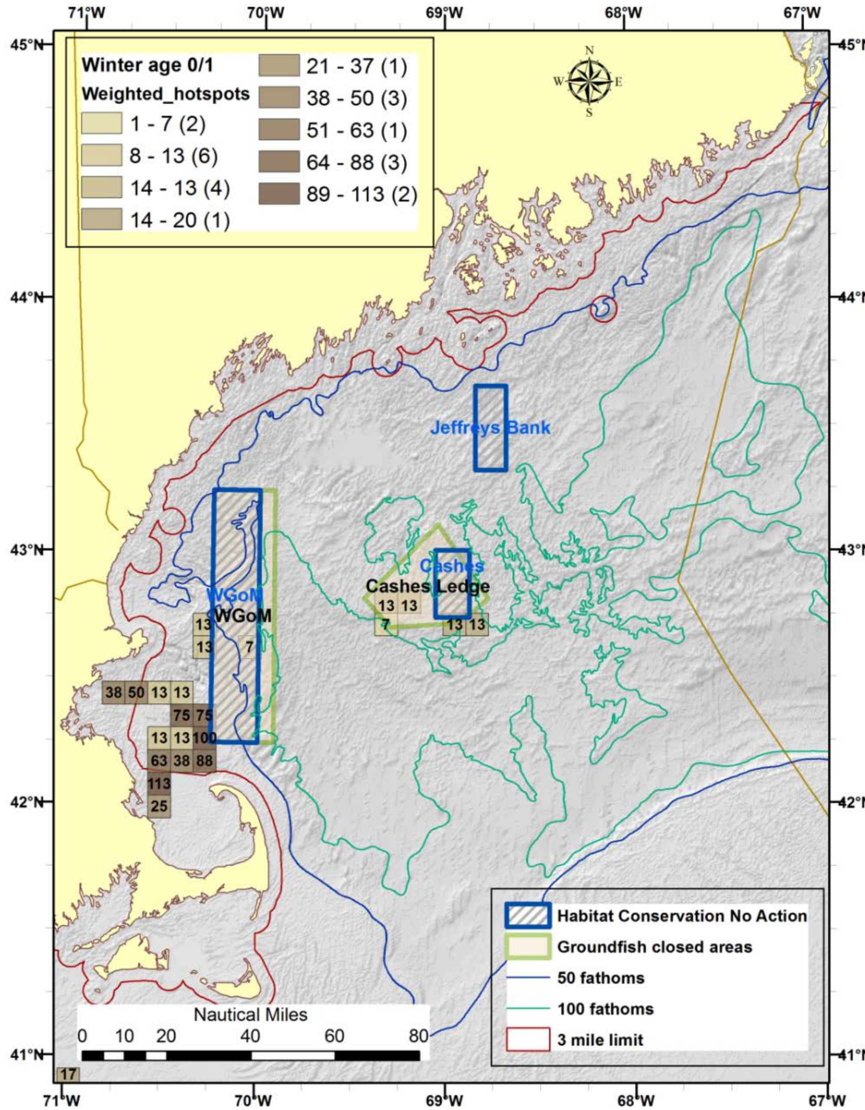
	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine No Action	92	288.1	104	175.8	101	386.8	5	33.6

Map 39 - Overlap of No Action EFH closures and year round groundfish closed areas with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summary age 0/1
Weighted_hotspots
7 - 6 (5)
7 (19)
8 - 12 (2)
13 - 17 (10)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Jeffreys Bank
Cashes
Cashes Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
14 - 20 (1)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Jeffreys Bank
Cashes
Cashes Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80

4.1.2.1.2 Eastern Gulf of Maine and the Scotian Shelf

4.1.2.1.2.1 Alternative 2 (No Action, No HMAs)

Total unweighted and weighted hotspots in the areas proposed for habitat management in EGOM Alternatives 2 and 3 are summarized in the table below, compared to No Action. There are no EFH closures or year round groundfish closed areas in this sub-region, so no hotspots are encompassed within a habitat management area.

Only spring and fall surveys are conducted in this sub-region, a NMFS trawl survey and a coastal ME-NH trawl survey. In the spring, nearly all of the groundfish hotspots overlap the proposed Machias Habitat Management Area (Map 40), with a weighted total of 235 (Table 27). In the fall, more hotspots overlap the proposed Eastern Maine, Large Habitat Management Area, giving a weighted score of 591.7.

Both weighted scores are patently greater than zero for No Action and therefore are likely to improve habitat benefits for age 0/1 groundfish that are associated with coarse and hard substrates. Overall, the amount of weighted hotspots are about the same as those for Alternative 3, so would be expected to have similar conservation benefits for groundfish stocks, that when young, are associated with coarse and hard substrates. The total number of hotspots for species given non-zero weights were somewhat higher in Alternative 2 for redfish and witch flounder (Table 28). The number of hotspots were also higher for species given a zero weight, such as red hake, silver hake, and white hake. The higher number of hotspots for these hakes suggest that Alternative 2 has more softer substrates included in them than Alternative 3.

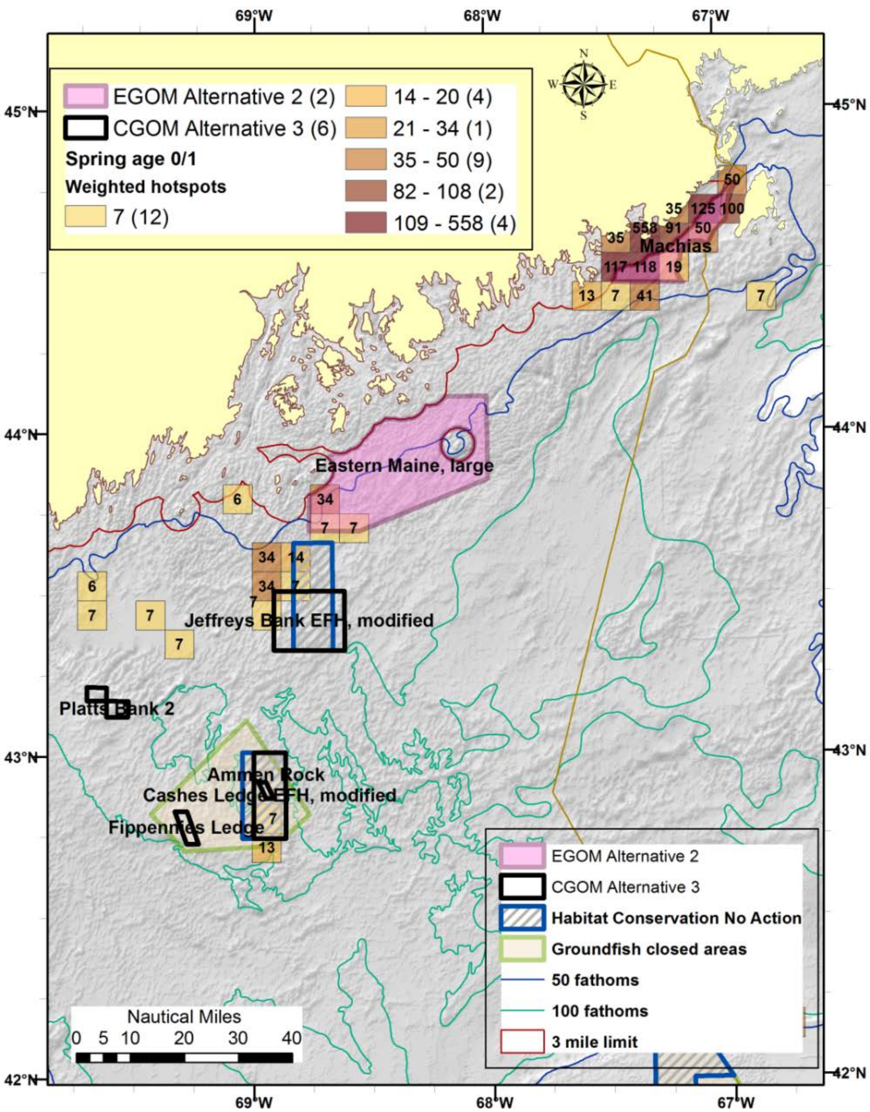
There were no age 0/1 cod hotspots in the proposed Large Eastern Maine Habitat Management Area, but age 0/1 cod and herring hotspots were identified inshore within ME state waters. Habitat protection in the Large Eastern Maine Habitat Management Area could be important to cod and other species when coupled with the synergistic effects of the Penobscot River Restoration Project.

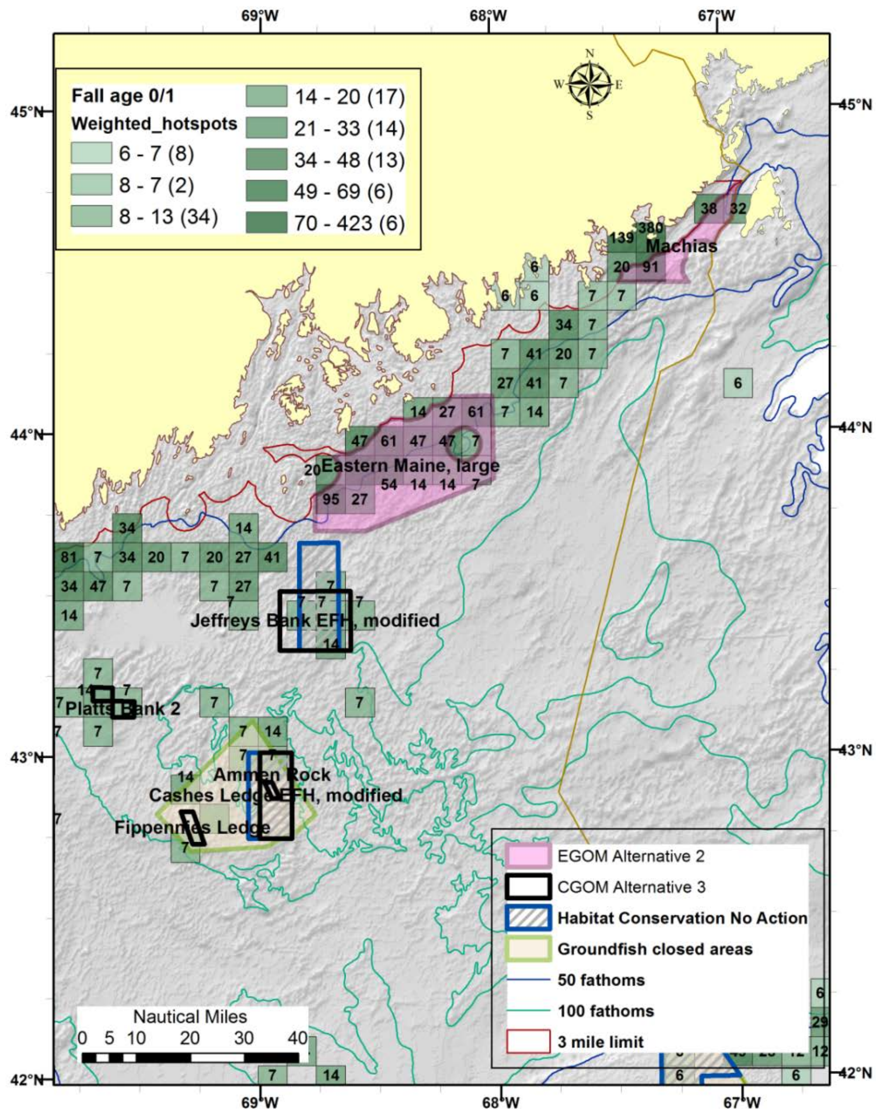
This Project is intended to restore the river to more natural conditions for diadromous migratory fish, including herring and shad. Dam removal and fish passage construction has begun and will continue into 2014 (NOAA Fisheries Navigator, Commercial Fisheries News, Nov 2013 p4). One of the expected benefits of this Project is to restore native sea run fish stocks, which has system-wide ecosystem benefits. It is thought that restoration of these forage fish around the Penobscot Bay will also promote restoration of important coastal fish stocks, including cod. Additional protection of cod habitat in this region could act synergistically to boost cod recovery in areas that had historic cod populations (Ames ???). The Large Eastern Maine Habitat Management Area could provide more protection to cod habitats in this region than the smaller area proposed in Alternative 3.

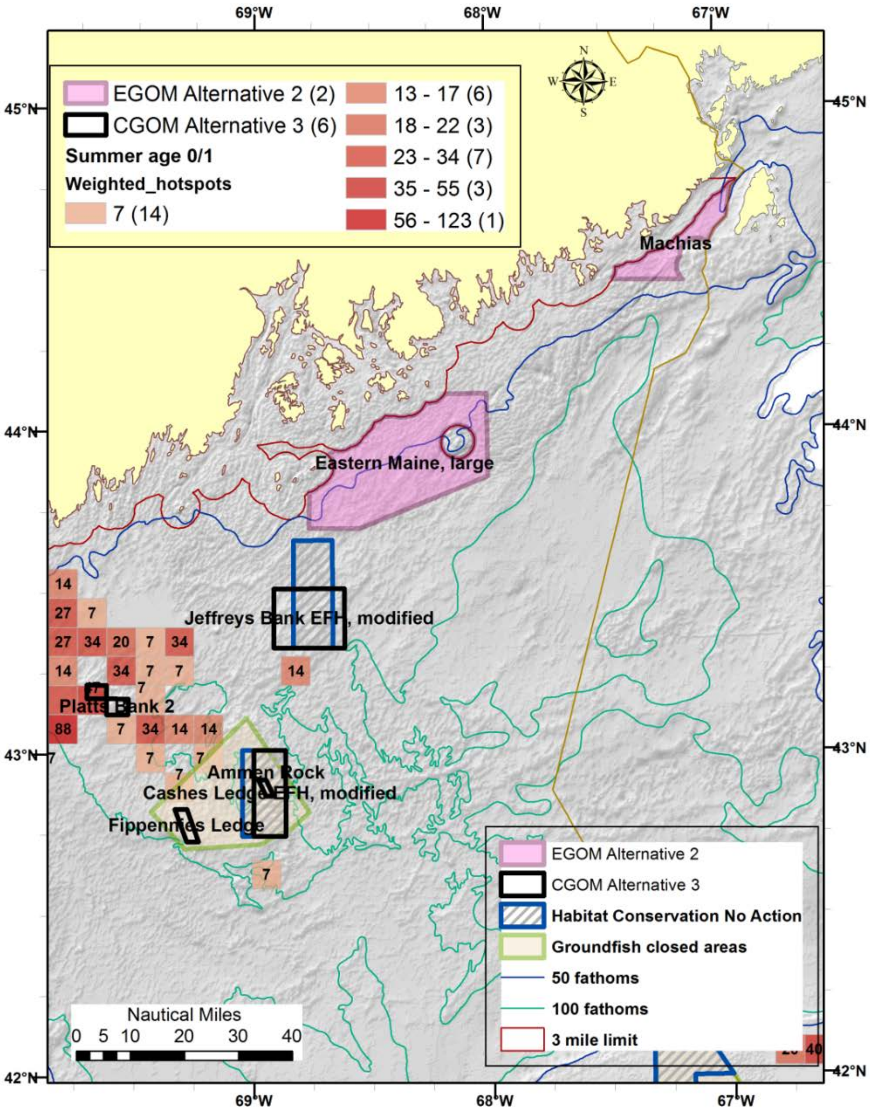
Table 27 – Total unweighted and weighted hotspots in EGOM habitat management area alternatives, compared to No Action.

	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Eastern GOM								
No Action	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
EFH closure	0	0.0	0	0.0	0	0.0	0	0.0
GF closure	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 2	150	235.0	4	0.0	274	591.7	0	0.0
Alternative 3	119	268.8	33	0.0	190	449.8	0	0.0

Map 40. EGOM Alternative 2 and CGOM Alternative 3 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






EGOM Alternative 2 (2)
CGOM Alternative 3 (6)
Summer age 0/1
Weighted_hotspots
7 (14)
13 - 17 (6)
18 - 22 (3)
23 - 34 (7)
35 - 55 (3)
56 - 123 (1)
Machias
Eastern Maine, large
Jeffreys Bank EFH, modified
Platts Bank 2
Ammen Rock
Cashes Ledge EFH, modified
Fippennies Ledge
EGOM Alternative 2
CGOM Alternative 3
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
69°W
68°W
67°W
45°N
44°N
43°N
42°N

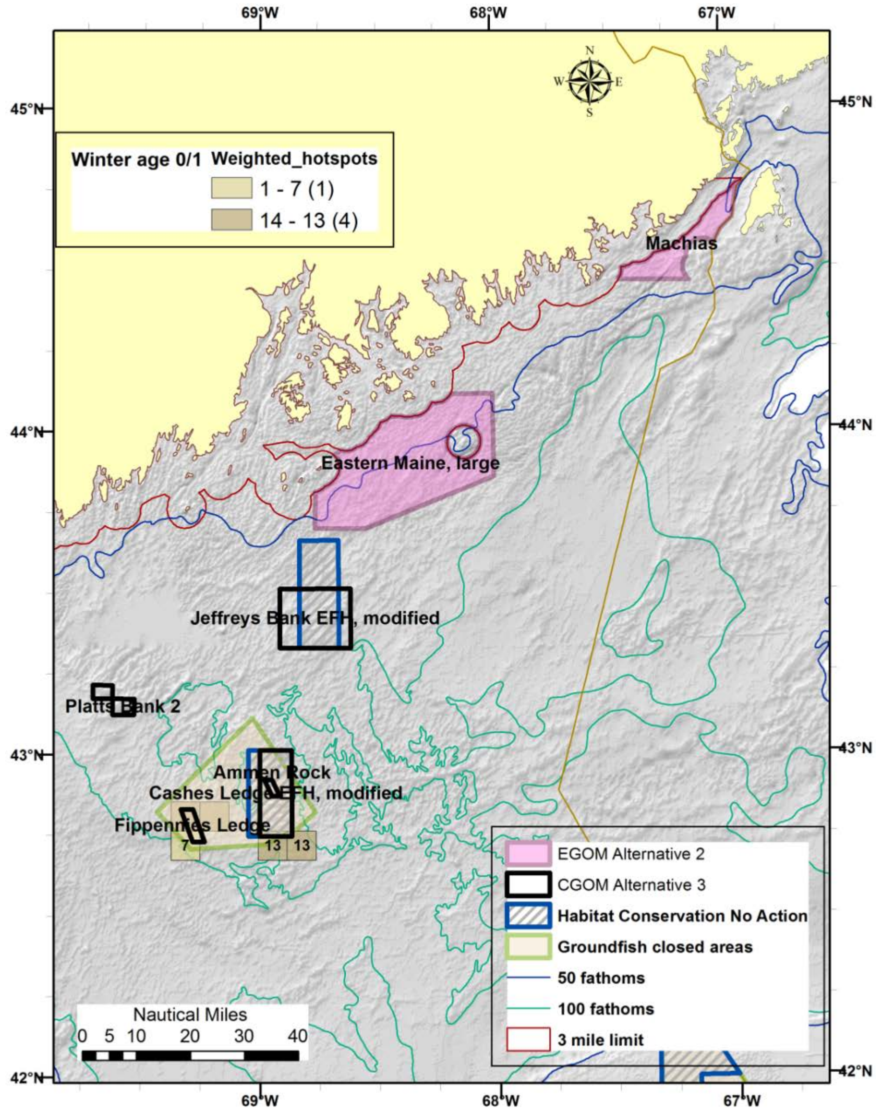

Winter age 0/1 Weighted_hotspots
1 - 7 (1)
14 - 13 (4)
Machias
Eastern Maine, large
Jeffreys Bank EFH, modified
Platts Bank 2
Ammen Rock
Cashes Ledge EFH, modified
Fippennies Ledge
EGOM Alternative 2
CGOM Alternative 3
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
69°W
68°W
67°W
45°N
44°N
43°N
42°N

Table 28 – Total hotspots by species for EGOM habitat management area alternatives, compared to No Action.

	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Eastern Gulf of Maine																		
Alternative 1 (No Action)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 2	81	0	0	2	0	13	0	7	0	0	7	143	98	13	20	44	0	428
Alternative 3	65	1	0	2	0	13	0	7	0	0	30	109	57	13	18	27	0	342

4.1.2.1.2.2 Alternative 3

Although they encompass different areas and hotspots, the total weighted hotspots in habitat management areas proposed by this alternative are similar in quantity than those for Alternative 2, and of course considerably more than the zero hotspots for Alternative 1 (No Action).

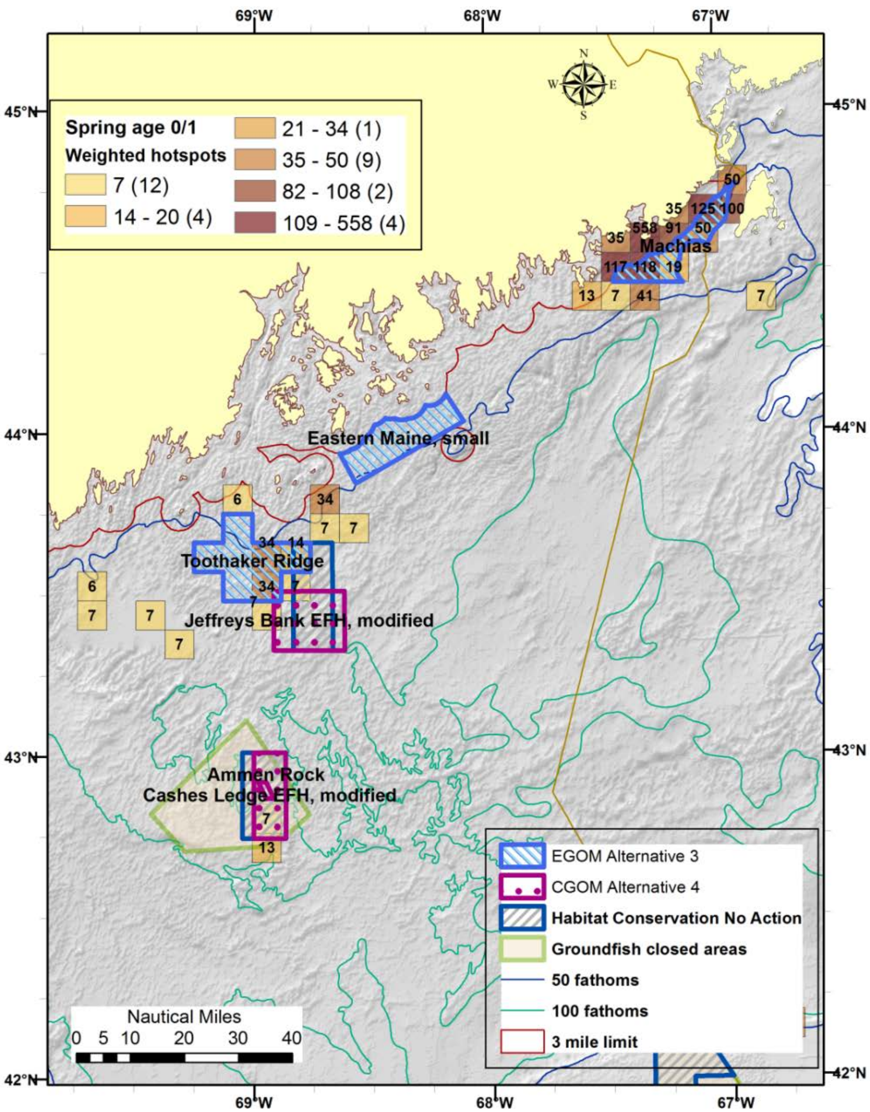
Only spring and fall surveys are conducted in this sub-region, a NMFS trawl survey and a coastal ME-NH trawl survey. In the spring, nearly all of the groundfish hotspots overlap the proposed Machias Habitat Management Area (Map 41), with a weighted total of 268.8 (Table 27). In the fall, more hotspots overlap the proposed Eastern Maine, Small Habitat Management Area and Toothaker Ridge area, giving a weighted score of 449.8. The Toothaker Ridge Area offers some habitat protection for age 0/1 groundfish to offset the smaller Eastern Maine Area.

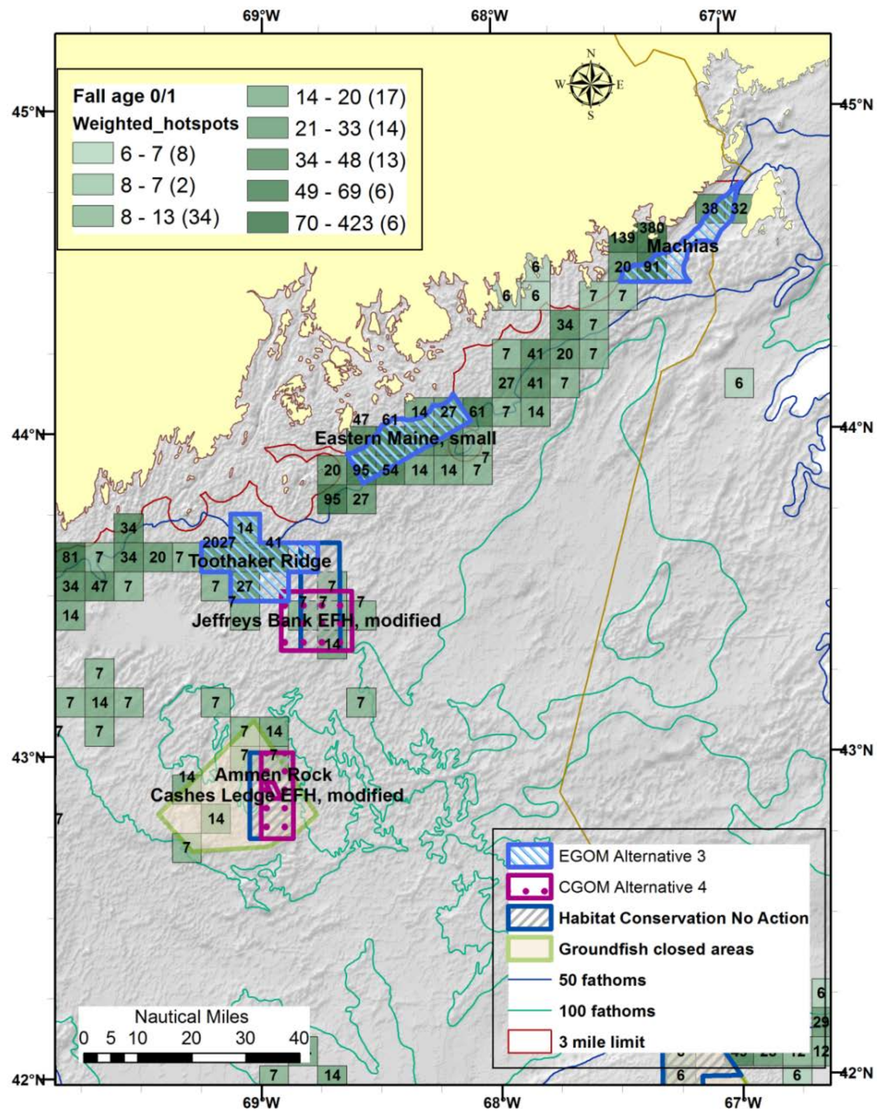
Both weighted scores are patently greater than zero for No Action and therefore are likely to improve habitat benefits for age 0/1 groundfish that are associated with coarse and hard substrates. Overall, the amount of weighted hotspots are about the same as those for Alternative 2, so would expected to have similar conservation benefits for groundfish stocks that when young are associated with coarse and hard substrates.

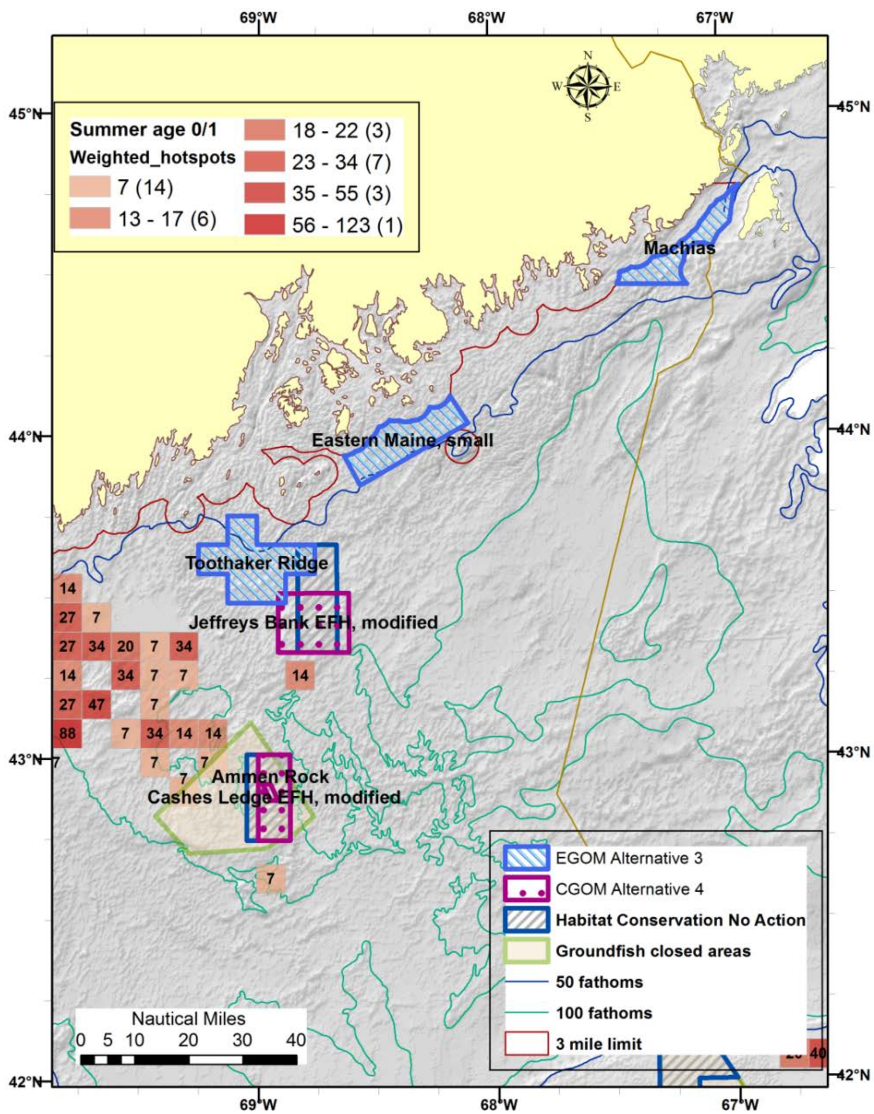
The total number of hotspots for species associated with hard and coarse substrates was lower than those for Alternative 2, particularly for redfish and witch flounder (Table 28), but exactly the same for cod.

There were no age 0/1 cod hotspots in the proposed Small Eastern Maine Habitat Management Area, but age 0/1 cod and herring hotspots were identified inshore within ME state waters. Habitat protection in the Small Eastern Maine Habitat Management Area could be important to cod and other species when coupled with the synergistic effects of the Penobscot River Restoration Project, summarized in Alternative 2 above. The smaller habitat management area protection is not as extensive as those for the larger area in Alternative 2, but may also provide benefits of nearly the same magnitude. Existing groundfish data do not provide a level of precision to distinguish between the two areas.

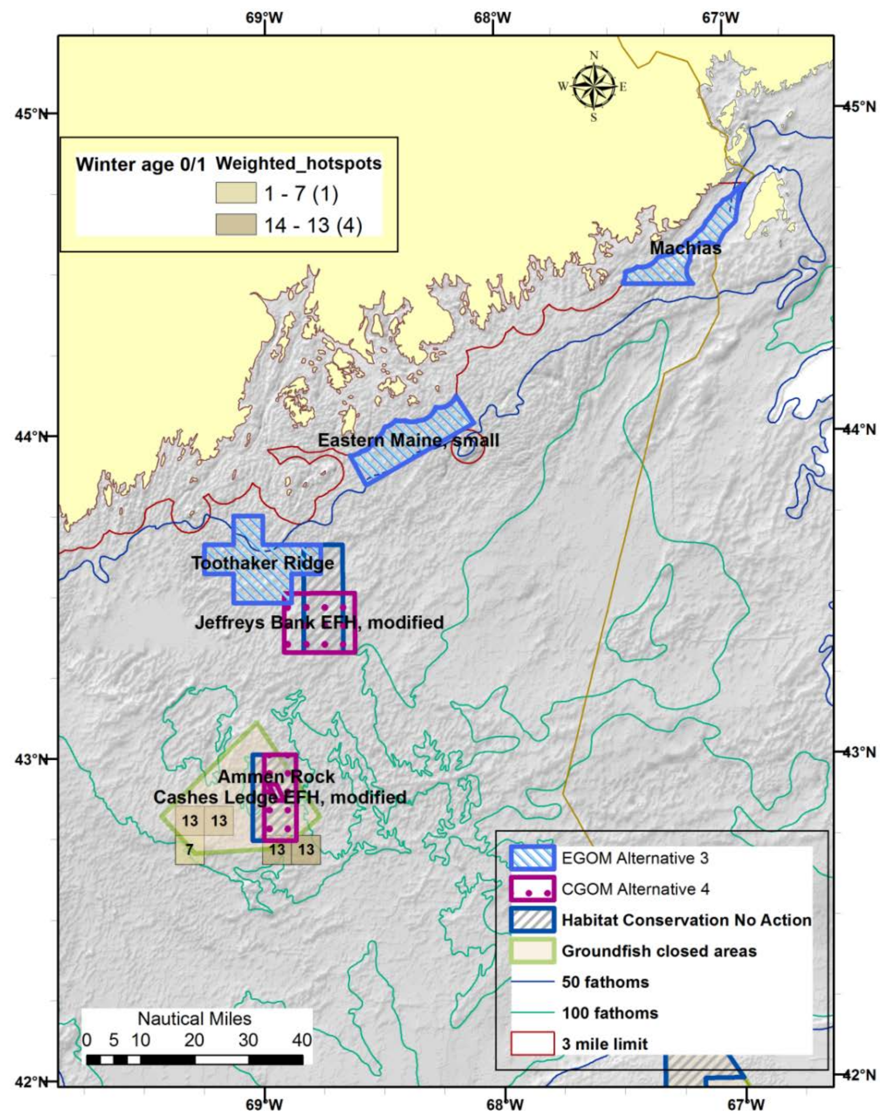
Map 41 – EGOM Alternative 3 and CGOM Alternative 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.







69°W
68°W
67°W
45°N
44°N
43°N
42°N
Summer age 0/1
Weighted_hotspots
7 (14)
13 - 17 (6)
18 - 22 (3)
23 - 34 (7)
35 - 55 (3)
56 - 123 (1)
Machias
Eastern Maine, small
Toothaker Ridge
Jeffreys Bank EFH, modified
Ammen Rock
Cashes Ledge EFH, modified
EGOM Alternative 3
CGOM Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40



69°W
68°W
67°W
45°N
44°N
43°N
42°N
Winter age 0/1 Weighted_hotspots
1 - 7 (1)
14 - 13 (4)
Machias
Eastern Maine, small
Toothaker Ridge
Jeffreys Bank EFH, modified
Ammen Rock
Cashes Ledge EFH, modified
EGOM Alternative 3
CGOM Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

4.1.2.1.3 Central Gulf of Maine

4.1.2.1.3.1 Alternative 2 (No HMAs)

Alternative 2 proposes no habitat management areas for the Central Gulf of Maine sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have lower benefits for groundfish stocks than either Alternative 1 (No Action), or Alternatives 3 and 4.

4.1.2.1.3.2 Alternative 3

Alternative 3 proposes a revised Jeffreys Bank and Cashes Ledge Area for habitat management (Map 40), as well as an Ammen Rock management area which would be closed to mobile bottom tending gears and gillnets. Unlike Alternative 4 below, this alternative also proposed two areas overlapping Platts Bank and one area overlapping Fippennies Ledge as habitat management areas.

Total weighted and unweighted groundfish hotspots are summarized in the table below. These hotspots are likely to be underestimated because of the reduced survey tows in the immediate vicinity of Cashes Ledge, Fippennies Ledge, and Platts Bank. The summer shrimp survey trawl and the winter IBS cod surveys partially overlap the areas proposed for habitat management in the CGOM. Areas included in Alternative 3 have fewer hotspots (Table 29) than Alternative 1 (No Action).

Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable (Table 30), but both are generally lower than those for Alternative 1 (No Action). There are no age 0/1 cod hotspots for any alternative, but this is probably due to the undersampling of the areas noted above. This alternative includes habitat management areas for Platts Bank and Fippennies Ledge, both having some catches of age 0/1 cod surrounding them, but did not produce any age 0/1 hotspots due to undersampling around these oceanographic features. These additional habitat management areas could convey some additional habitat conservation for cod and other groundfish species, however.

Based on the number and distribution of hotspots, Alternative 3 has less conservation benefits than Alternative 1 (No Action). Alternative 1 (No Action) does not include any EFH Closures around Platts Bank and Fippennies Ledge however, two areas with some survey catches of age 0/1 cod and other groundfish, but not enough to produce hotspots probably due to undersampling of these features.

Table 29 – Total unweighted and weighted hotspots in CGOM habitat management area alternatives compared to No Action.

Row Labels	Spring Total hotspots	Spring Total weighted hotspots	Summer Total hotspots	Summer Total weighted hotspots	Fall Total hotspots	Fall Total weighted hotspots	Winter Total hotspots	Winter Total weighted hotspots
Central GOM								
No Action	**1**	**6.7**	**16**	**13.5**	**12**	**47.3**	**4**	**26.8**
EFH closure	1	6.7	2	0.0	2	6.8	0	0.0
GF closure	1	6.7	16	13.5	12	47.3	4	26.8
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	1	6.7	8	0.0	18	40.6	2	13.4
Alternative 4	1	6.7	8	0.0	17	33.8	0	0.0

4.1.2.1.3.3 Alternative 4

Alternative 4 proposes a revised Jeffreys Bank and Cashes Ledge Area for habitat management (Map 41), as well as an Ammen Rock management area which would be closed to mobile bottom tending gears and gillnets. Unlike Alternative 3, habitat management areas around Platts Bank and Fippennies Ledge are not included.

Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable (Table 30), but both are generally lower than those for Alternative 1 (No Action). Based on the number and distribution of hotspots, Alternative 3 has less conservation benefits than Alternative 1 (No Action). Alternative 1 (No Action) does not include any EFH Closures around Platts Bank and Fippennies Ledge however, two areas with some survey catches of age 0/1 cod and other groundfish, but not enough to produce hotspots probably due to undersampling of these features.

Table 30 – Total hotspots by species for CGOM habitat management area alternatives, compared to No Action.

	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Central Gulf of Maine																		
Alternative 1 (No Action)	18	0	15	0	0	0	1	6	0	0	9	36	20	0	0	1	0	106
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	6	0	3	0	0	0	0	3	0	0	4	8	5	0	0	0	0	29
Alternative 4	5	0	3	0	0	0	0	1	0	0	4	8	5	0	0	0	0	26

4.1.2.1.4 Western Gulf of Maine

4.1.2.1.4.1 Alternative 2 (No HMAs)

Alternative 2 proposes no habitat management areas for the Western Gulf of Maine sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have lower benefits for groundfish stocks than either Alternative 1 (No Action), or any of the other alternatives for this sub-region. Under this alternative it is assumed that the existing roller gear restricted area in Alternative 7.1 would continue, although it might not be explicitly recognized as a habitat protection measure. In this case, Alternative 2 and Alternative 7.1 would otherwise be synonymous and provide equal habitat conservation benefits, but less than Alternative 1 (No Action), Alternatives 3-6, and Alternative 7.2. Therefore, the overall impact of this alternative on managed large mesh groundfish is expected to be negative.

4.1.2.1.4.2 Alternative 3

Alternative 3 proposes a new Large Bigelow Bight habitat management area coupled with a Large Stellwagen area, the latter overlapping the southern half of the existing Western Gulf of Maine EFH Closure (Map 42).

Alternative 3 areas contain considerably more age 0/1 groundfish hotspots than areas included in Alternative 1 (No Action), weighted more heavily for stocks that have low biomass and/or have a high affinity for coarse and hard substrates. The total weighted hotspots (Table 31) are similar to the totals for Alternative 4, but higher than those for Alternatives 5 and 6. Comparison to the number of hotspots in the much larger existing or expanded roller gear management area in Alternative 7 may not be appropriate because the proposed habitat management areas would have different habitat management measures, including prohibiting or restricting the use of all mobile tending bottom gears within the proposed areas, including shrimp and small mesh multispecies trawls.

Most of the age 0/1 groundfish hotspots in the proposed Alternative 3 areas include redfish, plaice, red hake, and silver hake (Table 32). The 19 age 0/1 cod hotspots is nearly the same as 16 hotspots for Alternative 1 (No Action), but the 20 age 0/1 haddock is about half. The number of cod hotspots is nearly the same for all of the action alternatives, except for the much larger existing (Alternative 7.1) or modified (Alternative 7.2) roller gear restricted areas, which also encompass the large number of cod hotspots in Massachusetts Bay and west of the Western Gulf of Maine closed area.

Based on the number and prevalence of weighted hotspots being nearly 2 to 3 times those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates. Therefore, the overall impact of this alternative on managed large mesh groundfish is expected to highly positive.

4.1.2.1.4.3 Alternative 4

Alternative 4 includes the Large Bigelow Bight area in Alternative 3, but proposes two areas (Jeffreys Ledge and Stellwagen Small) instead of one that overlaps the existing Western Gulf of Maine EFH Closure (Map 42).

Alternative 4 areas also contain considerably more age 0/1 groundfish hotspots than areas included in Alternative 1 (No Action), weighted more heavily for stocks that have low biomass and/or have a high affinity for coarse and hard substrates. The total weighted hotspots (Table 31) are similar to the totals for Alternative 3, but higher than those for Alternatives 5 and 6. Comparison to the number of hotspots in the much larger existing or expanded roller gear management area in Alternative 7 may not be appropriate because the proposed habitat management areas would have different habitat management measures, including prohibiting or restricting the use of all mobile tending bottom gears within the proposed areas, including shrimp and small mesh multispecies trawls.

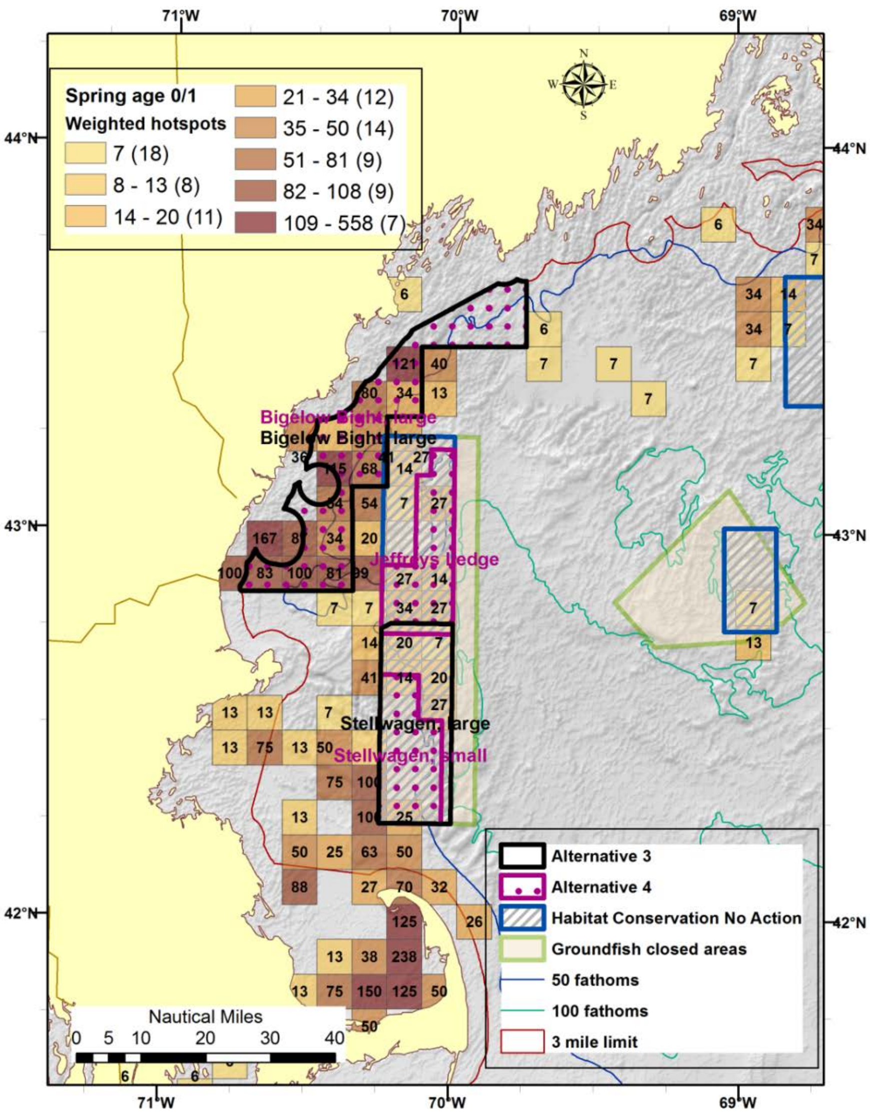
Likewise, the hotspot species composition for Alternative 4 is similar to that for Alternative 3, with most of the hotspots include redfish, plaice, red hake, and silver hake (Table 32). The number of age 0/1 cod hotspots (16) is identical to that for Alternative 3, and nearly the same as that for Alternative 1 (No Action). There are more age 0/1 haddock hotspots in the Jeffreys Ledge area, so the number of haddock hotspots are nearly the same as Alternative 1 (No Action) and double that for Alternative 3. The number of cod hotspots is nearly the same for all of the action alternatives, except for the much larger existing (Alternative 7.1) or modified (Alternative 7.2) roller gear restricted areas, which also encompass the large number of cod hotspots in Massachusetts Bay and west of the Western Gulf of Maine closed area.

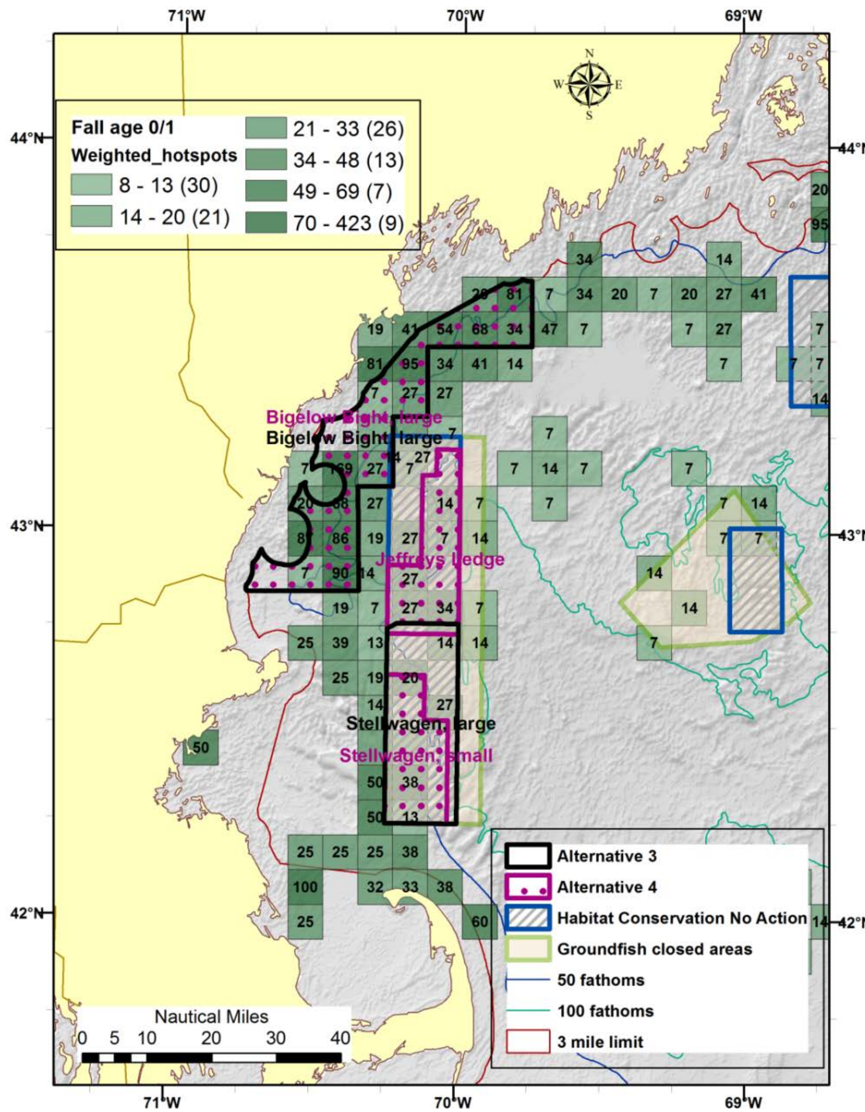
Based on the number and prevalence of weighted hotspots being nearly 2 to 3 times those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates.

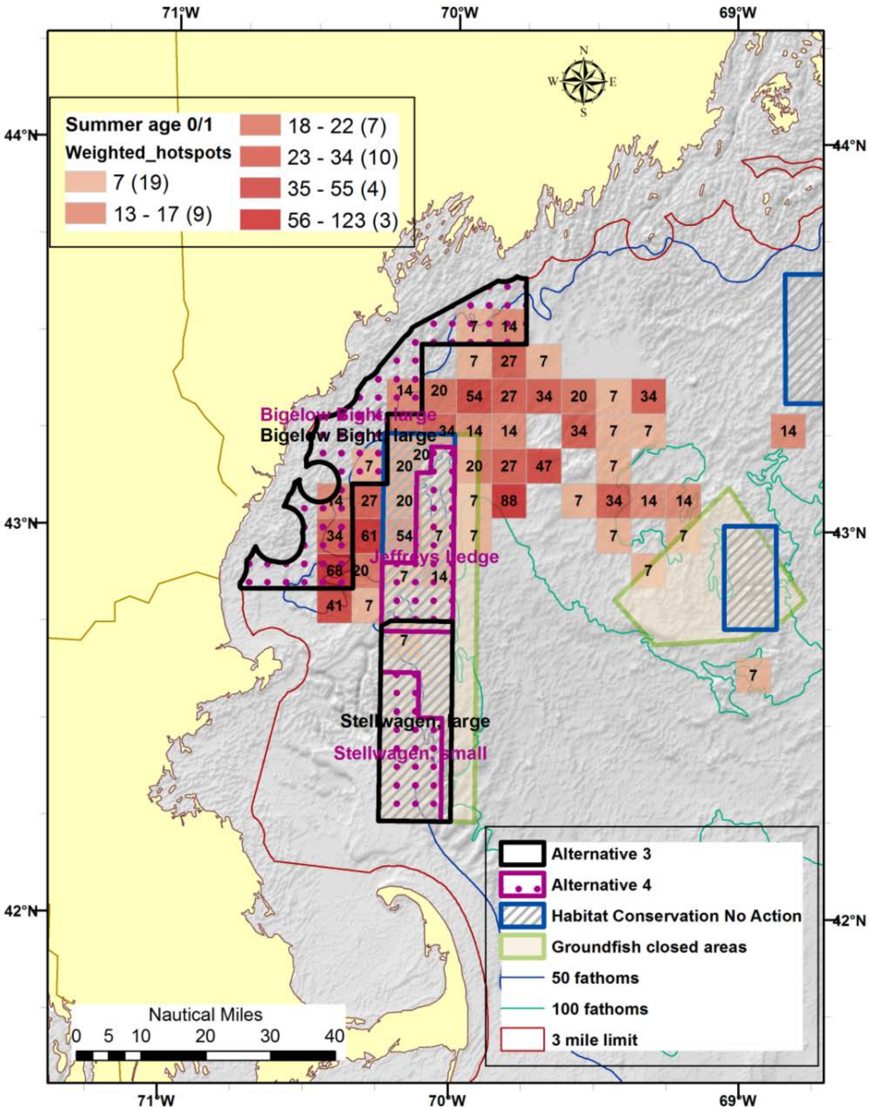
Table 31 – Total unweighted and weighted hotspots in WGOM habitat management area alternatives compared to No Action.

	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Western GOM								
No Action	**84**	**261.1**	**49**	**162.2**	**67**	**305.7**	**1**	**6.7**
EFH closure	70	261.1	32	128.4	56	265.2	1	6.7
GF closure	84	261.1	49	162.2	67	305.7	1	6.7
Gear management area	1050	2686.9	213	500.2	1018	1886.8	133	720.9
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	486	939.3	83	162.2	500	968.1	12	6.7
Alternative 4	493	992.7	83	182.5	520	1035.4	11	0.0
Alternative 5	181	518.1	57	142.0	190	460.9	6	0.0
Alternative 6	24	112.9	6	6.8	17	123.5	1	6.7
Alternative 7.1	1050	2686.9	213	500.2	1018	1886.8	133	720.9
Alternative 7.2	549	1518.2	90	189.3	562	1263.9	67	357.6

Map 42 – WGOM Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Bigelow Bight, large
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

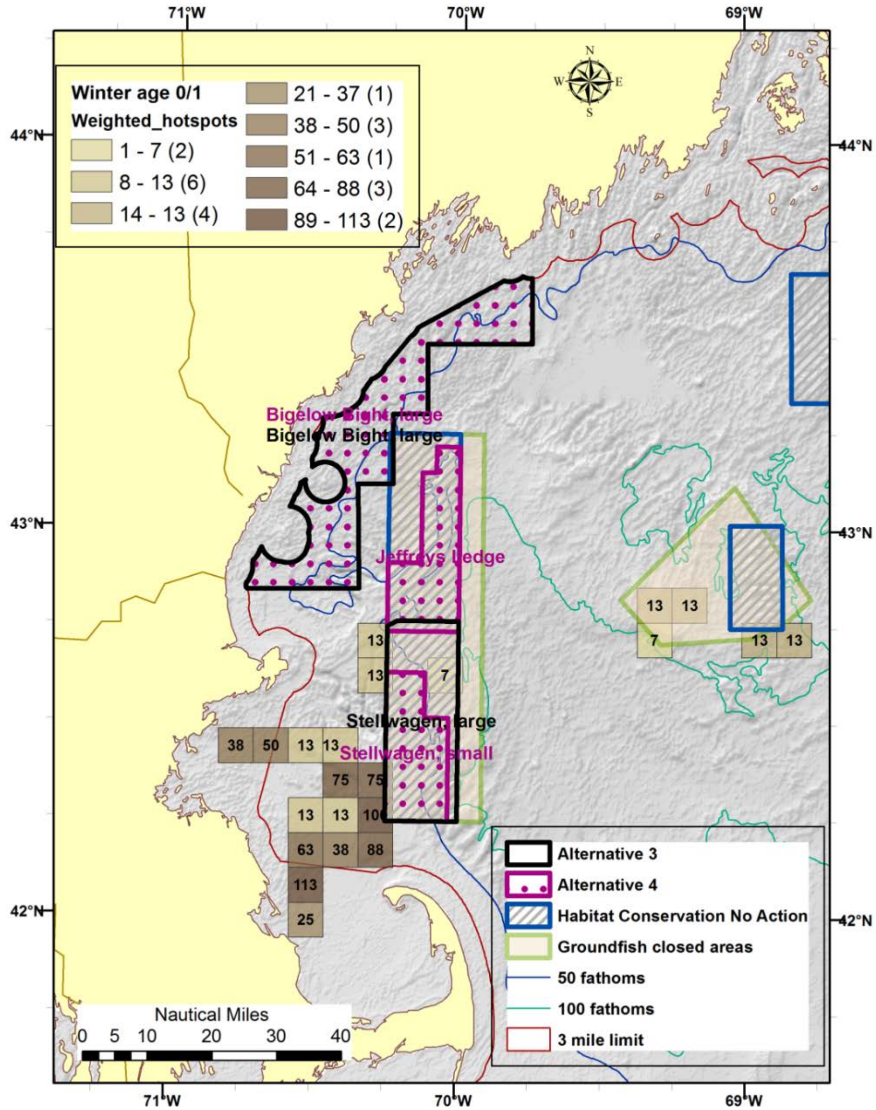

Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Bigelow Bight, large
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

Table 32 – Total hotspots by species for WGOM habitat management area alternatives, compared to No Action.

	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Western Gulf of Maine																		
Alternative 1 (No Action)	143	0	68	0	0	16	6	38	0	0	33	50	2	0	2	4	0	362
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	221	45	357	0	0	19	13	20	9	9	112	196	41	0	21	17	1	1081
Alternative 4	224	45	364	0	0	19	13	37	9	9	106	201	41	0	21	17	1	1107
Alternative 5	98	0	148	0	0	19	1	29	0	4	23	72	11	0	21	7	1	434
Alternative 6	23	0	4	0	0	7	0	1	0	0	6	5	1	0	1	0	0	48
Alternative 7.1	354	33	706	0	2	214	9	64	13	13	226	348	39	0	350	24	20	2415
Alternative 7.2	242	45	371	0	0	98	13	38	9	9	113	206	41	0	63	17	3	1268

4.1.2.1.4.4 Alternative 5

The proposed habitat management areas in Alternative 5 are the same as Alternative 4 except that it includes a much smaller Bigelow Bight area (Map 43), which of course contains fewer age 0/1 groundfish hotspots than Alternatives 3 and 4, but nearly double the total weighted hotspots for Alternative 1 (No Action) using the spring and fall surveys for comparison (Table 31). The total weighted hotspots are also somewhat less than those in either Alternatives 3 or 4, and less than those for Alternative 1 (No Action).

Compared to Alternatives 3 and 4, this alternative contains fewer age 0/1 hotspots for redfish, plaice, red hake, silver hake, and white hake (Table 32). It has fewer redfish and haddock hotspots than Alternative 1 (No Action) does, but more plaice hotspots. As noted above, the number of cod hotspots are nearly the same as in other alternatives, with the notable exception of Alternatives 7.1 and 7.2 that have more cod hotspots because they include portions of Massachusetts Bay and west of the Western Gulf of Maine EFH closure where cod hotspots occur inshore of Stellwagen Bank in the spring and on the offshore side of the Bank in the fall.

Based on the number and prevalence of weighted hotspots being nearly double those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates.

4.1.2.1.4.5 Alternative 6

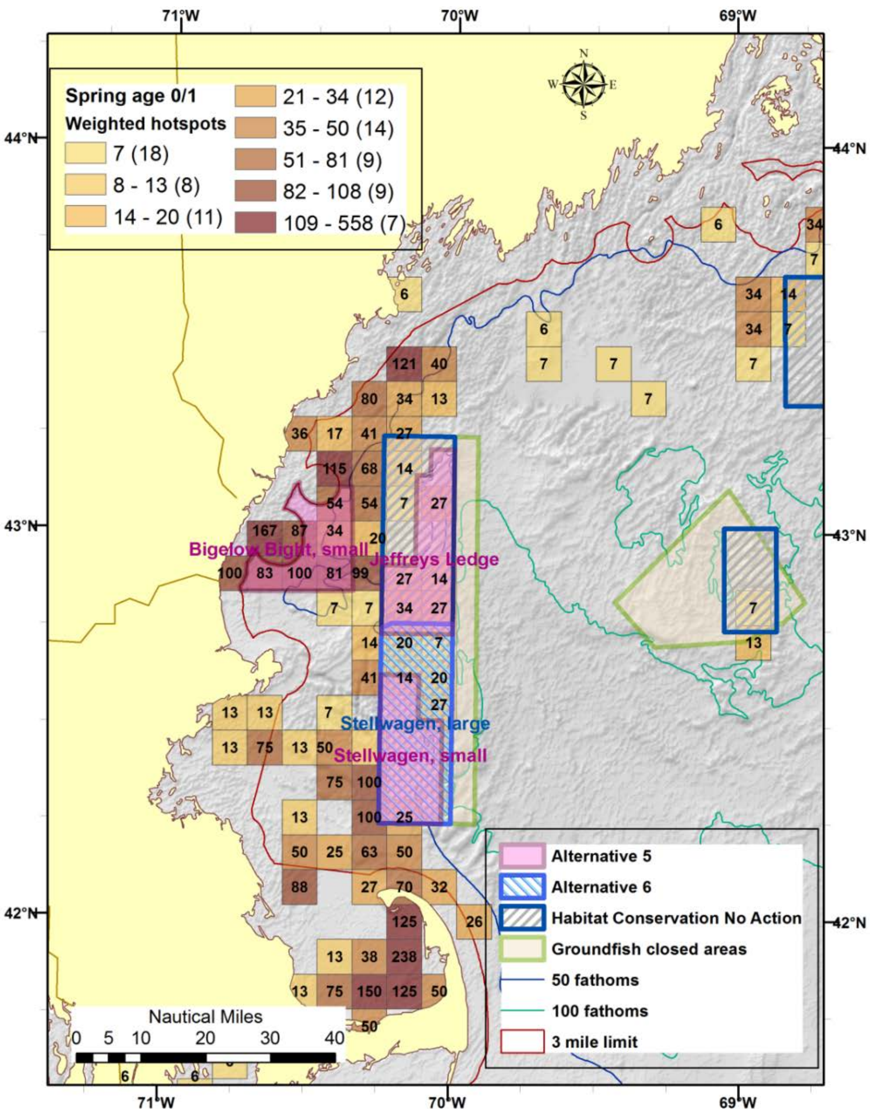
This alternative proposes only one area, the Stellwagen Large area, as a habitat management area in the Western Gulf of Maine (Map 43). It is similar to Alternative 3, but does not include either the Small or Large Bigelow Bight Area, which contains a considerable amount of weighted hotspots. This alternative has the lowest amount of total weighted hotspots as any alternative (Table 31), including Alternative 1 (No Action).

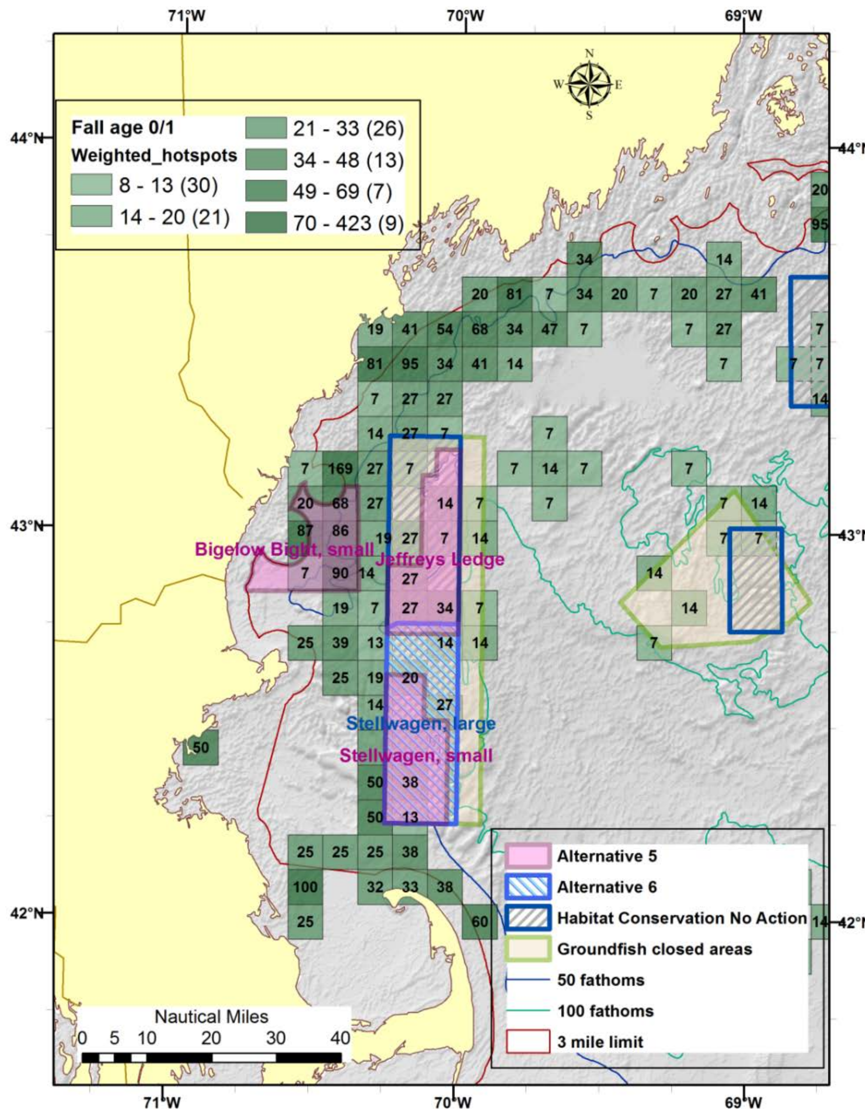
By species, this alternative has fewer age 0/1 hotspots than any other alternative including Alternative 1 (No Action) for redfish, plaice, cod, haddock, red hake, silver hake, white hake, and winter flounder (Table 32).

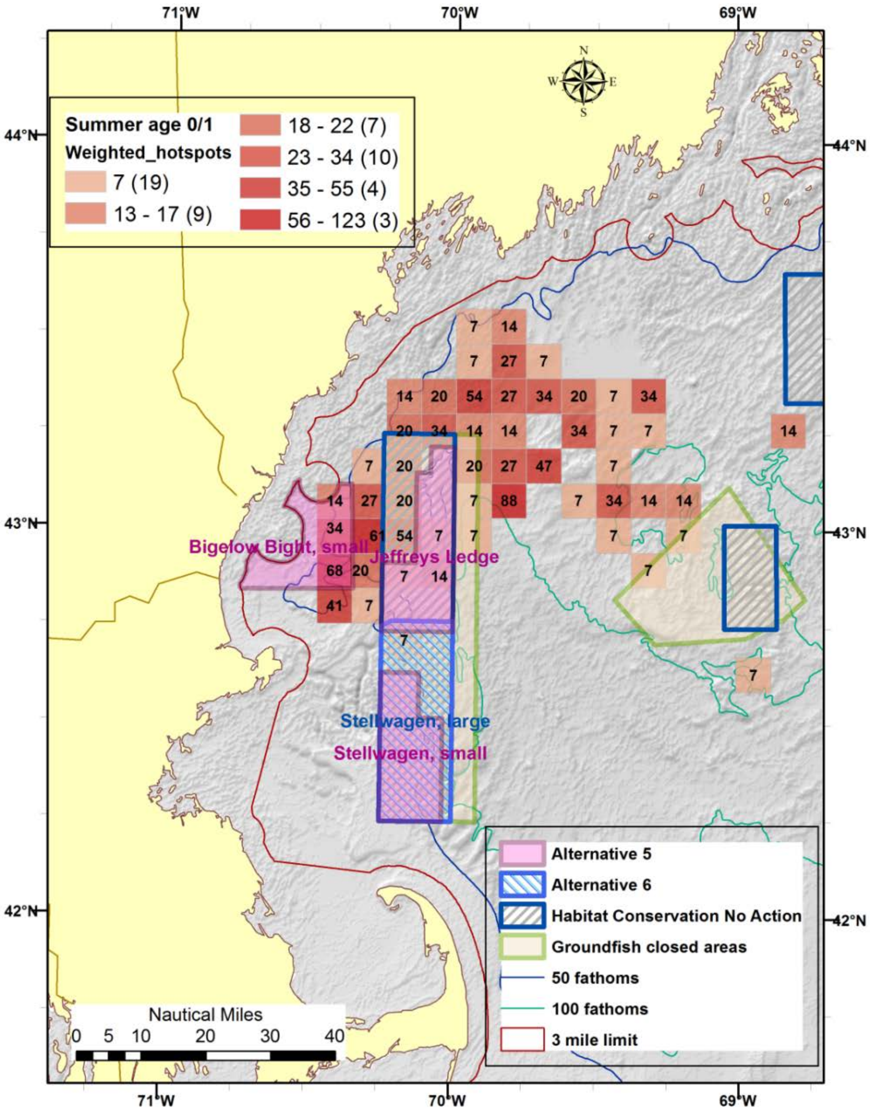
Based on the number and prevalence of weighted hotspots being a third to a half of those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have considerably less conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard substrates.

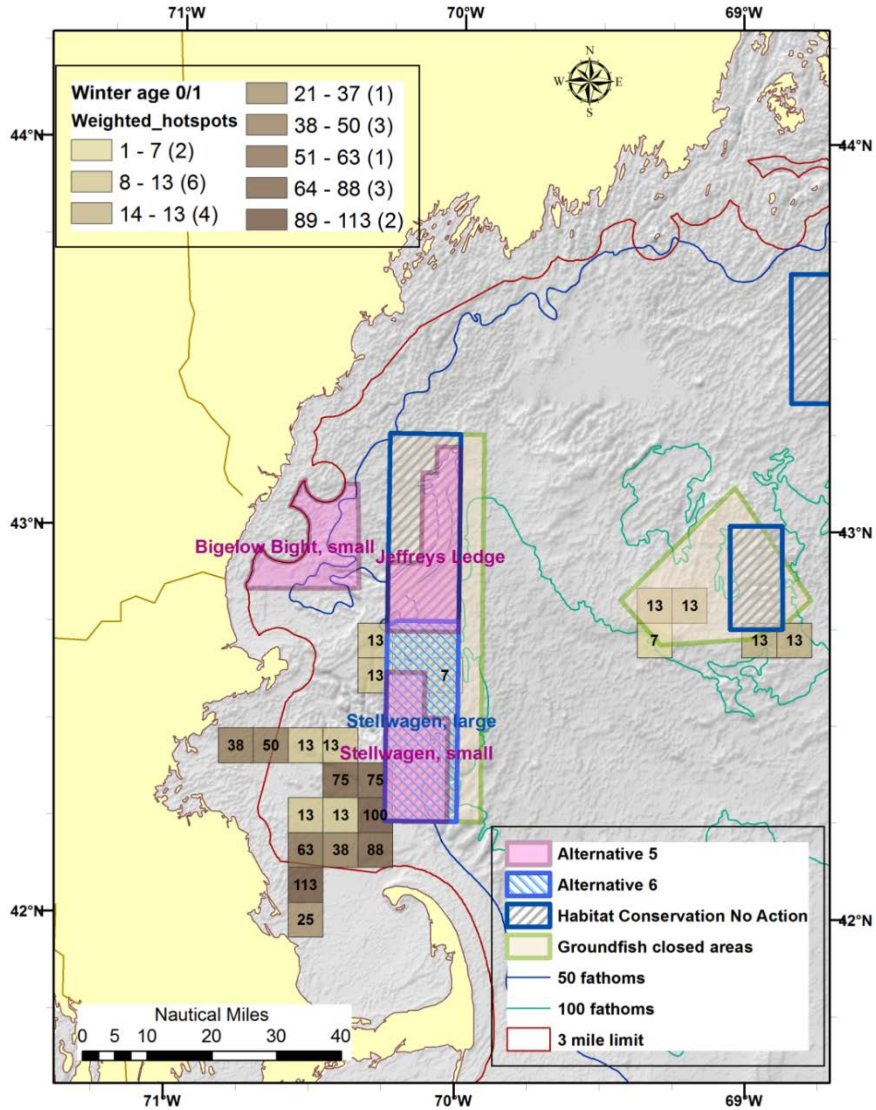
It should be noted however that the analysis (Section ???) shows that age 2+ sub-legal juvenile cod are present further offshore than for age 0/1 cod. The distribution of these older codfish has substantial overlap with the Large Stellwagen Bank Area, proposed as a habitat management area in this alternative. To the extent that cod between 25 and 55 cm (about 10 to 22 inches) rely on coarse and hard substrates for survival and growth, this alternative may have some benefits to Gulf of Maine cod.

Map 43 – WGOM Alternatives 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Bigelow Bight, small
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 5
Alternative 6
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Bigelow Bight, small
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 5
Alternative 6
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

4.1.2.1.4.6 Alternative 7.1

This alternative adapts the existing roller gear area (shown hatched in the maps below) to recognize its potential benefits to habitat conservation. According to fishermen, vessels with low to moderate horsepower are restricted to areas with softer bottoms and sand when they use nets with smaller roller gear than used elsewhere. They also report that high horsepower vessels are able to fish the harder bottoms with nets having smaller roller gear despite the restriction.

Although not summarized by vessel horsepower, there is some indication in the observer data that vessels using certain types of trawls in the restricted roller gear area fish in areas having less coarse and hard substrates (Map 44). This map shows the geographic distribution of observed hauls since 2008 by fishery for vessels using trawls, compared to the existing restricted roller gear area, outlined by a red border. The inshore roller gear restricted area in Alternative 7.2 is outlined with a black border. Under either alternative, all vessels using trawls to target any species would be required to use rollers no larger than a 12" diameter. This measure differs from No Action, because the existing roller gear restriction applies only to sector vessels and vessels on a day-at-sea (including vessels using a day-at-sea to target skates and monkfish).

Vessels targeting shrimp, herring, and small mesh multispecies are using small-mesh trawls. Vessels targeting LM multispecies, monkfish, and skates are typically fishing on a day-at-sea or under sector rules and are using large-mesh trawls. The bottom type shown in the map is the same information used in the SASI analysis, showing the top 30% of trawl vulnerability scores (100 km2 cells that are outlined).

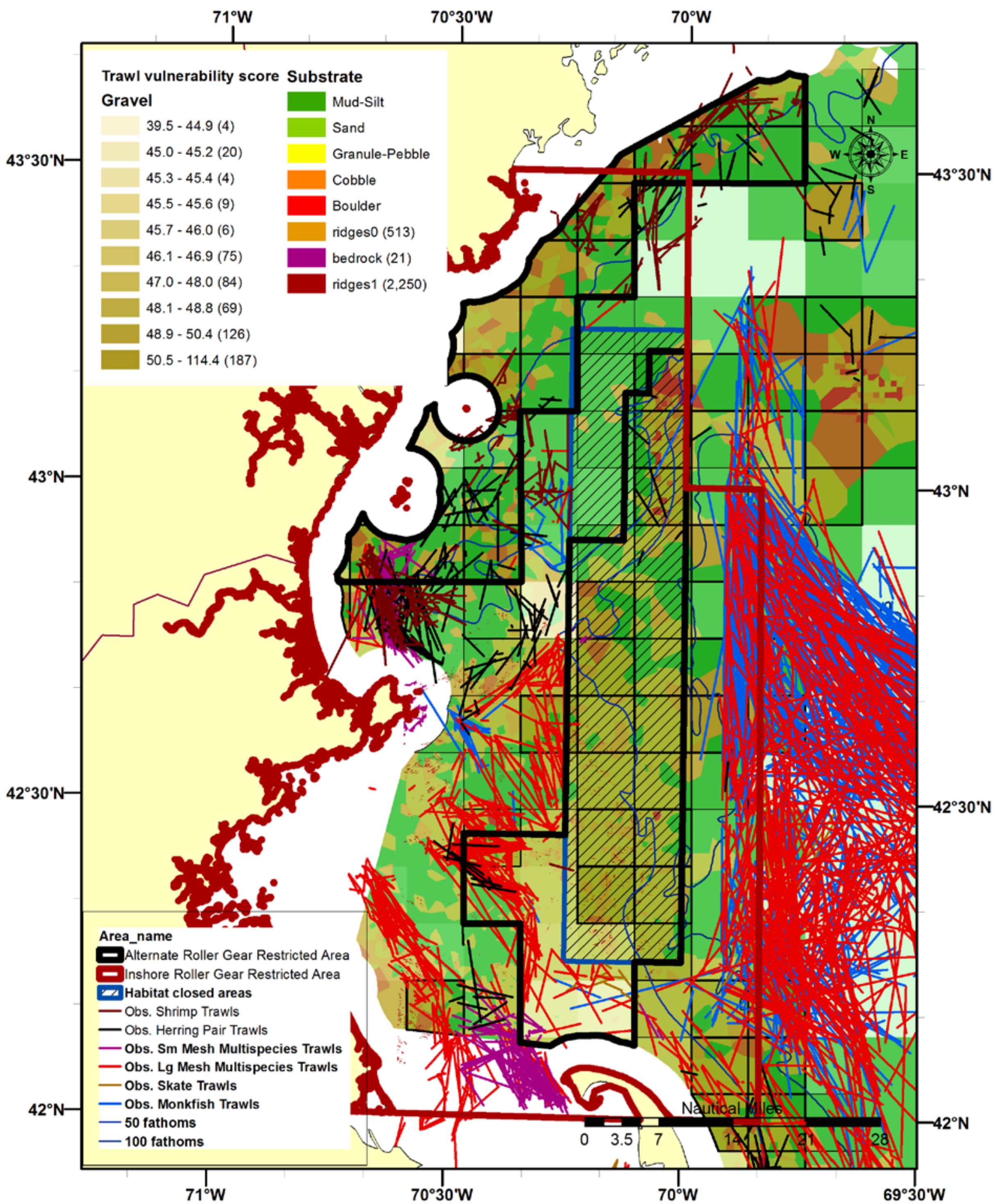
Vessels fishing targeting large-mesh multispecies and monkfish offshore of the Western Gulf of Maine Closed Area are fishing on mud-silt and sand bottom, which is less vulnerable to adverse effects caused by trawl fishing. Although fishing occurs in the restricted roller gear area here, many tows continue outside of the roller gear area and compliance with the roller gear restriction here is a little dubious.

Elsewhere, small-mesh trawl fishing for whiting, shrimp, and herring appears to occur mainly on mud-silt and sand substrates within the roller gear area. One possible exception is some overlap with granule-pebble and cobble substrates in the Ipswich Bay area, within the SW portion of the proposed Bigelow Bight habitat management area. Observed hauls are however plotted using begging and ending haul locations which could miss the fine scale changes in tow direction to avoid these harder substrates. The Vornoii grids used to classify substrate type also tend to overestimate the localized distribution of the small oceanographic hard substrate features in some areas.

On the other hand, LM multispecies and monkfish trawl fishing inshore of the Western Gulf of Maine area in Massachusetts Bay appears to occur mainly on granule-pebble and cobble substrates. This area also is interspersed with hard substrate ridges and bedrock outcroppings. Notable places where observed trawl fishing occurred was the area bear the hard bottom off Scituate, MA, the NW corner of Stellwagen Bank, and the southern flank of Jeffreys Ledge. According to the data, these areas have granule-pebble substrates.

In this impact analysis on age 0/1 groundfish, it is more important whether fishing with these gears favors or avoids areas where age 0/1 groundfish occur, especially those associated with coarse and hard substrates. Using the weighted hotspot results that favor these species, the overlap of observed trawling effort is shown relative to the hotspots derived from the spring and fall NMFS, MADMF, ME-NH, and IBS cod surveys. The observed hauls were not separated by season, because the effects of using mobile bottom-tending gear on coarse and hard substrates are not seasonal, although juvenile groundfish may use these important habitats during specific seasons.

Map 44 – Location of observes hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared with outlined 100 km2 blocks with the 30% of highest trawl vulnerability scores and substrate types in the Western Gulf of Maine sub-region.



Compared with the weighted age 0/1 groundfish hotspots in the spring (Map 45, left), there is some overlap with shrimp and herring pair trawl fishing off the southern ME coastline. A considerable amount of small mesh fishing in Ipswich Bay does not coincide with the groundfish hotspots. Conversely, there is a fairly high amount of correspondence between LM multispecies trawl fishing and some herring pair trawl fishing NW of Cape Cod, particularly on the inshore side of Stellwagen Bank.

Compared to the fall age 0/1 groundfish hotspots (Map 45, right), there has been some scattered shrimp and herring pair trawl fishing in the northern portion of the Western Gulf of Maine, but not as much LM multispecies trawling that coincides with the fall age 0/1 groundfish hotspots.

If this measure is as effective as a habitat management area is in reducing the use of mobile bottom-tending gear on vulnerable substrates it could be considerably more effective in reducing adverse impacts to those habitats that have groundfish stocks with low biomass and/or high affinity for coarse and hard substrates.

Encompassing a much bigger area, which overlaps Massachusetts and Cape Cod Bays where IBS cod and winter trawl surveys have taken place, the total number of age 0/1 weighted groundfish hotspots is considerably higher than any other alternative (Table 31), including five to ten times the number for Alternative 1 (No Action).

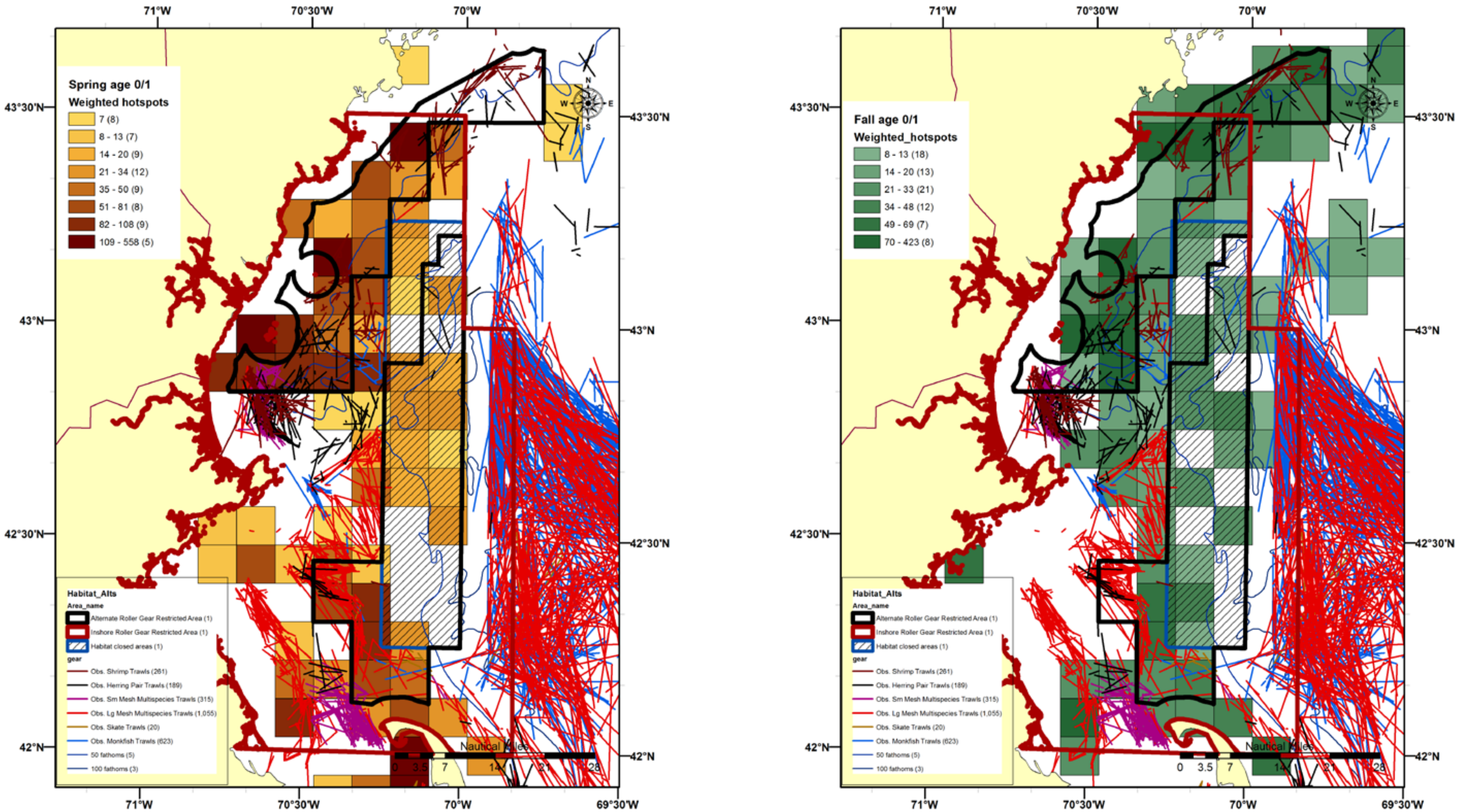
It includes far more age 0/1 hotspots than Alternative 1 and most other alternatives for redfish, alewife, plaice, cod, haddock, ocean pout, pollock, red hake, silver hake, winter flounder, witch flounder, and yellowtail flounder (Table 32).

It generally appears that fishing with small-mesh trawls for whiting, herring, and shrimp tends to already occur on mud-silt and sand bottom and does not generally correspond with the age 0/1 groundfish hotspots. Additionally, the large-mesh trawl fishing offshore of the Western Gulf of Maine Closed Area does not correspond with the hard substrate types nor with the age 0/1 groundfish hotspots. Requiring these vessels to use roller gear less than 12" would produce neutral effects on groundfish habitat.

On the other hand, LM trawl fishing for groundfish and monkfish south and west of the Western Gulf of Maine Closed Area does seem to correspond with areas having harder substrates and with age 0/1 groundfish hotspots, even though these vessels are required to use small roller gear. Requiring these vessels to use small roller gear less than 12" diameter is unlikely to change their fishing behavior, avoid areas of harder substrates, nor improve groundfish habitat.

Relying on an expanded roller gear restriction in the area for this alternative is likely have negative or detrimental impacts on groundfish habitat, compared to Alternative 1 (No Action) which closes a large area of vulnerable substrates to mobile bottom-tending gear fishing.

Map 45 – Location of observes hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared spring (left) and fall (right) age 0/1 groundfish hotspots heavily weighted in favor of stocks that are at low biomass and/or associated with coarse and hard substrates.



4.1.2.1.4.7 Alternative 7.2

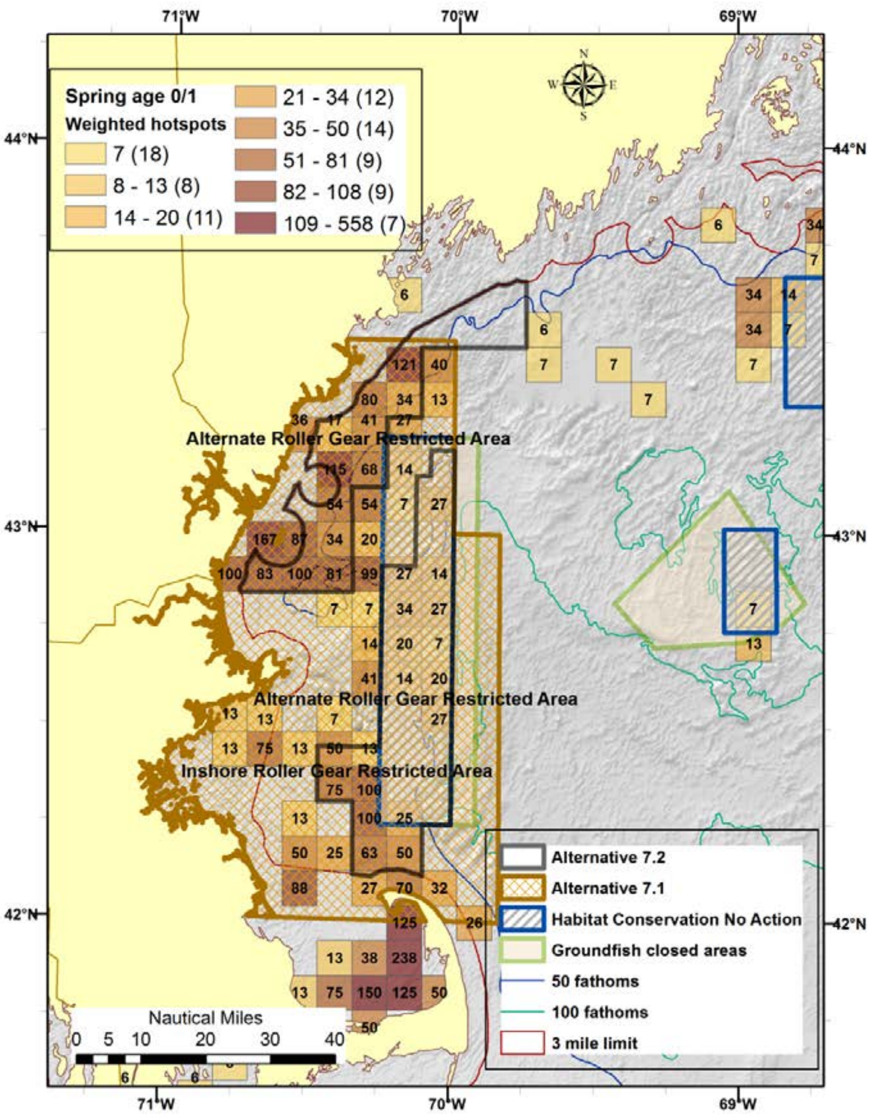
This alternative proposes a smaller area than Alternative 7.2 in the Western Gulf of Maine as a restricted gear area to protect vulnerable habitat. It is not clear whether the existing roller gear would remain in place and if so how it would be differentiated from the areas in this alternative except for a northeast extension of the roller gear area off the central ME coastline in federal waters.

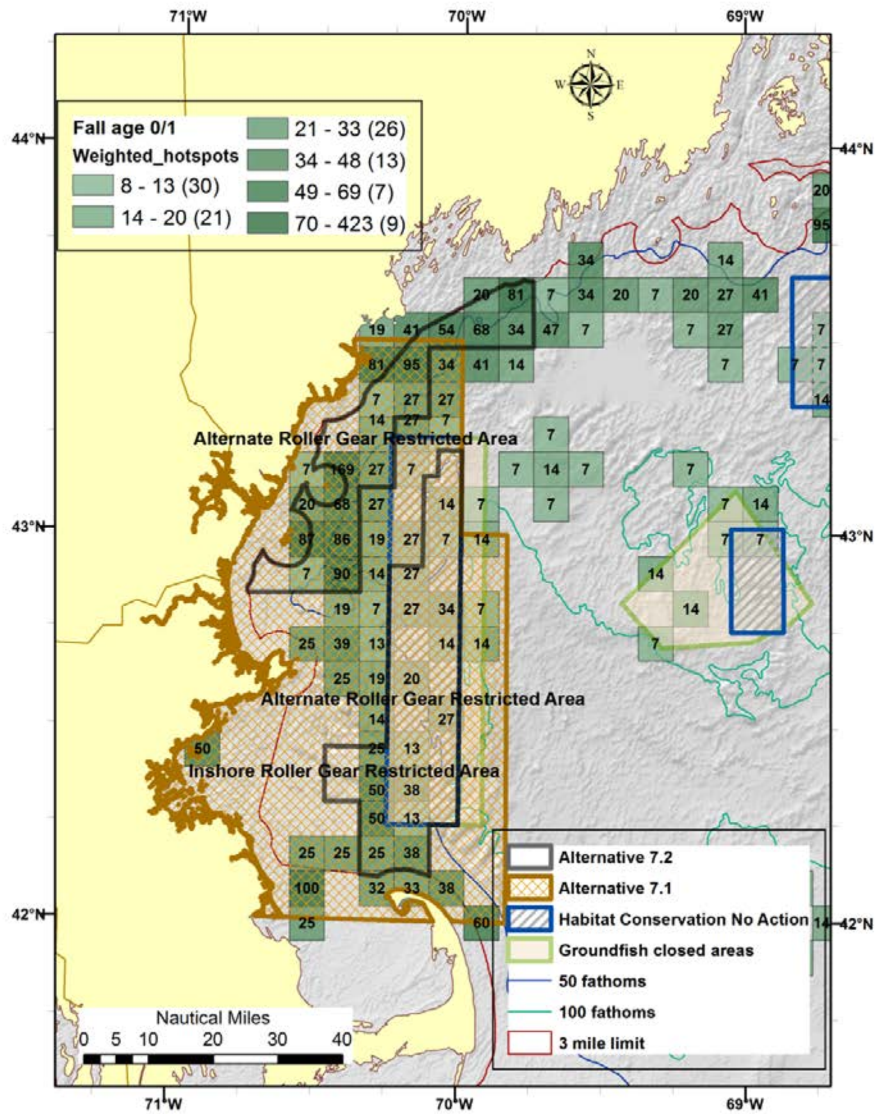
The area encompassed by this alternative contains fewer age 0/1 weighted groundfish hotspots (Table 31) than Alternative 7.1, but more than Alternative 1 (No Action). This is true for redfish, plaice, cod, haddock, red hake, silver hake, winter flounder, and yellowtail flounder (Table 32). Conversely, there are more hotspots for alewife and goosefish due to the proposed northeast extension of the existing restricted roller gear area (Map 46).

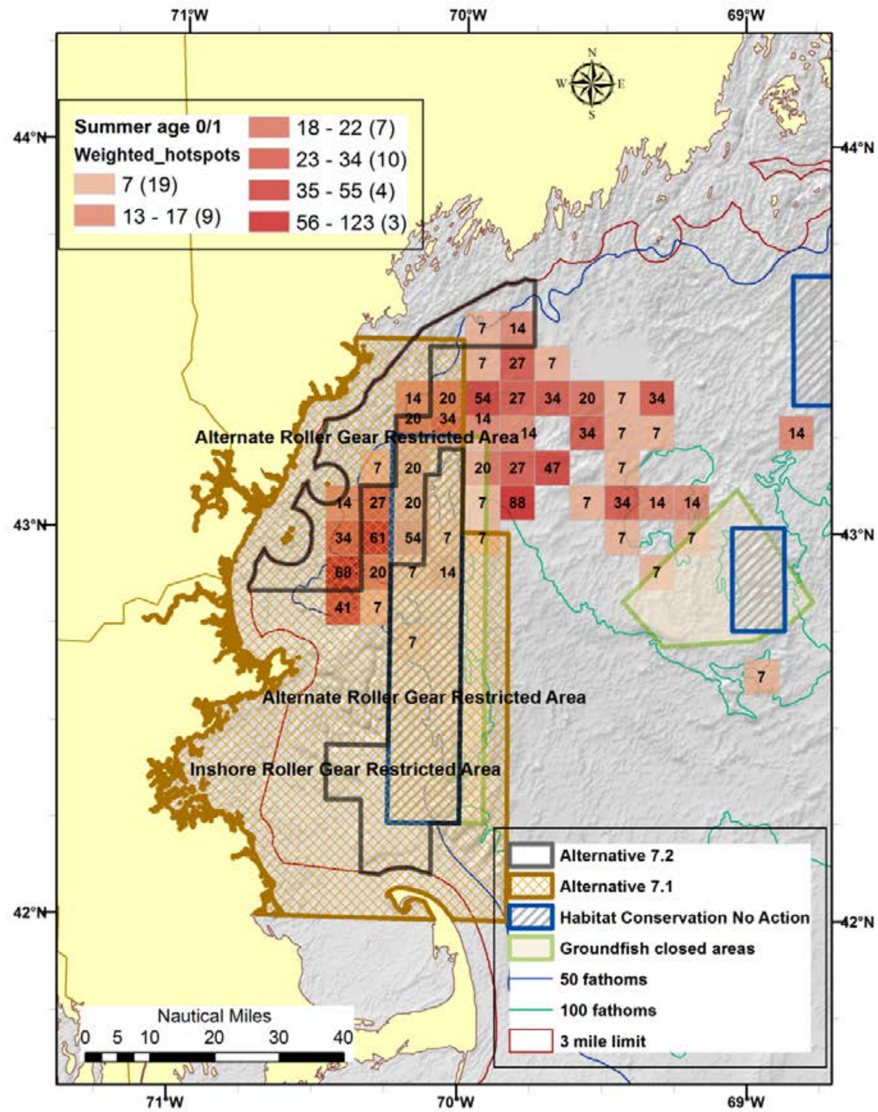
Similar to Alternative 7.1, it does not appear that requiring 12" or less diameter roller gear in a smaller area of the Western Gulf of Maine will change fishing behavior to avoid areas with vulnerable groundfish habitat. It would encompass an area around Stellwagen Bank where LM multispecies trawl fishing occurs (Map 46), but these vessels are already required to use small roller gear on the net.

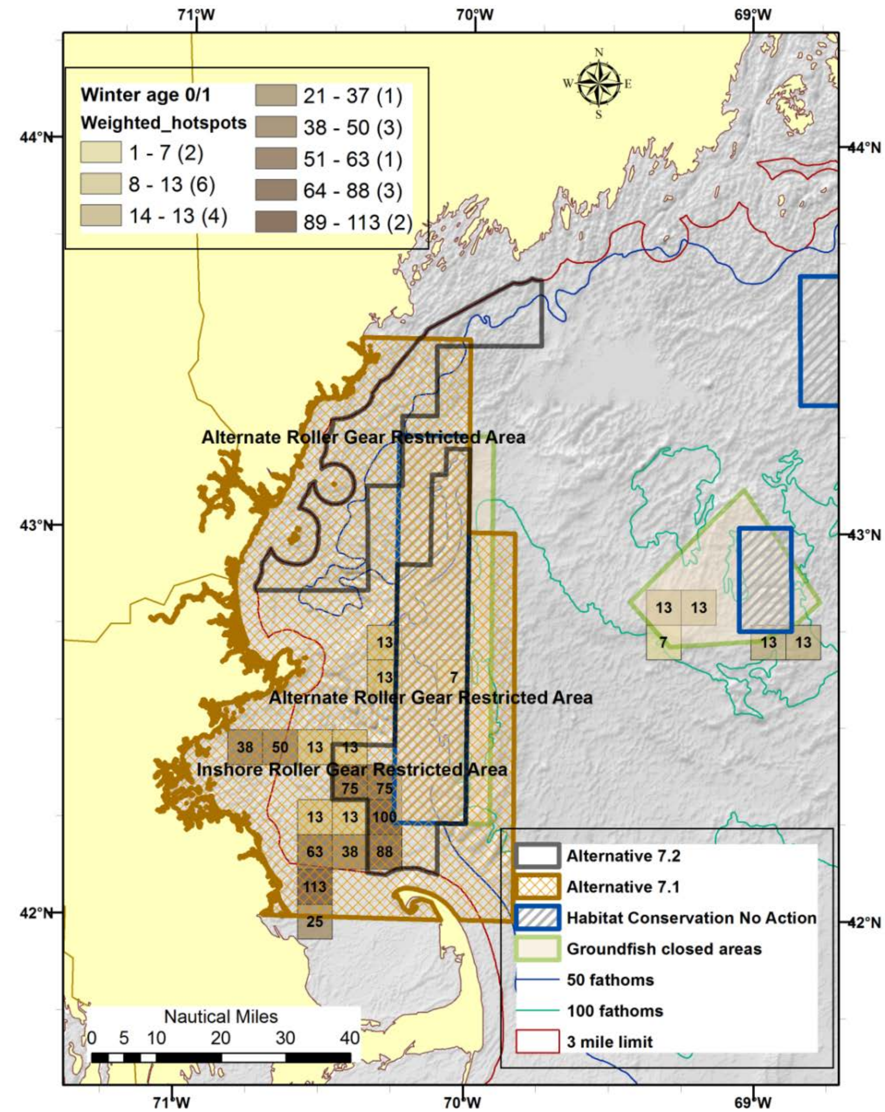
Compared to Alternative 1 (No Action) which prohibits fishing with mobile bottom-tending gear in an area that has vulnerable groundfish habitat, this alternative is likely to have a negative or detrimental impact on groundfish habitat.

Map 46 – WGOM Alternatives 7.1 and 7.2 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summary age 0/1
Weighted_hotspots
7 (19)
13 - 17 (9)
18 - 22 (7)
23 - 34 (10)
35 - 55 (4)
56 - 123 (3)
Alternate Roller Gear Restricted Area
Alternate Roller Gear Restricted Area
Inshore Roller Gear Restricted Area
Alternative 7.2
Alternative 7.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
71°W
70°W
69°W
44°N
43°N
42°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Alternate Roller Gear Restricted Area
Alternate Roller Gear Restricted Area
Inshore Roller Gear Restricted Area
Alternative 7.2
Alternative 7.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
71°W
70°W
69°W
44°N
43°N
42°N

4.1.2.2 *Georges Bank and Southern New England*

4.1.2.2.1 No Action

The amount of unweighted and weighted age 0/1 groundfish hotspots in each survey season is summarized in the table below, with the distribution of the weighted hotspots shown in Map???. Data used to identify these hotspots, or clusters of significantly high abundance of small juvenile groundfish, include the spring, fall, and winter NMFS trawl suveys and the summer dredge survey (see Section ???). IBS yellowtail flounder and monkfish surveys were included in the analysis, but few to no age 0/1 groundfish hotspots were identified from these data. In general, hotspots from the 2002-2012 survey data were less prevalent on Georges Bank than they were in the Gulf of Maine. This outcome may be caused by generally lower survey CPUE on Georges Bank during this period and/or more dispersion of age 0/1 fish than occurs in the Gulf of Maine, and/or less variation in catches here than in the Gulf of Maine (i.e. there are more catches that were significantly above the region-wide mean[4]).

Judging the effects of year round groundfish closed areas and EFH closures on Georges Bank is more complicated than it is elsewhere. While the fishing regulations in the EFH closures are the same as they are elsewhere (no fishing with mobile bottom-tending gear), there are a variety of dredge and trawl special access programs that apply to portions of the groundfish closed areas that do not overlap the EFH closures. These include haddock and yellowtail flounder special access programs and scallop access areas in Closed Area I and Closed Area II. Other than a separator panel that is unlikely to have a positive or negative habitat effect, the areas are essentially open to fishing with mobile bottom-tending gear. Seasonal restrictions do not have a substantial positive effect on habitat (although they may influence the amount of discards and spawning fish caught by the fisheries).

The most important groundfish habitat protection is associated with the EFH closures, the Cod HAPC within Closed Area II and the Northern and Southern EFH closures within Closed Area I. Total weighted hotspots in the EFH closures were 11.5 in the fall survey and zero during the other survey seasons (TAB???). The total weighted hotspots in the year round groundfish closed areas were 63.3 in the spring, 195.5 in the summer, 46.0 in the fall, and 0.0 in the winter surveys. A considerable majority of hotspots in the summer were from age 0/1 haddock hotspots in the southern portion of Closed Area II (Map 47), which has been open to both scallop dredge and groundfish trawl fishing in respective access programs.

On Eastern Georges Bank, juvenile cod are scattered across the bank, with some concentration on the Northern Edge, from the Cod HAPC into Canada (Map 49). Although there were few cod hotspots and none in outside the Cod HAPC, the rest of Closed Area II appears to provide some protection to areas where juvenile cod were caught by spring and summer surveys. It is not

[4] The Council's Closed Area Technical Team conducted some Georges Bank-only hotspot analyses to test the hypothesis that the catches were lower or had a different spatial autocorrelation, but few hotspots were identified by those sensitivity analyses. This led to the conclusion that the sparseness of age 0/1 hotspots was more due to less variation and more dispersion (i.e. less concentration) of age 0/1 catches in the survey tows on Georges Bank.

apparent, however, that Closed Area II is protecting critical cod habitat, except possibly for the Northern Edge and the northern portion of the Cod HAPC. In the fall surveys, it appears that the juvenile cod have left the shallower portions of the bank and most of Closed Area II, except for some age 0/1 and larger sub-legal cod along the Northern Edge into Canada.

In contrast, age 0/1 and larger sub-legal haddock are distributed across broad regions of Eastern Georges Bank during the spring and summer surveys (Map 50, left). Age 0/1 and larger sub-legal haddock appear to be well mixed in the shallower areas of the bank and along the northern edge of the bank, from well west of the Cod HAPC to areas in Canada to the east. Closed Area II appears to provide protection to a substantial fraction of juvenile haddock on Eastern Georges Bank during the spring. Hotspots for age 0/1 haddock were found in this area, indicating clusters of high catches and potential preferred habitat. This habitat does not appear to be as vulnerable to fishing effects as coarser and harder substrates found elsewhere.

Juvenile haddock in the fall and winter appear to locate into deeper water around the Georges Bank perimeter, particularly for the older sub-legal haddock. Age 0/1 haddock appear to remain in shallower water on Georges Bank compared to older sub-legal haddock (Map 50, right). Both cohorts of haddock appear to take up residence in deeper water in the Cod HAPC and this is where age 0/1 haddock hotspots also occur.

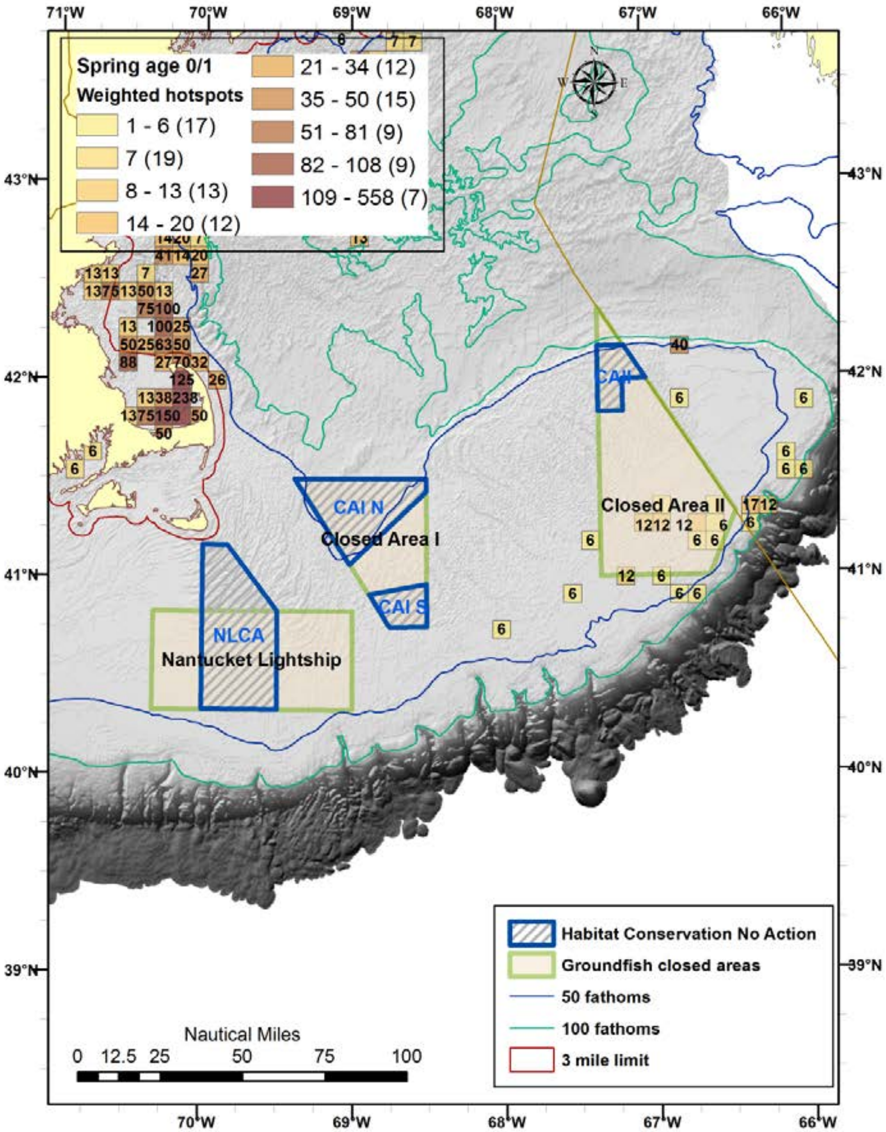
Although the hotspots were sparser on Georges Bank than in the Gulf of Maine, the totals within existing and proposed habitat management areas for Georges Bank are comparable to each other. Even though there were few age 0/1 hotspots identified in US waters of Georges Bank, there were a substantial number of unweighted and weighted hotspots on the Northern Edge, mostly in Canadian waters and partially in US waters (Map 47).

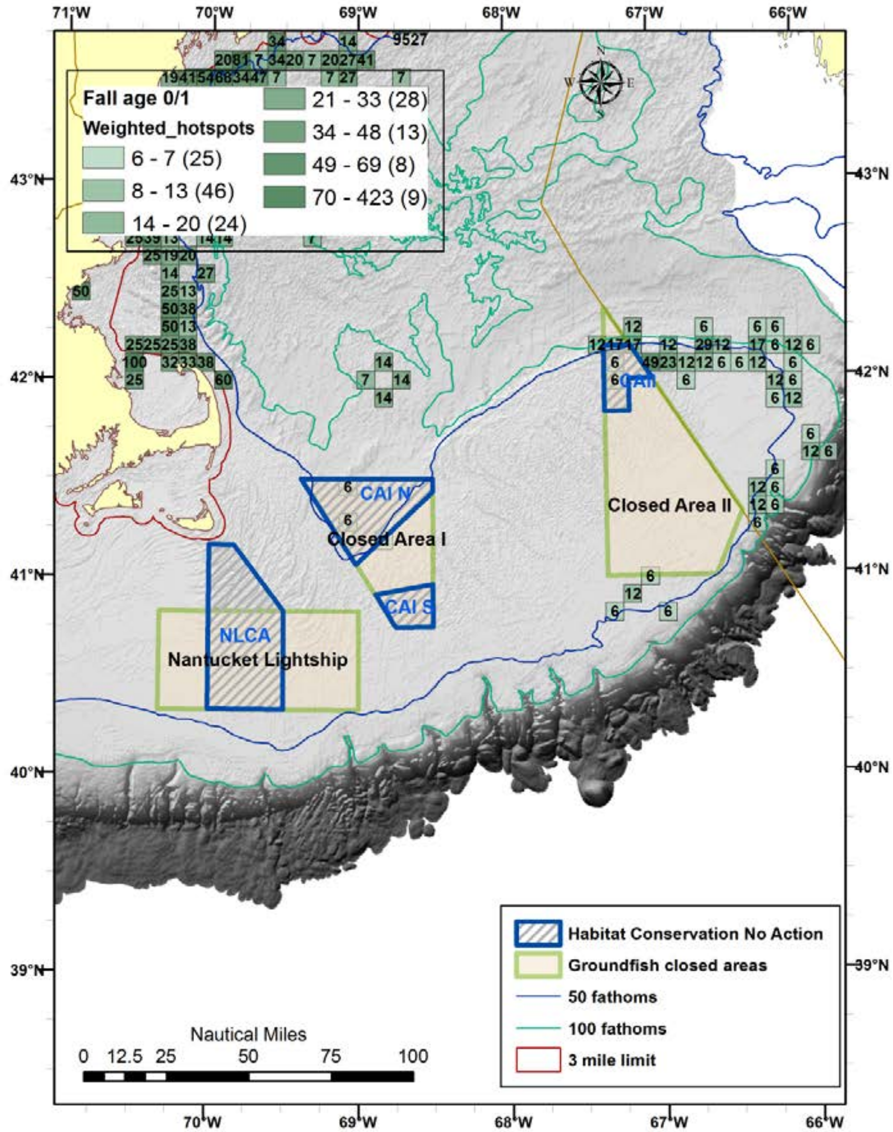
Impacts on groundfish habitat and groundfish populations from Alternative 1 (No Action) are likely to be beneficial to species inhabiting coarse and hard substrates in the EFH closures, but not the other portions of the year round groundfish closed areas due to the effect of access program fishing. Based on the above analysis and the analyses in Multispecies Framework Adjustment 48 that suggest positive impacts of closed areas on haddock and winter flounder, plus the potential benefit realized by the fishery fishing along the margins of closed areas (particularly on the western edge of Closed Area II), there is a strong positive impact of the No Action alternative on the groundfish resource. Since much of these areas is comprised of mobile sediments and these areas are open to special access program fishing, the impact of the No Action alternative on age 0/1 groundfish habitats is slightly positive.

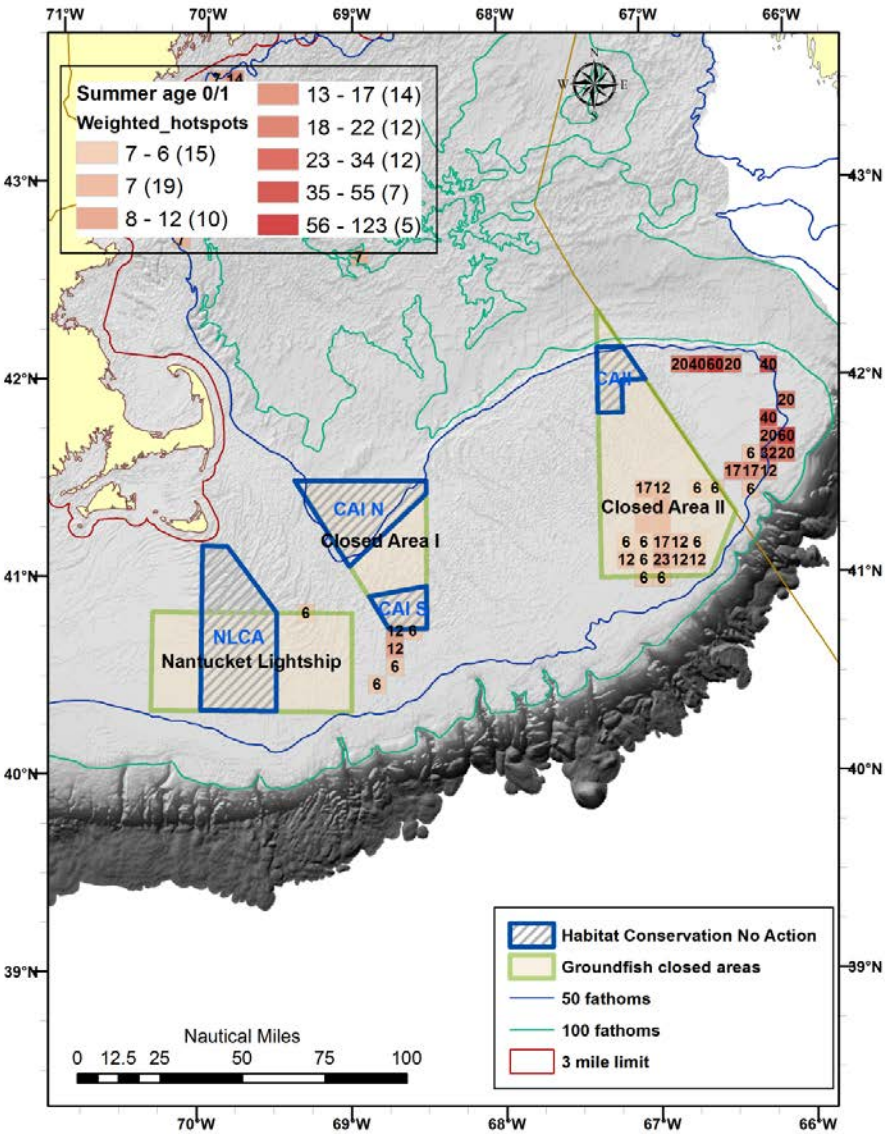
Table 33 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Georges Bank region.

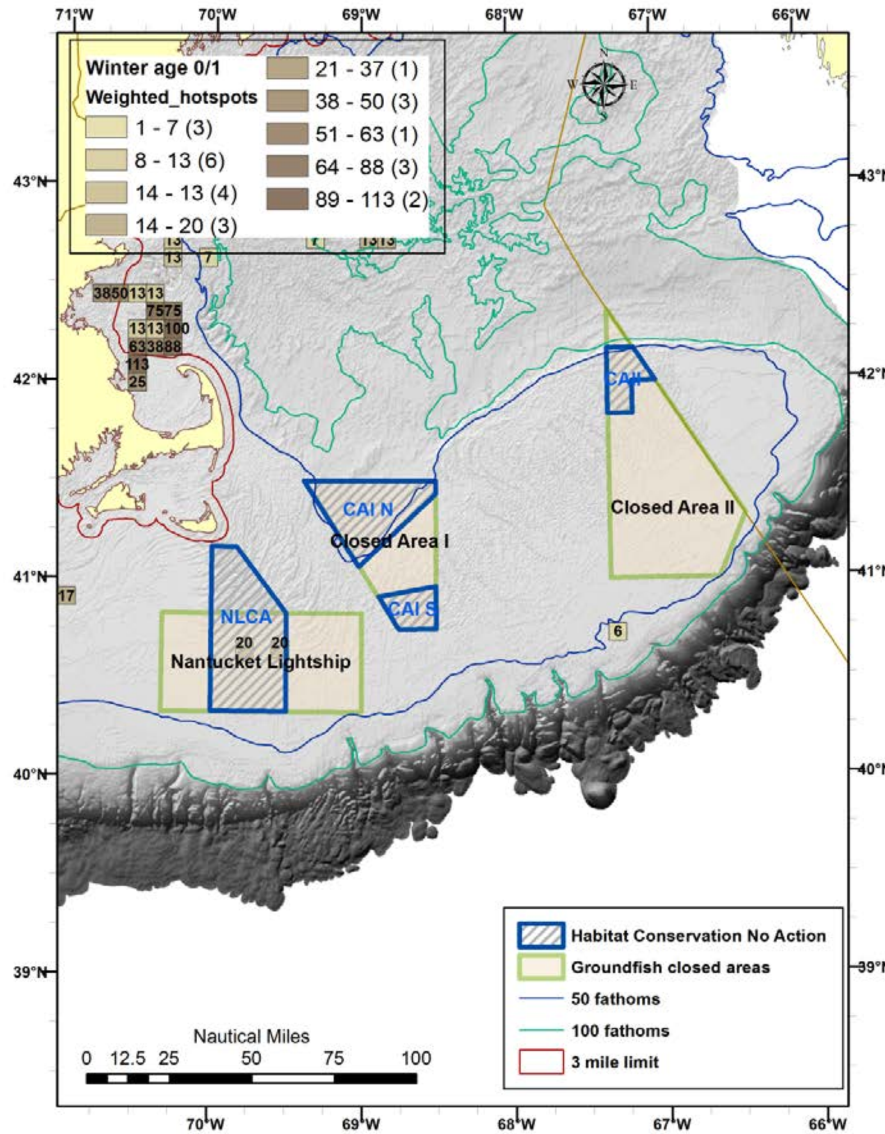
	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank/Southern New England								
Georges Bank	11	63.3	39	195.5	51	46.0	0	0.0
EFH closure								
Closed Area I EFH N	0	0.0	0	0.0	10	11.5	0	0.0
Closed Area II EFH	0	0.0	5	0.0	4	11.5	0	0.0
Groundfish closure								
Closed Area I GF	0	0.0	0	0.0	35	17.3	0	0.0
Closed Area II GF	11	63.3	39	195.5	16	28.8	0	0.0

Map 47 – GB Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 - 6 (15)
7 (19)
8 - 12 (10)
13 - 17 (14)
18 - 22 (12)
23 - 34 (12)
35 - 55 (7)
56 - 123 (5)
CAI N
Closed Area I
CAI S
CAII
Closed Area II
NLCA
Nantucket Lightship
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100


Winter age 0/1
Weighted_hotspots
1 - 7 (3)
8 - 13 (6)
14 - 13 (4)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
CAI N
Closed Area I
CAI S
CAII
Closed Area II
NLCA
Nantucket Lightship
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100

4.1.2.2.2 Georges Bank

4.1.2.2.2.1 Alternative 2 (No HMAs)

Alternative 2 proposes no habitat management areas for the Georges Bank sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have lower benefits for groundfish stocks than either Alternative 1 (No Action), or any of the other alternatives for this sub-region. It will have negative effects on groundfish habitat compared to Alternative 1 (No Action) and other alternatives in this section.

4.1.2.2.2.2 Alternative 3

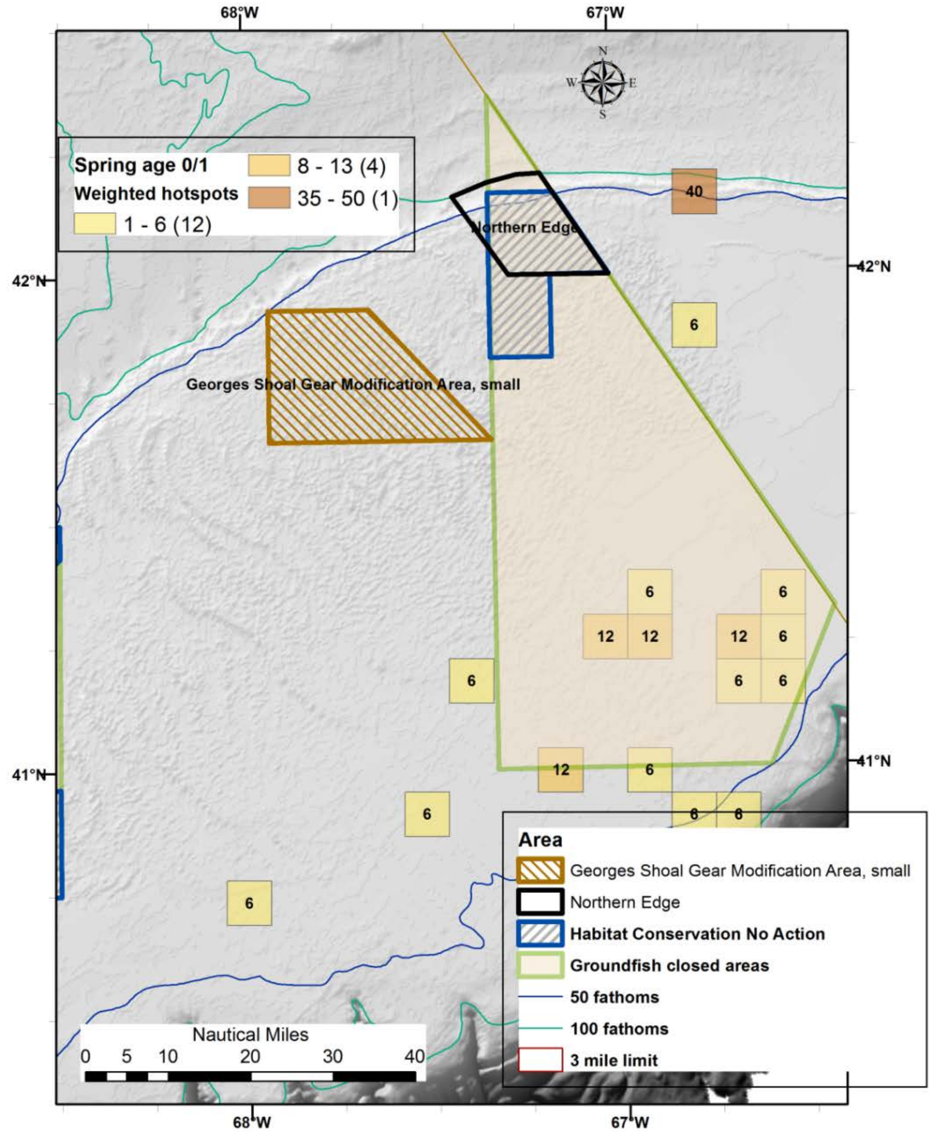
Alternative 3 includes a new Northern Edge habitat management area that largely overlaps the existing Cod HAPC, but extends slightly into the deeper water slope on the Northern Edge. The total number of age 0/1 groundfish hotspots, heavily weighted in favor of stocks at low biomass and/or having a high affinity for coarse and hard substrates, was 34.5 in the fall and zero in other survey seasons.

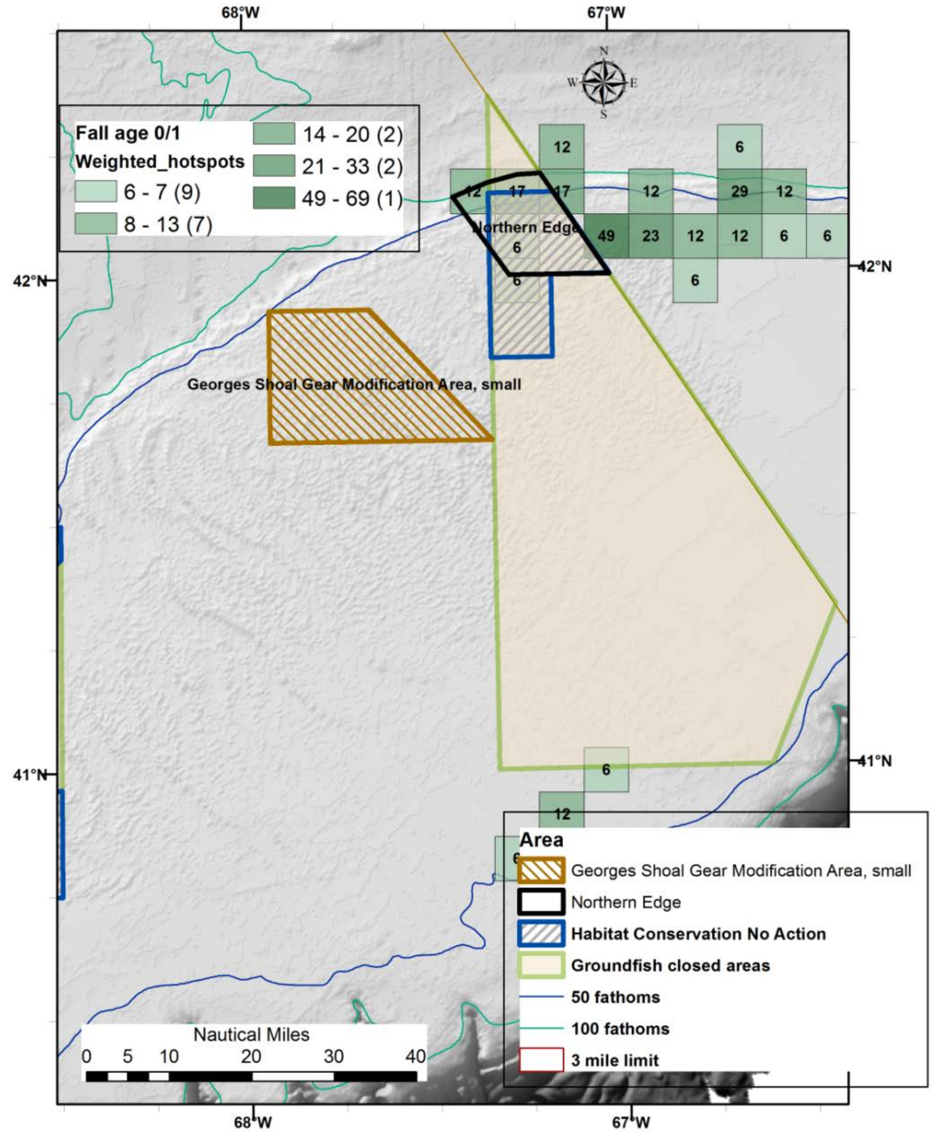
Based on the amount and presence of weighted hotspots, this alternative would have negative effects on groundfish habitat relative to that for Alternative 1 (No Action). The amount of protection of habitat for age 0/1 and larger sub-legal cod is about the same as No Action (Map 49), but the protection of habitats where age 0/1 haddock are present is considerably less than Alternative 1 (No Action), with one substantial caveat is that the areas where age 0/1 haddock are abundant (Map 50) and where hotspots occur (Table 35) are already fished by both multispecies trawl and scallop dredge access programs. Haddock and red hake hotspots (Table 35) are present in the proposed Northern Edge habitat management area.

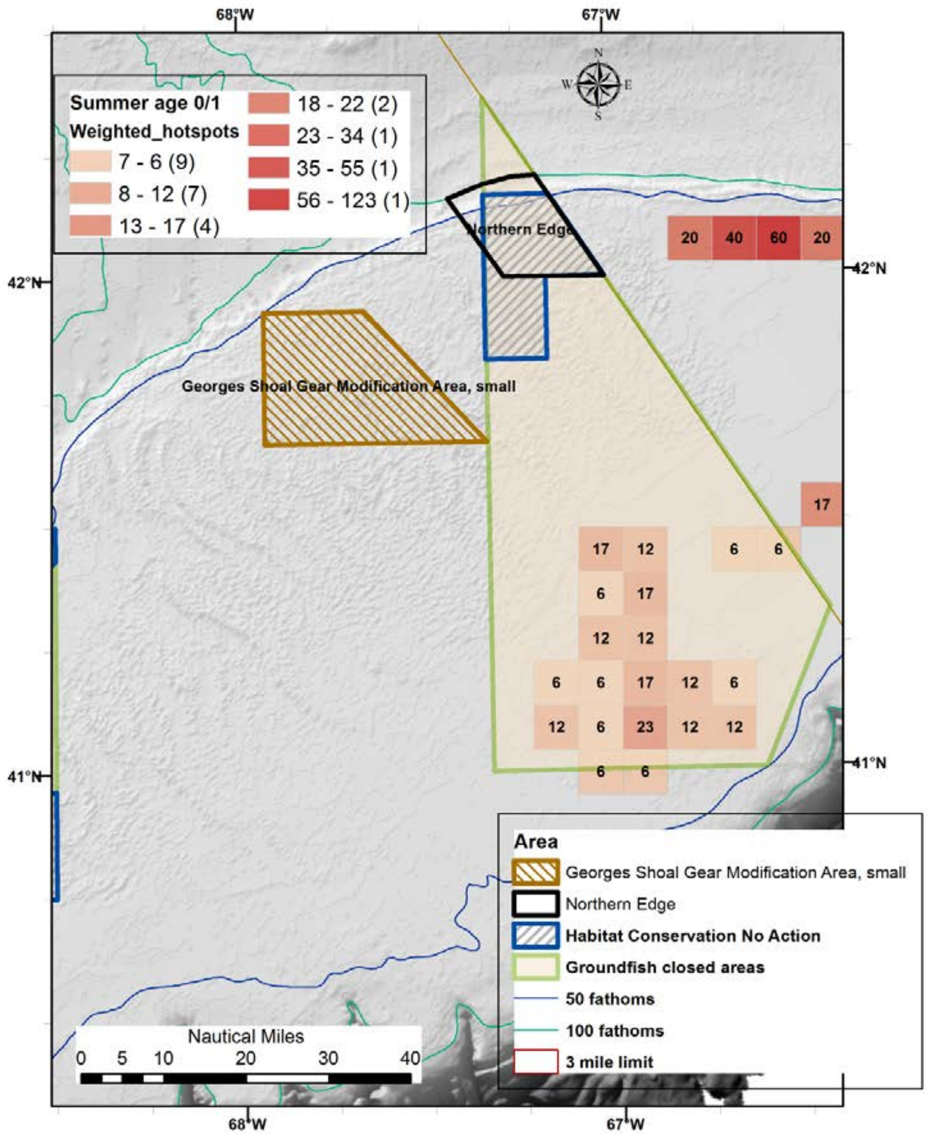
Table 34 – Total unweighted and weighted hotspots in GB habitat management area alternatives compared to No Action.

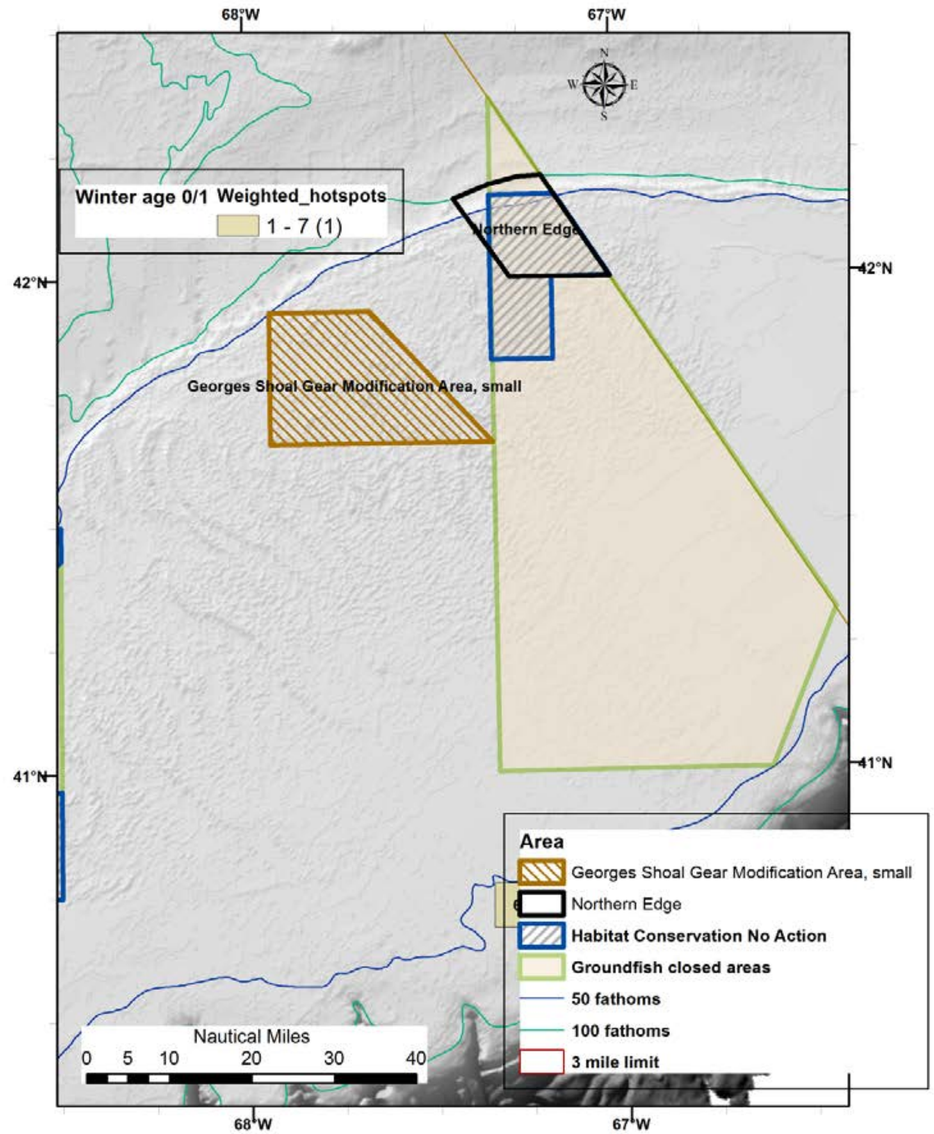
	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank								
No Action	**11**	**63.3**	**39**	**195.5**	**51**	**46.0**	**0**	**0.0**
EFH closure	0	0.0	5	0.0	14	23.0	0	0.0
GF closure	11	63.3	39	195.5	51	46.0	0	0.0
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	0	0.0	0	0.0	8	34.5	0	0.0
Alternative 4	0	0.0	1	0.0	12	34.5	0	0.0
Alternative 5	6	0.0	15	0.0	33	11.5	0	0.0

Map 48 – GB Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data. Alternative 3 includes the Northern Edge only, while Alternative 4 includes both the Northern Edge and the Georges Shoal Gear Modification Area.



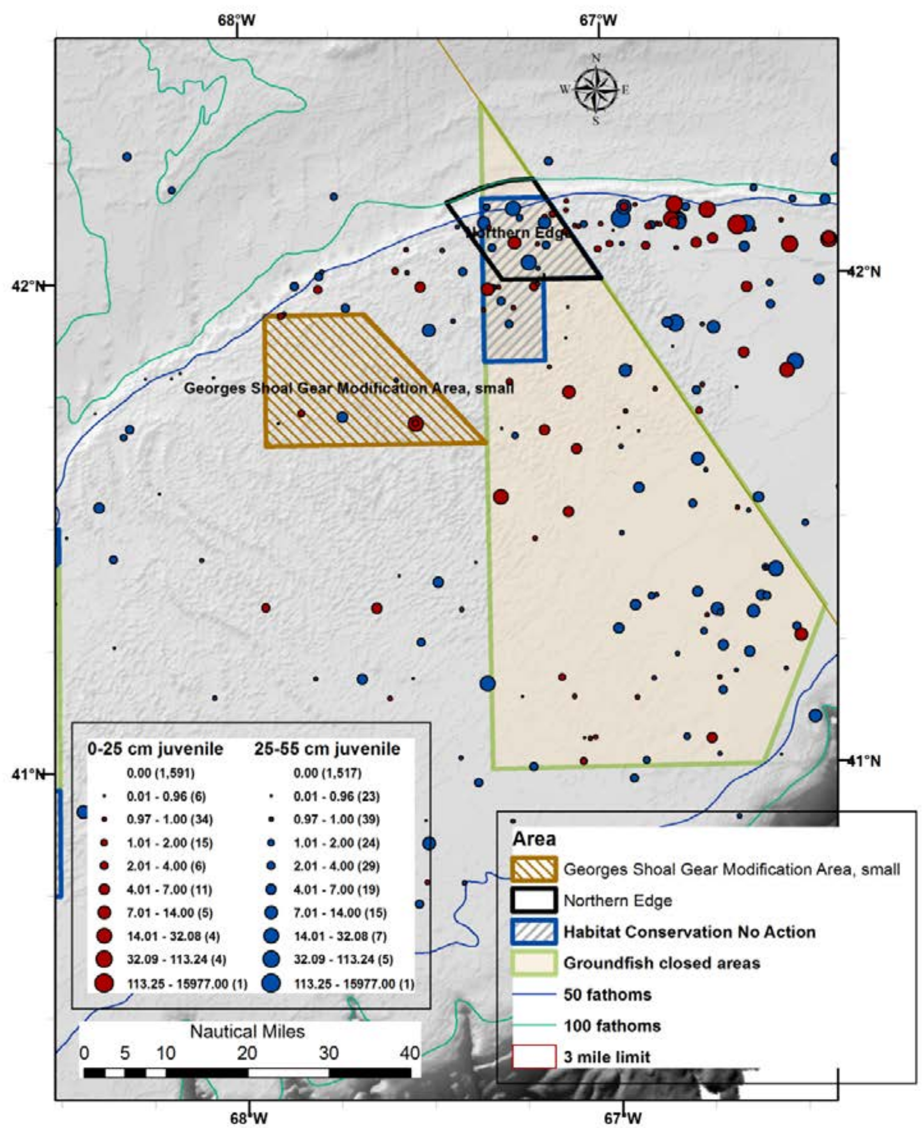



68°W
67°W
42°N
41°N
Summer age 0/1
Weighted_hotspots
7 - 6 (9)
8 - 12 (7)
13 - 17 (4)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
Northern Edge
Georges Shoal Gear Modification Area, small
Nautical Miles
0 5 10 20 30 40
Area
Georges Shoal Gear Modification Area, small
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit

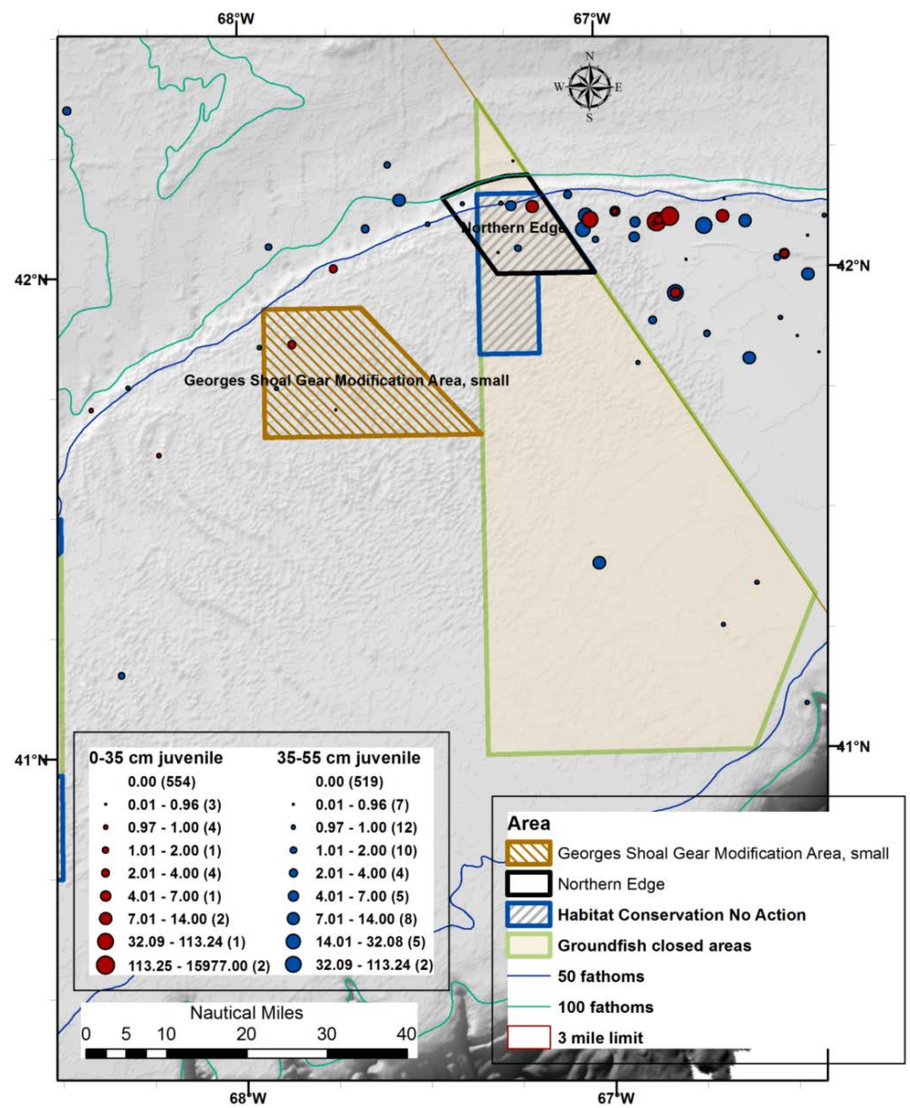

68°W
67°W
42°N
41°N
Winter age 0/1 Weighted_hotspots
1 - 7 (1)
Northern Edge
Georges Shoal Gear Modification Area, small
Nautical Miles
0 5 10 20 30 40
Area
Georges Shoal Gear Modification Area, small
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit

Map 49 – Overlap of GB Alternatives 3 and 4 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer

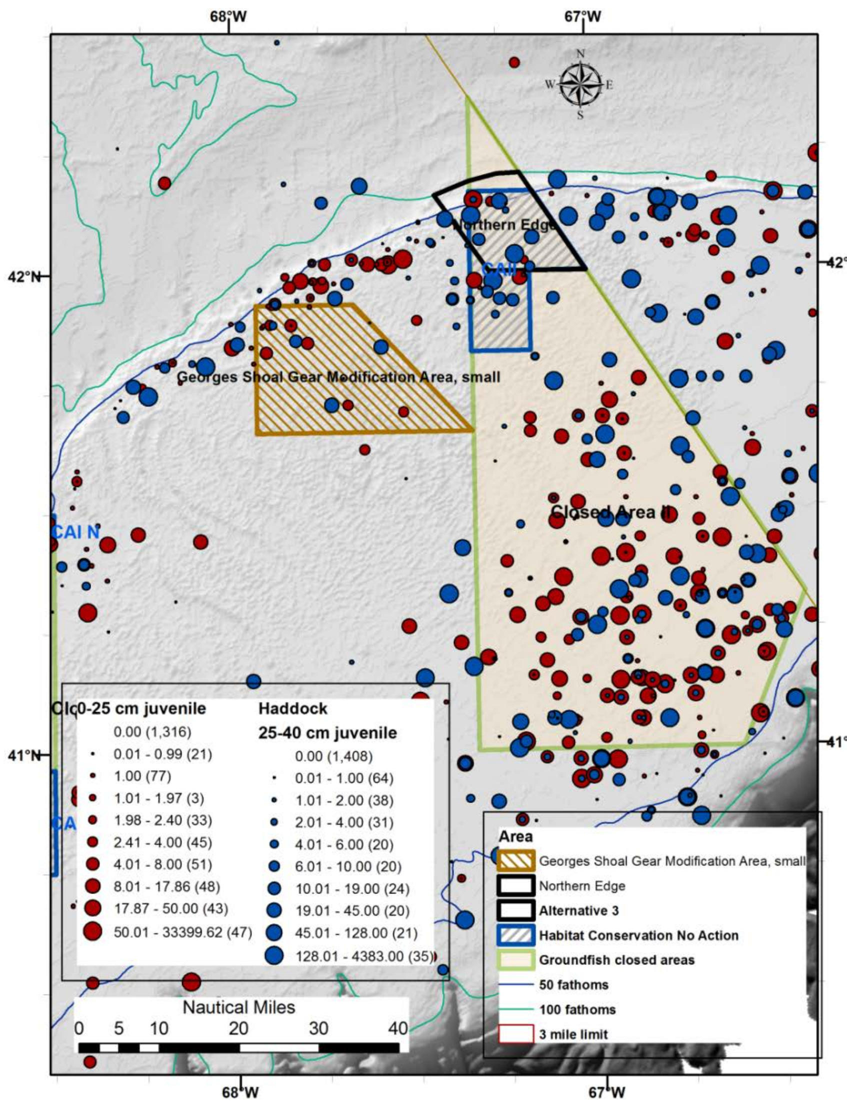


Fall and winter



Map 50 – Overlap of GB Alternatives 3 and 4 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.

Spring and summer



Fall and winter

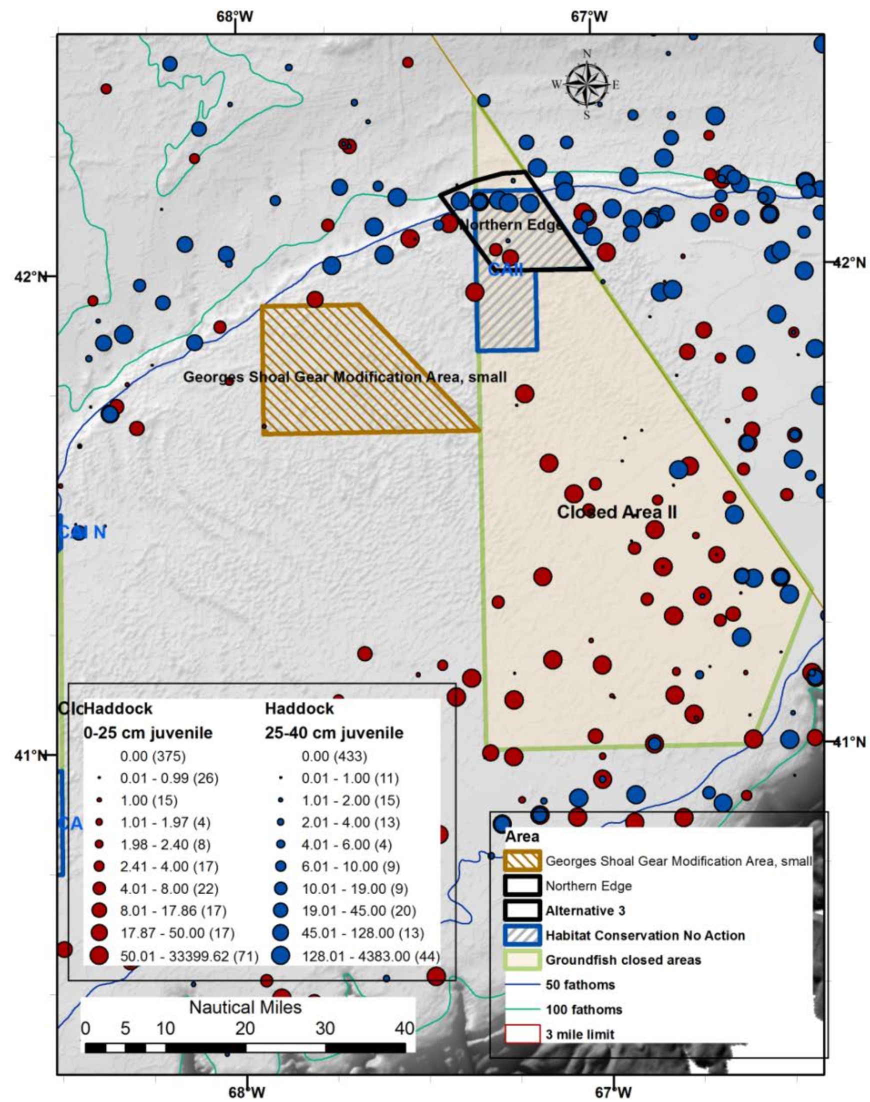


Table 35 – Total hotspots by species for GB habitat management area alternatives, compared to No Action.

	Acadian redfish	Alewife	American plaice	Atlantic halibut	Atlantic herring	Cod	Goosefish	Haddock	Ocean pout	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Yellowtail flounder	Grand Total
Georges Bank																		
Alternative 1 (No Action)	0	0	2	0	0	0	0	57	0	0	42	8	0	1	10	0	0	120
Alternative 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 3	0	0	0	0	0	0	0	6	0	0	2	0	0	0	0	0	0	8
Alternative 4	0	0	0	0	0	0	0	6	0	0	6	0	0	0	0	0	1	13
Alternative 5	0	0	0	0	0	0	0	2	0	0	34	1	0	2	14	0	1	54

4.1.2.2.2.3 Alternative 4

Alternative 4 includes the same Northern Edge habitat management area as Alternative 3, but also includes a Georges Shoal gear modification area. While any level of habitat management measures could apply to the Northern Edge area, only a gear modification like prohibition or limits on ground cable would apply in the Georges Shoal area.

The total weighted hotspots for Alternative 4 are the same as Alternative 3 (Table 34), with slightly more red hake hotspots (Table 35). Weighted and species hotspots are also considerably less than those for Alternative 1 (No Action). The expected impacts on groundfish habitat and groundfish stocks are therefore negative compared to Alternative 1 (No Action), and about the same as Alternative 3, based on the number of weighted hotspots and on the expected effect of gear modifications (Section 0).

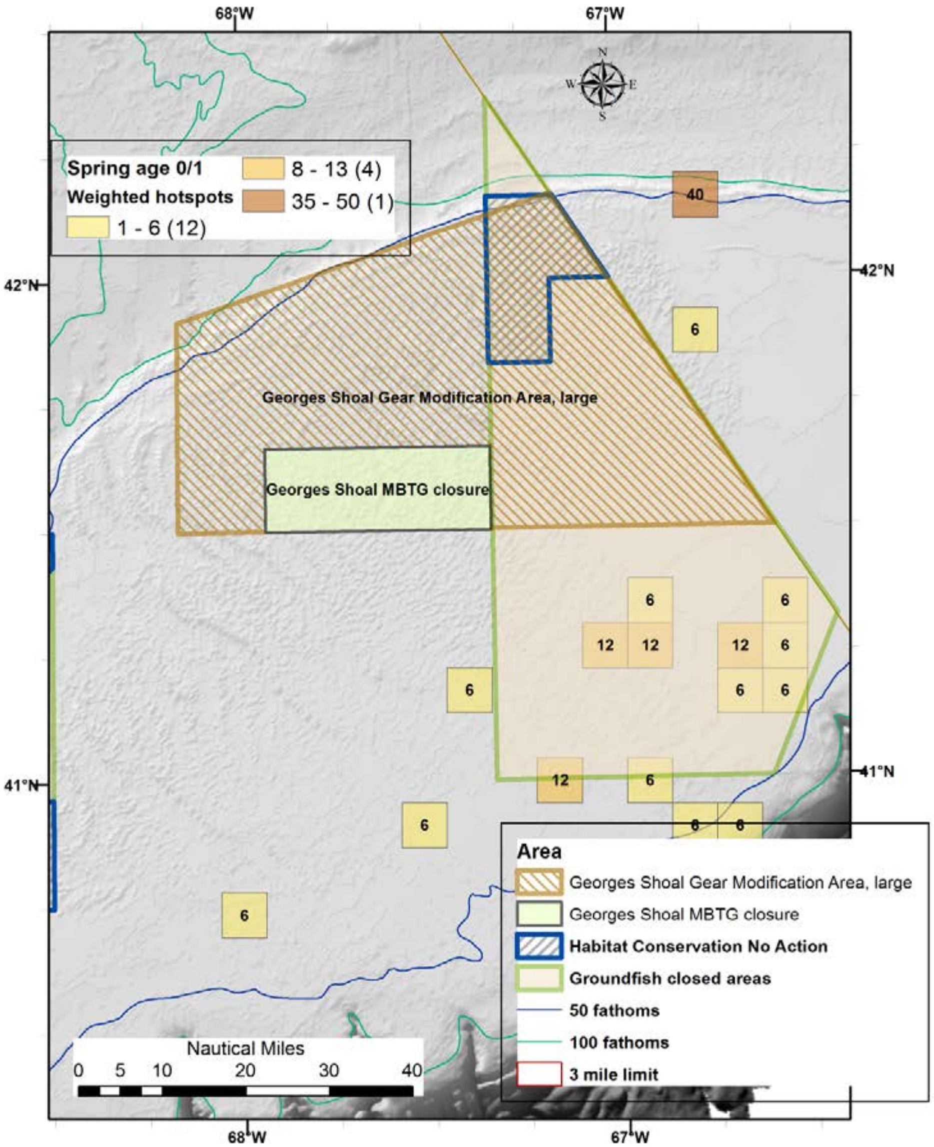
4.1.2.2.2.4 Alternative 5

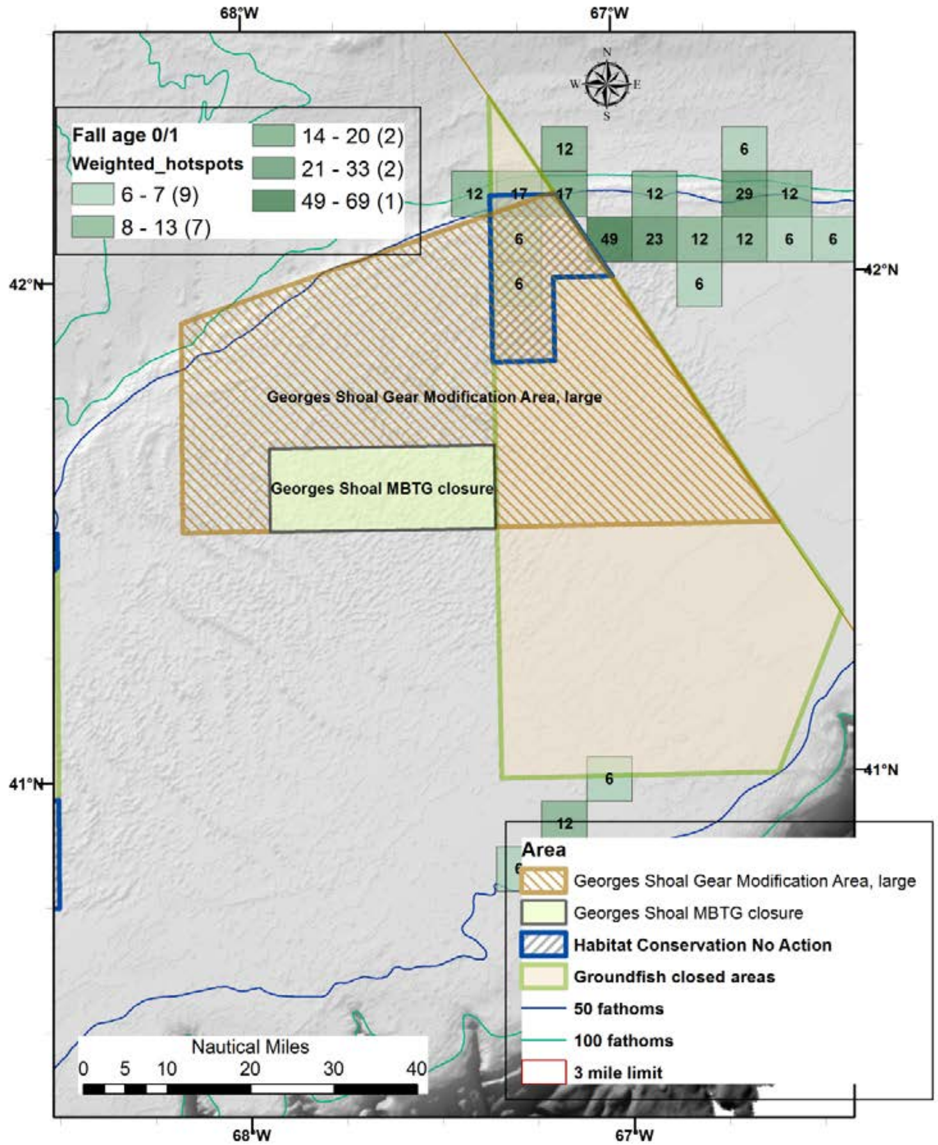
Alternative 5 includes a much larger Georges Shoal gear modification area, overlapping the Cod HAPC and proposed Northern Edge habitat management area in Alternatives 3 and 4. An additional Georges Shoal MBTG closure area would apply, west of the Closed Area II boundary (Map 51). These areas contain fewer weighted age 0/1 groundfish hotspots (MAO) than any other alternative (except Alternative 2 having no closures or gear modification areas).

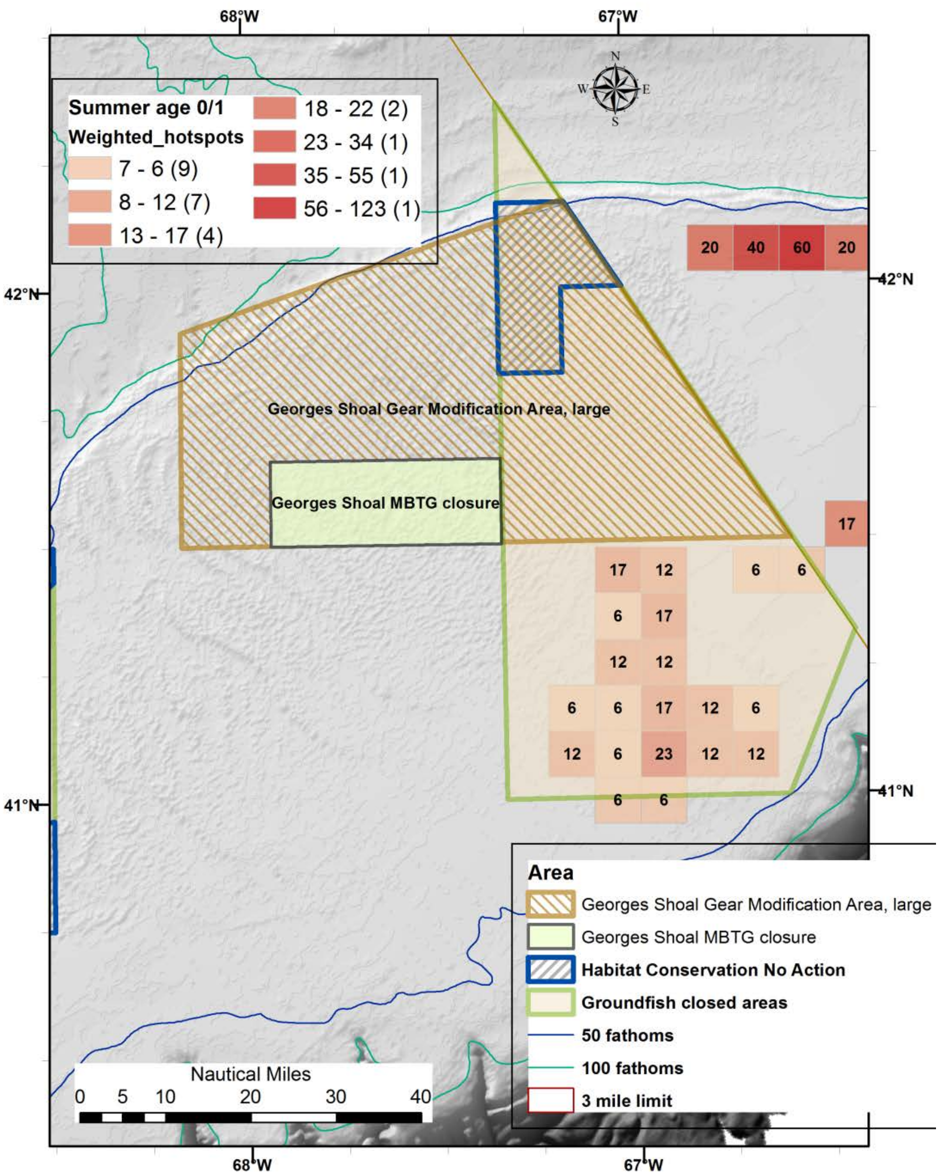
It has fewer hotspots for haddock and red hake, but slightly more winter flounder hotspots (TAB). There does not appear to be more abundance of age 0/1 and older sublegal cod in the gear modification area and no cod or haddock juvenile catches in the proposed Georges Shoal MBTG closure area. Extending into deeper water than the gear modification area proposed by Alternative 4, there does appear to be some added protection for age 0/1 and juvenile haddock on the northern perimeter of Georges Bank (Map 50), depending on the effect of gear modifications (Section 0).

Based on the amount of weighted hotspots and the distribution of age 0/1 and older sublegal cod and haddock, the expected impacts on groundfish habitat and groundfish stocks is expected to be negative compared to Alternative 1 (No Action), and possibly worse than Alternatives 2 and 3 depending on whether mobile bottom-tending gear is prohibited in the Northern Edge habitat management area.

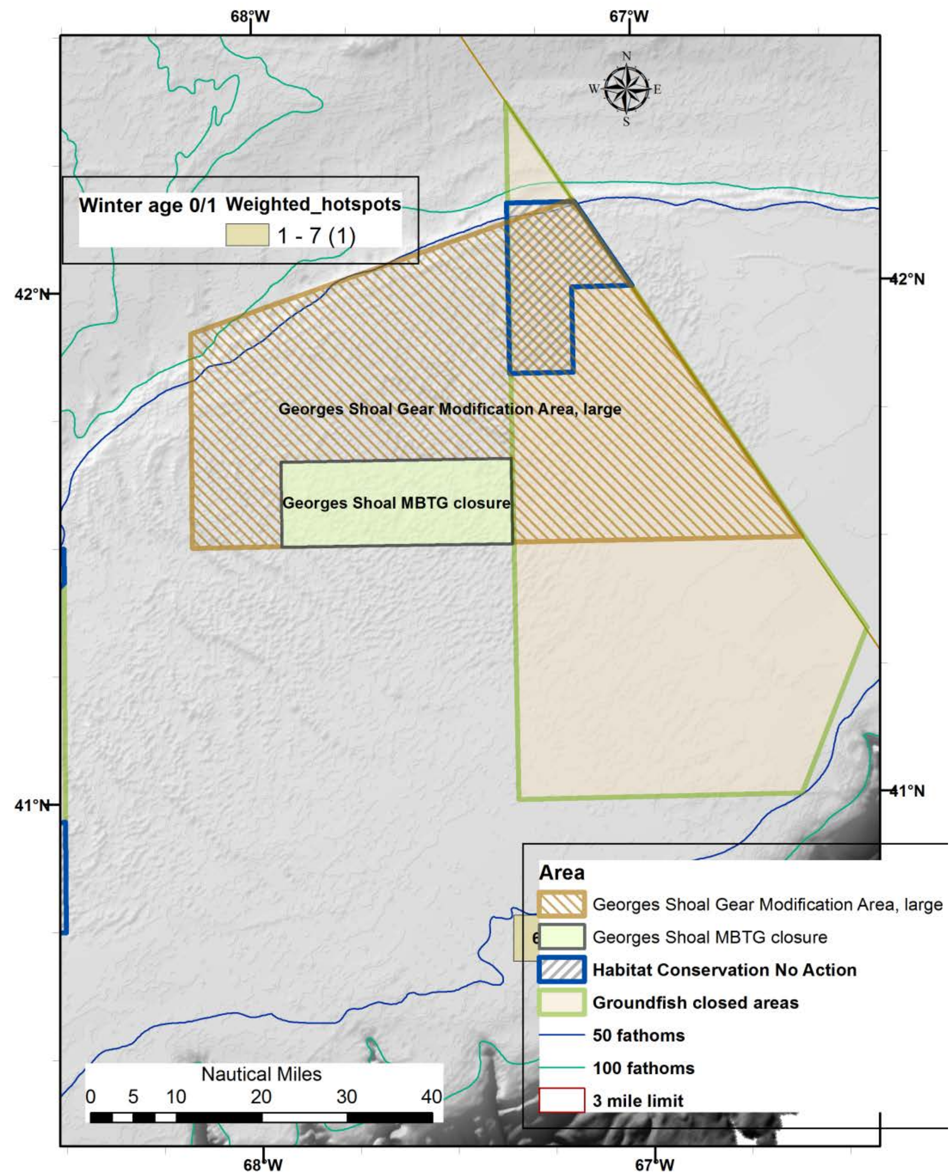
Map 51 – GB Alternative 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.







Summer age 0/1
Weighted_hotspots
7 - 6 (9)
8 - 12 (7)
13 - 17 (4)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
68°W
67°W
42°N
41°N
Area
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40



Winter age 0/1 Weighted_hotspots
1 - 7 (1)
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
68°W
67°W
42°N
41°N
Area
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

4.1.2.2.3 Great South Channel and Southern New England

4.1.2.2.3.1 Alternative 2 (No HMAs)

Alternative 2 proposes no habitat management areas for the Great South Channel sub-region and therefore no hotspots are encompassed within a habitat management area. This alternative is therefore expected to have lower benefits for groundfish stocks than either Alternative 1 (No Action), or any of the other alternatives for this sub-region. It will have negative effects on groundfish habitat compared to Alternative 1 (No Action) and other alternatives in this section.

4.1.2.2.3.2 Alternative 3

Alternative 3 includes proposed two small habitat management areas around Coxes Ledge and a large Great South Channel area extended a little east into the deeper portion of the channel.

Like any other action alternative for the Great South Channel subregion, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 36; Map 53). It is difficult to assess much of anything about groundfish habitat in the proposed habitat management areas however, because a large portion that overlaps the Nantucket Shoals is not surveyed (Map ??? in Section ???).

Map 53 shows the relationship between the proposed habitat management alternatives and survey catches of age 0/1 and larger sub-legal cod. There does not appear to be much juvenile cod abundance in the existing EFH closures in any of the seasonal surveys, but there is some overlap with juvenile cod catches with the proposed Great South Channel extended area.

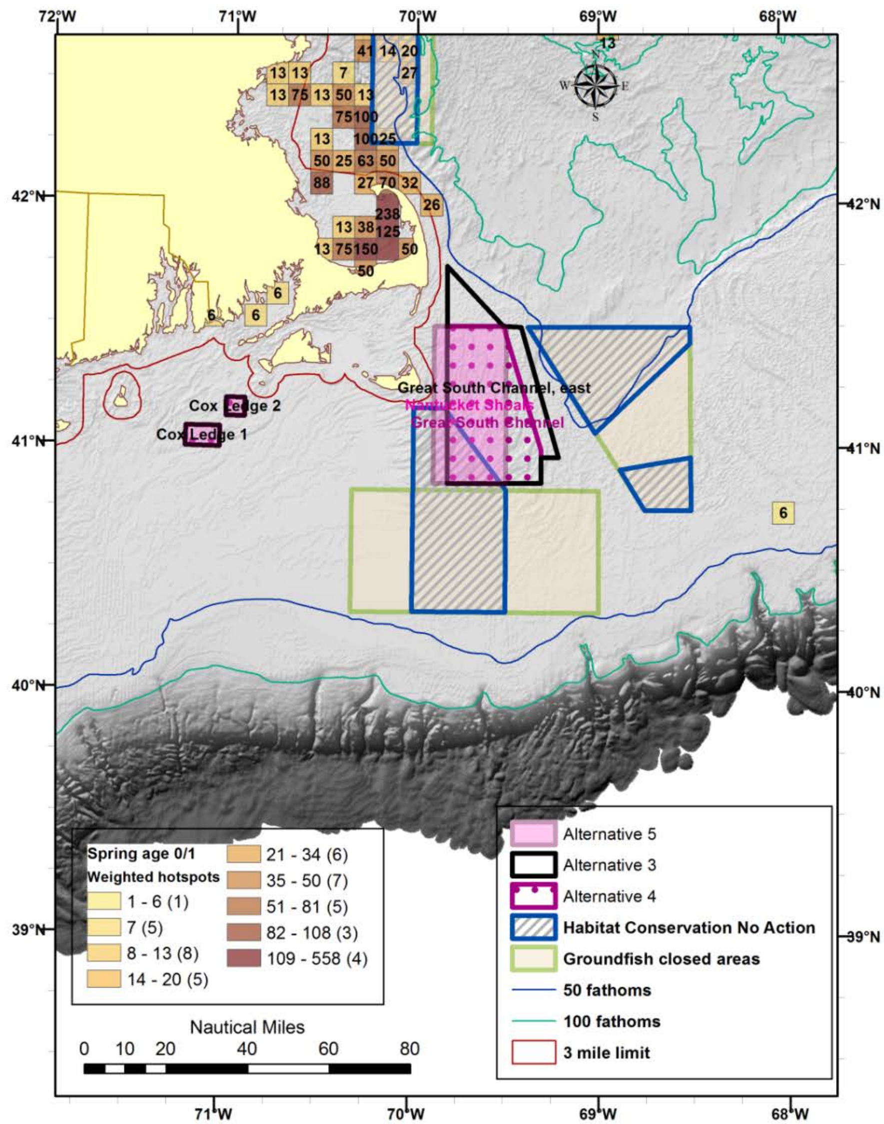
Map 54 shows the relationship between the proposed habitat management alternatives and survey catches of age 0/1 and larger sub-legal haddock. Except for the central portion of Closed Area I and the northeastern part of the Nantucket Lightship Area (which are also scallop dredge access areas), there is little overlap of age 0/1 haddock with any EFH closure, year round groundfish closure or proposed habitat management area. There is some indication that the northern area of Closed Area I (which is proposed as a DHRA in Section ???) hosts older sub-legal juvenile haddock, although it is unclear whether it also includes areas with vulnerable substrate that older haddock rely on.

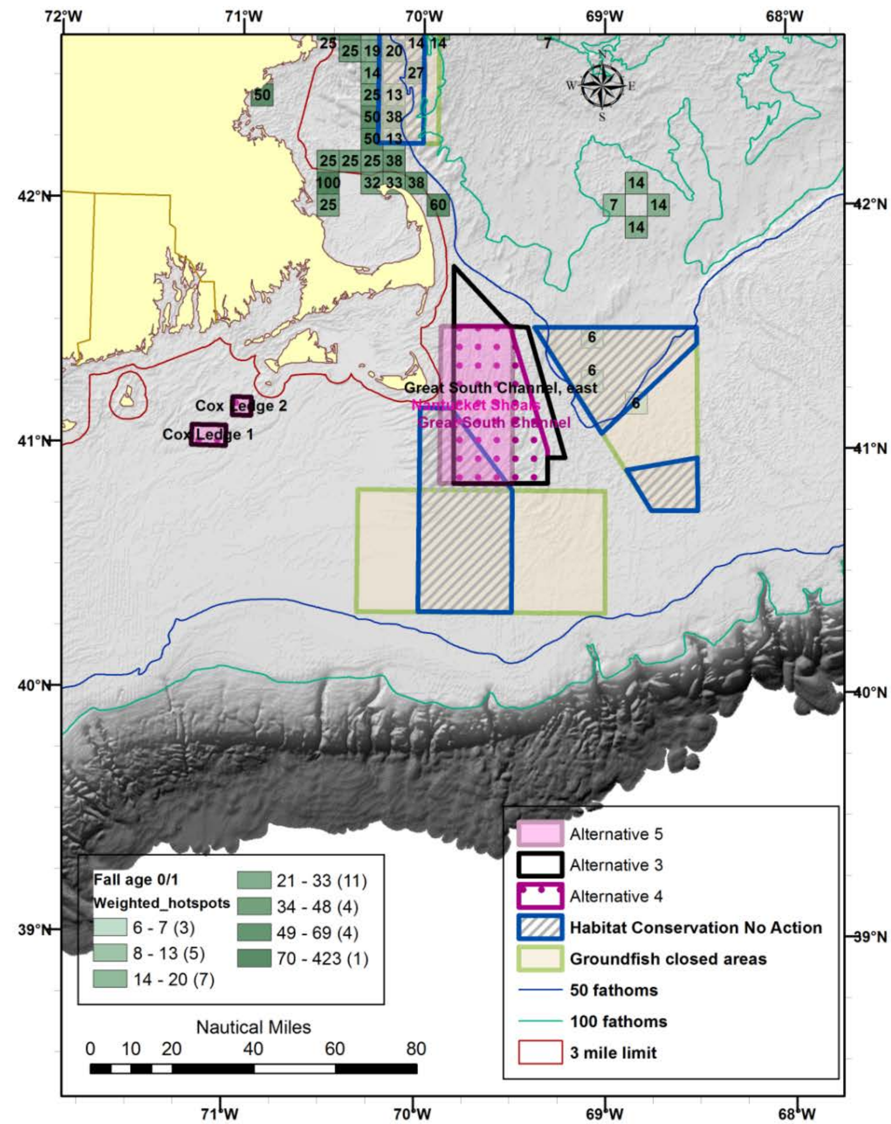
The effect of this alternate on groundfish habitat and on groundfish stocks is therefore highly uncertain.

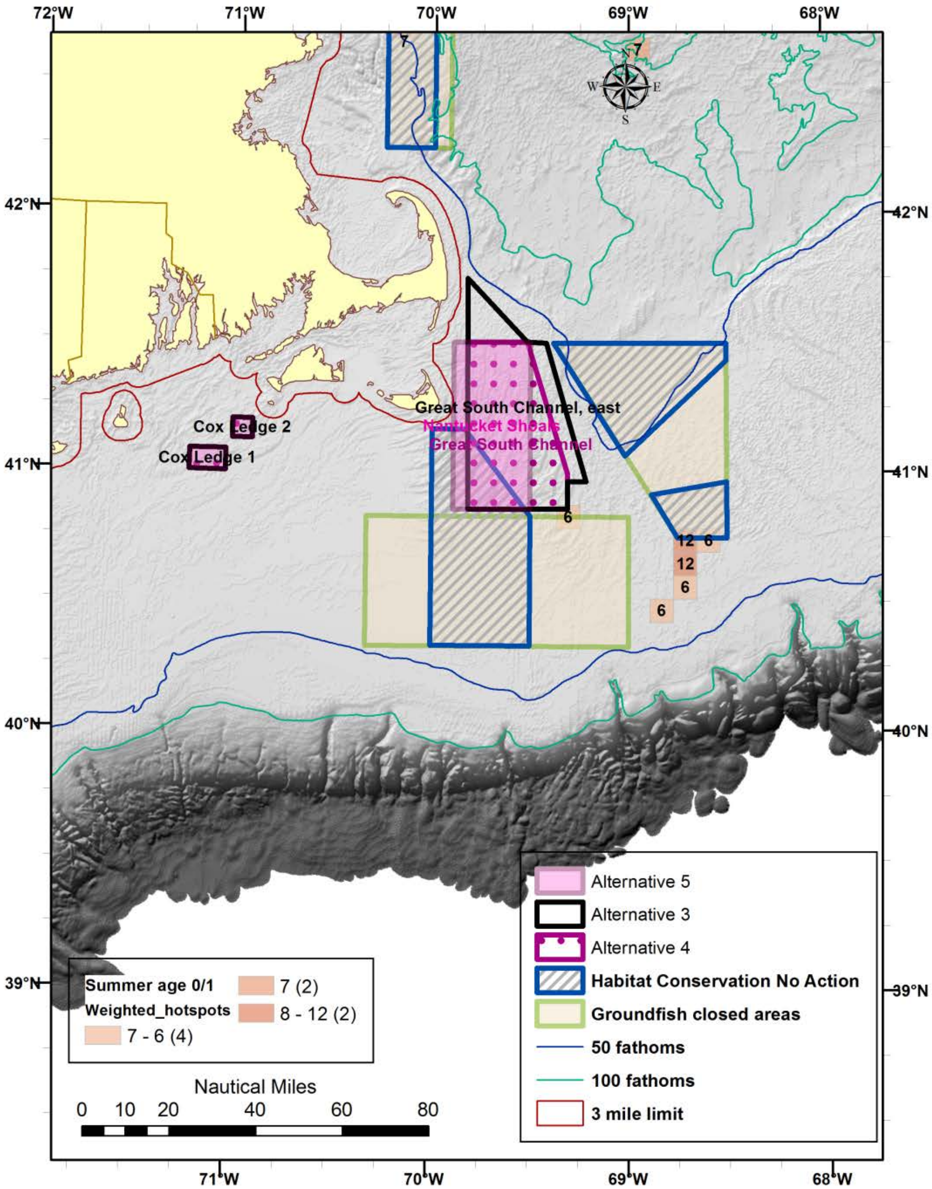
Table 36 – Total unweighted and weighted hotspots in GSC habitat management area alternatives compared to No Action.

	Spring		Summer		Fall		Winter	
Row Labels	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Great South Channel								
No Action	**26**	**0.0**	**133**	**5.8**	**1**	**0.0**	**6**	**80.4**
EFH closure	10	0.0	54	0.0	0	0.0	2	40.2
GF closure	16	0.0	79	5.8	1	0.0	4	40.2
Alternative 2	0	0.0	0	0.0	0	0.0	0	0.0
Alternative 3	0	0.0	0	0.0	9	0.0	0	0.0
Alternative 4	0	0.0	0	0.0	6	0.0	0	0.0
Alternative 5	0	0.0	0	0.0	1	0.0	0	0.0
Alternative 6	0	0.0	0	0.0	13	0.0	0	0.0

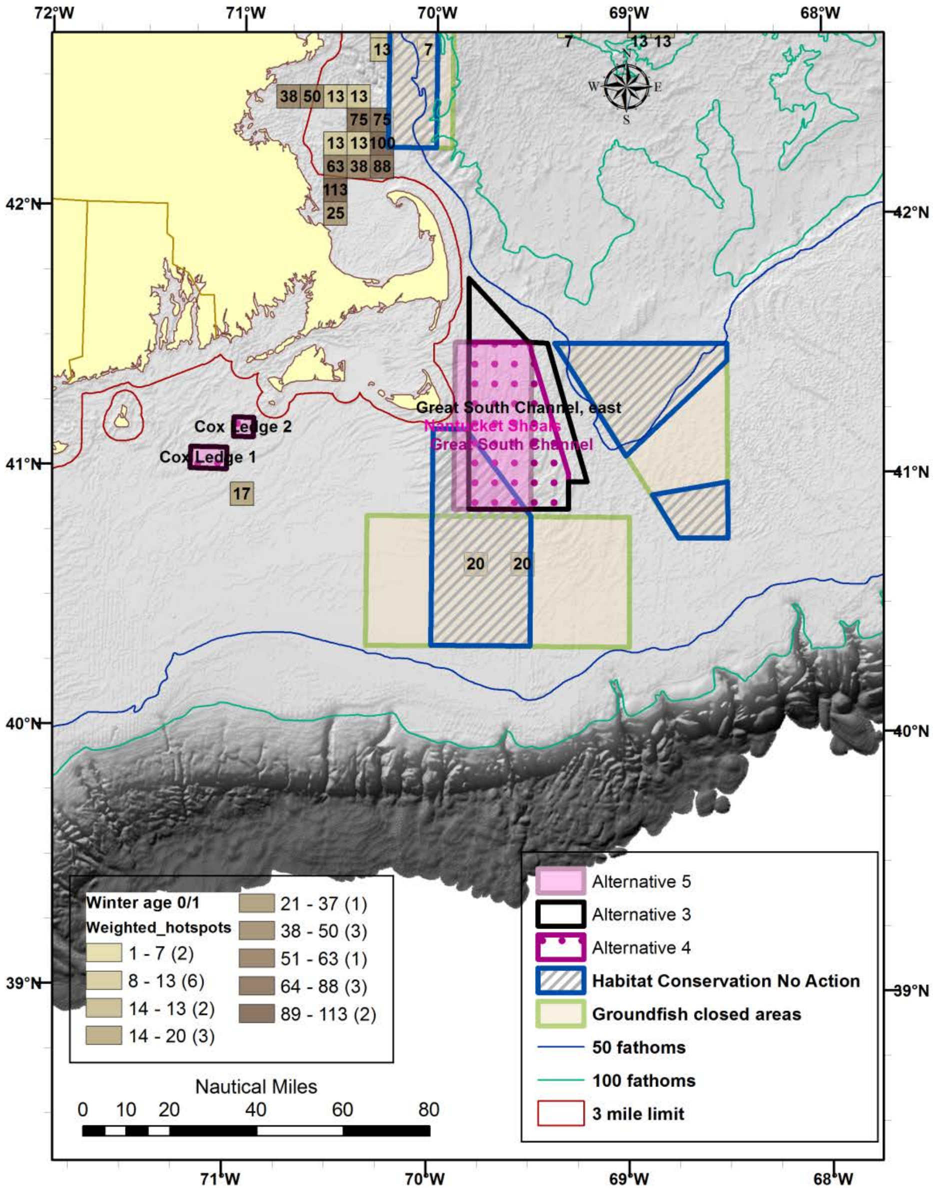
Map 52 – GSC Alternatives 3, 4, and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.







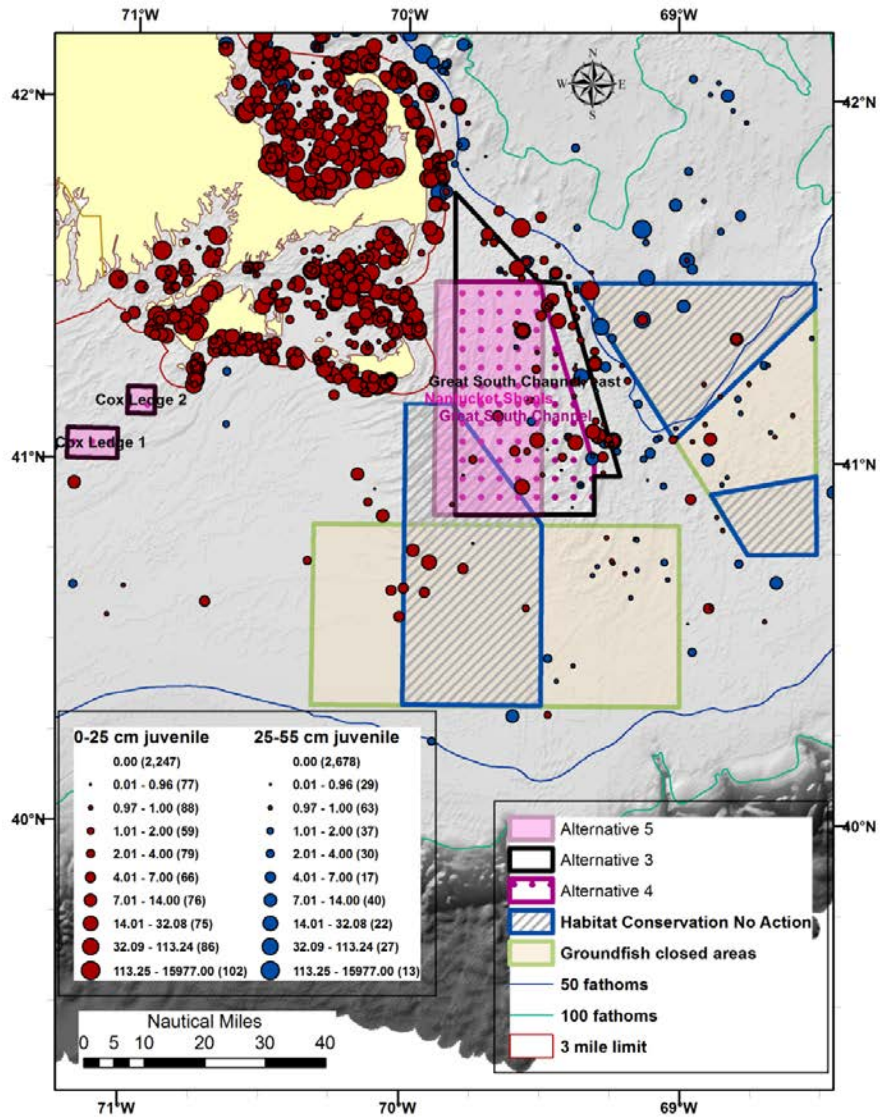
Great South Channel, east
Nantucket Shoals
Great South Channel
Cox Ledge 2
Cox Ledge 1
Summer age 0/1
Weighted_hotspots
7 - 6 (4)
7 (2)
8 - 12 (2)
Nautical Miles
0 10 20 40 60 80
Alternative 5
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit



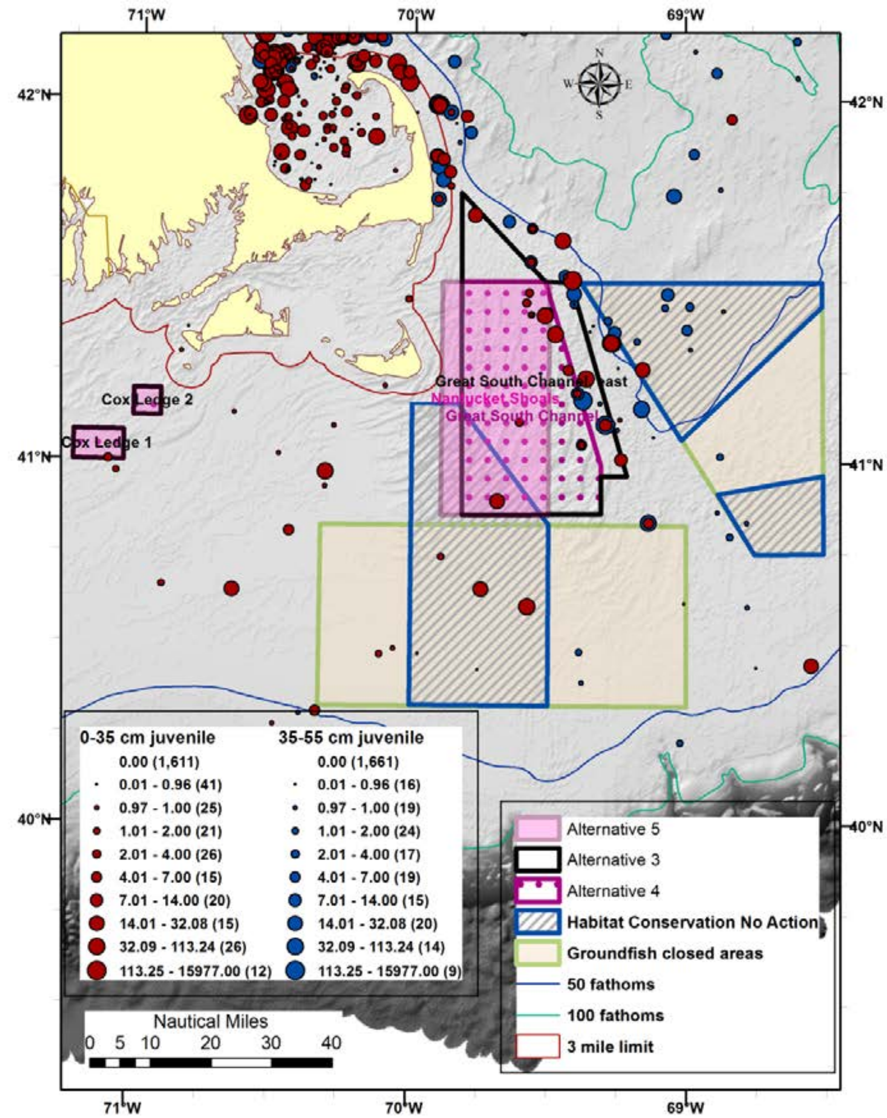
Great South Channel, east
Nantucket Shoals
Great South Channel
Cox Ledge 2
Cox Ledge 1
Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (2)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Nautical Miles
0 10 20 40 60 80
Alternative 5
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit

Map 53 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys.

Spring and summer

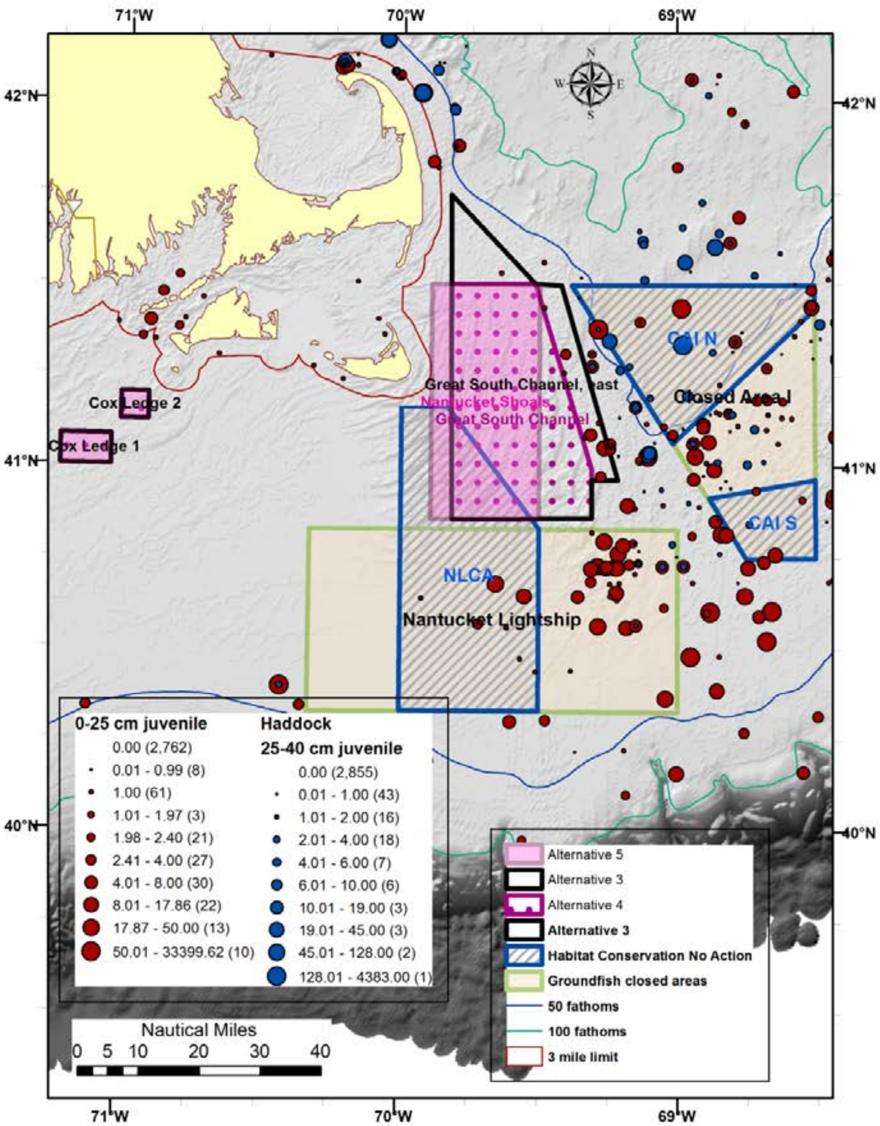


Fall and winter

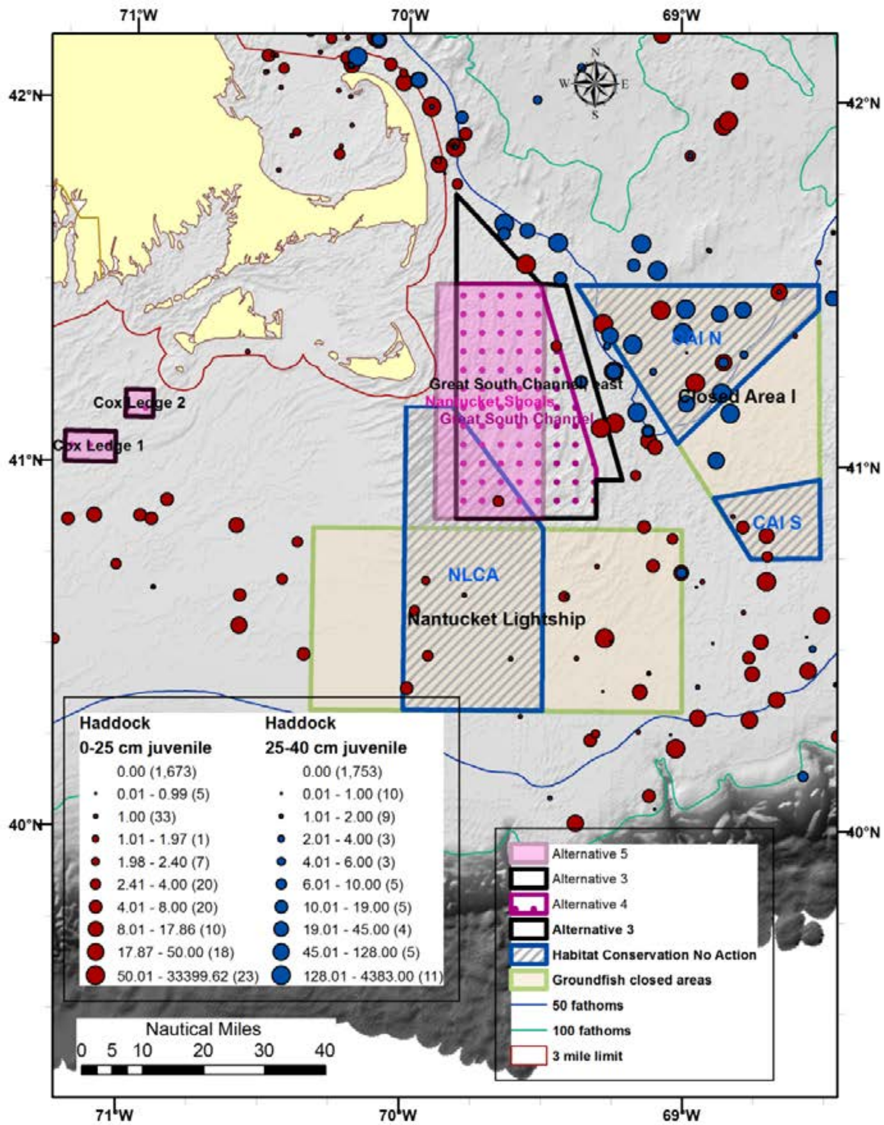


Map 54 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal haddock number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys.

Spring and summer



Fall and winter



4.1.2.2.3.3 Alternative 4

Alternative 4 includes the same areas as Alternative 3, but the Great South Channel habitat management area does not extend as far east into deeper waters of the Great South Channel.

Like any other action alternative for the Great South Channel subregion, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 36; Map 53). It is difficult to assess much of anything about groundfish habitat in the proposed habitat management areas however, because a large portion that overlaps the Nantucket Shoals is not surveyed (Map ??? in Section ???).

The effect of this alternate on groundfish habitat and on groundfish stocks is therefore highly uncertain. Due to less overlap with cod distribution in the Great South Channel, it is likely to have less habitat benefit than Alternative 3.

4.1.2.2.3.4 Alternative 5

Alternative 5 also includes two habitat management areas around Coxes Ledge, but proposes a Nantucket Shoals west habitat management area that includes the northern portion of the Nantucket Lightship EFH closure and overlaps Nantucket Shoals, where there are few to no survey observations.

Like any other action alternative for the Great South Channel subregion, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 36; Map 55). It is difficult to assess much of anything about groundfish habitat in the proposed habitat management areas however, because a large portion that overlaps the Nantucket Shoals is not surveyed (see Map in hotspot analysis section of Affected Environment, Volume 1).

The effect of this alternate on groundfish habitat and on groundfish stocks is therefore highly uncertain. Due to less overlap with cod distribution in the Great South Channel, it is likely to have less habitat benefit than Alternative 3.

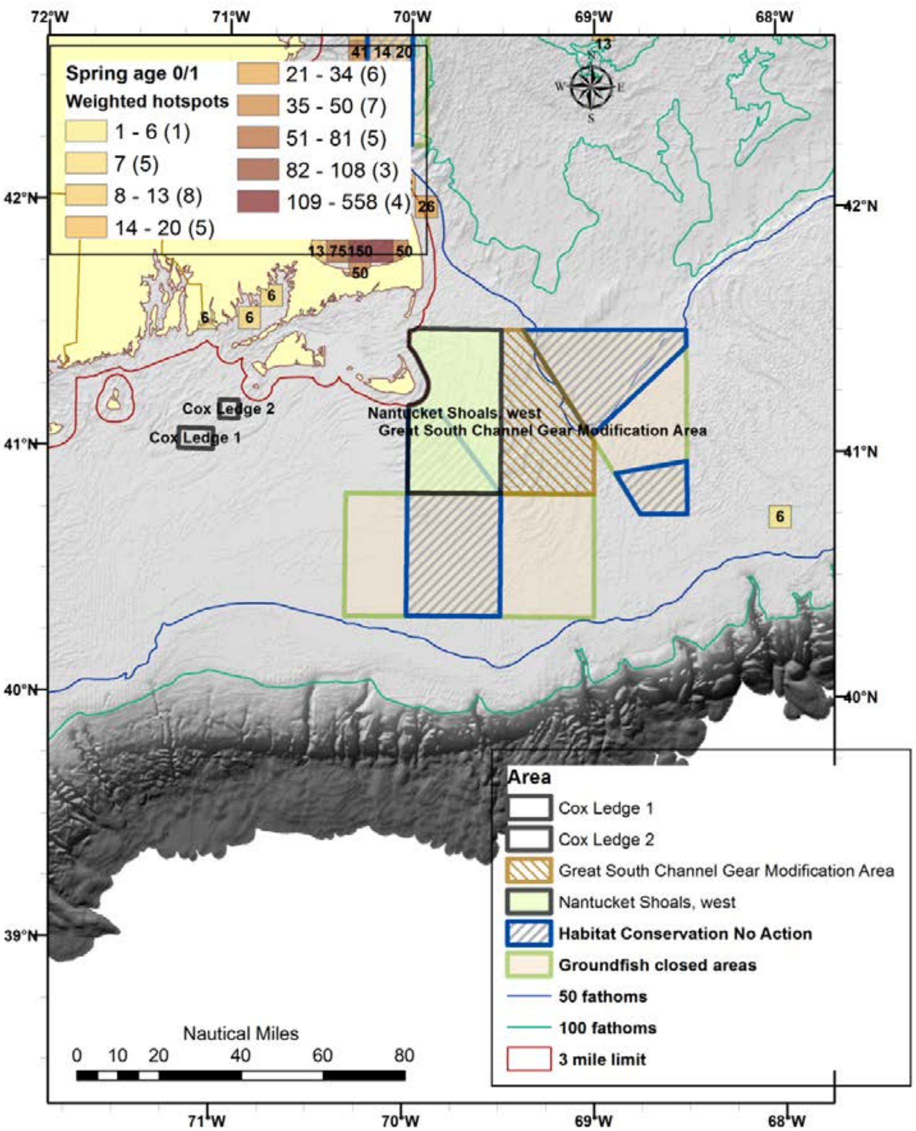
4.1.2.2.3.5 Alternative 6

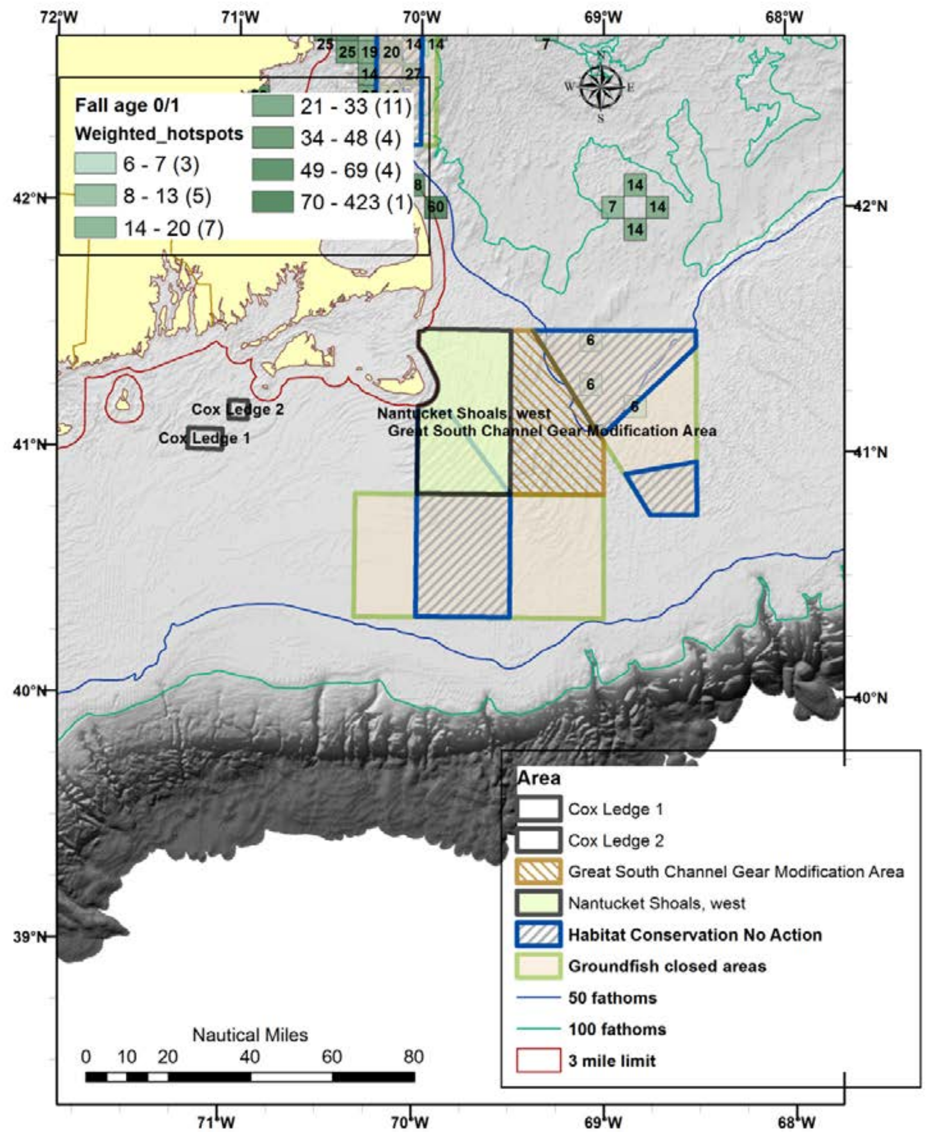
Alternative 6 proposes the same habitat management areas as Alternative 5, but adds a gear modification area which includes all of the Great South Channel east to the boundary of Closed Area I (Map 55) and the proposed Georges Bank DHRA.

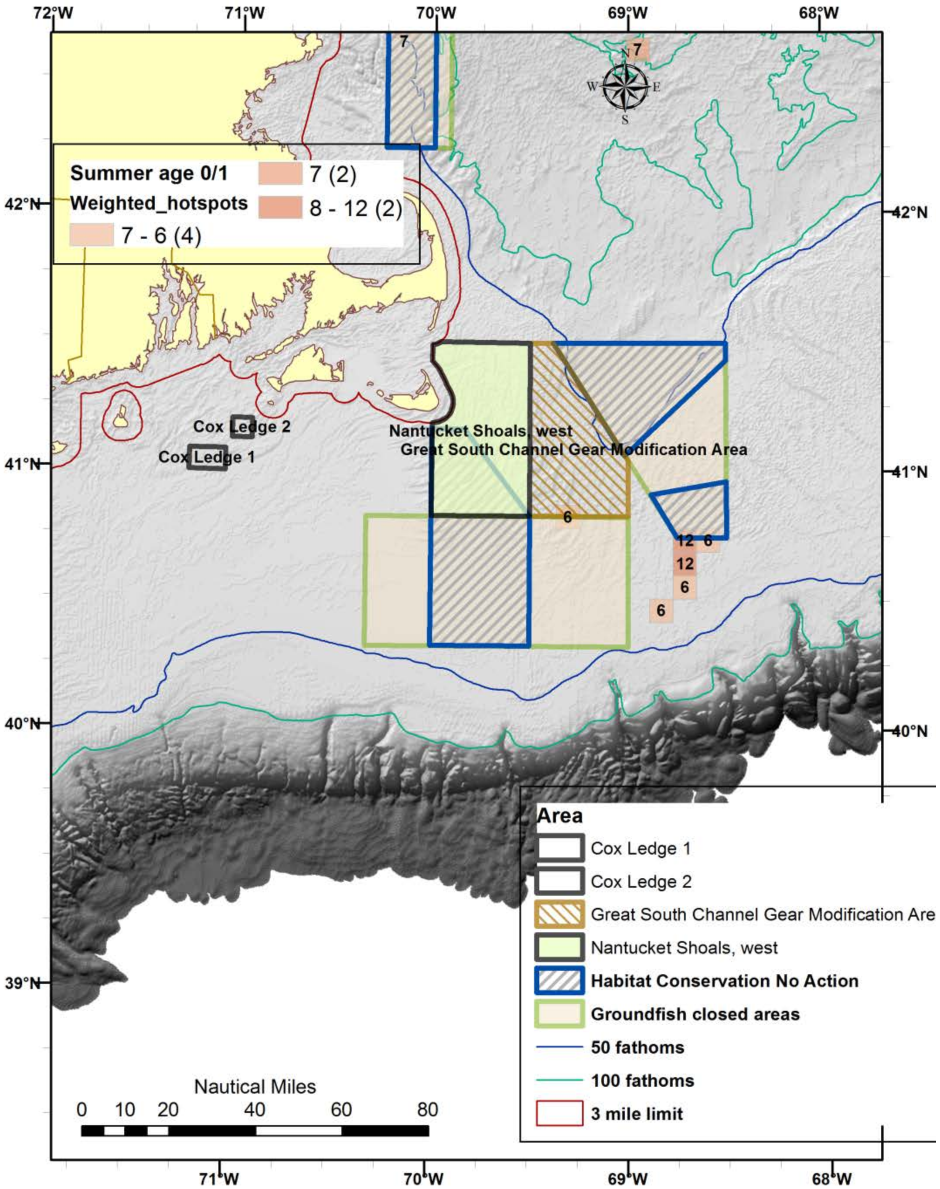
Assessing the effect on groundfish habitat is difficult because the proposed areas have considerable overlap with unsurveyed areas of Nantucket Shoals. Nonetheless the gear modification area has substantial overlap with known catches of age 0/1 cod that inhabit the channel.

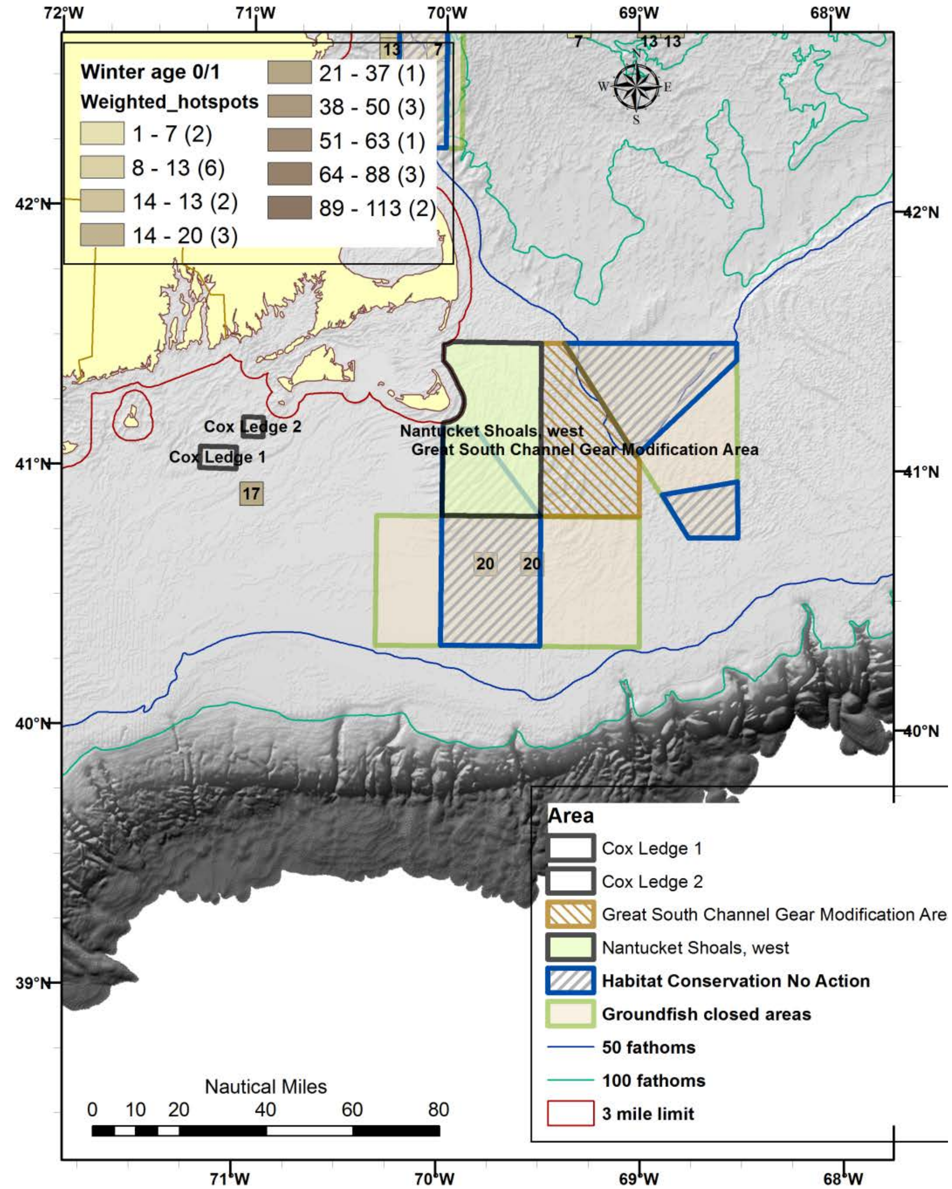
The effect of this alternate on groundfish habitat and on groundfish stocks is also highly uncertain. It may however have more positive effects on groundfish habitat conservation than the other alternatives in this sub-region, depending on the effectiveness of proposed trawl gear modifications coupled with exemptions for fishing with scallop and clam dredges (discussed in Section 0).

Map 55 – GSC Alternatives 5 and 6 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.






Summer age 0/1
Weighted_hotspots
7 - 6 (4)
7 (2)
8 - 12 (2)
Cox Ledge 2
Cox Ledge 1
Nantucket Shoals, west
Great South Channel Gear Modification Area
Area
Cox Ledge 1
Cox Ledge 2
Great South Channel Gear Modification Are
Nantucket Shoals, west
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
72°W 71°W 70°W 69°W 68°W
42°N 41°N 40°N 39°N


Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (2)
14 - 20 (3)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Cox Ledge 2
Cox Ledge 1
Nantucket Shoals, west
Great South Channel Gear Modification Area
Area
Cox Ledge 1
Cox Ledge 2
Great South Channel Gear Modification Are
Nantucket Shoals, west
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
72°W 71°W 70°W 69°W 68°W
42°N 41°N 40°N 39°N

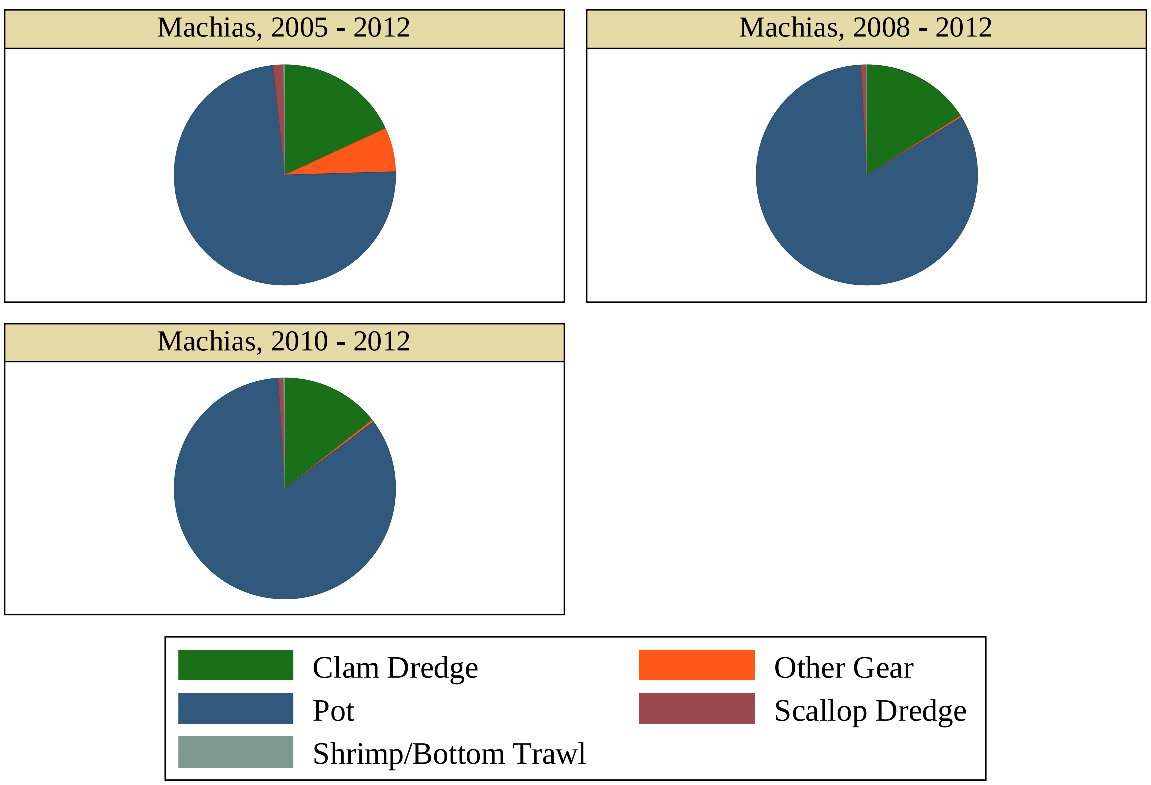
4.1.3 Human communities and the fishery

4.1.3.1 *Economic impacts*

4.1.3.1.1 Eastern GOM and the Scotian Shelf

Tables and figures related to analysis of the economic impacts of the Eastern GOM and Scotian Shelf habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 16 – Machias revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 476,109; 2008 - 2012 = $ 416,544; 2010 - 2012 = $ 439,210



Graphs by Area and years

Figure 17 – Large E. Maine area revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,076,300; 2008 - 2012 =$ 2,059,535; 2010 - 2012 = $ 2,719,470

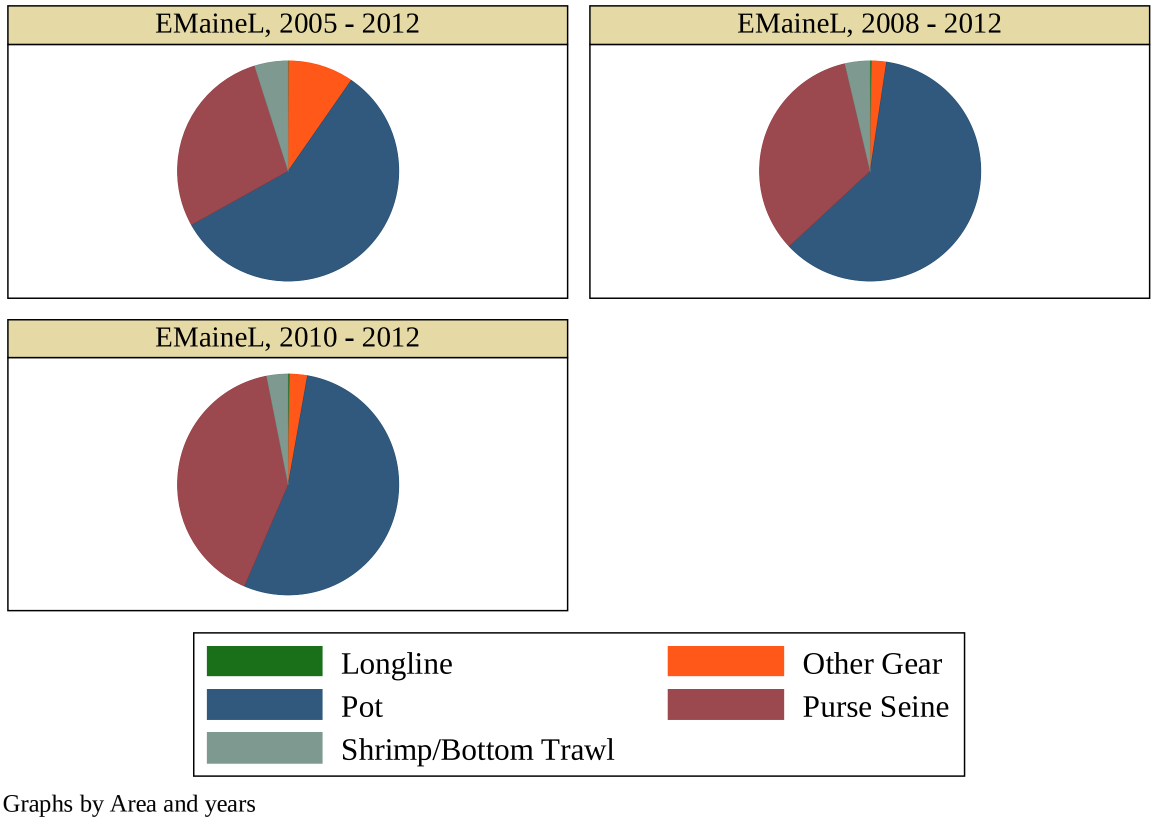


Figure 18 – Small E. Maine revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 612,696; 2008 - 2012 =$ 574,660; 2010 - 2012 = $ 661,771

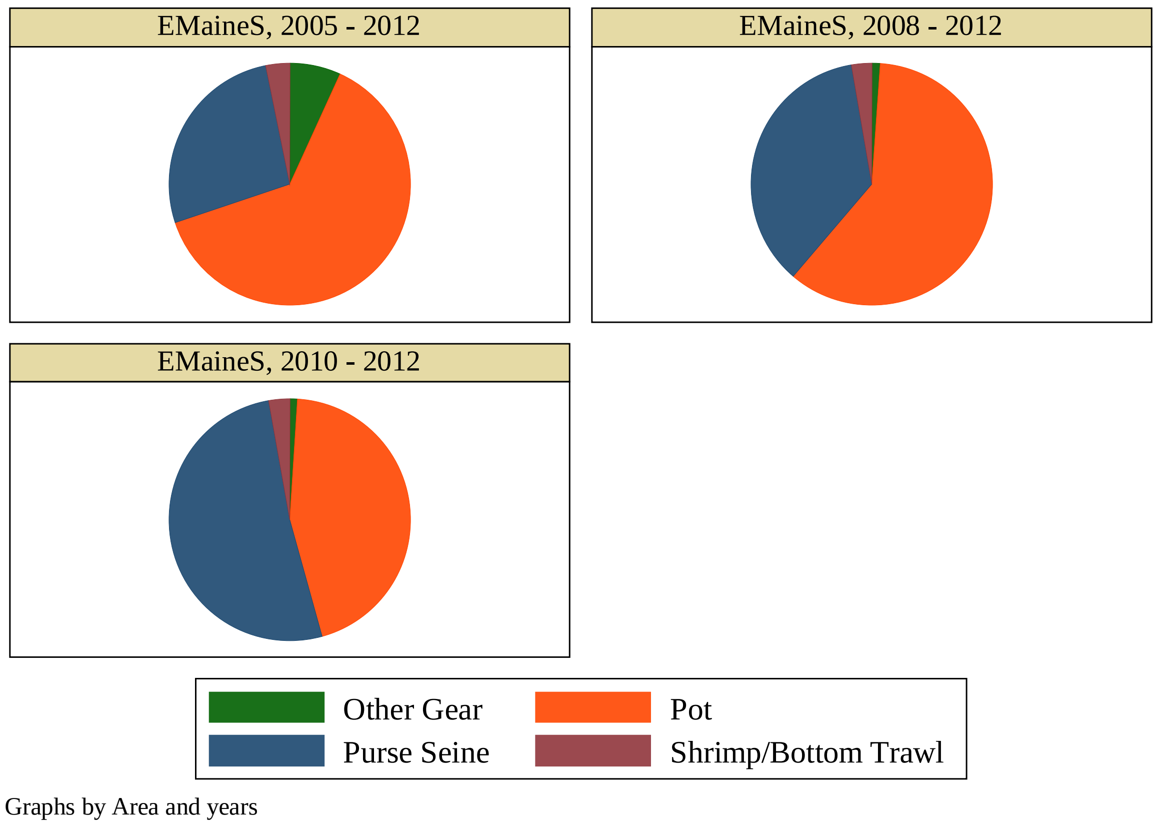
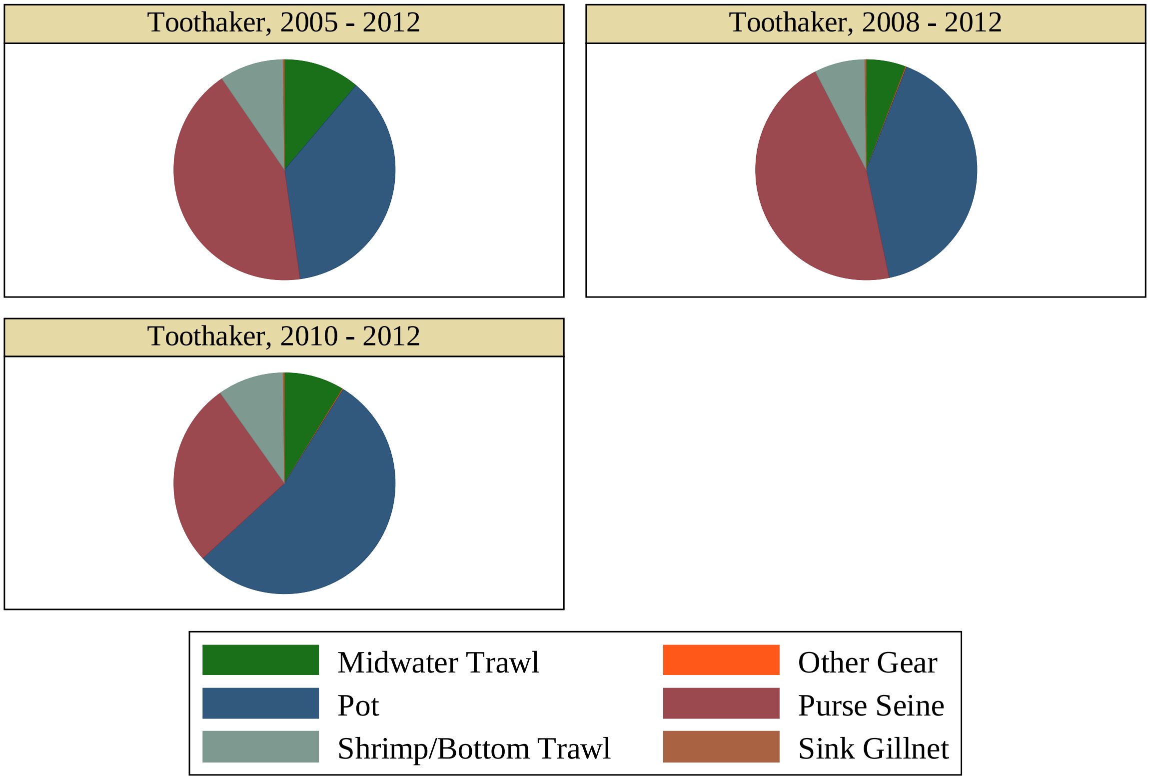


Figure 19 – Toothaker revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 774,603; 2008 - 2012 = $ 825,982; 2010 - 2012 = $ 776,860



Graphs by Area and years

Table 37 – Mobile bottom-tending gear potentially impacted by the Eastern Maine Habitat Alternative 2 options. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U= unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Clam Dredge	Machias	ALL	85,964	70,422	45,947	168,542	42,572	18	877	2005 - 2012
Clam Dredge	Machias	ALL	66,409	69,268	22,444	99,680	42,572	15	701	2008 - 2012
Clam Dredge	Machias	ALL	63,264	69,268	12,452	71,577	48,948	12	624	2010 - 2012
Scallop Dredge	Machias	ALL	7,345	4,232	8,099	26,158	565	8	88	2005 - 2012
Scallop Dredge	Machias	ALL	3,085	3,388	1,565	4,828	565	6	56	2008 - 2012
Scallop Dredge	Machias	ALL	3,344	3,388	317	3,637	3,007	6	67	2010 - 2012
Shrimp/Bottom Trawl	Machias	ALL	851	618	761	1,898	16	7	18	2005 - 2012
Shrimp/Bottom Trawl	Machias	ALL	581	227	763	1,898	16	5	19	2008 - 2012
Shrimp/Bottom Trawl	Machias	ALL	887	574	896	1,898	190	5	19	2010 - 2012
Shrimp/Bottom Trawl	EMaineL	L	20,136	23,112	11,945	41,552	6,027	11	45	2005 - 2012
Shrimp/Bottom Trawl	EMaineL	L	17,546	8,548	15,037	41,552	6,027	11	44	2008 - 2012
Shrimp/Bottom Trawl	EMaineL	L	24,385	23,164	16,590	41,552	8,439	14	57	2010 - 2012
Shrimp/Bottom Trawl	EMaineL	M	49,066	40,277	21,732	81,638	23,883	17	107	2005 - 2012
Shrimp/Bottom Trawl	EMaineL	M	34,236	36,280	7,183	42,249	23,883	11	71	2008 - 2012
Shrimp/Bottom Trawl	EMaineL	M	30,884	30,463	7,221	38,306	23,883	10	68	2010 - 2012
Shrimp/Bottom Trawl	EMaineL	S/U	31,899	26,100	20,205	74,381	12,686	15	135	2005 - 2012
Shrimp/Bottom Trawl	EMaineL	S/U	23,183	18,738	12,598	44,442	12,686	14	126	2008 - 2012
Shrimp/Bottom Trawl	EMaineL	S/U	28,164	24,087	14,671	44,442	15,962	14	142	2010 - 2012

Table 38 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Eastern GOM Alternative 2, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
EMaineL	Bottom Trawl	2005 - 2012	19.30	11.88	1.63	0.12	5.12
EMaineL	Bottom Trawl	2008 - 2012	12.21	9.20	1.33	0.20	2.80

EMaineL	Bottom Trawl	2010 - 2012	3.42	6.67	0.51	0.04	1.01
EMaineL	LA Scallop	2005 - 2012	0.04	0.75	0.05	0.01	0.08
Machias	GC Scallop	2005 - 2012	5.37	1.13	4.77	2.17	7.70

Table 39 – Recreational fishing revenue associated with the Eastern GOM Alternative 2 management areas. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD_Revenue
EMaineL	2006 - 2012	1249.764	0.571429	7.857143	2187.088	1970.975	2206.69
EMaineL	2008 - 2012	1719.84	0.6	10.8	2866.4	3430.45	2129.654
EMaineL	2010 - 2012	1722.917	0.666667	10.33333	2584.375	2584.375	2931.488

Table 40 – Mobile bottom-tending gear potentially impacted by the Eastern Maine Habitat Alternative 3 options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Shrimp/Bottom Trawl	EMaineS	L	3,886	4,644	2,755	8,630	247	9	35	2005 - 2012
Shrimp/Bottom Trawl	EMaineS	L	3,243	1,505	3,439	8,630	247	9	32	2008 - 2012
Shrimp/Bottom Trawl	EMaineS	L	4,512	4,658	4,194	8,630	247	12	41	2010 - 2012
Shrimp/Bottom Trawl	EMaineS	M	9,596	9,886	3,820	14,542	5,489	14	76	2005 - 2012
Shrimp/Bottom Trawl	EMaineS	M	7,829	5,826	3,874	14,542	5,489	9	49	2008 - 2012
Shrimp/Bottom Trawl	EMaineS	M	8,619	5,826	5,132	14,542	5,489	9	49	2010 - 2012
Shrimp/Bottom Trawl	EMaineS	S/U	6,264	3,846	5,414	17,530	2,093	14	96	2005 - 2012
Shrimp/Bottom Trawl	EMaineS	S/U	4,508	3,238	3,806	11,224	2,093	13	93	2008 - 2012
Shrimp/Bottom Trawl	EMaineS	S/U	5,648	3,626	4,890	11,224	2,093	13	108	2010 - 2012
Clam Dredge	Machias	ALL	85,964	70,422	45,947	168,542	42,572	18	877	2005 - 2012
Clam Dredge	Machias	ALL	66,409	69,268	22,444	99,680	42,572	15	701	2008 - 2012
Clam Dredge	Machias	ALL	63,264	69,268	12,452	71,577	48,948	12	624	2010 - 2012
Scallop Dredge	Machias	ALL	7,345	4,232	8,099	26,158	565	8	88	2005 - 2012
Scallop Dredge	Machias	ALL	3,085	3,388	1,565	4,828	565	6	56	2008 - 2012
Scallop Dredge	Machias	ALL	3,344	3,388	317	3,637	3,007	6	67	2010 - 2012

Shrimp/Bottom Trawl	Machias	ALL	851	618	761	1,898	16	7	18	2005 - 2012
Shrimp/Bottom Trawl	Machias	ALL	581	227	763	1,898	16	5	19	2008 - 2012
Shrimp/Bottom Trawl	Machias	ALL	887	574	896	1,898	190	5	19	2010 - 2012
Shrimp/Bottom Trawl	Toothaker	L	9,502	6,963	8,255	28,187	2,350	17	83	2005 - 2012
Shrimp/Bottom Trawl	Toothaker	L	11,012	8,314	10,265	28,187	2,350	17	95	2008 - 2012
Shrimp/Bottom Trawl	Toothaker	L	16,098	11,794	10,613	28,187	8,314	22	138	2010 - 2012
Shrimp/Bottom Trawl	Toothaker	M	24,404	22,825	9,161	40,847	12,321	23	214	2005 - 2012
Shrimp/Bottom Trawl	Toothaker	M	18,946	19,247	4,703	25,311	12,321	18	159	2008 - 2012
Shrimp/Bottom Trawl	Toothaker	M	21,054	20,338	3,949	25,311	17,512	19	161	2010 - 2012
Shrimp/Bottom Trawl	Toothaker	S/U	38,814	37,652	14,026	57,724	18,052	28	394	2005 - 2012
Shrimp/Bottom Trawl	Toothaker	S/U	31,306	31,213	9,945	44,400	18,052	25	327	2008 - 2012
Shrimp/Bottom Trawl	Toothaker	S/U	37,322	36,353	6,647	44,400	31,213	25	347	2010 - 2012

Table 41 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Eastern GOM Alternative 3, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the yearly means, while the statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
EMaineS	Bottom Trawl	2005 - 2012	0.29	2.63	0.11	0.01	0.27
EMaineS	Bottom Trawl	2008 - 2012	0.22	1.60	0.14	0.00	0.33
Machias	GC Scallop	2005 - 2012	5.37	1.13	4.77	2.17	7.70
Toothaker	Bottom Trawl	2005 - 2012	187.77	17.88	10.50	0.23	24.48
Toothaker	Bottom Trawl	2008 - 2012	213.33	15.20	14.03	2.04	24.98
Toothaker	Bottom Trawl	2010 - 2012	200.55	12.67	15.83	3.10	27.52
Toothaker	Shrimp Trawl	2005 - 2012	18.79	2.75	6.83	2.69	9.16
Toothaker	Shrimp Trawl	2008 - 2012	25.87	3.60	7.19	2.43	9.95
Toothaker	Shrimp Trawl	2010 - 2012	29.86	4.00	7.46	2.43	9.63

4.1.3.1.1.1 Alternative 1 (No action/No Habitat Management Areas)

To be completed later.

4.1.3.1.1.2 Alternative 2

Figure 16 and Figure 17 identify the major gears currently fishing in the vicinity of the Machias and Large Eastern Maine management alternatives. Pots are the primary gear type in Machias, highlighting the importance of lobster in this area of the Gulf of Maine. This result is despite the fact that lobster landings are underrepresented in the federal VTR database. Of note is that the "Other Gear" category in Machias includes Other Dredges (i.e. not Clam or Scallop Dredge) which would potentially be affected by the area management alternatives. However, for privacy purposes these gears could not be broken out separately. Although pots still account for over 50% of the average revenue in the Large Eastern Maine area, Purse Seine in particular represents another significant fishery in the area. In the Large Eastern Maine area, the "Other Gear" category includes Other Dredges, Clam Dredges, and Scallop Dredges, which would potentially be affected by the area management alternatives but cannot be detailed for privacy purposes.

Table 37 provides a more detailed view of the mobile bottom-tending gears for which the management options 1 – 4 potentially apply. In Machias, the fishery with the most potential revenue displacement is the clam fishery. The annual revenue metric is high, despite the average revenue displaced per trip being on the order of $100. This can be explained by the fact that the Machias alternative abuts productive clam beds to the south (see for instance the 44th SAW Assessment Report Appendix A8, Stock Assessment for Ocean Quahog in Maine Waters), and although there is evidence of clam fishery activity, the majority of the clam activity in the area, as represented by the logbook data, looks to occur outside of the Machias management area alternative. Scallop Dredge revenue seems to follow a similar pattern, with an average revenue displacement per trip of $50 between 2010 and 2012. The Shrimp /Bottom Trawl revenues potentially displaced are minimal in Machias. In the Large Eastern Maine area, the Shrimp and Bottom Trawl gears represent the most revenue potentially displaced by the Eastern Gulf of Maine Alternative 2, with vessels of all categories plying these waters although there does seem to be a downward trend through time. The average revenue per trip for Shrimp/Bottom Trawl vessels > 70 ft is estimated to be $428, for vessels between 40 and 70 ft it is $450, and for vessels smaller than 40 ft it is $198. Although not insignificant amounts, the trawl revenue in Large Eastern Maine again seems to represent fishing on the edges of more productive fishing grounds as opposed to centers of fishing themselves.

Table 38 presents the VMS analysis of fishing effort in Machias and Large Eastern Maine, which seem to bear out the VTR analysis of Table 37. Historically some small amount of GC scalloping has occurred within the boundaries of Machias, while Large Eastern Maine has played host to both Bottom Trawl and LA scalloping, neither of which are substantial.

Table 39 summarizes the recreational fishing reported within the bounds of the Eastern GOM Alternative 2 management areas. The 10 angler trips reported within the Large Eastern Maine area is minimal, while no recreational trips were reported within the boundaries of Machias during the time period analyzed.

Option 1 has a relatively small impact on the total revenues being generated from the waters of the Machias and Large Eastern Maine area alternatives, with a complete exclusion of mobile bottom-tending gears affecting less than 7% of the total revenue generated from the areas being considered between 2010 and 2012. Option 2 as written exempts only hydraulic clam dredges from the management areas. Although the clam logbook data does not include a gear categorization, Stevenson et al. (2004) indicates that the clam fishery in Machias, which would benefit most from this exemption, is actually prosecuted with the dry clam dredge and thus would not qualify for the exemption. Option 3 and 4 would primarily exempt fishermen dredging in Machias, and thus the majority of the revenue potentially displaced by area management. However, as discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in these options in terms of habitat conservation are highly uncertain.

4.1.3.1.1.3 Alternative 3

Figure 16, Figure 18, and Figure 19 present the major gear types fishing in the vicinity of the Eastern GOM Alternative 3 management areas. Although the overall pattern of gear usage is similar, the Small E. Maine alternative encompasses roughly 25-30% of the revenue associated with the Large E. Maine area within the Eastern GOM Alternative 2. Again, Purse Seine and Lobster Pots are the dominant gear types in the Small E. Maine alternative. This result is despite the fact that lobster landings are underrepresented in the federal VTR database. The “Other Gear” category in the Small E. Maine alternative includes Clam Dredges, Scallop Dredges, and Other Dredges (i.e. not Clam or Scallop Dredge), which would be subject to options being considered within Alternative 3 but cannot be detailed due to privacy concerns. Pots are the primary gear type in Machias, again highlighting the importance of lobster in this area of the Gulf of Maine. The “Other Gear” category in Machias includes Other Dredges which would potentially be affected by the area management alternatives, but cannot be detailed due to privacy concerns. Toothaker is dominated by Purse Seine and Lobster Pot gear, with the latter seeming to increase its share of the revenue in the most recent three years analyzed (2010 – 2012). “Other Gear” includes Clam Dredges, Scallop Dredges, and Other Dredges, which would be subject to management options being considered within Alternative 3 but cannot be detailed due to privacy concerns.

Table 40 provides a more detailed view of the mobile bottom-tending gears for which the management options 1 – 4 potentially apply. In Machias, the fishery with the most potential revenue displacement is the clam fishery. The annual revenue metric is high, despite the average revenue displaced per trip being on the order of $100. This can be explained by the fact that the Machias alternative abuts productive clam beds to the south (see for instance the 44th SAW Assessment Report Appendix A8, Stock Assessment for Ocean Quahog in Maine Waters), and although there is evidence of clam fishery activity, the majority of the clam activity in the area, as represented by the logbook data, looks to occur outside of the Machias management area alternative. Scallop Dredge revenue seems to follow a similar pattern, with an average revenue displacement per trip of $50 between 2010 and 2012. The Shrimp /Bottom Trawl revenues potentially displaced are minimal in Machias. In the Small Eastern Maine alternative, the Shrimp and Bottom Trawl gears represent the most revenue potentially displaced by the Eastern Gulf of Maine Alternative 2, with vessels of all categories plying these waters although there does seem to be a downward trend through time. The average revenue per trip for Shrimp/Bottom Trawl vessels > 70 ft is estimated to be $110, for vessels between 40 and 70 ft it is $176, and for vessels smaller than 40 ft it is $52. Although not insignificant amounts, this trawl revenue in Large Eastern Main seems to represent fishing on the edges of more productive fishing grounds as opposed to centers of fishing themselves. This result is mirrored within the boundaries of Toothaker Ridge, with average revenue displaced per trip for Shrimp/Bottom Trawl vessels > 70 ft is estimated to be $116, for vessels between 40 and 70 ft it is $130, and for vessels smaller than 40 ft it is $108. However, a total of 646 Bottom Trawl trips are estimated to overlap the boundaries of Toothaker Ridge, suggesting that this area abuts much more productive fishing grounds though it is not a major center of fishing itself.

Table 41 presents the VMS analysis of fishing effort in Machias, Small Eastern Maine, and Toothaker Ridge, which seem to bear out the VTR analysis of Table 3. Historically some small amount of GC scalloping has occurred within the boundaries of Machias. Small Eastern Maine has had minimal Bottom Trawl effort within its boundaries. Bottom Trawl effort within Toothaker Ridge is somewhat more pronounced. The median is much smaller than the mean effort, suggesting that a few individuals utilize this area more intensively than the majority of individuals fishing in the area. Shrimp trawl effort is also estimated to fall within Toothaker Ridge, though at relatively low levels.

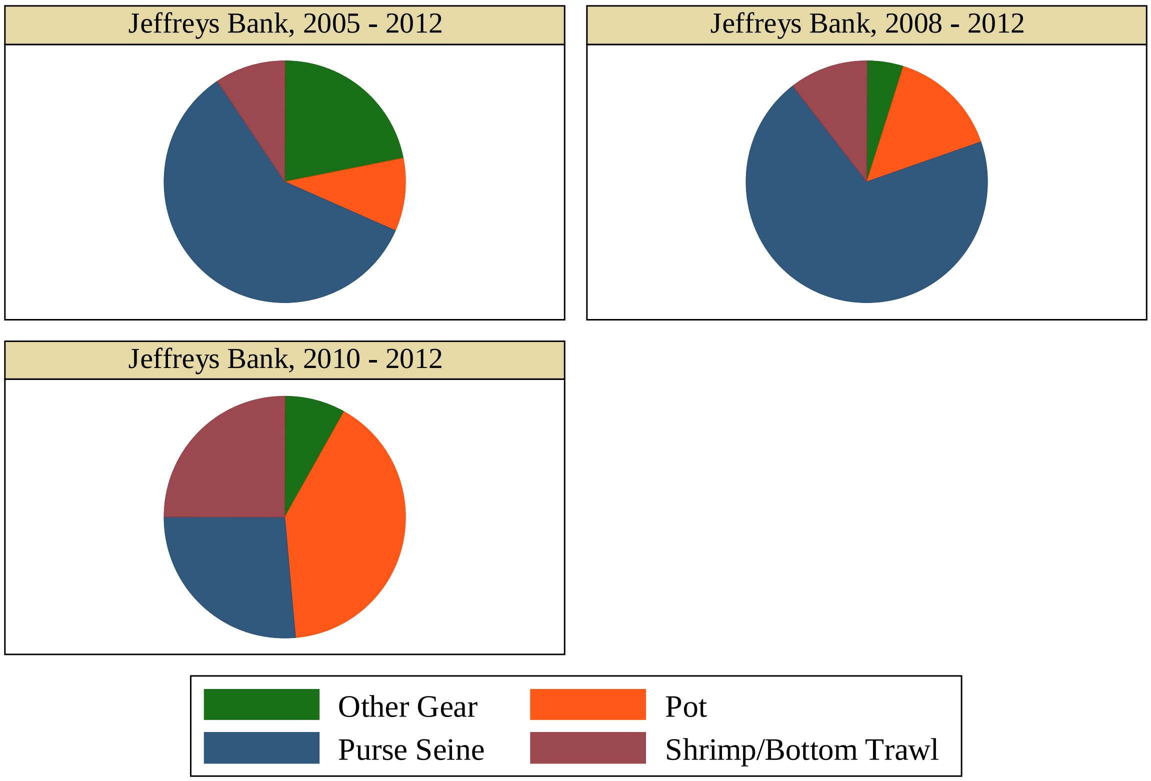
Although there have historically been some recreational trips whose VTR location place them within the Small Eastern Maine and Toothaker Ridge areas, this information cannot be presented due to privacy concerns.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect roughly $170,000, or 9% of the total revenue generated from the waters surrounding the areas in the most recent three year period (2010 – 2012).

4.1.3.1.2 Central GOM

Tables and figures related to analysis of the economic impacts of the Central GOM habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 20 – Jeffreys Bank revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 490,005; 2008 - 2012 = $ 424,539; 2010 - 2012 = $ 212,244



Graphs by Area and years

Figure 21 – Platts Bank revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 206,164; 2008 - 2012 = $ 185,991; 2010 - 2012 = $ 209,074

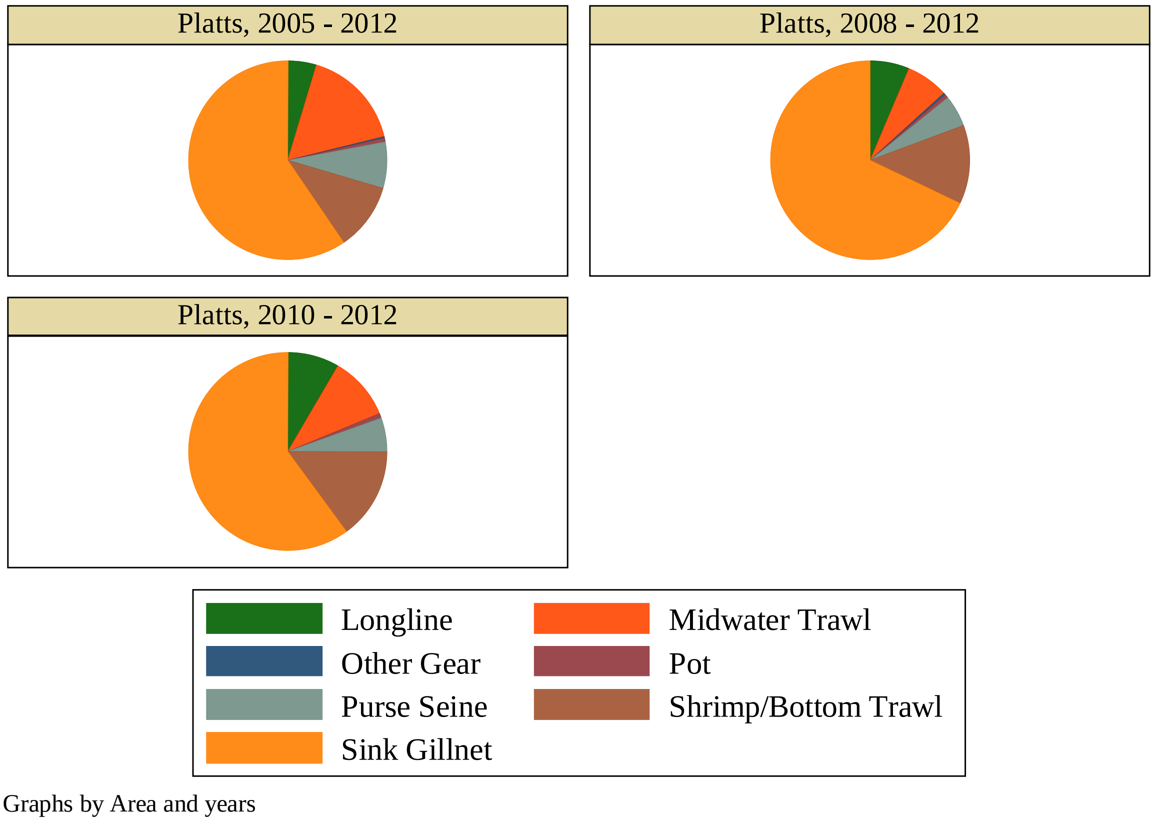


Table 42 – Mobile bottom-tending gear in currently open portions of the Central GOM Habitat Alternatives potentially displaced by the management options. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Shrimp/Bottom Trawl	Jeffreys Bank	L	10,591	6,052	12,949	42,170	2,505	21	116	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	L	13,698	7,985	16,153	42,170	2,505	20	130	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	L	20,029	9,933	19,199	42,170	7,985	25	186	2010 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	15,054	14,375	6,888	24,697	5,669	20	144	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	10,804	9,895	4,245	17,389	5,669	16	94	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	M	12,882	11,361	3,972	17,389	9,895	16	88	2010 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	20,558	18,423	6,131	32,356	14,743	13	113	2005 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	19,917	18,644	4,554	27,024	14,743	11	85	2008 - 2012
Shrimp/Bottom Trawl	Jeffreys Bank	S/U	20,137	18,644	6,275	27,024	14,743	10	89	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	7,763	6,437	6,002	20,099	638	29	218	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	9,351	7,415	7,324	20,099	638	30	264	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	L	13,309	12,413	6,389	20,099	7,415	38	376	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	11,237	11,323	3,886	18,138	4,290	30	212	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	11,164	11,352	5,033	18,138	4,290	25	192	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	M	14,049	12,659	3,600	18,138	11,352	25	234	2010 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,484	3,366	1,133	5,610	1,961	26	148	2005 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,405	2,800	1,460	5,610	1,961	19	119	2008 - 2012
Shrimp/Bottom Trawl	Platts Bank	S/U	3,891	4,102	1,834	5,610	1,961	17	117	2010 - 2012

Table 43 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Central GOM Alternatives, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the yearly means, while the statistics are calculated at the individual level. Note that Shrimp Trawl effort is unreported due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Jeffreys Bank	Bottom Trawl	2005 - 2012	99.44	18.38	5.41	0.12	13.75
Jeffreys Bank	Bottom Trawl	2008 - 2012	117.99	16.40	7.19	0.41	15.95

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Jeffreys Bank	Bottom Trawl	2010 - 2012	88.97	14.67	6.07	0.33	14.09
Platts Bank	Bottom Trawl	2005 - 2012	3.81	14.13	0.27	0.01	0.59
Platts Bank	Bottom Trawl	2008 - 2012	3.02	11.40	0.26	0.01	0.61
Platts Bank	Bottom Trawl	2010 - 2012	2.04	12.33	0.17	0.01	0.41

Table 44 – Recreational fishing revenue associated with Platts Bank. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Platts Bank	2006 - 2012	29355.19	3.142857	197.4286	1360.836	1193.2	583.5898
Platts Bank	2008 - 2012	25704.98	3	173.2	1460.51	1416.925	663.2817
Platts Bank	2010 - 2012	22507.52	3	152.3333	1534.603	1491.5	731.2774

Table 45 – Cashes Ledge: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	299	273	509	152	74	66	130	156	145	302	157	221
	Cod	$51	$55	$64	$92	$26	$12	$20	$9	$19	$46	$34	$42
		3%	3%	4%	5%	2%	1%	2%	1%	2%	4%	3%	2%
	Redfish	$45	$107	$59	$59	$112	$56	$220	$139	$166	$93	$148	$226
		3%	6%	4%	3%	10%	4%	17%	13%	16%	8%	14%	12%
	Pollock	$321	$362	$578	$694	$225	$443	$293	$293	$181	$388	$173	$155
		21%	19%	34%	40%	20%	34%	23%	27%	18%	35%	16%	8%
	Plaice	$227	$172	$139	$141	$98	$93	$118	$149	$171	$160	$211	$131
		15%	9%	8%	8%	9%	7%	9%	13%	17%	14%	20%	7%
	Witch Flounder	$160	$300	$241	$232	$132	$48	$63	$52	$48	$76	$63	$352
		10%	16%	14%	13%	12%	4%	5%	5%	5%	7%	6%	19%

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	White Hake	$150	$145	$92	$118	$196	$240	$179	$150	$181	$141	$120	$144
		10%	8%	5%	7%	18%	18%	14%	14%	18%	13%	11%	8%
	Monkfish	$485	$608	$370	$313	$234	$253	$258	$249	$236	$176	$241	$679
		32%	33%	22%	18%	21%	19%	20%	23%	23%	16%	23%	37%
	Lobster	$53	$79	$65	$67	$54	$146	$100	$43	$9	$8	$13	$68
		3%	4%	3%	4%	5%	12%	8%	4%	1%	1%	1%	3%
Fixed Gillnet	Total Hauls	96	27	86	53	73	52	149	110	103	64	65	
	Cod	80	43	37	91	98	63	106	130	98	96	128	
		9%	5%	5%	13%	18%	8%	14%	18%	14%	17%	17%	
	Haddock	16	6	9	22	5	4	4	2	2	6	8	
		2%	1%	1%	3%	1%	1%	1%	0%	0%	1%	1%	
	Redfish	12	14	13	6	9	35	16	7	11	14	21	
		1%	2%	2%	1%	2%	5%	2%	1%	2%	3%	3%	
	Pollock	591	653	558	478	57	129	215	305	335	209	420	
		70%	80%	71%	69%	10%	17%	29%	42%	48%	38%	55%	
	White Hake	37	55	73	21	283	423	193	143	103	83	76	
		4%	7%	9%	3%	51%	57%	26%	20%	15%	15%	10%	
	Lobster	$32	$37	$17	$4	$44	$37	$69	$10	$22	$7	$7	
		4%	5%	2%	1%	8%	5%	9%	1%	3%	1%	1%	
Separator Trawl	Total Hauls						32				19		
	Cod						$41				$38		
							3%				4%		
	Haddock						$32				$69		
							2%				7%		
	Redfish						$1,200				$83		
							77%				8%		
	Pollock						$78				$669		
							5%				64%		

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	White Hake						$70				$124		
							4%				12%		

Table 46 – Jeffreys Bank: Average value per bottom trawl haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

	Month									
	Jan-Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Hauls		***9***	***29***	***84***	***100***	***37***	***22***	***35***	***51***	***98***
Atlantic cod		$103	$151	$64	$82	$70	$31	$24	$20	$19
		9%	19%	6%	7%	6%	3%	2%	1%	1%
Atlantic halibut		$118	$5	$6	$6	$6	$19	$0	$8	$9
		11%	1%	1%	1%	1%	2%	0%	0%	0%
Acadian redfish		$4	$9	$24	$15	$64	$46	$36	$51	$65
		0%	1%	2%	1%	5%	5%	3%	3%	4%
Pollock		$124	$33	$23	$35	$40	$112	$2	$5	$10
		11%	4%	2%	3%	3%	11%	0%	0%	1%
American plaice		$41	$89	$62	$61	$143	$89	$75	$174	$80
		4%	11%	5%	5%	12%	9%	6%	9%	5%
Witch flounder		$222	$327	$678	$573	$190	$228	$276	$165	$282
		20%	41%	60%	51%	16%	23%	22%	9%	16%
White hake		$43	$20	$35	$73	$259	$76	$88	$66	$93
		4%	3%	3%	6%	22%	8%	7%	4%	5%
Monkfish		$228	$153	$231	$255	$409	$387	$725	$1,315	$1,103
		21%	19%	20%	23%	34%	39%	59%	71%	62%
American lobster		$209	$5	$5	$3	$0	$2	$0	$39	$105
		19%	1%	0%	0%	0%	0%	0%	2%	6%

Table 47 – Recreational fishing revenue associated with Cashes Ledge. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the average number of anglers per year. All other statistics are estimates at the trip level. Although some recreational fishing has been reported for the current Jeffreys Bank closed area, the data cannot be presented due to privacy concerns.

Area	Years	Annual revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Cashes Ledge	2006 - 2012	70130.55	5.14	405.86	4631.26	4537.7	2776.84
Cashes Ledge	2008 - 2012	66321.63	4	374	4670.54	5029.83	2589.67
Cashes Ledge	2010 - 2012	62794.66	4.67	360	3844.57	4098.38	2321.80

4.1.3.1.2.1 Alternative 1 (No action)

To be completed later.

4.1.3.1.2.2 Alternative 2 (No Habitat Management Areas)

The economic benefits arising from removing management areas in the Central Gulf of Maine are expected to arise from two main sources; 1) increasing fishing revenue or 2) decreasing the costs of fishing. Generally the underlying reasoning for this is providing fishermen more flexibility and options in when and how to fish. The economic costs of removing management areas are likely to arise from impacts on fish productivity, impact on non-targeted species, and gear interactions and effort displacement from other fisheries.

Table 45and Table 46 identify all species that contribute at least 5% of haul-level revenues in any given month from areas adjoining the current Cashes Ledge and Jeffreys Bank habitat closures. Pollock in particular seems to be an important species across all gear types for Cashes Ledge, while witch flounder consistently generates a large portion of revenues associated with hauls surrounding Jeffreys Bank. In the vicinity of Cashes Ledge, white hake and redfish generate a substantial amount of revenue for the fixed gillnet and separator trawl gears respectively in the late spring and early summer months. Observed bottom trawl trips in the vicinity of both Cashes Ledge and Jeffreys Bank also generate substantial revenue from monkfish. Given that witch flounder are overfished and overfishing is occurring, no positive benefit is likely to be generated by this species through access to Jeffreys Bank. Pollock, monkfish, redfish, and white hake are not overfished, and are not subject to overfishing. Some small increase in revenue is likely to be generated by allowing additional targeting of these species within currently closed areas. However, the analysis conducted for the sector exemptions within Framework 48 of the Northeast Multispecies FMP indicate that Cashes Ledge hosts neither larger individuals nor higher densities of monkfish, white hake, redfish, or pollock, as compared to currently open waters. The managed species (4.2) and Human Communities (4.3) section of the Description of the Affected Environment seems to reaffirm this result for monkfish, white hake, redfish, and pollock in the existing Jeffreys Bank and Cashes Ledge management areas.

Although both Jeffreys Bank and Cashes Ledge are relatively near shore, their size and productivity suggests that, if opened, only local effort is likely to flow into their waters. Given the information presented in this document, access to Cashes Ledge and Jeffreys Bank is not expected to induce individuals not currently fishing to begin fishing.

Table 47 presents the recreational fishing revenue estimated to be generated from Cashes Ledge. Recreational fishing on Jeffreys Bank is not detailed due to privacy concerns. VTR data suggest that a small number of individuals are using Cashes Ledge relatively intensively, with an average gross annual revenue of $13,456 being generated per recreational vessel operating in the area. Increased fishing gear interactions and potential displacement of existing recreational fishing effort within the Cashes Ledge closure are other potential costs of this alternative. The increased costs accruing to the recreational fishery, due to congestion from an influx of commercial gear, depend on the flow of effort into the area, and the gear conflict avoidance measures taken by both recreational fishermen and groundfish/mobile bottom tending gear fishermen. This effect is likely to be slightly negative, given the recreational fishing currently reported within the Cashes Ledge closure.

4.1.3.1.2.3 Alternative 3

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank and Platts Bank management areas are presented in Figure 20 and Figure 21. The currently open area of the Modified Jeffreys Bank has supported a substantial amount of revenue derived from gears not being considered within the Alternative 3 options, although the proportion derived from Bottom/Shrimp Trawls has increased in the most recent 3 year period. However 2010 – 2012 generated only about half of the longer run average revenue from this area. Platts Bank revenue has similarly been dominated by gear not currently under consideration for area management in the Alternative 3 options. Table 42 presents more detailed information for the Bottom/Shrimp Trawl fishery, with these two gears being combined due to privacy concerns. The only vessels in these gear types potentially presenting an upward trend in revenue (trips) is the over 70 ft vessels, with a 46% (42%) difference between the three year and five year average on Jeffreys Bank, and a 42% (42%) difference between the three and five year average on Platts Bank.

Table 43 presents VMS effort estimates for the currently open areas of Modified Jeffreys Bank and Platts Bank. Of the two areas, Modified Jeffreys Bank is associated with the majority of the estimated effort, consistent with the VTR analysis in Table 42. Again, the larger mean as compared to the median of the distribution suggests that a few fishermen use this area more intensively than the majority of individuals.

Table 44 details the recreational fishing revenue reported to fall within the boundaries of the currently open areas of the Modified Jeffreys Bank and Platts Bank areas. The revenue generated from recreational fishing in Platts Bank is on the same order of magnitude as the Bottom Trawl revenue.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect between $84,000 - $101,000 in gross revenue (20-24% of the total) generated from the open waters surrounding the Modified Jeffreys Bank and Platts Bank areas in the most recent three year period (2010 – 2012). This works out to be $77 - $88 per affected trip, suggesting that although the areas are fished, the center of Bottom/Shrimp Trawl activity in the Central Gulf of Maine is outside of the management areas being considered within CGOM Alternative 3.

4.1.3.1.2.4 Alternative 4

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank and Platts Bank management areas are presented in Figure 20 and Figure 21. The currently open area of the Modified Jeffreys Bank has supported a substantial amount of revenue derived from gears not being considered within the Alternative 3 options, although the proportion derived from Bottom/Shrimp Trawls has increased in the most recent 3 year period. However 2010 – 2012 generated only about half of the longer run average revenue from this area. Platts Bank revenue has similarly been dominated by gear not currently under consideration for area management in the Alternative 3 options. Table 42 presents more detailed information for the Bottom/Shrimp Trawl fishery, with these two gears being combined due to privacy concerns. The only vessels in these gear types potentially presenting an upward trend in revenue (trips) is the over 70 ft vessels, with a 46% (42%) difference between the three year and five year average on Jeffreys Bank, and a 42% (42%) difference between the three and five year average on Platts Bank.

Table 43 presents VMS effort estimates for the currently open areas of Modified Jeffreys Bank and Platts Bank. Of the two areas, Modified Jeffreys Bank is associated with the majority of the estimated effort, consistent with the VTR analysis in Table 42. Again, the larger mean as compared to the median of the distribution suggests that a few fishermen use this area more intensively than the majority of individuals.

Table 44 details the recreational fishing revenue reported to fall within the boundaries of the currently open areas of the Modified Jeffreys Bank and Platts Bank areas. The revenue generated from recreational fishing in Platts Bank is on the same order of magnitude as the Bottom Trawl revenue.

A complete exclusion of mobile bottom-tending gear, as per Option 1, would affect between $84,000 - $101,000 in gross revenue (20-24% of the total) generated from the open waters surrounding the Modified Jeffreys Bank and Platts Bank areas in the most recent three year period (2010 – 2012). This works out to be $77 - $88 per affected trip, suggesting that although the areas are highly fished, the center of Bottom/Shrimp Trawl activity in the Central Gulf of Maine is outside of the management areas being considered within CGOM Alternative 3.

4.1.3.1.3 Western GOM

Tables and figures related to analysis of the economic impacts of the Western GOM habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 22 – Large Bigelow area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 6,507,068; 2008 - 2012 = $ 7,206,629; 2010 - 2012 = $ 7,860,367

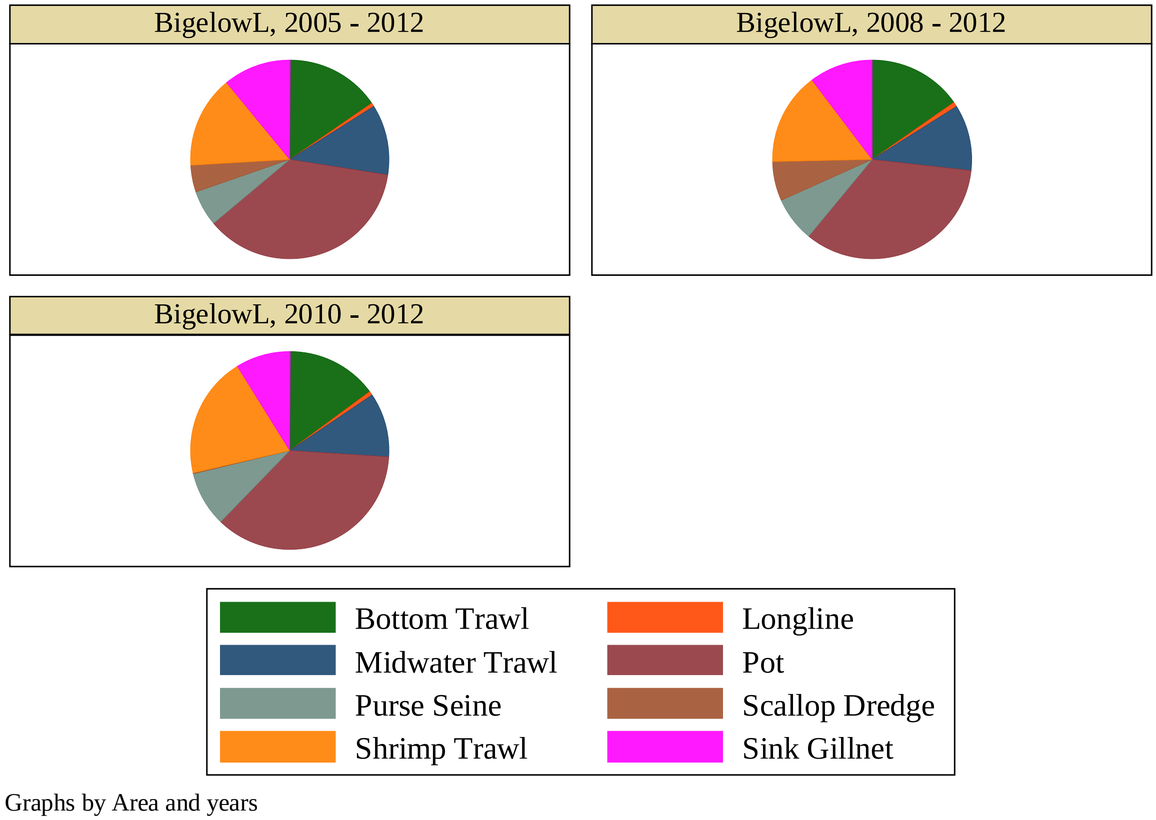


Figure 23 – Small Bigelow area commercial fishing revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 3,007,689; 2008 - 2012 = $ 3,117,597; 2010 - 2012 = $ 3,110,068

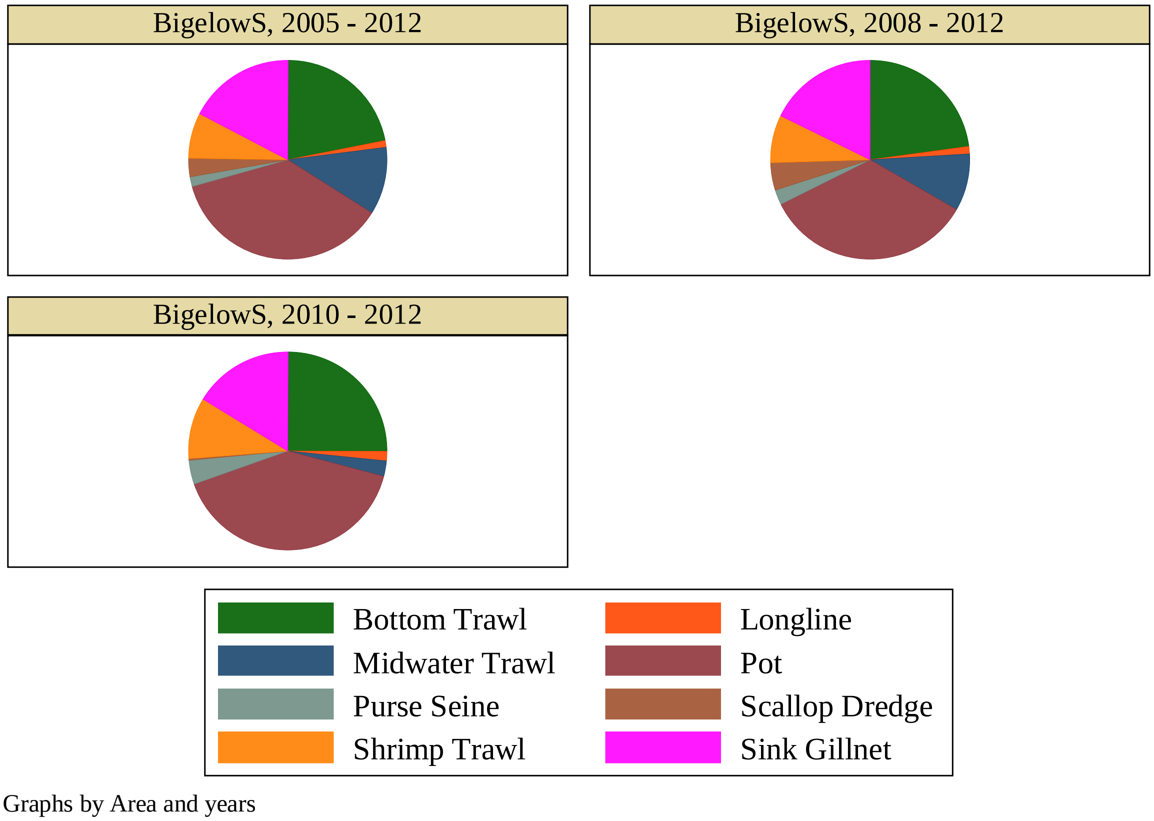


Table 48 – Mobile bottom-tending gear in currently open portions of the Western Maine Habitat Alternative 4 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dashes indicate information dropped due to privacy concerns.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	BigelowL	L/U	153,354	96,588	120,103	344,961	41,565	33	322	2005 - 2012
Bottom Trawl	BigelowL	L/U	206,737	223,359	124,248	344,961	58,527	33	382	2008 - 2012
Bottom Trawl	BigelowL	L/U	210,066	223,359	101,601	304,367	102,473	42	515	2010 - 2012
Bottom Trawl	BigelowL	M	326,353	316,090	104,408	538,907	201,200	42	642	2005 - 2012
Bottom Trawl	BigelowL	M	348,782	350,086	127,419	538,907	201,200	37	593	2008 - 2012
Bottom Trawl	BigelowL	M	423,620	381,866	101,098	538,907	350,086	35	661	2010 - 2012
Bottom Trawl	BigelowL	S	518,540	503,988	88,202	677,644	404,238	61	1,284	2005 - 2012
Bottom Trawl	BigelowL	S	547,222	557,443	94,880	677,644	434,450	53	1,083	2008 - 2012
Bottom Trawl	BigelowL	S	526,326	557,443	80,936	587,086	434,450	50	948	2010 - 2012
Scallop Dredge	BigelowL	ALL	287,143	6,510	795,625	2,256,200	1,347	19	135	2005 - 2012
Scallop Dredge	BigelowL	ALL	456,750	8,793	1,005,930	2,256,200	1,347	18	106	2008 - 2012
Scallop Dredge	BigelowL	ALL	8,734	8,793	2,322	11,025	6,383	13	99	2010 - 2012
Shrimp Trawl	BigelowL	L/U	80,690	-	-	-	-	3	54	2005 - 2012
Shrimp Trawl	BigelowL	L/U	112,590	-	-	-	-	3	61	2008 - 2012
Shrimp Trawl	BigelowL	L/U	176,087	155,447	37,396	-	-	4	87	2010 - 2012
Shrimp Trawl	BigelowL	M	328,587	262,307	202,267	759,329	119,248	17	386	2005 - 2012
Shrimp Trawl	BigelowL	M	375,327	355,154	253,117	759,329	119,248	15	384	2008 - 2012
Shrimp Trawl	BigelowL	M	524,001	457,520	210,129	759,329	355,154	19	470	2010 - 2012
Shrimp Trawl	BigelowL	S	564,532	514,067	309,493	1,066,776	192,454	54	983	2005 - 2012
Shrimp Trawl	BigelowL	S	595,770	507,414	405,031	1,066,776	192,454	50	902	2008 - 2012
Shrimp Trawl	BigelowL	S	847,795	969,194	298,789	1,066,776	507,414	59	1,128	2010 - 2012

Table 49 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Western GOM Alternative 4, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the yearly means, while the statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
BigelowL	Bottom Trawl	2005 - 2012	2,192.86	81.876	26.78	6.80	48.13

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
BigelowL	Bottom Trawl	2008 - 2012	2,065.51	81	25.50	7.15	42.04
BigelowL	Bottom Trawl	2010 - 2012	1,680.96	82	20.50	6.99	30.84
BigelowL	GC Scallop	2005 - 2012	8.69	6	1.45	0.41	2.59
BigelowL	GC Scallop	2008 - 2012	7.74	4.6	1.68	0.46	2.81
BigelowL	GC Scallop	2010 - 2012	9.58	5.33	1.80	0.59	2.97
BigelowL	LA Scallop	2005 - 2012	2.84	5.38	0.53	0.03	1.48
BigelowL	LA Scallop	2008 - 2012	1.53	3.2	0.48	0.05	1.07
BigelowL	LA Scallop	2010 - 2012	1.43	2.33	0.61	0.03	1.52
BigelowL	Shrimp Trawl	2005 - 2012	3,101.23	41.13	75.41	47.60	79.52
BigelowL	Shrimp Trawl	2008 - 2012	3,987.73	46.8	85.21	58.98	85.73
BigelowL	Shrimp Trawl	2010 - 2012	5,102.96	52	97.51	66.70	93.46

Table 50 – Recreational fishing revenue associated with the Western GOM Alternative 4. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
BigelowL	2006 - 2012	1,118,180.22	41.14	10,085.86	2,196.20	1,790.25	1,736.98
BigelowL	2008 - 2012	1,011,674.03	40.20	9,287.00	2,215.67	1,875.50	1,698.56
BigelowL	2010 - 2012	915,081.68	36.67	8,174.00	2,314.71	2,046.00	1,723.44

Table 51 – Mobile bottom-tending gear in currently open portions of the Western GOM HMA Alternative 4 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	BigelowS	L/U	77,758	37,722	69,017	181,720	23,435	30	261	2005 - 2012
Bottom Trawl	BigelowS	L/U	101,505	100,433	86,228	181,720	23,435	29	299	2008 - 2012
Bottom Trawl	BigelowS	L/U	96,888	96,888	103,878	170,341	23,435	38	432	2010 - 2012
Bottom Trawl	BigelowS	M	191,965	165,251	108,663	417,614	80,639	39	514	2005 - 2012
Bottom Trawl	BigelowS	M	196,102	143,077	151,664	417,614	80,639	33	464	2008 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	BigelowS	M	269,259	269,259	209,806	417,614	120,904	34	562	2010 - 2012
Bottom Trawl	BigelowS	S	338,321	348,587	98,697	448,986	170,712	50	1,028	2005 - 2012
Bottom Trawl	BigelowS	S	340,890	371,931	126,792	448,986	170,712	42	836	2008 - 2012
Bottom Trawl	BigelowS	S	297,911	297,911	179,887	425,110	170,712	40	701	2010 - 2012
Scallop Dredge	BigelowS	ALL	99,890	2,746	255,119	678,423	1,167	17	124	2005 - 2012
Scallop Dredge	BigelowS	ALL	171,821	3,847	337,743	678,423	1,167	14	84	2008 - 2012
Scallop Dredge	BigelowS	ALL	3,758	3,758	3,664	6,348	1,167	11	90	2010 - 2012
Shrimp Trawl	BigelowS	OTHER	97,887	88,552	53,220	200,482	37,459	8	169	2005 - 2012
Shrimp Trawl	BigelowS	OTHER	117,328	98,744	57,526	200,482	71,342	9	213	2008 - 2012
Shrimp Trawl	BigelowS	OTHER	144,517	144,517	79,146	200,482	88,552	11	278	2010 - 2012
Shrimp Trawl	BigelowS	S	126,748	122,356	82,391	288,207	38,708	25	346	2005 - 2012
Shrimp Trawl	BigelowS	S	125,029	86,601	114,875	288,207	38,708	22	326	2008 - 2012
Shrimp Trawl	BigelowS	S	205,282	205,282	117,275	288,207	122,356	30	518	2010 - 2012

Table 52 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Western GOM Alternative 5, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the total across all years identified, while the statistics are calculated at the individual level. Note that some year/gear combinations are not presented due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
BigelowS	Bottom Trawl	2005 - 2012	1,680.90	55.38	30.35	9.00	52.53
BigelowS	Bottom Trawl	2008 - 2012	1,574.23	56.00	28.11	9.76	43.80
BigelowS	Bottom Trawl	2010 - 2012	1,389.55	61.67	22.53	9.70	32.84
BigelowS	GC Scallop	2005 - 2012	8.46	5.38	1.57	0.57	2.70
BigelowS	GC Scallop	2008 - 2012	7.41	4.40	1.69	0.39	2.87
BigelowS	GC Scallop	2010 - 2012	9.04	5.00	1.81	0.57	3.07
BigelowS	LA Scallop	2005 - 2012	1.97	3.38	0.58	0.03	1.59
BigelowS	LA Scallop	2008 - 2012	1.50	2.80	0.54	0.05	1.13
BigelowS	LA Scallop	2010 - 2012	1.42	2.33	0.61	0.03	1.51
BigelowS	Shrimp Trawl	2005 - 2012	979.19	18.88	51.88	27.79	63.18
BigelowS	Shrimp Trawl	2008 - 2012	1,251.65	22.60	55.38	27.79	68.69

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
BigelowS	Shrimp Trawl	2010 - 2012	1,656.72	27.33	60.61	27.09	76.30

Table 53 – Recreational fishing revenue associated with the Western GOM Alternative 5. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
BigelowS	2006 - 2012	796,808.50	35.14	7,903.57	2,022.36	1,534.50	1,715.14
BigelowS	2008 - 2012	780,816.36	35.20	7,712.40	2,118.33	1,705.00	1,734.67
BigelowS	2010 - 2012	687,350.03	32.67	6,629.00	2,226.84	1,875.50	1,763.07

Table 54 – Western Gulf of Maine: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	1,256	1,357	1,432	686	540	354	528	608	648	734	824	951
	Cod	$245	$349	$368	$302	$616	$365	$313	$499	$648	$739	$523	$489
		17%	20%	23%	21%	33%	27%	30%	44%	58%	54%	45%	34%
	Haddock	$17	$97	$126	$7	$76	$48	$16	$24	$39	$39	$25	$26
		1%	5%	8%	0%	4%	4%	2%	2%	3%	3%	2%	2%
	Redfish	$41	$81	$69	$86	$82	$60	$28	$20	$22	$22	$23	$29
		3%	5%	4%	6%	4%	4%	3%	2%	2%	2%	2%	2%
	Pollock	$240	$327	$268	$357	$565	$359	$204	$256	$140	$140	$115	$204
		17%	18%	17%	25%	30%	27%	20%	23%	12%	10%	10%	14%
	Monkfish	$278	$280	$205	$135	$116	$101	$98	$77	$70	$90	$127	$160
		19%	16%	13%	9%	6%	8%	9%	7%	6%	7%	11%	11%
	Witch Flounder	$182	$161	$115	$116	$65	$38	$56	$44	$64	$116	$84	$126
		13%	9%	7%	8%	3%	3%	5%	4%	6%	8%	7%	9%
	Plaice	$133	$131	$110	$93	$57	$102	$129	$79	$52	$102	$118	$118

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		9%	7%	7%	6%	3%	8%	12%	7%	5%	7%	10%	8%
	White Hake	$157	$210	$187	$257	$226	$167	$106	$71	$52	$79	88	90
		11%	12%	12%	18%	12%	13%	10%	6%	5%	6%	8%	6%
	Lobster	$76	$87	$53	$52	$58	$63	$46	$17	$5	$5	29	56
		5%	5%	3%	4%	3%	5%	4%	2%	0%	0%	3%	4%
Longline	Total Hauls	67	120	323		62							24
	Cod	$550	$377	$122		$241							$447
		91%	92%	40%		41%							90%
	Haddock	$50	$31	$176		$307							$34
		8%	7%	58%		53%							7%
Fixed Gillnet	Total Hauls	799	610	649	95	402	709	848	979	966	926	828	761
	Cod	$483	$306	$178	$289	$489	$450	$559	$661	$642	$765	$826	$649
		45%	48%	43%	66%	74%	26%	51%	58%	61%	60%	52%	36%
	Haddock	$6	$24	$60	$4	$3	$6	$3	$3	$3	$34	$5	$5
		1%	4%	15%	1%	0%	0%	0%	0%	0%	3%	0%	0%
	Pollock	$458	$121	$6	$106	$22	$861	$217	$173	$230	$329	$659	$1,014
		43%	19%	1%	24%	3%	50%	20%	15%	22%	26%	41%	57%
	Yellowtail	$35	$117	$127	$11	$5	$2	$1	$0	$0	$0	$0	$1
		3%	18%	31%	2%	1%	0%	0%	0%	0%	0%	0%	0%
	Spiny Dogfish	$-	$-	$-	$-	$15	$48	$143	$76	$2	$0	$0	$-
						2%	3%	13%	7%	0%	0%	0%	
	Monkfish	$13	$1	$0	$1	$24	$49	$66	$59	$45	$45	$54	$45
		1%	0%	0%	0%	4%	3%	6%	5%	4%	4%	3%	2%
Separator Trawl	Total Hauls				25		19		11	4			
	Cod				$367		$875		$1,344	$907			
					23%		47%		66%	63%			
	Haddock				$7		$130		$9	$7			
					0%		7%		0%	1%			

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Redfish				$312		$241		$89	$279			
					20%		13%		4%	19%			
	Pollock				$626		$474		$466	$182			
					39%		26%		23%	13%			
	Lobster				$127		$18		$6	$13			
					8%		1%		0%	1%			
Handline	Total Hauls	175	57	22									9
	Cod	$125	$93	$111									$84
		100%	100%	100%									99%

Table 55 – Recreational fishing revenue associated with the Western GOM HMA Alternatives. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
WGOM	2006 - 2012	4,401,368.01	104.29	33,601.14	2,284.56	1,117.74	2,122.40
WGOM	2008 - 2012	3,836,231.91	99.20	29,995.40	2,159.80	1,117.74	1,905.85
WGOM	2010 - 2012	3,581,579.90	97.33	28,521.67	2,081.10	1,117.74	1,855.08

4.1.3.1.3.1 Alternative 1 (No action)
To be completed later.

4.1.3.1.3.2 Alternative 2 (No Habitat Management Areas)
Table 54 presents the haul-level revenue generated by species caught on observed trips in the area within a 10 nautical mile buffer of the Western Gulf of Maine closure. A substantial amount of effort occurs within this 10 nautical mile buffer, for a varied mix of gear types. Cod and Pollock account for a substantial portion of the revenue across all gear types. The Gulf of Maine Cod stock is overfished, and overfishing is occurring (section 4.2.1.1.3), and thus in the short term no significant increases in revenue are expected to develop from this species under the Western GOM Alternative 2. Pollock is not overfished, and overfishing is not occurring. In addition, both the analysis conducted for Framework 48 of the Northeast Multispecies FMP and section 4.2 suggest the Western Gulf of Maine closures contain substantial Pollock biomass. Access to this biomass would likely provide some increased revenue, but the analysis in Framework 50 for the Northeast Multispecies FMP highlights that only 33% of the total ACE was caught in 2010, and 50% in 2011, indicating that biomass access has not historically been the limiting factor for Pollock landings in the Gulf of Maine. Haddock also plays an important role for Longline fishermen in the vicinity of the Western Gulf of Maine closures. However, this is likely due to a selectivity issue as opposed to biomass availability, given that this pattern is not repeated across other gear types capable of catching Haddock. No large increase in revenue would be expected from Haddock due to the adoption of Western GOM Alternative 2.

At a combined 883 square nautical miles (see table 23), the Western Gulf of Maine closures amount to a large portion of the inshore WGOM. Opening this area up to fishing is likely to decrease the costs of fishing for commercial groundfish and mobile bottom-tending gear fishermen, who will not need to travel as far in order to access open fishing grounds. Maps 103 - 106 indicate that a substantial amount of effort currently occurs very near to the area boundaries. Statistical area 514, overlapping the Western GOM closure, in particular generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears, though separator trawls are more active in other statistical areas. Some of this effort would redistribute into the current closure if Western GOM alternative 2 was chosen. Furthermore, the sheer size and position of the Western Gulf of Maine management areas suggest that their reopening could induce currently inactive fishermen back into the fishery, for the purpose of exploratory fishing if not more sustained undertakings.

Table 55 presents the revenue from recreational charter and party vessels whose VTR points fall within the boundaries of the Western Gulf of Maine closures. A large number of permit holders, and a substantially larger number of anglers, currently ply these waters. Increased fishing gear interactions and potential displacement of existing recreational fishing effort within the Western GOM closure are other potential costs of this alternative. The increased costs accruing to the recreational fishery, due to congestion from an influx of commercial gear, depend on the flow of effort into the exemption area, and the gear conflict avoidance measures taken by both recreational fishermen and groundfish/mobile bottom tending gear fishermen. This effect is likely to be negative, given the substantial recreational fishing currently reported within the Western GOM closure.

4.1.3.1.3.3 Alternative 3
To be completed later.

4.1.3.1.3.4 Alternative 4

Figure 22 illustrates the diverse, and relatively stable, assemblage of fishing gears used to fish the waters of the Large Bigelow Bight area. The most obvious change between 2005 – 2012 is the substantial decrease in scallop dredge revenue in the most recent three year period. As can be seen from table 9, the difference in scallop landings across time is explained by a single year (2008) with $2,256,200 in revenue, skewing the distribution. Bottom Trawl and Shrimp Trawl revenues are much more stable across time. The VTR analysis estimates that within the Bottom Trawl fleets area management in Bigelow Bight would affect a median revenue of $408 per trip for vessels > 70 ft, $641 per trip for vessels between 50 ft and 70 ft, and $555 per trip for vessels < 50 ft. The Shrimp Trawl fishery would be affected to an even greater extent, with a median trip revenue of $9,745 for vessels >70 ft, $1,115 for vessels between 50 ft and 70 ft, and $156 for vessels < 50 ft. Given that these waters abut New Hampshire state waters, in which there is a complete ban on mobile gear fishing, including all Otter Trawls (http://www.gencourt.state.nh.us/rules/state_agencies/fis600.html), the impact on New Hampshire fishermen in particular is likely to be acute.

Table 49 presents the VMS analysis for effort estimated to fall within the Large Bigelow Bight management area. Neither the GC nor the LA scallop estimates of effort reflect the revenue spike estimated for 2008 through the VTR analysis. Bottom Trawl effort seems to be on a downward trend in the area, with the 2010 – 2012 average 23% lower than the 2005 – 2012 average. Again, this trend is not apparent in the VTR analysis, with the average number of trips only down 6% over the same time periods across all vessel sizes. Additonal analysis is necessary in order to ascertain whether the VMS and VTR results differ significantly for Bottom Trawl and Scallop Dredge. Conversely, the Shrimp Trawl shows a marked increase in effort estimated to fall within the Large Bigelow Bight area, with an increase of 65% in the mean annual effort when comparing 2010 – 2012 to the full 2005 - 2012 series average. This is consistent with the VTR analysis, which indicates a 59% increase over the same time periods. Although some discrepancies exist between the VTR and VMS analysis, they paint a similar broad picture, with both indicating the importance of Large Bigelow Bight to Bottom and Shrimp Trawl fishermen in particular.

Table 50 details the recreational fishing revenue generated from the Large Bigelow Bight area. There is significant charter and party boat fishing in the area, with a substantial number of angler trips and permitted vessels reported in the area.

4.1.3.1.3.5 Alternative 5

Figure 23 identifies the fishing gear active in Small Bigelow Bight, and their relative share of total revenue. In total, the borders of Small Bigelow Bight encompasses 40% of the revenue generated from Large Bigelow Bight, with a relatively larger share of the revenue generated using Bottom Trawl and Sink Gillnet in the former area. Table 51 details the revenue generated by gear potentially impacted by the Western GOM HMA. This revenue represents 37% of what is generated within Large Bigelow Bight with the same gear, although a larger portion is contributed by Bottom Trawl (57%) as opposed to Shrimp Trawl (23%). The Small Bigelow Bight area is an important Bottom Trawl fishing ground for vessels >70 ft ($268/trip), vessels between 50 and 70 ft ($441/trip), and vessels < 50 ft ($467/trip), although these averages are significantly reduced when compared to the Large Bigelow Bight area. Nevertheless, the VTR analysis estimates that 80% of Bottom Trawl trips potentially impacted by the Large Bigelow Bight area would still be impacted by the Small Bigelow Bight management area, as compared to only 47% of the Shrimp Trawl trips. These results are again backed up by the VMS analysis presented in Table 13, which estimates that the Bottom and Shrimp Trawl effort in Small Bigelow Bight are respectively 83% and 32% of what falls within the boundary of Large Bigelow Bight. Combined, this suggests that the Small Bigelow Bight excludes the most intensively fished grounds for Shrimp Trawl, but still encapsulates a large portion of the Bottom Trawl fishing grounds associated with Large Bigelow Bight.

Table 52 represents the recreational fishing effort reported within Small Bigelow Bight, which encompasses 75% of the revenue, and 81% of the angler trips associated with Large Bigelow Bight. This suggests that Small Bigelow Bight is an important center for recreational fishing.

4.1.3.1.3.6 Alternative 6

To be completed later.

4.1.3.1.3.7 Alternative 7

To be completed later.

4.1.3.1.4 Georges Bank

Tables and figures related to analysis of the economic impacts of the Georges Bank habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 24 – Northern Edge area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 9,574,151; 2008 - 2012 = $ 11,186,519; 2010 - 2012 = $ 15,425,379

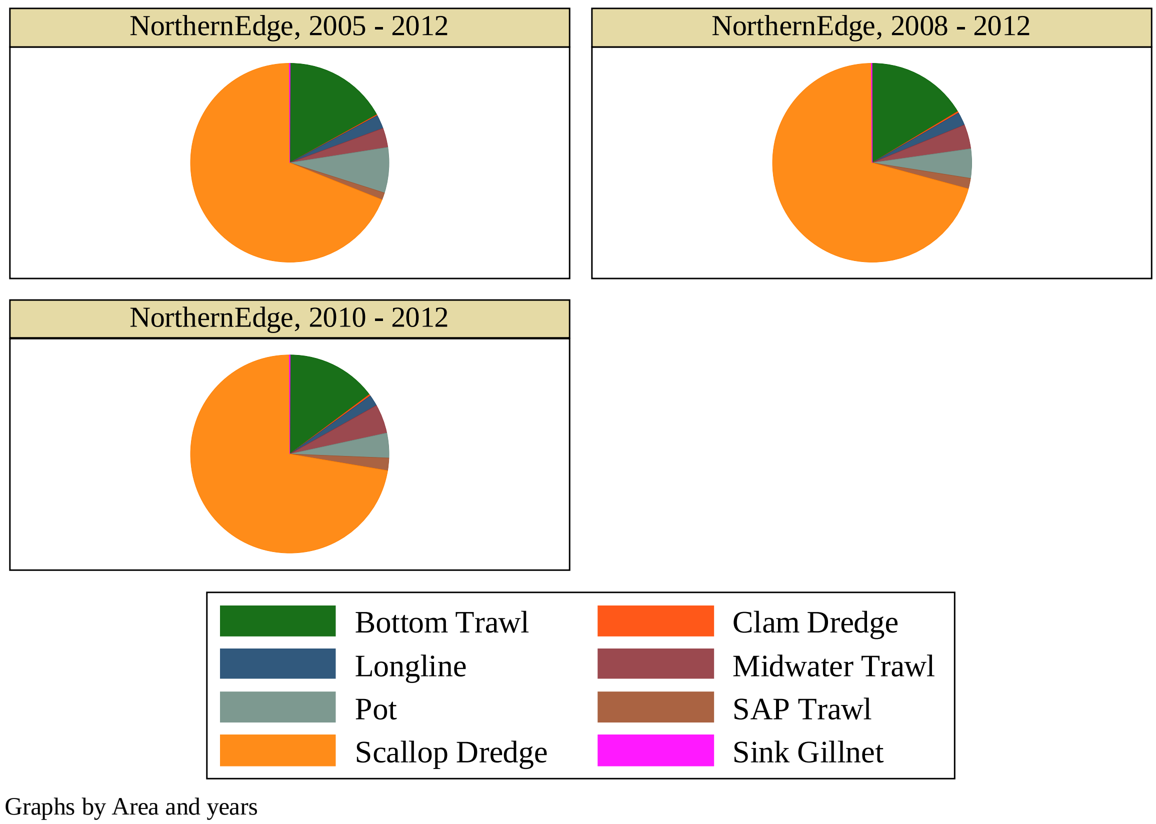
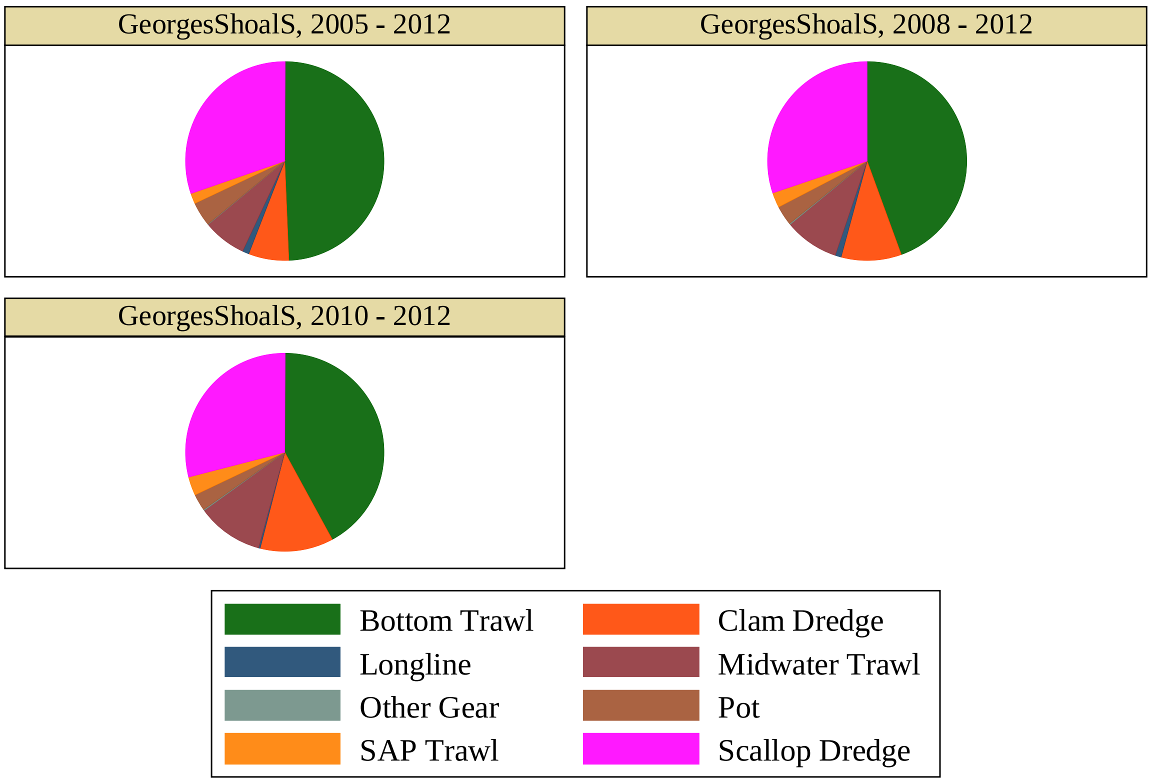


Figure 25 – Small Georges Shoal area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 3,448,932; 2008 - 2012 = $ 3,702,336; 2010 - 2012 = $ 5,053,355



Graphs by Area and years

Figure 26 – Large Georges Shoal area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 19,384,365; 2008 – 2012 = $ 21,334,179; 2010 – 2012 = $ 29,024,703

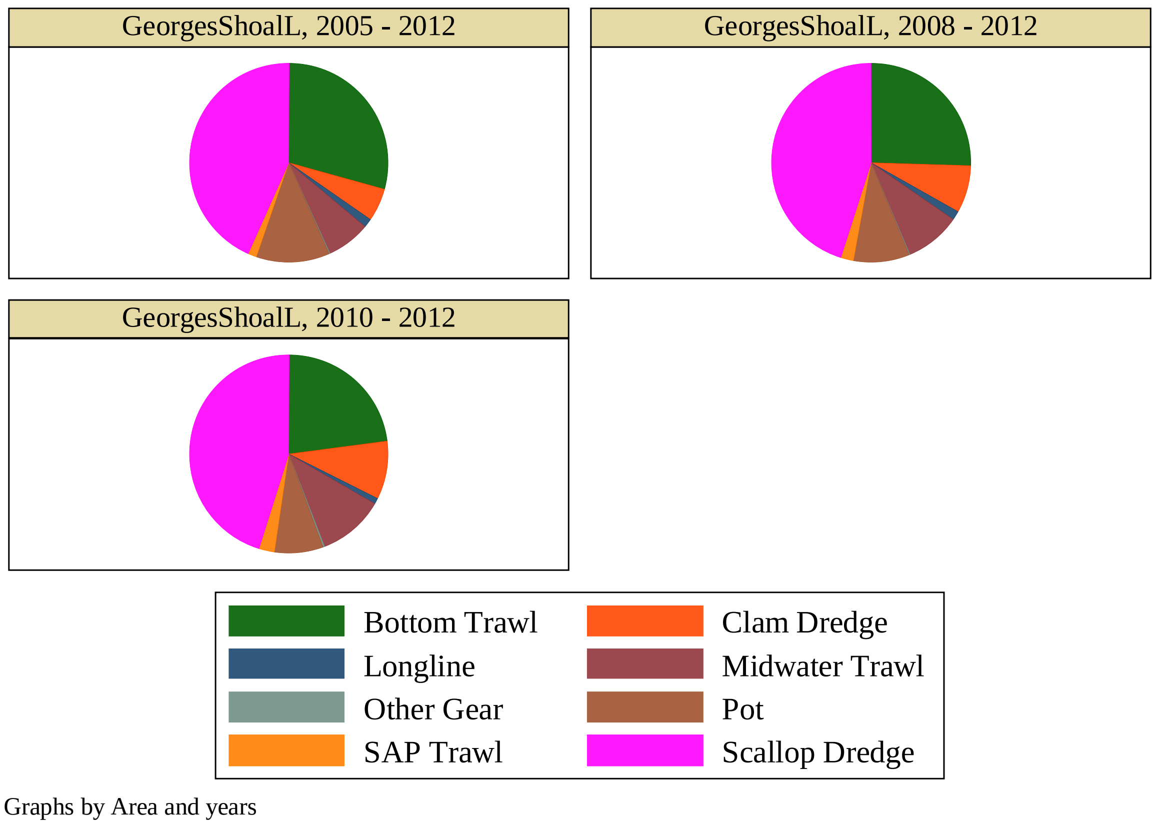


Figure 27 – Georges Shoal MBTG area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that three gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 1,966,622; 2008 – 2012 = $ 2,106,342; 2010 – 2012 = $ 2,944,249

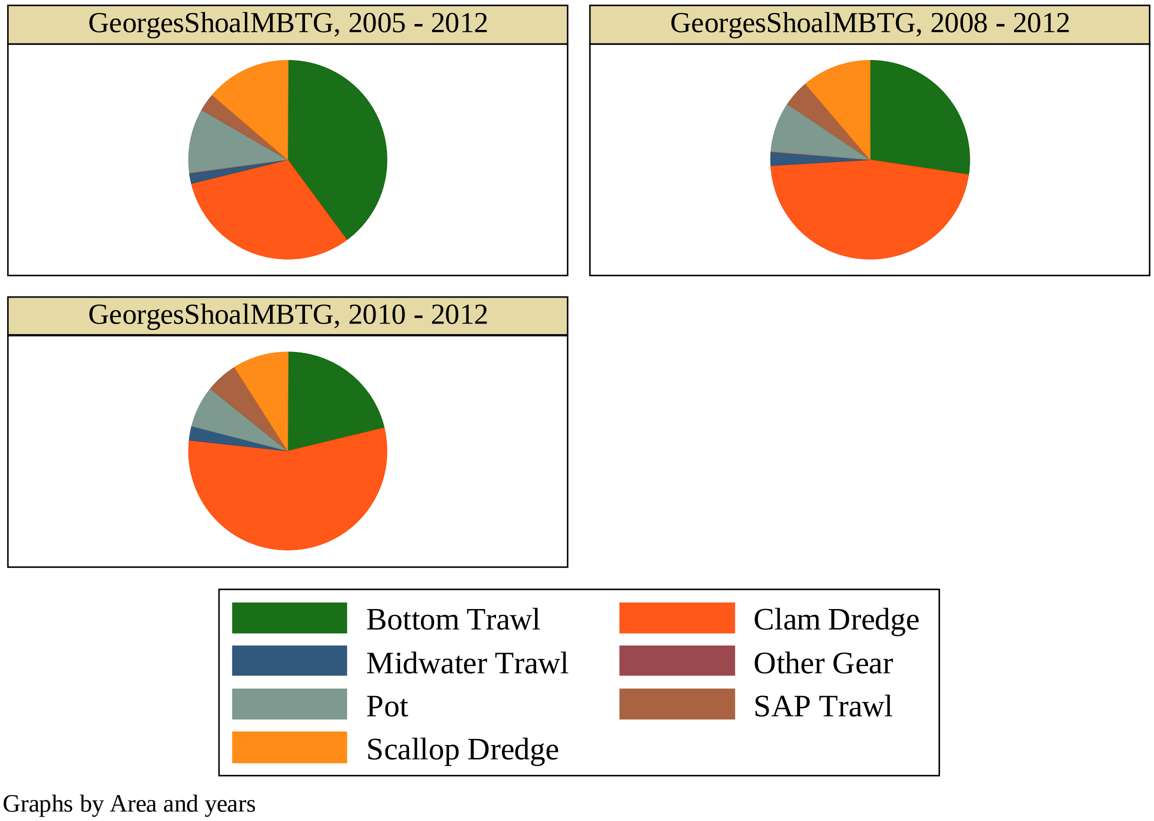


Table 56 – Mobile bottom-tending gear in currently open portions of the Georges Bank Habitat Alternative 3 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	NorthernEdge	L	1,470,890	1,388,669	737,203	2,840,771	542,514	86	756	2005 - 2012
Bottom Trawl	NorthernEdge	L	1,705,222	1,581,161	849,170	2,840,771	542,514	70	769	2008 - 2012
Bottom Trawl	NorthernEdge	L	2,134,145	2,109,597	694,677	2,840,771	1,452,066	72	897	2010 - 2012
Bottom Trawl	NorthernEdge	OTHER	152,262	148,097	48,123	223,044	76,296	23	108	2005 - 2012
Bottom Trawl	NorthernEdge	OTHER	127,401	132,800	33,119	160,182	76,296	18	92	2008 - 2012
Bottom Trawl	NorthernEdge	OTHER	129,164	151,015	46,014	160,182	76,296	17	99	2010 - 2012
Clam Dredge	NorthernEdge	ALL	16,592	0	33,201	89,916	0	2	8	2005 - 2012
Clam Dredge	NorthernEdge	ALL	26,548	0	39,984	89,916	0	2	12	2008 - 2012
Clam Dredge	NorthernEdge	ALL	44,247	42,824	44,975	89,916	0	2	20	2010 - 2012
SAP Trawl	NorthernEdge	ALL	117,362	0	198,827	551,678	0	25	58	2005 - 2012
SAP Trawl	NorthernEdge	ALL	187,779	131,973	229,461	551,678	0	25	92	2008 - 2012
SAP Trawl	NorthernEdge	ALL	312,965	255,244	215,724	551,678	131,973	25	153	2010 - 2012
Scallop Dredge	NorthernEdge	L	6,194,212	5,268,422	5,048,035	16,437,647	849,696	39	58	2005 - 2012
Scallop Dredge	NorthernEdge	L	7,450,083	5,687,058	5,876,146	16,437,647	849,696	37	54	2008 - 2012
Scallop Dredge	NorthernEdge	L	10,516,978	9,426,229	5,457,664	16,437,647	5,687,058	41	58	2010 - 2012
Scallop Dredge	NorthernEdge	OTHER	390,087	433,542	278,864	735,373	0	5	6	2005 - 2012
Scallop Dredge	NorthernEdge	OTHER	453,864	499,556	291,612	735,373	0	4	4	2008 - 2012
Scallop Dredge	NorthernEdge	OTHER	633,931	666,864	121,309	735,373	499,556	4	5	2010 - 2012

Table 57 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the Georges Bank Habitat Alternative 3, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Northern Edge	Bottom Trawl	2005 - 2012	7,040.12	89.88	78.33	24.10	131.53
Northern Edge	Bottom Trawl	2008 - 2012	8,704.96	79.60	109.36	33.57	162.93
Northern Edge	Bottom Trawl	2010 - 2012	8,590.28	70.67	121.56	30.73	188.92
Northern Edge	GC Scallop	2005 - 2012	342.43	4.13	83.01	88.20	61.12

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Northern Edge	GC Scallop	2008 - 2012	463.40	5.60	82.75	94.05	65.77
Northern Edge	GC Scallop	2010 - 2012	529.23	4.67	113.41	126.74	63.99
Northern Edge	LA Scallop	2005 - 2012	7,298.31	53.00	137.70	120.10	111.18
Northern Edge	LA Scallop	2008 - 2012	6,788.87	50.20	135.24	119.73	98.54
Northern Edge	LA Scallop	2010 - 2012	6,214.73	48.33	128.58	117.35	82.25

Table 58 – Mobile bottom-tending gear in currently open portions of the Georges Bank Habitat Alternative 4 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GeorgesShoalS	L	1,552,085	1,668,829	574,181	2,263,786	398,000	92	966	2005 - 2012
Bottom Trawl	GeorgesShoalS	L	1,508,644	1,690,509	722,179	2,263,786	398,000	75	947	2008 - 2012
Bottom Trawl	GeorgesShoalS	L	1,963,998	1,937,697	287,542	2,263,786	1,690,509	77	1,112	2010 - 2012
Bottom Trawl	GeorgesShoalS	OTHER	150,431	151,352	44,351	218,177	79,899	25	143	2005 - 2012
Bottom Trawl	GeorgesShoalS	OTHER	136,513	126,833	44,864	195,496	79,899	19	126	2008 - 2012
Bottom Trawl	GeorgesShoalS	OTHER	162,487	165,133	34,408	195,496	126,833	18	130	2010 - 2012
SAP Trawl	GeorgesShoalS	L	55,208	0	91,418	256,113	0	24	64	2005 - 2012
SAP Trawl	GeorgesShoalS	L	88,333	86,604	104,727	256,113	0	24	102	2008 - 2012
SAP Trawl	GeorgesShoalS	L	147,222	98,949	94,504	256,113	86,604	24	170	2010 - 2012
SAP Trawl	GeorgesShoalS	M	1,562	-	-	-	-	3	4	2005 - 2012
SAP Trawl	GeorgesShoalS	M	2,499	-	-	-	-	3	7	2008 - 2012
SAP Trawl	GeorgesShoalS	M	4,165	-	-	-	-	3	11	2010 - 2012

Table 59 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Georges Bank Alternative 4, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
GeorgesShoalS	Bottom Trawl	2005 - 2012	6,404.36	102.75	62.33	20.53	89.84
GeorgesShoalS	Bottom Trawl	2008 - 2012	5,796.35	88.80	65.27	17.38	97.99

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
GeorgesShoalS	Bottom Trawl	2010 - 2012	4,997.69	76.33	65.47	9.57	114.94

Table 60 – Mobile bottom-tending gear in currently open portions of the Georges Bank Habitat Alternative 5 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GeorgesShoalL	L	5,114,013	4,982,598	1,932,954	7,945,043	1,606,149	96	1,142	2005 - 2012
Bottom Trawl	GeorgesShoalL	L	4,941,968	4,723,674	2,433,392	7,945,043	1,606,149	78	1,096	2008 - 2012
Bottom Trawl	GeorgesShoalL	L	6,126,673	6,509,766	2,037,115	7,945,043	3,925,209	81	1,303	2010 - 2012
Bottom Trawl	GeorgesShoalL	OTHER	579,782	566,568	182,716	936,752	355,355	27	177	2005 - 2012
Bottom Trawl	GeorgesShoalL	OTHER	487,115	534,179	117,092	630,842	355,355	21	150	2008 - 2012
Bottom Trawl	GeorgesShoalL	OTHER	508,001	537,805	140,141	630,842	355,355	20	158	2010 - 2012
SAP Trawl	GeorgesShoalL	L	265,317	0	466,970	1,330,220	0	26	71	2005 - 2012
SAP Trawl	GeorgesShoalL	L	424,508	340,471	545,100	1,330,220	0	26	114	2008 - 2012
SAP Trawl	GeorgesShoalL	L	707,513	451,847	542,148	1,330,220	340,471	26	189	2010 - 2012
SAP Trawl	GeorgesShoalL	M	9,290	-	-	-	-	3	4	2005 - 2012
SAP Trawl	GeorgesShoalL	M	14,864	-	-	-	-	3	7	2008 - 2012
SAP Trawl	GeorgesShoalL	M	24,774	-	-	-	-	3	12	2010 - 2012
Bottom Trawl	GeorgesShoalMBTG	L	706,762	723,825	389,042	1,450,060	152,958	94	1,024	2005 - 2012
Bottom Trawl	GeorgesShoalMBTG	L	522,154	602,145	275,430	790,314	152,958	77	988	2008 - 2012
Bottom Trawl	GeorgesShoalMBTG	L	562,145	743,164	355,150	790,314	152,958	80	1,163	2010 - 2012
Bottom Trawl	GeorgesShoalMBTG	OTHER	78,357	70,661	48,758	172,837	20,306	24	149	2005 - 2012
Bottom Trawl	GeorgesShoalMBTG	OTHER	55,672	48,824	35,067	113,120	20,306	19	129	2008 - 2012
Bottom Trawl	GeorgesShoalMBTG	OTHER	60,750	48,824	47,543	113,120	20,306	18	132	2010 - 2012
Clam Dredge	GeorgesShoalMBTG	ALL	613,797	-	-	-	-	3	22	2005 - 2012
Clam Dredge	GeorgesShoalMBTG	ALL	982,076	-	-	-	-	3	35	2008 - 2012
Clam Dredge	GeorgesShoalMBTG	ALL	1,636,793	-	-	-	-	3	59	2010 - 2012
SAP Trawl	GeorgesShoalMBTG	L	54,170	0	111,631	323,520	0	26	68	2005 - 2012
SAP Trawl	GeorgesShoalMBTG	L	86,672	52,958	135,227	323,520	0	26	108	2008 - 2012
SAP Trawl	GeorgesShoalMBTG	L	144,453	56,880	155,089	323,520	52,958	26	181	2010 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
SAP Trawl	GeorgesShoalMBTG	M	2,803	-	-	-	-	3	4	2005 - 2012
SAP Trawl	GeorgesShoalMBTG	M	4,484	-	-	-	-	3	7	2008 - 2012
SAP Trawl	GeorgesShoalMBTG	M	7,474	-	-	-	-	3	12	2010 - 2012
Scallop Dredge	GeorgesShoalMBTG	ALL	270,002	306,711	181,440	509,051	0	51	74	2005 - 2012
Scallop Dredge	GeorgesShoalMBTG	ALL	237,565	283,873	187,230	471,933	0	42	57	2008 - 2012
Scallop Dredge	GeorgesShoalMBTG	ALL	267,160	329,548	242,073	471,933	0	44	58	2010 - 2012

Table 61 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Georges Bank Alternative 5, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
GeorgesShoalL	Bottom Trawl	2005 - 2012	21,520.40	118.13	182.18	96.81	217.90
GeorgesShoalL	Bottom Trawl	2008 - 2012	21,117.03	102.80	205.42	89.02	259.43
GeorgesShoalL	Bottom Trawl	2010 - 2012	18,542.35	92.33	200.82	60.42	284.34
GeorgesShoalL	GC Scallop	2005 - 2012	376.31	4.13	91.23	104.28	59.76
GeorgesShoalL	GC Scallop	2008 - 2012	488.13	5.60	87.17	95.88	63.48
GeorgesShoalL	GC Scallop	2010 - 2012	533.59	4.67	114.34	129.55	63.98
GeorgesShoalL	LA Scallop	2005 - 2012	7,913.12	59.63	132.71	115.83	113.83
GeorgesShoalL	LA Scallop	2008 - 2012	7,238.48	54.40	133.06	117.30	100.60
GeorgesShoalL	LA Scallop	2010 - 2012	6,529.49	53.33	122.43	113.30	87.36
GeorgesShoalMBTG	Bottom Trawl	2005 - 2012	1,171.44	89.50	13.09	2.41	24.40
GeorgesShoalMBTG	Bottom Trawl	2008 - 2012	722.82	78.80	9.17	1.76	17.79
GeorgesShoalMBTG	Bottom Trawl	2010 - 2012	492.78	68.00	7.25	0.92	14.13
GeorgesShoalMBTG	GC Scallop	2005 - 2012	0.01	1.88	0.01	0.00	0.02
GeorgesShoalMBTG	GC Scallop	2008 - 2012	0.01	2.40	0.00	0.00	0.01
GeorgesShoalMBTG	LA Scallop	2005 - 2012	3.41	19.13	0.18	0.00	0.41
GeorgesShoalMBTG	LA Scallop	2008 - 2012	1.41	11.20	0.13	0.00	0.34
GeorgesShoalMBTG	LA Scallop	2010 - 2012	0.44	10.33	0.04	0.00	0.14

Table 62 – Closed Area I: Average value per haul (calendar year 2007-2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents, for species of interest in Framework 48. NEFOP and ASM observer landings data.

		Month											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bottom Trawl	Total Hauls	444	680	641	478	304	1,222	1,293	1,342	1,336	1,410	1,187	445
	Cod	$171	$370	$405	$480	$220	$176	$175	$146	$178	$203	$ 164	$143
		19%	26%	41%	43%	16%	13%	17%	15%	21%	22%	17%	12%
	Haddock	$173	$606	$404	$309	$937	$920	$313	$202	$163	$208	$ 214	$310
		19%	43%	40%	28%	66%	66%	31%	21%	19%	22%	22%	25%
	Yellowtail	$49	$11	$0	$5	$34	$9	$31	$61	$64	$76	$45	$36
		5%	1%	0%	0%	2%	1%	3%	6%	7%	8%	5%	3%
	Lobster	$166	$151	$106	$101	$35	$67	$64	$57	$39	$39	$69	$118
		18%	11%	11%	9%	2%	5%	6%	6%	5%	4%	7%	10%
	Winter Skate	$40	$16	$5	$18	$14	$22	$35	$49	$51	$44	$40	$9
		4%	1%	0%	2%	1%	2%	3%	5%	6%	5%	4%	1%
	Scallops	$46	$21	$0	$5	$24	$12	$27	$44	$16	$18	$14	$3
		5%	1%	0%	0%	2%	1%	3%	5%	2%	2%	1%	0%
	Winter Flounder	$11	$3	$1	$2	$20	$33	$174	$166	$94	$98	$203	$71
		1%	0%	0%	0%	1%	2%	17%	17%	11%	11%	21%	6%
	Witch Flounder	$58	$45	$22	$51	$20	$25	$30	$69	$80	$74	$76	$235
		6%	3%	2%	5%	1%	2%	3%	7%	9%	8%	8%	19%
	Monkfish	$76	$117	$29	$61	$17	$33	$43	$46	$61	$73	$72	$148
		8%	8%	3%	6%	1%	2%	4%	5%	7%	8%	7%	12%
	Plaice	$44	$31	$9	$37	$43	$55	$61	$67	$75	$52	$59	$98
		5%	2%	1%	3%	3%	4%	6%	7%	9%	6%	6%	8%
Ruhle Trawl	Total Hauls					13	94						
	Cod					$7	$187						
						0%	9%						

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Haddock					$2,065	$1,718						
						99%	86%						
	Yellowtail					$5	$32						
						0%	2%						
Fixed Gillnet	Total Hauls						128	196	129	211	93	40	30
	Cod						$128	$247	$431	$256	$677	$612	$292
							20%	47%	74%	55%	86%	71%	67%
	Haddock						$38	$56	$15	$16	$ 10	$14	$9
							6%	11%	3%	3%	1%	2%	2%
	Pollock						$4	$25	$49	$24	$ 13	$23	$56
							1%	5%	8%	5%	2%	3%	13%
	Lobster						$40	$17	$14	$14	$12	$51	$8
							6%	3%	2%	3%	2%	6%	2%
	Winter Skate						$336	$110	$44	$120	$45	$143	$31
							52%	21%	8%	26%	6%	16%	7%
	Skate						$10	$28	$0	$8	$14	$-	$-
							2%	5%	0%	2%	2%		
	Spiny Dogfish						$73	$29	$6	$0	$-	$-	$-
							11%	6%	1%	0%			
Separator Trawl	Total Hauls	26	15		18	45	204	142	46	115	89	27	11
	Cod	$151	$408		$99	$ 144	$171	$33	$106	$67	$139	$173	$20
		9%	56%		3%	8%	7%	3%	11%	8%	12%	10%	4%
	Haddock	$1,083	$166		$2,868	$1,578	$2,277	$933	$465	$564	$751	$1,055	$350
		65%	23%		92%	87%	88%	91%	49%	67%	63%	62%	66%
	Redfish	$25	$1		$56	$0	$4	$3	$36	$23	$27	$122	$9
		1%	0%		2%	0%	0%	0%	4%	3%	2%	7%	2%
	Pollock	$259	$63		$6	$23	$31	$9	$7	$116	$37	$45	$6
		15%	9%		0%	1%	1%	1%	1%	14%	3%	3%	1%

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Yellowtail	$1	$-		$25	$17	$4	$7	$51	$5	$78	$1	$13
		0%			1%	1%	0%	1%	5%	1%	7%	0%	2%
	Lobster	$89	$9		$36	$5	$16	$10	$5	$2	$4	$17	$42
		5%	1%		1%	0%	1%	1%	1%	0%	0%	1%	8%
Longline	Total Hauls									31			
	Cod									$321			
										79%			
	Haddock									$65			
										16%			
	Redfish									$1			
										0%			

Table 63 – Closed Area II: Average value per haul (calendar year 2007 - 2011) within a 10 nautical mile buffer, and percent of total haul revenue this value represents, for species of interest in Framework 48. NEFOP and ASM observer landings data.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottom Trawl	Total Hauls	758	85	449	1,560	1,332	1,024	517	835	659	652	798	1,107
	Cod	$57	$247	$227	$327	$137	$129	$60	$96	$68	$45	$64	$144
		5%	17%	13%	17%	8%	11%	4%	7%	6%	3%	5%	8%
	Haddock	$193	$53	$584	$949	$798	$372	$237	$412	$371	$332	$493	$684
		16%	4%	34%	49%	47%	30%	16%	29%	31%	25%	35%	37%
	Yellowtail flounder	$438	$95	$28	$190	$341	$203	$338	$186	$154	$245	$215	$397
		36%	7%	2%	10%	20%	17%	23%	13%	13%	18%	15%	22%
	Scallop	$167	$34	$40	$62	$105	$61	$121	$62	$65	$122	$43	$168
		14%	2%	2%	3%	6%	5%	8%	4%	5%	9%	3%	9%
	Winter flounder	$96	$31	$34	$92	$156	$247	$495	$315	$157	$225	$357	$249
		8%	2%	2%	5%	9%	20%	34%	22%	13%	17%	25%	14%

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Witch flounder	$15	$70	$39	$31	$48	$45	$18	$50	$66	$91	$41	$13
		1%	5%	2%	2%	3%	4%	1%	4%	6%	7%	3%	1%
	Winter skate	$117	$82	$141	$53	$22	$37	$19	$35	$155	$100	$52	$50
		10%	6%	8%	3%	1%	3%	1%	2%	13%	7%	4%	3%
	White hake	$6	$188	$78	$29	$7	$2	$2	$5	$7	$5	$15	$9
		0%	13%	4%	2%	0%	0%	0%	0%	1%	0%	1%	1%
	Lobster	$48	$412	$394	$103	$21	$61	$84	$149	$56	$62	$56	$22
		4%	29%	23%	5%	1%	5%	6%	11%	5%	5%	4%	1%
	Monkfish	$38	$80	$99	$40	$25	$39	$52	$44	$76	$86	$49	$49
		3%	6%	6%	2%	1%	3%	4%	3%	6%	6%	3%	3%
Separator Trawl	Total Hauls	151	29	80	179	78	73	33	17	54	29	140	159
	Cod	109	91	159	516	189	31	6	19	31	71	129	193
		5%	4%	5%	18%	6%	2%	1%	1%	2%	7%	7%	8%
	Haddock	1,915	689	2,567	1,686	2,554	1,580	956	1,223	1,319	648	1,401	1,988
		83%	30%	87%	60%	83%	88%	84%	94%	84%	66%	73%	82%
	Pollock	145	337	17	13	4	9	-	2	21	16	130	37
		6%	14%	1%	0%	0%	1%		0%	1%	2%	7%	2%
	Yellowtail flounder	28	28	9	153	127	19	107	2	8	17	70	52
		1%	1%	0%	5%	4%	1%	9%	0%	1%	2%	4%	2%
	Lobster	28	184	91	176	1	68	9	16	19	5	13	5
		1%	8%	3%	6%	0%	4%	1%	1%	1%	1%	1%	0%
	Monkfish	$9	$16	$17	$16	$2	$22	$14	$8	$27	$55	$5	$6
		0%	1%	1%	1%	0%	1%	1%	1%	2%	6%	0%	0%
	Winter flounder	$32	$6	$26	$167	$191	$29	$13	$0	$0	$-	$119	$93
		1%	0%	1%	6%	6%	2%	1%	0%	0%		6%	4%
	Witch flounder	$4	$35	$7	$19	$0	$18	$5	$18	$93	$60	$19	$6
		0%	1%	0%	1%	0%	1%	0%	1%	6%	6%	1%	0%
	White hake	$24	$881	$32	$43	$-	$6	$-	$3	$18	$74	$10	$40

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		1%	38%	1%	2%		0%		0%	1%	8%	1%	2%
Longline	Total Hauls					79	103						
	Cod					386	275						
						30%	23%						
	Haddock					881	900						
						69%	76%						
Ruhle Trawl	Total Hauls		6		30	50	49						
	Cod		$14		$567	$73	$5						
			3%		25%	2%	0%						
	Haddock		$325		$1,416	$2,994	$969						
			74%		62%	96%	94%						
	Yellowtail flounder		$95		$193	$41	$15						
			21%		9%	1%	1%						

Table 64 – Recreational fishing revenue currently associated with CAI and CAII. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate information censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CAI	2006 - 2012	13,120.14	1.29	70.43	3,401.52	1,117.74	3,141.37
CAI	2008 - 2012	17,511.26	1.00	94.00	4,169.35	4,098.38	3,166.64
CAI	-	-	-	-	-	-	-
CAII	-	-	-	-	-	-	-
CAII	-	-	-	-	-	-	-
CAII	-	-	-	-	-	-	-

4.1.3.1.4.1 Alternative 1 (No action)

To be completed later.

4.1.3.1.4.2 Alternative 2 (No Habitat Management Areas)

Table 62 and Table 63 represent the species contributing substantially to the revenue of hauls within a 10 nautical mile buffer of the current CAI and CAII management areas. In the vicinity of CAI Cod and Haddock are the dominant species across all gear types, with Winter Skate important to Fixed Gillnet revenue as well. Haddock and Cod again play an important role across all gear types in the waters around CAII. In addition, Yellowtail Flounder, Winter Flounder, and Lobster generate substantial revenue for generic Bottom Trawl, while Ruhle Trawl lands some quantity of Yellowtail Flounder in the winter and early spring. Georges Bank Cod and Georges Bank Yellowtail Flounder are overfished, and overfishing is occurring, and thus Alternative 2 is unlikely to generate any significant benefits from these two species. Georges Bank Winter Flounder and Georges Bank Haddock are not overfished, and overfishing is not occurring. Furthermore, the analysis in Framework 48 suggested that a substantial concentration of Haddock existed within CAII, which could lead to additional flexibility in terms of higher revenue generated and lowered costs due to increased CPUE of this species. The analysis within Framework 48 also indicates that Cod, Haddock, and Winter Flounder within the boundaries of CAII are likely larger than the surrounding areas open to fishing and thus could generate additional revenue both from decreasing the ratio of unwanted bycatch (undersized fish), and capitalizing on any price premium on larger individuals that might exist in the marketplace. The magnitude of this benefit is uncertain, and depends on the size and duration of the increase in catch per unit effort (CPUE) for this species, as well as the ratio of large/small individuals, which cannot be quantified to any level of confidence. However, it is logical to expect that effort will flow into exemption areas until CPUE equates inside and outside the currently closed areas, and thus the benefits could be transitory.

However, it should be noted that Special Access Programs allow access to the southern portions of CAII below latitude 41° 30’ and the northern portion above latitude 42° 10’ for haddock fishing between May 1 and December 31 and May 1 and January 31 respectively. Thus, the magnitude of the benefit generated from additional access to this species depends on the relative concentration of haddock in the areas and times not currently open to groundfish fishing.

The following analysis depends on fishermen currently landing less than the permitted amount of non-groundfish species. If, instead, fishermen are already landing the entirety of their permitted landings, then the effect of exemptions described below are likely neutral.

Lobster consistently appears as an important non-target species for hauls surrounding CAI and CAII. This general trend is particularly true for bottom trawls. A large amount of offshore lobster pot effort is thought to be concentrated in Closed Area II. Two competing arguments for this are there could be the greater abundance of lobster and/or the lower levels of gear conflict in these areas, both of which could make lobster harvest by groundfish trawls more profitable. If the concentration of lobster pot effort in Closed Area II is due to the increased lobster abundance, then groundfish fishermen could benefit from access to these areas. Closed Area II is the exemption area most likely to provide this benefit to fishermen, if it exists. A similar argument for can be made for scallops in Closed Area I and II. Both of these closed areas are subject to significant effort from the scallop fishery, and to the extent that groundfish fishermen will gain access to areas with high scallop biomass, they could expect increased fishing revenue.

Although there are potential benefits associated with increased access to the skate complex, the biological analysis within Framework 48 fails to identify how these benefits would be generated. The Scallop PDT is conducting a more thorough economic analysis of access to CAI and CAII for the LA and GC scallop fishermen. Although successful exploratory fishing for Surf Clam and Ocean Quahog has recently been conducted on Georges Bank, the recently reopened portions of Georges Bank fall outside both CAI and CAII, and thus Alternative 2 is not expected to benefit the Surf Clam/Ocean Quahog fishery.

Increased fishing gear interactions and potential displacement of existing fishing effort using non-groundfish/non-mobile bottom tending gear within CAI and CAII are other potential costs of this alternative. For example, it has already been noted that Closed Area II currently supports a large amount of lobster pot fishing. The increased costs accruing to the lobster pot fishery, due for example to lost pots if strings are trawled over, depend on the flow of effort into the exemption area, and the gear conflict avoidance measures taken by both lobstermen and groundfish fishermen. If, for example, groundfish fishermen take pains in avoiding pot strings, then these costs are expected to be minimal. However, the lobster pot/groundfish interaction is likely to be idiosyncratic, given that there is no manner to ensure due care is taken in avoidance by either groundfish fishermen or lobstermen. This effect is likely to be slightly negative, given the groundfish/mobile bottom-tending gear effort currently surrounding CAII. Table 64 details the recreational fishing reported to have occurred within CAI and CAII. Although recreational fishing has been reported for both areas, the usage is concentrated within a very small number of permit holders, and although the annual revenue is not insignificant where it is not censored, neither CAI nor CAII are centers of recreational fishing. Thus, increased interactions between commercial and recreational fisheries in CAI and CAII are not expected.

4.1.3.1.4.3 Alternative 3

Scallops and Bottom trawl generate the largest revenue from the portions of Northern Edge HMA currently open to fishing, as illustrated by Figure 24. CAII and its surrounding areas have long been important for vessels > 70 ft in both of these fisheries, as highlighted by Table 15. Mean Bottom Trawl revenue per trip is $2,379 for this largest vessel class in the Northern Edge. Scallop revenue per trip are substantially higher at $181,327. However, these waters are also productive for the Surf Clam and Ocean Quahog fishery, represented by the Clam Dredge gear, which is not apparent in the VTR analysis due to the Georges Bank Paralytic Shellfish Poisoning area closure. What little revenue has been generated in the area by Clam Dredges represents exploratory fishing over the past three years, and only through two actions in January and, more relevant to discussions of the Northern Edge, August of 2013 were areas in this portion of Georges Bank open to more general Surf Clam and Ocean Quahog fishing (http://www.nero.noaa.gov/nr/2013/August/13clamsreopengbcaphl.pdf). The true value of this area to the Surf Clam and Ocean Quahog is thus higher than what can be gleaned from the VTR analysis. Nevertheless, the exploratory fishing looks to have been concentrated somewhat outside of the Northern Edge area, as will be seen from the analysis of the Georges Shoal areas in the Georges Bank Habitat Management Alternatives 4 and 5. Nevertheless, as Table 56 indicates, 89% of all revenues currently generated from Northern Edge would be affected by options being considered within Georges Bank HMA Alternative 3.

Table 57 presents the VMS analysis, which again identifies the importance of this area for Bottom Trawl and LA Scallop fishermen in particular. This is apparent in terms of both hours and individuals fishing within the bounds of Northern Edge. There is no recreational fishing currently reported within the boundaries of Northern Edge.

4.1.3.1.4.4 Alternative 4

Figure 24 and Figure 25 overview the current revenue being generated within the boundaries of the Northern Edge and Small Georges Shoals management areas being considered as a part of the Georges Bank HMA Alternative 4. Scallops and Bottom trawl generate the largest revenue from the portions of Northern Edge and Georges Shoal Small HMA currently open to fishing. CAII and its surrounding areas have long been important for vessels > 70 ft in both of these fisheries, as highlighted by Table 56 and Table 58. Mean Bottom Trawl revenue per trip is $1,766 for this largest vessel class in Georges Shoal Small, and $2,379 in the Northern Edge. Scallop revenue per trip are substantially higher at $181,327. However, these waters are also productive for the Surf Clam and Ocean Quahog fishery, represented by the Clam Dredge gear, which is not apparent in the VTR analysis due to the Georges Bank Paralytic Shellfish Poisoning area closure. What little revenue has been generated in the area by Clam Dredges represents exploratory fishing over the past three years, and only through two actions in January and, more relevant to discussions of the Northern Edge, August of 2013 were areas in this portion of Georges Bank open to more general Surf Clam and Ocean Quahog fishing (http://www.nero.noaa.gov/nr/2013/August/13clamsreopengbcaphl.pdf). The true value of this area to the Surf Clam and Ocean Quahog is thus higher than what can be gleaned from the VTR analysis. Nevertheless, the exploratory fishing looks to have been concentrated somewhat outside of the Northern Edge area, as will be seen from the Analysis of the Georges Shoal alternatives in the Georges Bank HMA 5. As Table 56 and Table 58 indicate, 78% ($16,049,301) of all revenues currently generated from Northern Edge and Georges Shoal Small would be affected by options being considered within Georges Bank HMA Alternative 4.

Table 57 and Table 59 present the VMS analysis, which again identifies the importance of this area for Bottom Trawl and LA Scallop fishermen in particular. This is apparent in terms of both hours and individuals fishing within the bounds of Northern Edge.

There is no recreational fishing currently reported within the boundaries of Northern Edge. Although some recreational fishing has been reported within the boundaries of the Small Georges Shoals area, this information is not presented due to privacy concerns.

4.1.3.1.4.5 Alternative 5

Figure 26 and Figure 27 illustrate the gears currently employed within the boundaries of the Large Georges Shoal and Georges Shoal MBTG areas being considered within the Georges Bank HMA Alternative 5. Revenue generated within the Large Georges Shoal area is dominated by Scallop Dredge and Bottom Trawl fishermen, while in the Georges Shoal MBTG area Clam Dredge and Bottom Trawl are the two most prolific revenue sources. Table 60 details statistics for the gears being considered for management in options within the Georges Bank HMA Alternative 5. Of note is that the Bottom Trawl and SAP trawl revenue presented as corresponding to Georges Shoal MBTG is also contained within the totals associated with the Georges Shoal Large area. Though double counting, the differing management options for the two areas suggests that the comparison of the results of the nested MBTG area with the totality of the Georges Shoal Large area is of interest. Mean revenue per trip in the Georges Shoal Large area is $4,702 for Bottom trawl vessels > 70 ft, and $3,215 for all other Bottom Trawl vessel classes. SAP Trawl trips in the area generate similar mean revenue, with $3,743 per trip for vessels > 70 ft, and $2,065 for vessels between 50 ft and 70 ft. The Georges Shoal MBTG area encapsulates a much smaller portion of the Trawl revenue, with a mean per trip revenue of $690 for vessels > 70 ft, and $460 per trip for other vessel classes of Bottom Trawls, and SAP Trawl per trip revenue estimated to be $798 for vessels > 70 ft and $623 for vessels between 50 ft and 70 ft. Overall, the VTR analysis suggests that the MBTG area encapsulates 11% of the revenue generated by SAP and Bottom Trawls combined in the Georges Shoal Large area.

The Georges Shoal MBTG area hosted a substantial amount of the exploratory fishing conducted by the Surf Clam and Ocean Quahog fishery over the past three years, as represented by the Clam Dredge revenue. Due to the Georges Bank Paralytic Shellfish Poisoning area closure the VTR analysis under-represents the revenue generating potential of this area to the Surf Clam and Ocean Quahog fishery, particularly given two actions in January and August of 2013 in which areas in this portion of Georges Bank are now open to more general Surf Clam and Ocean Quahog fishing (http://www.nero.noaa.gov/nr/2013/August/13clamsreopengbcaphl.pdf). The true value of this area to the Surf Clam and Ocean Quahog is thus higher than what can be gleaned from the VTR analysis. The mean revenue per trip from Clam Dredge activity estimated to fall within the Georges Shoal MBTG area is $27,742 over the last three year period. Conversely, the mean Scallop Dredge revenue per trip is $4,606, suggesting that the most productive Scallop beds in this area do not fall within the Georges Shoal MBTG area. These general results are again mirrored within the VMS analysis. Bottom Trawl effort is particularly high in the Georges Shoal Large area, and only 3% of this effort is estimated to fall within the MBTG area. The VMS analysis also indicates that both GC and LA Scallop effort in the MBTG area is low relative to the surrounding waters. Similarly to the VTR analysis, the Georges Shoal Large and MBTG areas double count the effort estimates, and thus effort cannot be summed across areas.

Although there have been some recreational trips reported within the boundaries of the Large Georges Shoal Area, this information is not presented due to privacy concerns.

4.1.3.1.5 Great South Channel/Southern New England

Tables and figures related to analysis of the economic impacts of the Great South Channel/Southern New England habitat management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Although as of this writing NE Multispecies Framework 50 has not been given final approval, the preferred alternative for SNE/MA Winter Flounder would permit the landing of SNE/Winter Flounder, worth an estimated $5.2 million. Industry has expressed concerns that the Great South Channel encapsulates a significant portion of the biomass for this species in SNE. In order to investigate this claim, revenue generated from observed haul level Winter Flounder landings prior to Amendment 16, which prohibited landings of SNE/MA Winter Flounder, were compared between the Great South Channel area and a 10 nautical mile buffer surrounding Nantucket Lightship. This includes the years 2007 – 2009. A two-tailed test for the equality of variance between the two samples was significant at the 1% (probability = 0.0000), meaning that a t-test is inappropriate. Instead, a nonparametric Wilcoxon ranksum test for the equality of the Winter Flounder revenue distributions between the two areas was conducted. The null hypothesis of equality between the two samples was rejected, again at the 1% level (probability = 0.0000), with Great South Channel presenting the higher mean haul level revenue of the two areas, by $98. Additionally, a test of proportions was conducted in order to understand whether the proportion of hauls on which Winter Flounder was caught differed significantly between the two areas. Again, the test was significant at the 1% level, with Winter Flounder landed on 64% of hauls within the Great South Channel, while the species was landed on only 30% of hauls within Nantucket Lightship. Although there are reasons, including potential shifts in distributions between the historical and current population of SNE\MA Winter Flounder or differences in density inside Nantucket Lightship versus in a 10 nautical mile buffer surrounding Nantucket Lightship, the analysis above suggests that catch rates are likely to differ significantly between Great South Channel and Nantucket Lightship. These results would hold for the Great South Channel Extended area, given that the Great South Channel area is nested within the extended area. It is unclear whether this same result holds for the Nantucket Shoals and Nantucket Shoals west areas, and additional analysis is needed before any conclusion is made in these areas.

Figure 28 – Great South Channel area revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 22,732,371; 2008 – 2012 = $ 24,429,534; 2010 – 2012 = $ 36,185,396

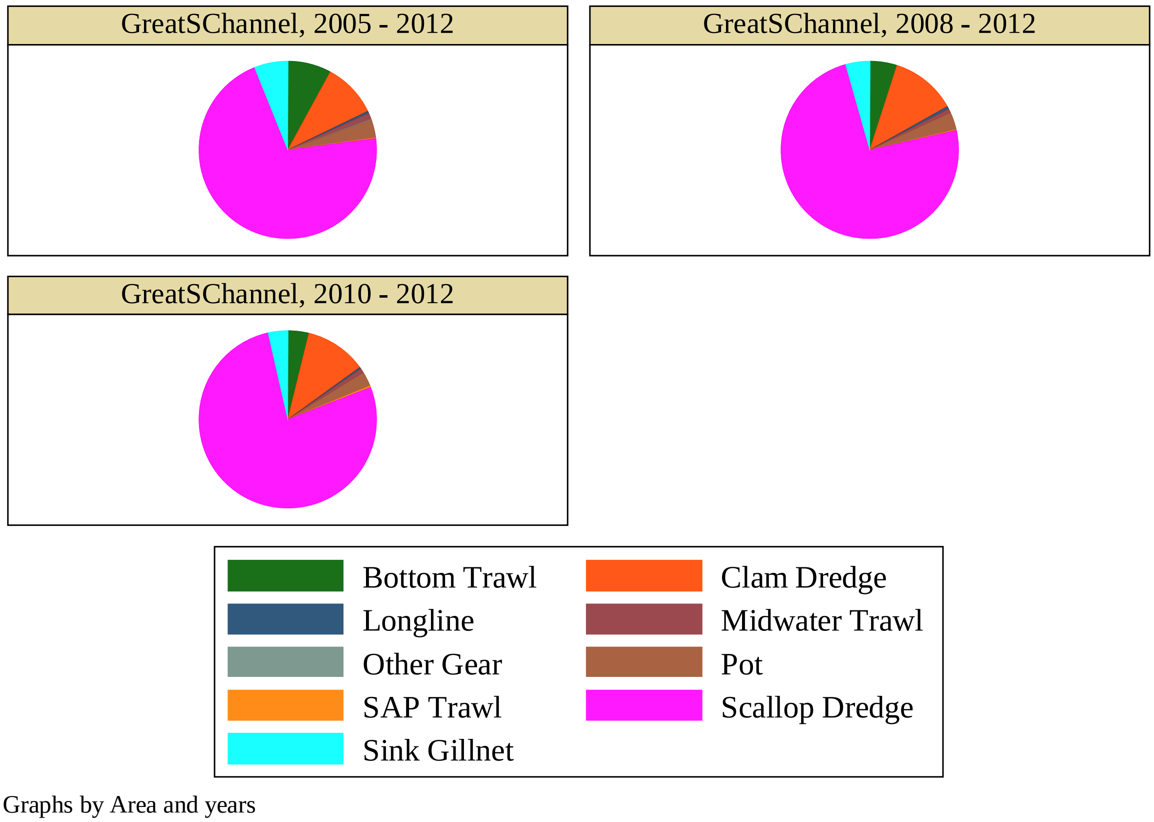


Figure 29 – Cox Ledge area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 814,471; 2008 – 2012 = $ 895,190; 2010 – 2012 = $ 1,070,794

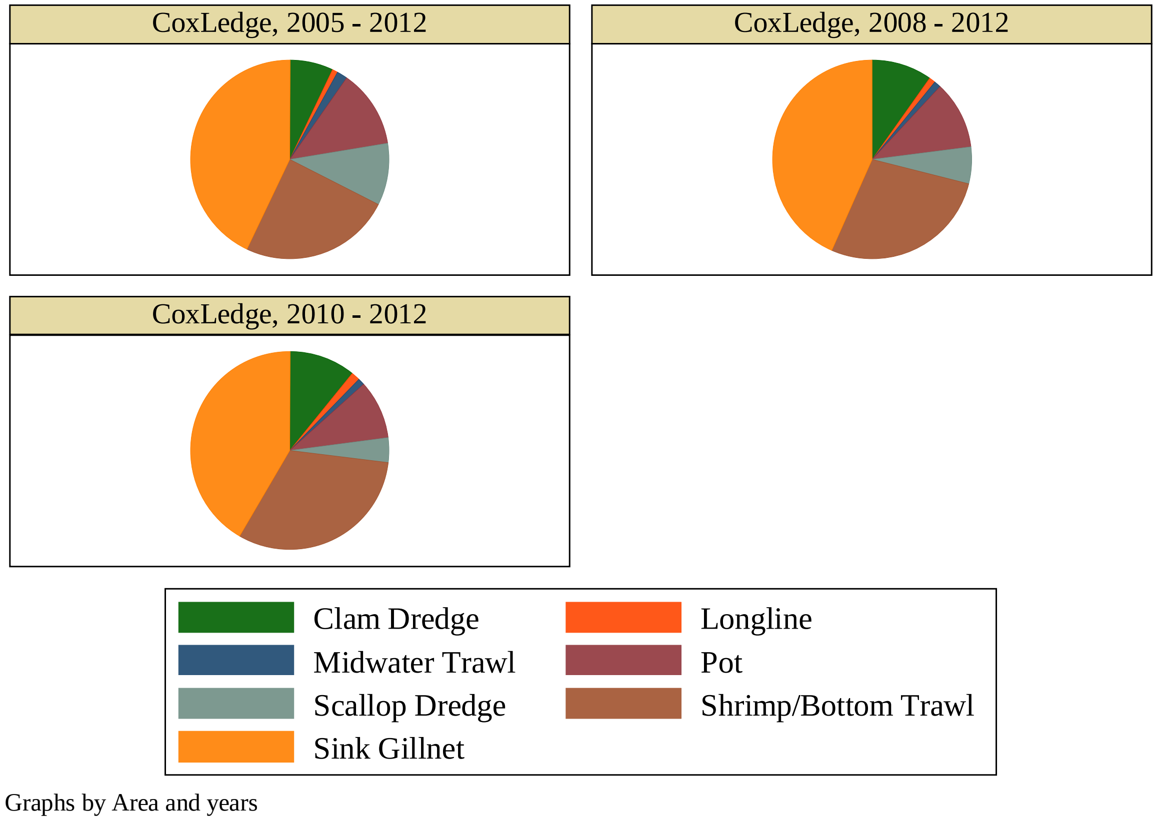


Figure 30 – Small Great South Channel area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863

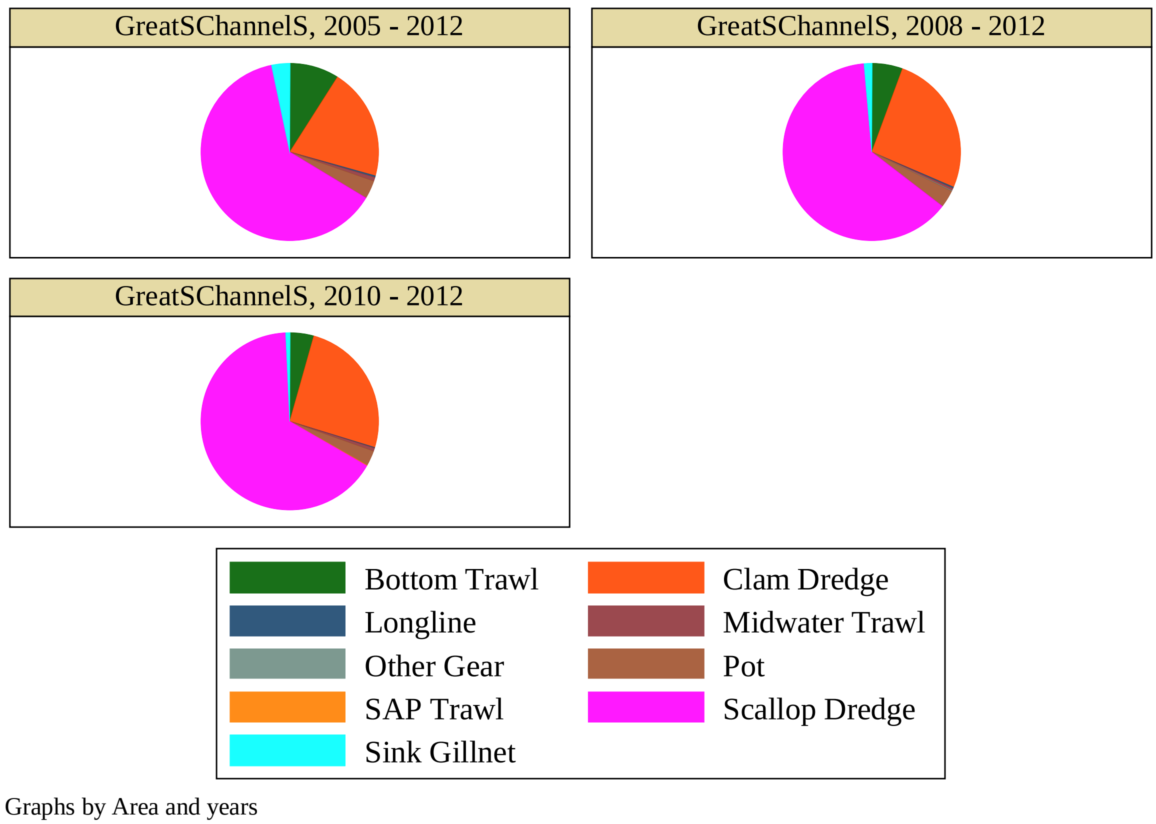


Figure 31 – Small Nantucket Shoals area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 10,851,955; 2008 – 2012 = $ 11,044,579; 2010 – 2012 = $ 15,589,863

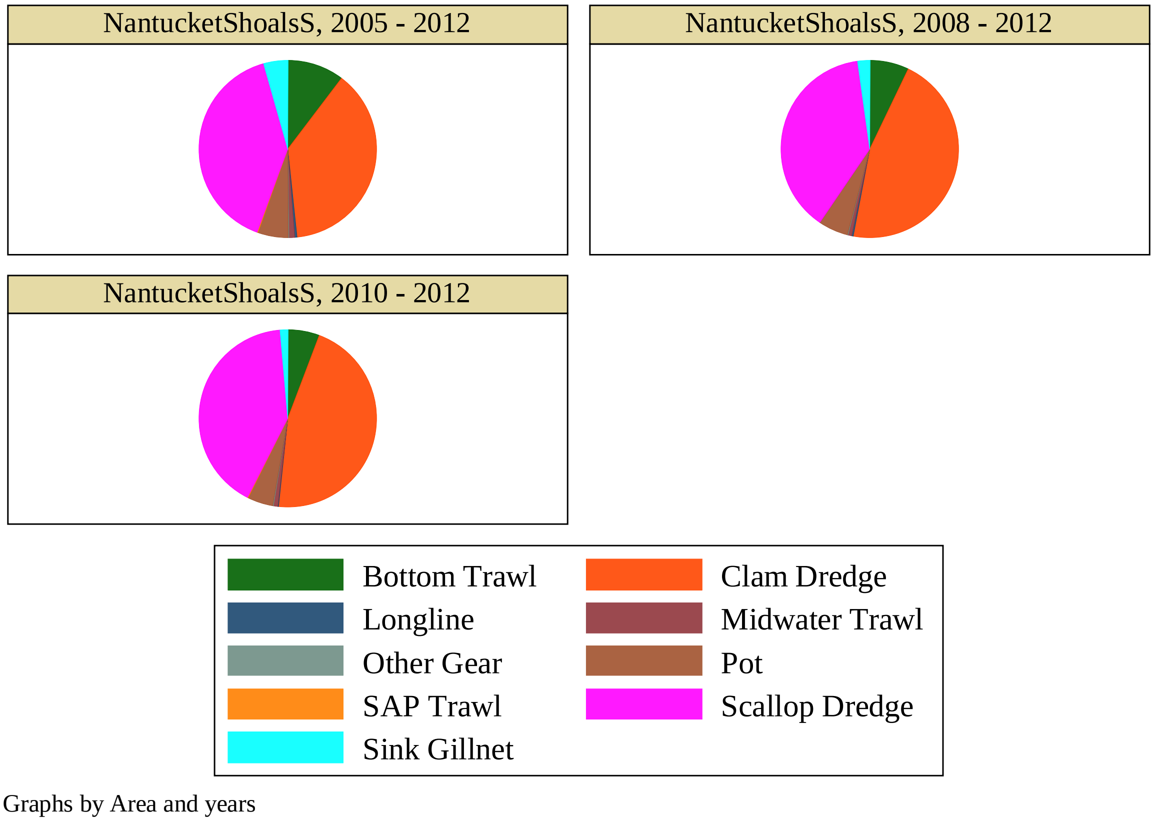


Figure 32 – Large Nantucket Shoals area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 7,585,618; 2008 – 2012 = $ 8,118,389; 2010 – 2012 = $ 11,383,584

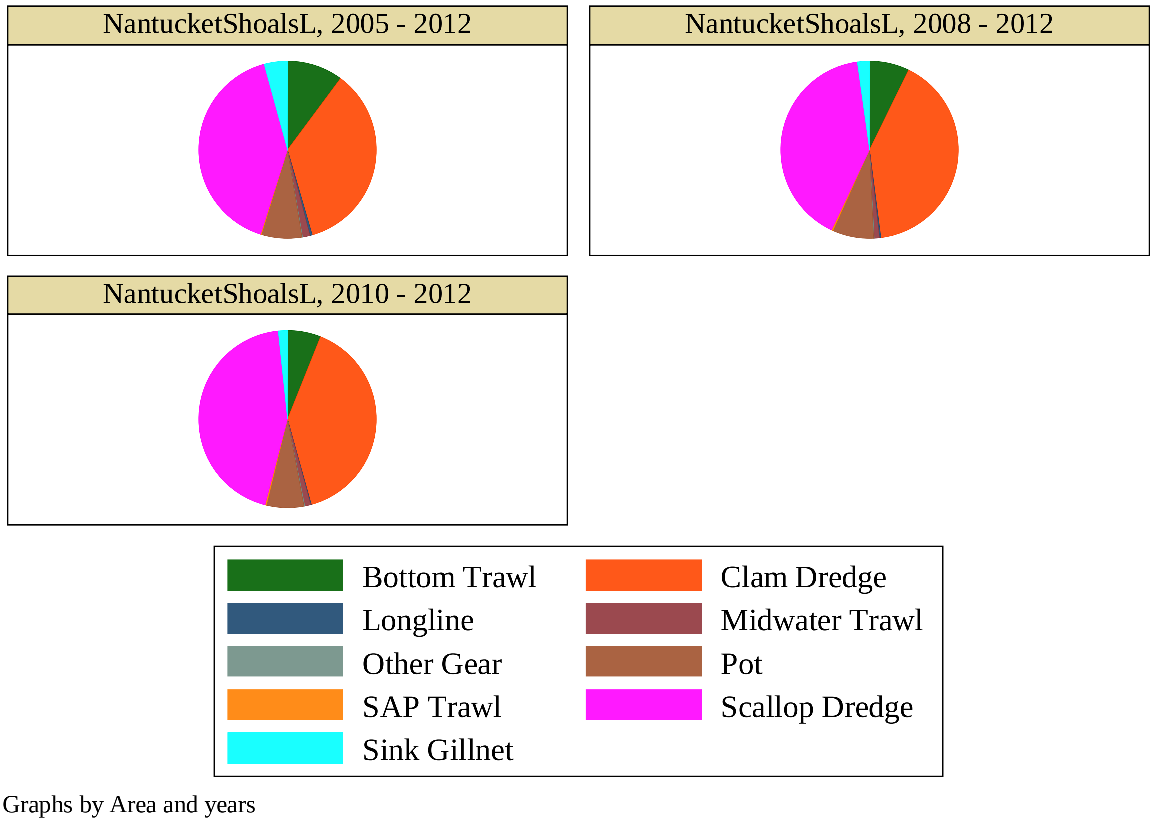


Figure 33 – Great South Channel Gear Modification area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 38,690,902; 2008 – 2012 = $ 43,448,967; 2010 – 2012 = $ 65,038,480

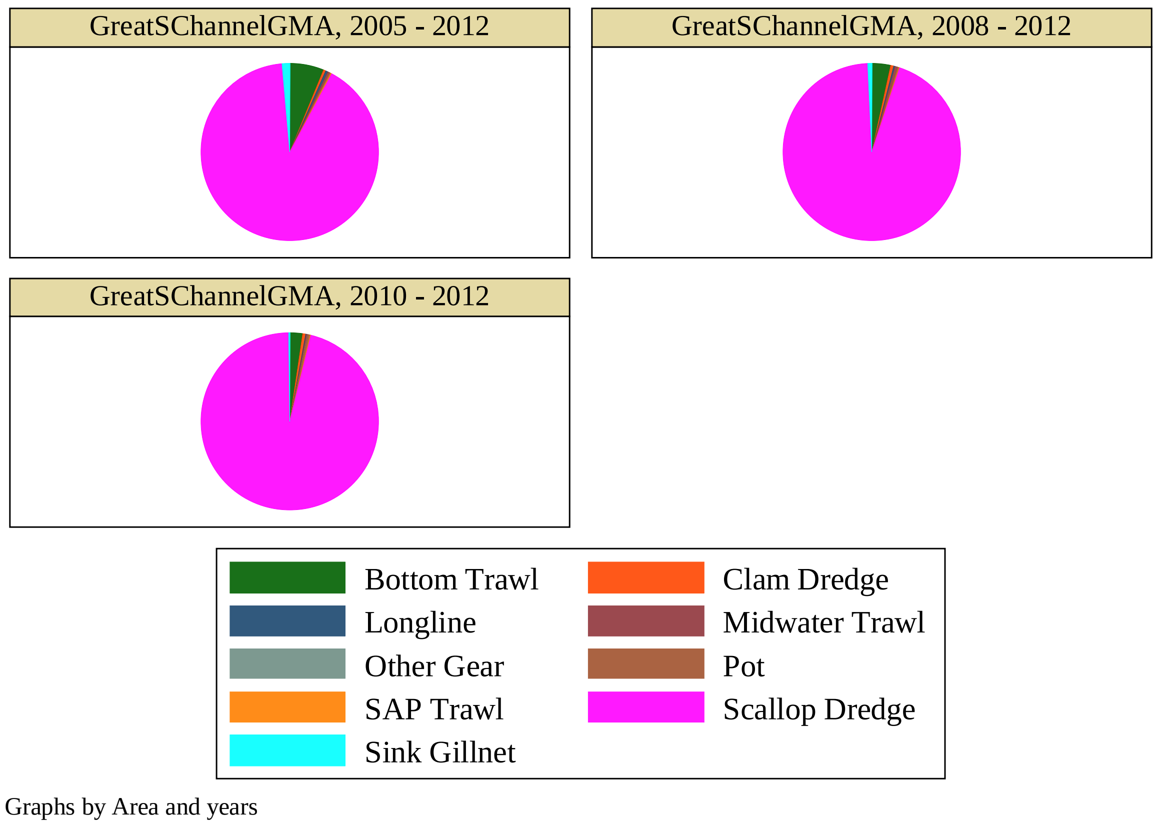


Table 65 – Mobile bottom-tending gear in currently open portions of the Great South Channel Alternative 3 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Clam Dredge	CoxLedge	ALL	57,218	49,156	57,190	153,413	984	5	68	2005 - 2012
Clam Dredge	CoxLedge	ALL	87,709	91,732	50,836	153,413	11,518	6	99	2008 - 2012
Clam Dredge	CoxLedge	ALL	115,175	100,379	33,396	153,413	91,732	6	114	2010 - 2012
Scallop Dredge	CoxLedge	L	29,052	28,940	18,997	51,628	1,678	12	112	2005 - 2012
Scallop Dredge	CoxLedge	L	24,401	22,592	16,710	45,111	1,678	9	83	2008 - 2012
Scallop Dredge	CoxLedge	L	23,127	22,592	21,722	45,111	1,678	10	43	2010 - 2012
Scallop Dredge	CoxLedge	M	20,461	15,927	21,910	67,869	686	11	145	2005 - 2012
Scallop Dredge	CoxLedge	M	12,793	5,610	13,656	31,034	686	6	109	2008 - 2012
Scallop Dredge	CoxLedge	M	9,107	2,962	12,665	23,673	686	5	49	2010 - 2012
Scallop Dredge	CoxLedge	S/U	32,708	18,850	35,426	113,251	5,124	17	157	2005 - 2012
Scallop Dredge	CoxLedge	S/U	15,759	16,869	8,768	27,720	5,124	11	86	2008 - 2012
Scallop Dredge	CoxLedge	S/U	10,560	9,686	5,921	16,869	5,124	8	58	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	40,645	42,363	14,773	68,231	22,663	47	515	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	36,436	38,893	10,844	46,999	22,663	44	491	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	35,796	38,893	11,892	45,833	22,663	48	487	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	153,160	91,547	139,297	448,705	32,213	50	1,051	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	203,243	179,333	157,735	448,705	61,751	48	1,079	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	293,070	251,171	139,488	448,705	179,333	49	1,139	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	7,058	6,279	3,521	14,883	4,133	23	304	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	8,656	7,758	3,622	14,883	5,480	21	273	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	10,241	8,083	4,023	14,883	7,758	20	279	2010 - 2012
Bottom Trawl	GreatSChannel	L	1,589,391	1,459,779	931,448	3,279,062	405,329	97	796	2005 - 2012
Bottom Trawl	GreatSChannel	L	1,039,036	1,194,849	478,962	1,512,271	405,329	86	802	2008 - 2012
Bottom Trawl	GreatSChannel	L	1,198,334	1,407,287	455,867	1,512,271	675,445	92	1,044	2010 - 2012
Bottom Trawl	GreatSChannel	M	165,090	163,089	80,735	314,978	58,429	52	286	2005 - 2012
Bottom Trawl	GreatSChannel	M	125,024	129,270	57,652	203,490	58,429	46	283	2008 - 2012
Bottom Trawl	GreatSChannel	M	137,994	129,270	61,599	203,490	81,222	47	315	2010 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GreatSChannel	S/U	31,616	29,760	19,006	64,815	12,652	22	255	2005 - 2012
Bottom Trawl	GreatSChannel	S/U	30,770	27,927	20,536	64,815	12,990	19	206	2008 - 2012
Bottom Trawl	GreatSChannel	S/U	37,644	31,592	24,708	64,815	16,524	18	231	2010 - 2012
Clam Dredge	GreatSChannel	ALL	2,231,270	1,672,132	1,768,077	5,704,136	534,663	8	272	2005 - 2012
Clam Dredge	GreatSChannel	ALL	2,900,127	2,516,257	1,962,642	5,704,136	545,820	9	358	2008 - 2012
Clam Dredge	GreatSChannel	ALL	4,016,726	3,829,786	1,602,140	5,704,136	2,516,257	12	507	2010 - 2012
SAP Trawl	GreatSChannel	ALL	30,108	0	63,099	180,154	0	13	22	2005 - 2012
SAP Trawl	GreatSChannel	ALL	48,173	10,059	76,680	180,154	0	13	35	2008 - 2012
SAP Trawl	GreatSChannel	ALL	80,288	50,650	88,836	180,154	10,059	13	58	2010 - 2012
Scallop Dredge	GreatSChannel	L	12,919,203	9,186,329	12,633,294	39,748,220	1,289,888	164	497	2005 - 2012
Scallop Dredge	GreatSChannel	L	14,752,988	8,655,284	15,721,955	39,748,220	1,289,888	148	412	2008 - 2012
Scallop Dredge	GreatSChannel	L	22,841,630	20,121,390	15,723,944	39,748,220	8,655,284	205	594	2010 - 2012
Scallop Dredge	GreatSChannel	M	1,603,713	1,143,571	1,463,980	4,782,829	239,651	33	349	2005 - 2012
Scallop Dredge	GreatSChannel	M	1,730,217	921,938	1,882,001	4,782,829	239,651	23	225	2008 - 2012
Scallop Dredge	GreatSChannel	M	2,659,122	2,272,598	1,959,252	4,782,829	921,938	30	273	2010 - 2012
Scallop Dredge	GreatSChannel	S/U	1,617,857	1,502,562	1,145,197	3,289,623	204,571	39	947	2005 - 2012
Scallop Dredge	GreatSChannel	S/U	1,622,333	1,194,299	1,465,433	3,289,623	204,571	19	597	2008 - 2012
Scallop Dredge	GreatSChannel	S/U	2,512,441	3,053,401	1,147,638	3,289,623	1,194,299	20	797	2010 - 2012

Table 66 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Great South Channel Alternative 3, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Shrimp Trawl effort is not reported due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Cox Ledge	Bottom Trawl	2005 - 2012	40.57	65.13	0.62	0.06	1.54
Cox Ledge	Bottom Trawl	2008 - 2012	40.56	63.80	0.64	0.09	1.56
Cox Ledge	Bottom Trawl	2010 - 2012	42.03	65.00	0.65	0.13	1.56
Cox Ledge	GC Scallop	2005 - 2012	27.25	12.63	2.16	0.37	4.72
Cox Ledge	GC Scallop	2008 - 2012	15.30	10.20	1.50	0.21	2.89
Cox Ledge	GC Scallop	2010 - 2012	10.10	4.67	2.16	0.29	3.67

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Cox Ledge	LA Scallop	2005 - 2012	94.35	53.75	1.76	0.03	6.58
Cox Ledge	LA Scallop	2008 - 2012	45.62	34.40	1.33	0.04	4.99
Cox Ledge	LA Scallop	2010 - 2012	19.16	28.00	0.68	0.01	3.68
GreatSChannelL	Bottom Trawl	2005 - 2012	3,802.93	111.63	34.07	0.90	91.14
GreatSChannelL	Bottom Trawl	2008 - 2012	1,730.40	93.60	18.49	0.88	66.78
GreatSChannelL	Bottom Trawl	2010 - 2012	1,176.55	80.33	14.65	1.15	45.54
GreatSChannelL	GC Scallop	2005 - 2012	1,706.94	63.63	26.83	4.07	52.16
GreatSChannelL	GC Scallop	2008 - 2012	1,470.81	51.80	28.39	1.91	60.91
GreatSChannelL	GC Scallop	2010 - 2012	1,776.07	46.00	38.61	2.04	75.55
GreatSChannelL	LA Scallop	2005 - 2012	13,559.23	283.75	47.79	1.96	101.20
GreatSChannelL	LA Scallop	2008 - 2012	10,703.60	238.60	44.86	1.19	92.49
GreatSChannelL	LA Scallop	2010 - 2012	13,548.11	258.33	52.44	1.93	101.09

Table 67 – Recreational fishing revenue associated with the Great South Channel Alternative 3. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CoxLedge	2006 - 2012	105,303.00	12.00	974.14	2,340.07	2,034.52	1,755.97
CoxLedge	2008 - 2012	109,873.91	11.40	1,016.00	2,357.81	2,034.52	1,765.19
CoxLedge	2010 - 2012	106,187.16	12.33	971.00	2,123.74	1,820.36	1,615.31
GreatSChannelL	2006 - 2012	80,829.54	9.14	459.14	2,595.44	1,117.74	2,598.89
GreatSChannelL	2008 - 2012	35,831.25	6.80	198.40	1,905.92	931.45	2,161.29
GreatSChannelL	2010 - 2012	9,438.69	4.67	50.67	884.88	838.31	428.48

Table 68 – Mobile bottom-tending gear in currently open portions of the Great South Channel Alternative 4 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Clam Dredge	CoxLedge	ALL	57,218	49,156	57,190	153,413	984	5	68	2005 - 2012
Clam Dredge	CoxLedge	ALL	87,709	91,732	50,836	153,413	11,518	6	99	2008 - 2012
Clam Dredge	CoxLedge	ALL	115,175	100,379	33,396	153,413	91,732	6	114	2010 - 2012
Scallop Dredge	CoxLedge	L	29,052	28,940	18,997	51,628	1,678	12	112	2005 - 2012
Scallop Dredge	CoxLedge	L	24,401	22,592	16,710	45,111	1,678	9	83	2008 - 2012
Scallop Dredge	CoxLedge	L	23,127	22,592	21,722	45,111	1,678	10	43	2010 - 2012
Scallop Dredge	CoxLedge	M	20,461	15,927	21,910	67,869	686	11	145	2005 - 2012
Scallop Dredge	CoxLedge	M	12,793	5,610	13,656	31,034	686	6	109	2008 - 2012
Scallop Dredge	CoxLedge	M	9,107	2,962	12,665	23,673	686	5	49	2010 - 2012
Scallop Dredge	CoxLedge	S/U	32,708	18,850	35,426	113,251	5,124	17	157	2005 - 2012
Scallop Dredge	CoxLedge	S/U	15,759	16,869	8,768	27,720	5,124	11	86	2008 - 2012
Scallop Dredge	CoxLedge	S/U	10,560	9,686	5,921	16,869	5,124	8	58	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	40,645	42,363	14,773	68,231	22,663	47	515	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	36,436	38,893	10,844	46,999	22,663	44	491	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	L	35,796	38,893	11,892	45,833	22,663	48	487	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	153,160	91,547	139,297	448,705	32,213	50	1,051	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	203,243	179,333	157,735	448,705	61,751	48	1,079	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	M	293,070	251,171	139,488	448,705	179,333	49	1,139	2010 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	7,058	6,279	3,521	14,883	4,133	23	304	2005 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	8,656	7,758	3,622	14,883	5,480	21	273	2008 - 2012
Shrimp/Bottom Trawl	CoxLedge	S/U	10,241	8,083	4,023	14,883	7,758	20	279	2010 - 2012
Bottom Trawl	GreatSChannelS	L	864,296	806,539	563,254	1,843,042	127,876	88	596	2005 - 2012
Bottom Trawl	GreatSChannelS	L	533,088	678,924	323,628	831,580	127,876	72	541	2008 - 2012
Bottom Trawl	GreatSChannelS	L	580,318	781,499	392,626	831,580	127,876	71	653	2010 - 2012
Bottom Trawl	GreatSChannelS	M	96,208	90,334	60,205	198,526	10,550	40	181	2005 - 2012
Bottom Trawl	GreatSChannelS	M	70,291	77,318	52,650	149,589	10,550	34	175	2008 - 2012
Bottom Trawl	GreatSChannelS	M	79,153	77,318	69,537	149,589	10,550	32	164	2010 - 2012
Bottom Trawl	GreatSChannelS	S/U	8,929	9,330	6,447	18,810	658	18	164	2005 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GreatSChannelS	S/U	6,784	9,254	4,932	12,112	658	14	104	2008 - 2012
Bottom Trawl	GreatSChannelS	S/U	7,392	9,406	5,987	12,112	658	13	110	2010 - 2012
Clam Dredge	GreatSChannelS	ALL	2,207,120	1,656,176	1,741,516	5,646,122	533,721	8	272	2005 - 2012
Clam Dredge	GreatSChannelS	ALL	2,862,667	2,504,223	1,935,987	5,646,122	545,615	9	358	2008 - 2012
Clam Dredge	GreatSChannelS	ALL	3,964,059	3,741,833	1,582,694	5,646,122	2,504,223	12	507	2010 - 2012
SAP Trawl	GreatSChannelS	ALL	5,452	0	10,254	29,540	0	11	13	2005 - 2012
SAP Trawl	GreatSChannelS	ALL	8,723	5,995	12,180	29,540	0	11	21	2008 - 2012
SAP Trawl	GreatSChannelS	ALL	14,539	8,082	13,033	29,540	5,995	11	35	2010 - 2012
Scallop Dredge	GreatSChannelS	L	6,135,054	3,815,659	6,475,767	20,674,308	800,514	137	406	2005 - 2012
Scallop Dredge	GreatSChannelS	L	6,337,287	2,772,530	8,142,704	20,674,308	800,514	107	280	2008 - 2012
Scallop Dredge	GreatSChannelS	L	9,371,129	4,858,787	9,854,912	20,674,308	2,580,292	136	376	2010 - 2012
Scallop Dredge	GreatSChannelS	M	547,707	278,272	666,258	2,095,588	102,676	29	247	2005 - 2012
Scallop Dredge	GreatSChannelS	M	553,811	184,815	864,479	2,095,588	102,676	17	138	2008 - 2012
Scallop Dredge	GreatSChannelS	M	823,064	270,928	1,105,244	2,095,588	102,676	21	152	2010 - 2012
Scallop Dredge	GreatSChannelS	S/U	154,635	119,898	136,834	358,762	9,146	36	497	2005 - 2012
Scallop Dredge	GreatSChannelS	S/U	69,425	61,294	58,734	164,314	9,146	15	212	2008 - 2012
Scallop Dredge	GreatSChannelS	S/U	78,251	61,294	78,962	164,314	9,146	14	237	2010 - 2012

Table 69 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Great South Channel Alternative 4, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level. Shrimp Trawl effort is not reported due to privacy concerns.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Cox Ledge	Bottom Trawl	2005 - 2012	40.57	65.13	0.62	0.06	1.54
Cox Ledge	Bottom Trawl	2008 - 2012	40.56	63.80	0.64	0.09	1.56
Cox Ledge	Bottom Trawl	2010 - 2012	42.03	65.00	0.65	0.13	1.56
Cox Ledge	GC Scallop	2005 - 2012	27.25	12.63	2.16	0.37	4.72
Cox Ledge	GC Scallop	2008 - 2012	15.30	10.20	1.50	0.21	2.89
Cox Ledge	GC Scallop	2010 - 2012	10.10	4.67	2.16	0.29	3.67
Cox Ledge	LA Scallop	2005 - 2012	94.35	53.75	1.76	0.03	6.58

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
Cox Ledge	LA Scallop	2008 - 2012	45.62	34.40	1.33	0.04	4.99
Cox Ledge	LA Scallop	2010 - 2012	19.16	28.00	0.68	0.01	3.68
GreatSChannelS	Bottom Trawl	2005 - 2012	1,641.46	105.25	15.60	0.65	49.20
GreatSChannelS	Bottom Trawl	2008 - 2012	758.79	90.00	8.43	0.62	38.33
GreatSChannelS	Bottom Trawl	2010 - 2012	349.57	78.00	4.48	0.72	11.64
GreatSChannelS	GC Scallop	2005 - 2012	80.45	51.25	1.57	0.26	4.36
GreatSChannelS	GC Scallop	2008 - 2012	57.39	43.00	1.33	0.16	5.07
GreatSChannelS	GC Scallop	2010 - 2012	53.71	36.33	1.48	0.06	6.83
GreatSChannelS	LA Scallop	2005 - 2012	2,027.16	271.13	7.48	0.39	29.41
GreatSChannelS	LA Scallop	2008 - 2012	1,388.10	229.60	6.05	0.33	22.05
GreatSChannelS	LA Scallop	2010 - 2012	1,401.53	249.00	5.63	0.41	20.12

Table 70 – Recreational fishing revenue associated with the Great South Channel Alternative 4. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CoxLedge	2006 - 2012	105,303.00	12.00	974.14	2,340.07	2,034.52	1,755.97
CoxLedge	2008 - 2012	109,873.91	11.40	1,016.00	2,357.81	2,034.52	1,765.19
CoxLedge	2010 - 2012	106,187.16	12.33	971.00	2,123.74	1,820.36	1,615.31
GreatSChannelS	2006 - 2012	64,469.76	6.00	365.86	3,049.25	1,117.74	2,709.01
GreatSChannelS	2008 - 2012	31,024.97	4.20	172.60	2,543.03	1,117.74	2,455.78
GreatSChannelS	2010 - 2012	6,458.05	2.67	34.67	1,019.69	931.45	462.06

Table 71 – Mobile bottom-tending gear in currently open portions of the Great South Channel Habitat Alternative 5 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	NantucketShoalsS	L	570,316	576,026	353,624	1,179,726	90,657	88	592	2005 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	NantucketShoalsS	L	374,087	442,386	224,900	584,302	90,657	72	538	2008 - 2012
Bottom Trawl	NantucketShoalsS	L	414,236	567,750	280,350	584,302	90,657	71	647	2010 - 2012
Bottom Trawl	NantucketShoalsS	M	79,626	75,473	45,170	160,701	11,767	41	241	2005 - 2012
Bottom Trawl	NantucketShoalsS	M	73,788	71,013	55,795	160,701	11,767	35	215	2008 - 2012
Bottom Trawl	NantucketShoalsS	M	81,160	71,013	74,984	160,701	11,767	33	189	2010 - 2012
Bottom Trawl	NantucketShoalsS	S/U	15,080	16,098	8,592	25,001	2,365	20	361	2005 - 2012
Bottom Trawl	NantucketShoalsS	S/U	13,008	12,344	8,595	23,145	2,365	17	298	2008 - 2012
Bottom Trawl	NantucketShoalsS	S/U	15,120	19,851	11,169	23,145	2,365	16	355	2010 - 2012
Clam Dredge	NantucketShoalsS	ALL	2,453,553	2,058,049	1,684,963	5,712,961	644,828	8	274	2005 - 2012
Clam Dredge	NantucketShoalsS	ALL	3,020,217	3,066,067	1,907,591	5,712,961	644,828	9	360	2008 - 2012
Clam Dredge	NantucketShoalsS	ALL	4,170,150	3,731,422	1,376,908	5,712,961	3,066,067	12	510	2010 - 2012
SAP Trawl	NantucketShoalsS	ALL	3,318	0	6,689	19,379	0	11	11	2005 - 2012
SAP Trawl	NantucketShoalsS	ALL	5,309	3,367	8,068	19,379	0	11	18	2008 - 2012
SAP Trawl	NantucketShoalsS	ALL	8,848	3,797	9,123	19,379	3,367	11	29	2010 - 2012
Scallop Dredge	NantucketShoalsS	L	2,247,293	1,428,113	2,566,978	7,859,841	159,673	101	262	2005 - 2012
Scallop Dredge	NantucketShoalsS	L	2,229,058	956,143	3,223,209	7,859,841	159,673	75	173	2008 - 2012
Scallop Dredge	NantucketShoalsS	L	3,306,533	1,900,083	4,038,158	7,859,841	159,673	92	221	2010 - 2012
Scallop Dredge	NantucketShoalsS	M	226,102	110,925	297,746	921,425	19,961	23	170	2005 - 2012
Scallop Dredge	NantucketShoalsS	M	229,945	58,357	387,653	921,425	19,961	13	95	2008 - 2012
Scallop Dredge	NantucketShoalsS	M	347,611	101,449	498,604	921,425	19,961	15	114	2010 - 2012
Scallop Dredge	NantucketShoalsS	S/U	98,242	77,045	92,458	255,234	5,956	33	396	2005 - 2012
Scallop Dredge	NantucketShoalsS	S/U	42,304	28,860	34,191	90,695	5,956	14	171	2008 - 2012
Scallop Dredge	NantucketShoalsS	S/U	53,349	63,395	43,253	90,695	5,956	12	205	2010 - 2012

Table 72 – Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Great South Channel Alternative 5, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
NantucketShoalsS	Bottom Trawl	2005 - 2012	666.10	105.00	6.34	0.65	19.27
NantucketShoalsS	Bottom Trawl	2008 - 2012	394.04	90.20	4.37	0.64	14.66
NantucketShoalsS	Bottom Trawl	2010 - 2012	251.70	78.33	3.21	0.71	9.40

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
NantucketShoalsS	GC Scallop	2005 - 2012	55.58	51.63	1.08	0.15	2.29
NantucketShoalsS	GC Scallop	2008 - 2012	36.84	43.20	0.85	0.07	1.93
NantucketShoalsS	GC Scallop	2010 - 2012	24.22	36.67	0.66	0.02	1.76
NantucketShoalsS	LA Scallop	2005 - 2012	565.24	270.88	2.09	0.25	11.21
NantucketShoalsS	LA Scallop	2008 - 2012	356.67	230.00	1.55	0.19	8.53
NantucketShoalsS	LA Scallop	2010 - 2012	393.38	247.33	1.59	0.23	8.86

Table 73 – Recreational fishing revenue associated with the Great South Channel Alternative 5. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
NantucketShoalsS	2006 - 2012	40,207.49	6.43	221.57	1,481.33	1,117.74	1,605.44
NantucketShoalsS	2008 - 2012	36,047.85	5.40	195.80	1,802.39	931.45	2,016.68
NantucketShoalsS	2010 - 2012	9,252.40	3.00	49.67	957.15	931.45	184.45

Table 74 – Mobile bottom-tending gear in currently open portions of the Great South Channel Habitat Alternative 6 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GreatSChannelGMA	L	2,207,843	1,916,766	1,370,059	4,836,469	638,137	98	732	2005 - 2012
Bottom Trawl	GreatSChannelGMA	L	1,388,785	1,640,367	638,480	2,177,729	638,137	84	671	2008 - 2012
Bottom Trawl	GreatSChannelGMA	L	1,376,020	1,640,367	471,293	1,655,802	831,890	92	874	2010 - 2012
Bottom Trawl	GreatSChannelGMA	M	131,637	86,331	114,172	339,215	16,297	36	139	2005 - 2012
Bottom Trawl	GreatSChannelGMA	M	56,397	61,349	34,125	103,969	16,297	31	124	2008 - 2012
Bottom Trawl	GreatSChannelGMA	M	78,004	68,693	22,785	103,969	61,349	33	150	2010 - 2012
Bottom Trawl	GreatSChannelGMA	S/U	5,498	3,620	4,964	14,261	888	8	32	2005 - 2012
Bottom Trawl	GreatSChannelGMA	S/U	3,073	2,321	2,401	6,589	888	6	25	2008 - 2012
Bottom Trawl	GreatSChannelGMA	S/U	2,630	2,321	1,634	4,396	1,173	6	31	2010 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
SAP Trawl	GreatSChannelGMA	ALL	48,830	0	94,631	266,653	0	15	25	2005 - 2012
SAP Trawl	GreatSChannelGMA	ALL	78,129	23,463	113,181	266,653	0	15	40	2008 - 2012
SAP Trawl	GreatSChannelGMA	ALL	130,214	100,526	124,284	266,653	23,463	15	66	2010 - 2012
Bottom Trawl	NantucketShoalsL	L	633,138	625,418	335,090	1,245,329	204,070	99	703	2005 - 2012
Bottom Trawl	NantucketShoalsL	L	446,622	468,734	188,460	626,400	204,070	85	677	2008 - 2012
Bottom Trawl	NantucketShoalsL	L	520,102	624,436	182,415	626,400	309,470	92	849	2010 - 2012
Bottom Trawl	NantucketShoalsL	M	99,294	87,403	47,127	200,484	54,946	48	338	2005 - 2012
Bottom Trawl	NantucketShoalsL	M	98,759	83,630	58,921	200,484	54,946	44	338	2008 - 2012
Bottom Trawl	NantucketShoalsL	M	115,355	83,630	74,516	200,484	61,953	45	335	2010 - 2012
Bottom Trawl	NantucketShoalsL	S/U	31,843	34,299	13,373	48,933	16,506	25	535	2005 - 2012
Bottom Trawl	NantucketShoalsL	S/U	30,869	28,333	14,441	48,933	16,506	23	505	2008 - 2012
Bottom Trawl	NantucketShoalsL	S/U	39,895	42,420	10,529	48,933	28,333	22	632	2010 - 2012
Clam Dredge	NantucketShoalsL	ALL	2,694,273	2,383,494	1,754,285	5,897,333	725,622	8	277	2005 - 2012
Clam Dredge	NantucketShoalsL	ALL	3,320,111	3,674,163	1,934,318	5,897,333	725,622	9	360	2008 - 2012
Clam Dredge	NantucketShoalsL	ALL	4,521,035	3,991,610	1,202,431	5,897,333	3,674,163	12	510	2010 - 2012
SAP Trawl	NantucketShoalsL	ALL	11,806	0	24,756	70,551	0	13	19	2005 - 2012
SAP Trawl	NantucketShoalsL	ALL	18,889	3,513	30,088	70,551	0	13	31	2008 - 2012
SAP Trawl	NantucketShoalsL	ALL	31,482	20,383	34,870	70,551	3,513	13	51	2010 - 2012
Scallop Dredge	NantucketShoalsL	L	2,717,833	2,170,291	2,473,056	7,935,455	273,143	129	327	2005 - 2012
Scallop Dredge	NantucketShoalsL	L	2,953,748	1,924,669	3,063,101	7,935,455	273,143	116	265	2008 - 2012
Scallop Dredge	NantucketShoalsL	L	4,510,166	3,670,374	3,092,140	7,935,455	1,924,669	160	372	2010 - 2012
Scallop Dredge	NantucketShoalsL	M	269,536	178,862	289,018	929,640	48,756	28	189	2005 - 2012
Scallop Dredge	NantucketShoalsL	M	294,678	102,134	373,504	929,640	48,756	19	123	2008 - 2012
Scallop Dredge	NantucketShoalsL	M	455,341	334,251	426,836	929,640	102,134	24	160	2010 - 2012
Scallop Dredge	NantucketShoalsL	S/U	102,472	82,210	91,793	257,792	20,699	35	418	2005 - 2012
Scallop Dredge	NantucketShoalsL	S/U	47,361	28,868	34,415	100,284	20,699	17	202	2008 - 2012
Scallop Dredge	NantucketShoalsL	S/U	61,706	64,136	39,848	100,284	20,699	17	254	2010 - 2012

Table 75 - Fishing Effort (in hours fished), and individuals fishing in areas currently open to fishing within the Great South Channel Alternative 6, estimated from VMS polls using the approach of Records and Demarest (2013). Total Effort and Individuals are the annual average across all years identified, while the remaining statistics are calculated at the individual level.

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
GreatSChannelGMA	Bottom Trawl	2005 - 2012	8,869.55	115.38	76.88	2.51	175.30
GreatSChannelGMA	Bottom Trawl	2008 - 2012	5,065.59	97.00	52.22	1.21	139.88
GreatSChannelGMA	Bottom Trawl	2010 - 2012	2,916.86	84.33	34.59	1.62	95.58
NantucketShoalsL	Bottom Trawl	2005 - 2012	693.25	105.50	6.57	0.81	19.25
NantucketShoalsL	Bottom Trawl	2008 - 2012	423.48	91.00	4.65	0.79	14.76
NantucketShoalsL	Bottom Trawl	2010 - 2012	275.85	79.33	3.48	0.90	9.49
NantucketShoalsL	GC Scallop	2005 - 2012	65.37	52.00	1.26	0.22	2.69
NantucketShoalsL	GC Scallop	2008 - 2012	44.87	43.40	1.03	0.10	2.57
NantucketShoalsL	GC Scallop	2010 - 2012	28.46	36.67	0.78	0.04	2.11
NantucketShoalsL	LA Scallop	2005 - 2012	688.08	275.00	2.50	0.39	11.96
NantucketShoalsL	LA Scallop	2008 - 2012	441.58	234.60	1.88	0.27	9.36
NantucketShoalsL	LA Scallop	2010 - 2012	486.45	252.00	1.93	0.29	9.65

Table 76 – Recreational fishing revenue associated with the Great South Channel Alternative 6. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
GSC GMA	2006 - 2012	96,898.40	5.14	538.14	4,743.28	5,588.70	2,772.29
GSC GMA	2008 - 2012	46,132.36	3.60	251.40	4,271.51	5,047.22	2,834.63
GSC GMA	2010 - 2012	24,466.09	3.33	131.33	2,823.01	1,117.74	2,193.29
NantucketShoalsL	2006 - 2012	55,776.01	7.71	305.14	1,323.50	931.45	1,428.93
NantucketShoalsL	2008 - 2012	49,050.89	6.80	265.60	1,459.85	931.45	1,693.14
NantucketShoalsL	2010 - 2012	22,603.19	5.00	121.33	1,027.42	931.45	828.13

4.1.3.1.5.1 Alternative 1 (No action)
To be completed later.

4.1.3.1.5.2 Alternative 2 (No Habitat Management Areas)
To be completed later

4.1.3.1.5.3 Alternative 3
Figure 28 and Figure 29 overview the gear active in the vicinity of Great South Channel Extended and Cox Ledge. The preponderance of revenue in Great South Channel Extended is generated by Scallop Dredge gear, while Cox Ledge has a substantial amount of revenue from both Sink Gillnet and Shrimp/Bottom Trawl trips. Table 65 provides more details on the mobile bottom-tending gear directly impacted by the management options being considered within the Great South Channel/Southern New England HMA 3. In Cox Ledge, the mean revenue per trip for Shrimp and Bottom Trawl vessels between 50 ft and 70 ft, which accounts for 86% of all the trawl revenue in this area, is $257. This result is likely due at least in part to the fact that Cox Ledge is small enough that it fails to fully encompass Shrimp and Bottom trawl trips. Additionally, the VTR points suggest that Cox Ledge abuts more productive centers for Shrimp and Bottom Trawl fishing, as opposed to being centers themselves. Mean Clam Dredge revenue per trip in Cox Ledge is estimated to be $1,010, with a much smaller number of individuals active. This suggests that a small number of individuals are more intensively using the waters around Cox Ledge, although again the small size of these areas likely drives some of the analytical results. Mean Scallop Dredge revenue per trip is $538 for vessels > 70 ft, $186 for vessels between 50 ft and 70 ft, and $18 for vessels < 50 ft.

The mean Scallop Dredge revenue from Great South Channel Extended is estimated to be $38,454 for vessels > 70 ft, $9,740 for vessels between 50 ft and 70 ft, and $3,152 for vessels < 50 ft. Clam Dredge is also estimated to be highly active in this area, with a mean per trip revenue of $7,923. Trip revenue from Bottom Trawls are estimated to be $1,148 for vessels > 70 ft, $438 for vessels between 50 ft and 70 ft, and $163 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $1,384.

Table 66 presents the VMS analysis. Bottom Trawl effort is estimated to be minimal within Cox Ledge, and the mean individual effort is just under 40 minutes a year, again lending credence to the assertion that this area is not a center of Bottom Trawl fishing, although the small size of Cox Ledge again plays a role in the results. Both LA and GC Scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The LA and GC effort in Great South Channel Extended is consistently high, as would be expected given VTR analysis. The Scallop PDT is conducting a more thorough analysis of the benefits and costs of management options in GSC/SNE Alternative 3, which will further inform the VTR and VMS analysis. However, the Bottom Trawl effort seems to follow a downward trend not witnessed in the VTR analysis, with the 2010 – 2012 annual effort at only 31% of the 2005 – 2012 average. Nevertheless, a substantial amount of Bottom Trawl effort is still estimated to fall within Great South Channel Extended.

Table 67 overviews the recreational fishing reported in Cox Ledge and Great South Channel Extended. Although the revenue reported within Cox Ledge is consistently high across all time periods, the Great South Channel has seen a decrease of 88% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 89% for the number of angler trips.

4.1.3.1.5.4 Alternative 4

Figure 29 and Figure 30 overview the gear active in the vicinity of Great South Channel and Cox Ledge. The Great South Channel area is nested within the borders of Great South Channel Extended area in the GSC/SNE Alternative 3, and thus the discussion will look to compare the two areas. Similarly to the larger Great South Channel Extended, revenue associated with Great South Channel is predominantly associated with Scallop Dredges, although a relatively large proportion is also generated by Clam Dredge. In Cox Ledge a substantial amount of revenue is generated from both Sink Gillnet and Shrimp/Bottom Trawl trips. Table 68 provides more details on the mobile bottom-tending gear directly impacted by the management options being considered within the Great South Channel/Southern New England HMA 4. In Cox Ledge, the mean revenue per trip for Shrimp and Bottom Trawl vessels between 50 ft and 70 ft, which accounts for 86% of all the trawl revenue in this area, is $257. This result is likely due at least in part to the fact that Cox Ledge is small enough that it fails to fully encompass Shrimp and Bottom trawl trips. Additionally, the VTR points suggest that Cox Ledge abuts more productive centers for Shrimp and Bottom Trawl fishing, as opposed to being centers themselves. Mean Clam Dredge revenue per trip in Cox Ledge is estimated to be $1,010, with a much smaller number of individuals active. This suggests that a small number of individuals are more intensively using the waters around Cox Ledge, although again the small size of these areas likely drives some of the analytical results. Mean Scallop Dredge revenue per trip is $538 for vessels > 70 ft, $186 for vessels between 50 ft and 70 ft, and $18 for vessels < 50 ft.

The mean Scallop Dredge revenue from Great South Channel is estimated to be $24,923 for vessels > 70 ft, $5,415 for vessels between 50 ft and 70 ft, and $330 for vessels < 50 ft. This is respectively 65%, 56%, and 10% of the per-trip revenue for the same vessel categories estimated for Great South Channel Extended area. Overall, the annual Scallop Dredge revenue for Great South Channel represents 37% of what is estimated to be derived from Great South Channel Extended. Nevertheless, the VTR analysis potentially overestimates the revenue generated from vessels employing Scallop Dredges in Great South Channel. This is because the alternative was developed with input from LA Scallop industry representatives specifically in order to mitigate the greatest portion of the impact to the scallop fishery. The original proposal from LA industry representatives suggests that the majority of LA scallop revenue is generated deeper than the 35 m depth contour, which was not accounted for within the VTR analysis. The more spatially refined VMS analysis below sheds additional light on this issue. Clam Dredge is also estimated to be highly active in this area, with a mean per trip revenue of $7,819, with both the per trip and annual revenue representing 99% of that estimated for the larger Great South Channel Extended area. Trip revenue from Bottom Trawls are estimated to be $889 for vessels > 70 ft, $483 for vessels between 50 ft and 70 ft, and $67 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $415. For generic Bottom Trawls these revenues are 77%, 110%, 41%, and 30% of the same respective per-trip revenues estimated for Great South Channel Extended. All told, the Bottom/SAP Trawl annual revenue encapsulates 47% of the revenue estimated for these gear types in the Great South Channel area of GSC/SNE Alternative 3.

Table 69 presents the VMS analysis. Bottom Trawl effort is estimated to be minimal within Cox Ledge, and the mean individual effort is just under 40 minutes a year, again lending credence to the assertion that this area is not a center of Bottom Trawl fishing, although the small size of Cox Ledge again plays a role in the results. Both LA and GC Scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The LA and GC effort estimated for Great South Channel, respectively at 10% and 3%, is a small fraction of what was estimated for Great South Channel Extended in Alternative 3. The disparity between the VTR and VMS estimates is likely due to the overestimation of revenue, as indicated in the discussion of the VTR analysis for this GSC/SNE Alternative 4, with the VMS likely more representative of the scallop fishing in this area. The Scallop PDT is conducting a more thorough analysis of the benefits and costs of management options in GSC/SNE Alternative 3, which will further inform the analysis for GSC/SNE Alternative 4. However, the Bottom Trawl effort aligns more closely with the VTR estimate, with annual effort estimated to represent 30% of the effort within the encompassing Great South Channel Extended area. An average individual fishing with Bottom Trawl in this area is estimated to annually spend 1 hour and 20 minutes within the border of Great South Channel. Table 70 overviews the recreational fishing reported in Cox Ledge and Great South Channel. Although the revenue reported within Cox Ledge is consistently high across all time periods, the Great South Channel has seen a decrease of 90% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 91% for the number of angler trips.

4.1.3.1.5.5 Alternative 5

Figure 29 and Figure 31 overview the gear active in the vicinity of Cox Ledge and Nantucket Shoals. The preponderance of revenue in Great South Channel Extended is generated by Scallop Dredge gear, while Cox Ledge has a substantial amount of revenue from both Sink Gillnet and Shrimp/Bottom Trawl trips. Table 65 provides more details on the mobile bottom-tending gear directly impacted by the management options being considered within the Great South Channel/Southern New England HMA 3. In Cox Ledge, the mean revenue per trip for Shrimp and Bottom Trawl vessels between 50 ft and 70 ft, which accounts for 86% of all the trawl revenue in this area, is $257. This result is likely due at least in part to the fact that Cox Ledge is small enough that it fails to fully encompass Shrimp and Bottom trawl trips. Additionally, the VTR points suggest that Cox Ledge abuts more productive centers for Shrimp and Bottom Trawl fishing, as opposed to being centers themselves. Mean Clam Dredge revenue per trip in Cox Ledge is estimated to be $1,010, with a much smaller number of individuals active. This suggests that a small number of individuals are more intensively using the waters around Cox Ledge, although again the small size of these areas likely drives some of the analytical results. Mean Scallop Dredge revenue per trip is $538 for vessels > 70 ft, $186 for vessels between 50 ft and 70 ft, and $18 for vessels < 50 ft.

The mean Scallop Dredge revenue from Great South Channel Extended is estimated to be $38,454 for vessels > 70 ft, $9,740 for vessels between 50 ft and 70 ft, and $3,152 for vessels < 50 ft. Clam Dredge is also estimated to be highly active in this area, with a mean per trip revenue of $7,923. Trip revenue from Bottom Trawls are estimated to be $1,148 for vessels > 70 ft, $438 for vessels between 50 ft and 70 ft, and $163 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $1,384.

Table 66 presents the VMS analysis. Bottom Trawl effort is estimated to be minimal within Cox Ledge, and the mean individual effort is just under 40 minutes a year, again lending credence to the assertion that this area is not a center of Bottom Trawl fishing, although the small size of Cox

Ledge again plays a role in the results. Both LA and GC Scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The LA and GC effort in Great South Channel Extended is consistently high, as would be expected given VTR analysis. The Scallop PDT is conducting a more thorough analysis of the benefits and costs of management options in GSC/SNE Alternative 3, which will further inform the VTR and VMS analysis. However, the Bottom Trawl effort seems to follow a downward trend not witnessed in the VTR analysis, with the 2010 – 2012 annual effort at only 31% of the 2005 – 2012 average. Nevertheless, a substantial amount of Bottom Trawl effort is still estimated to fall within Great South Channel Extended.

Table 67 overviews the recreational fishing reported in Cox Ledge and Great South Channel Extended. Although the revenue reported within Cox Ledge is consistently high across all time periods, the Great South Channel has seen a decrease of 88% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 89% for the number of angler trips.

4.1.3.1.5.6 Alternative 6

Figure 29, Figure 32, and Figure 33 overview the gear active in the vicinity of Cox Ledge, Nantucket Shoals West, and Great South Channel Gear Modification Area (GMA). Scallop Dredge and Clam Dredge generate the majority of revenue from Nantucket Shoals West, Scallop Dredge revenue dwarfs the revenue generated from all other gears within the Great South Channel GMA area, and Cox Ledge has a substantial amount of revenue from both Sink Gillnet and Shrimp/Bottom Trawl trips. Table 74 provides more details on the mobile bottom-tending gear directly impacted by the management options being considered within the Great South Channel/Southern New England HMA 6. In Cox Ledge, the mean revenue per trip for Shrimp and Bottom Trawl vessels between 50 ft and 70 ft, which accounts for 86% of all the trawl revenue in this area, is $257. This result is likely due at least in part to the fact that Cox Ledge is small enough that it fails to fully encompass Shrimp and Bottom trawl trips. Additionally, the VTR points suggest that Cox Ledge abuts more productive centers for Shrimp and Bottom Trawl fishing, as opposed to being centers themselves. Mean Clam Dredge revenue per trip in Cox Ledge is estimated to be $1,010, with a much smaller number of individuals active. This suggests that a small number of individuals are more intensively using the waters around Cox Ledge, although again the small size of these areas likely drives some of the analytical results. Mean Scallop Dredge revenue per trip is $538 for vessels > 70 ft, $186 for vessels between 50 ft and 70 ft, and $18 for vessels < 50 ft.

The mean Scallop Dredge revenue from Nantucket Shoals West is estimated to be $12,124 for vessels > 70 ft, $2,846 for vessels between 50 ft and 70 ft, and $243 for vessels < 50 ft. The total Scallop Dredge revenue estimated to fall within the Nantucket Shoals West area is 36% of the Scallop Dredge revenue within Nantucket Shoals, 18% of that of the adjoining Great South Channel Extended area, and 49% of Great South Channel. Clam Dredge is estimated to generate a mean per trip revenue of $8,865 within Nantucket Shoals West, and total revenue is 8% higher than Nantucket Shoals, 14% higher than the Great South Channel Extended and 12% higher than the Great South Channel areas. Per-trip revenue from Bottom Trawls is estimated to be $613 for vessels > 70 ft, $344 for vessels between 50 ft and 70 ft, and $63 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $617. Total combined Bottom Trawl and SAP Trawl revenues are estimated to be 36% higher than Nantucket Shoals, 51% lower than Great South Channel Extended, and 4% higher than Great South Channel.

The Great South Channel GMA also generates a substantial amount of Bottom and SAP Trawl revenue. The mean per-trip revenue estimated to fall within the GMA is $1,574 for vessels > 70 ft, $520 for vessels between 50 ft and 70 ft, and$85 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $1,973. Both the number of individuals and trips estimated to be affected by any gear modifications are relatively high.

Table 75 presents the VMS analysis. Bottom Trawl effort is estimated to be minimal within Cox Ledge, and the mean individual effort is just under 40 minutes a year, again lending credence to the assertion that this area is not a center of Bottom Trawl fishing, although the small size of Cox Ledge again plays a role in the results. Both LA and GC Scallop vessels are estimated to have effort levels that have tapered off over recent history, which is a trend also apparent from the VTR analysis. The LA Scallop effort in Nantucket Shoals West is relatively low for the surrounding areas, and is estimated to be 4% of the effort falling within the Great South Channel Extended, 45% of that associated with Great South Channel, and 124% of Nantucket Shoals. GC Scallop effort is substantially lower, estimated to be 47 minutes per year for the average individual, a level 1% of the Great South Channel Extended level, 53% of that estimated for Great South Channel, and 118% of Nantucket Shoals. The Scallop PDT is conducting a more thorough analysis of the benefits and costs of management options in GSC/SNE Alternative 3, which will further inform the VTR and VMS analysis. Bottom Trawl effort is estimated to be lower than both Great South Channel Extended and Great South Channel, respectively representing 23% and 79% of the effort associated with these two areas, although it is 110% of Nantucket Shoals. It is unclear what is driving the difference between the VMS and VTR analysis, with the VTR suggesting that Nantucket Shoals West generates higher Bottom/SAP trawl revenue than Great South Channel, and the VMS analysis suggesting that effort is lower in Nantucket Shoals West than Great South Channel. However, it is possible that some of the effort accounted for in the VTR is not in the VMS analysis due to the fact that VMS is not required on all vessels.

The VMS analysis indicates a substantial amount of effort associated with Bottom Trawls in the Great South Channel GMA, in terms of number of individuals and annual time, although the 2010 – 2012 annual effort estimate is only 33% of the 2005 – 2012 average suggesting a downward trend.

Table 76 overviews the recreational fishing reported in Cox Ledge, Nantucket Shoals West, and Great South Channel GMA areas. Although the revenue reported within Cox Ledge is consistently high across all time periods, both Nantucket Shoals West and Great South Channel GMA have respectively seen decreases of 59% and 75% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 40% and 76% for the number of angler trips, which is consistent with the other management alternatives in the area.

4.1.3.2 *Community impacts*

There are numerous social impacts associated with the habitat management alternatives. While each alternative includes distinct actions, impacts can be associated with five general actions: 1) maintaining the status quo/the no action alternative, 2) opening or modifying previously closed areas, 3) closing new areas, 4) gear modifications/exemptions. This section provides a discussion of the social impacts that are most likely to result from these five management tools that form the basis for most of the spatial habitat management alternatives under consideration in this amendment.

Maintain Status Quo/No Action Alternative

The No Action Alternatives would result in mainly neutral impacts as they would maintain the status quo. There may be some positive social impacts associated with the stability created by continuing current management strategies that allows for fishermen to keep consistent, long-term plans. In scenarios where there are currently no closed areas there could be possible small negative social impacts on the *Attitudes, Beliefs and Values* of the fishermen regarding management if they see this alternative as a missed opportunity to implement new management that could help improve fish populations. These negative impacts on the *Attitudes, Beliefs and Values* of the fishermen may also occur in scenarios where the no action alternative will maintain current closed areas. In informational interviews conducted by the NEFMC, fishermen questioned the success of the current closed areas, citing the continued decline in many groundfish stocks.

Opening previously closed areas (No HMAs)

There are also a number of social impacts associated with opening a previously closed area. Opening additional areas for access to fishing can create opportunities for increased catch and revenue, leading to increased occupational opportunities and positive impacts on the *Historic and Present Participation* as well as the *Size and Demographics* in the affected fisheries. Fishermen often comment that once areas are closed, they are never opened again, so the opening of previously closed areas may have a positive impact on the *Values, Attitudes and Beliefs* of fishermen regarding the flexibility of management.

There are many positive social impacts associated with opening closed areas, however there are some negative social impacts as well. First, if the current closed areas are improving fish stocks, creating a spillover benefit into fishable areas, this benefit is lost. Second, there is the potential for gear conflicts resulting from opening closed areas. Some gear types have been exempted from current closure areas and the addition of new, competing gears may cause conflicts between user groups which can exacerbate intra- and intercommunity conflicts, create additional perceptions of inequity, and weaken overall cohesion within communities. These conflicts can occur within a gear type as well, if the perception of larger available catches in a newly opened area creates a derby fishery, resulting in intense fishing effort concentrated in the area, landings that are too high, in too short a time period, causing lower prices and a waste of quota.

Closing new areas

Closing areas that are currently available to fishing will have numerous social impacts across various fisheries and communities. The most direct impacts will be on vessels currently fishing in these areas that will no longer have access due to the closures. The addition of new closed areas would force MBTG vessel operators to modify where and how they fish having a negative impact on the *Historic and Present Participation* in the affected fisheries. This would also have a negative social impact on the *Size and Demographics* of the affected fisheries because of a probable reduction in fishing opportunity, revenue and employment. Negative social impacts would be expected in *Life-style/Non-economic social aspects* of the fishery, as fishermen would have less flexibility in choosing where to fish. The ability to adapt to closed areas is highly variable and largely dependent on the physical location of the closed areas. Less mobile fishermen may bear a heavier burden as they are less able to easily switch harvest areas (out of closed areas, or into reopened areas). Smaller vessels will be less able to adapt to closures of areas near shore as their range is limited and they cannot easily target offshore areas. Any change in fishing behavior that attempts to employ a more mobile fishing strategy will have additional social costs such as disruptions to family and community life as well as increasing the likelihood of safety risks. Increased risk can result when fishermen spend longer periods at sea in order to minimize steam time to and from fishing grounds, operate with fewer crew, and fish in poor weather conditions. Fishermen severely impacted by the new closed areas may leave fishing entirely or at least seek temporary opportunities in another fishery or gear type that is less affected by the management alternatives. Both possibilities would cause a change in the *Size and Demographics* of the different fisheries.

The tables in the following section (beginning with Table 77) identify the communities impacted by each alternative. These communities were selected based on the port of landing or city of registration associated with vessels identified as impacted by the potential new closure areas by the economic analysis described in section 4.1.3.1. For background information on these communities see the Human Communities and the Fishery section of the Affected Environment (Volume 1). In addition to the ports explicitly identified, other ports are impacted but could not be detailed due to privacy concerns.

Communities impacted both at the port of landing and city of registration are included because of the differing impacts associated with each community type. Potential impacts related to the port of landing include a loss of landings and revenue that can affect the fisheries infrastructure in the community. The city where the permit is registered is generally where the permit owner resides. Impacts to these communities may be widespread beyond fisheries related aspects of the communities. Permits are often registered in different cities than the ports where the vessels land so the number of vessels cannot be added across community type as this may result in double counting vessels.

It not likely that this action would affect all of these communities to the same extent. Those communities that are more dependent on fishing particularly with the affected gear types would likely have more social impacts than those that participate in a range of fisheries and gear types. Even among communities with similar dependence, there are likely to be different impacts since some measures have localized impacts. Additionally, the general level of vulnerability and resilience of a community will determine the magnitude of the impact. Social Vulnerability Indicators of each community are listed in the Affected Environment section (Volume 1). These indices correspond to different components of social vulnerabilities that may affect communities. For more information on these indices see Jepson and Colburn, 2013 or http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/index. The number of vessels impacted is also included in the management area tables (Table 77-73) for a general representation of the impact to each community. This is not a representation of the magnitude of impact as each vessel may be impacted differently. It is important to remember that a single vessel can land in multiple ports so each vessel may be included in more than one community at the port level.

As fishermen change their behavior to attempt to adjust to the lack of access to a closed area there will likely be an impact on vessels currently fishing in areas in close proximity the proposed closed areas. When the original seasonal and year-round groundfish closures were implemented in the Gulf of Maine, the shift in otter trawl fishing effort was highly concentrated to the boarders of those closed areas (Murawski et al 2005). The shift in effort to marginal areas is an attempt to "fish the line" has been shown to be part of an optimal fishing strategy capitalizing on the biological "spillover" from a closed area (Kellner et al. 2007). Because closed areas do not reduce fishing effort, they only displace it, (Halpern et al. 2004, Greenstreet et al. 2009) the subsequent concentration of effort localized at the boundaries of closures has led to crowding and gear conflicts among fishermen (Suuronen et al. 2010). This congestion and conflict would have a negative social impact on *Social Structures and Organizations*. This impact on *Social Structures and Organizations* would be exacerbated if the new closed areas are seen as benefiting a particular segment of the fishery at the expense of another.

Additional impacts on the *Attitudes, Values and Beliefs* of fishermen may be more widespread and affect communities not directly impacted by the new closures. Some fishermen generally question the efficacy of habitat closures. In informational interviews conducted by the NEFMC fishermen commented that natural disturbances such as storms and large-scale oceanic changes have a greater impact on the benthic environment than fishing gear and that small levels of benthic disturbance are beneficial. There are many instances in which fishermen have differing views than those held by federal ocean/fisheries scientists. A fisherman's view is based largely on personal experience and their own proximal environment, which can be at odds with the larger environment described by fisheries scientists. This continued lack of faith in the science used to direct management decisions could undermine the perceived legitimacy of future management actions and have a negative social impact on the formation of *Attitudes and Beliefs* about management. The impact of revising closed area management strategies on the *Attitudes, Values and Beliefs* of fishermen is uncertain and is largely related to the level of acceptance and belief in the efficacy of closed area management by stakeholders, which varies considerably. While the aforementioned impacts are generally negative, there is the potential for positive social impacts derived from closing new areas. These are generally associated with the potential future and long-term benefits created by the improvement of fish stocks generated from new closed areas. These benefits are difficult to analyze because of the uncertainty associated with the magnitude of the benefit, how these benefits would be distributed among fishing communities and the timing of these impacts. For example, vessels that are unable to adapt to new restrictions in the short-term may not be able to benefit from the potential stock increases in the long-term. Additionally, the short-term impacts on markets, processing capability, and other infrastructure during the period of adjustment to new closed areas may be such that these shoreside resources are lost and unable to recover in the future when potential stock increases occur.

Additional discussion of the specific impacts of new area closures proposed in this amendment is provided within the discussion of the various alternatives.

Gear modifications (options 2-4)

In comparison to the no action alternatives, several gear modifications are being proposed in the alternatives under consideration. In terms of the SIA factors, gear modifications affect *changes in occupational opportunities and community infrastructure* and *Attitudes, Beliefs and Values* the most. Gear modifications can compromise business planning for shoreside support services and impose an economic burden on a large number of vessels. The social impacts likely to result from changes to gear restrictions are related to the cost for vessels to comply with and the ability of gear suppliers to adapt to the new gear restrictions. If the new gear required by the Proposed Action is not readily available, gear suppliers must order the gear well in advance of the effective date of the new regulation. In addition, new gear requirements can sometimes leave gear suppliers with a significant amount of the "old gear" that may no longer be marketable if it cannot be used in the fishery anymore (or in other fisheries). This results in a more significant loss of income for the gear suppliers.

Gear changes can affect short-term and long-term business planning for gear suppliers and related support services. The uncertainty associated with the implementation of new gear modification regulations necessitates gear suppliers to wait until it is definite that a new gear will be required. It is too risky and too expensive to order new gear prior to an official announcement of a new regulation. Quite often, this leaves gear suppliers uncertain about the short-term future needs for their business and makes it impossible for them to plan accordingly when developing longer-term business strategies.

Gear modifications place an additional economic burden on all affected fishing vessels. The ability to adapt to the new gear regulations will depend on vessels' current economic situation and ability to cover the short-term costs of the gear. If the new gear requirement is significantly different from current gear requirements, it is likely that the most marginal vessels will not be able to cover the costs of the new gear and will be forced to seek alternative fisheries or stop fishing altogether. For the vessels that can cover the short-term costs of the gear, long-term impacts are related more to the loss of revenues from fishing that may occur because of the new gear. For example, the ground cable modifications may affect the catch per unit effort of affected vessels. Thus a vessel may have to increase effort such as longer tows or more tows to achieve the same amount of catch. Over the long-term, this may result in more significant economic impacts and, ultimately, more severe dislocation of vessels in the fishery.

Modifications to daily routines can make long-term planning difficult. New gear and equipment must be ordered months in advance resulting in changes to daily routines when these modifications cannot be met in a time and cost efficient manner. Further the cost of making such changes may prove to be a burden for some vessel owners. Additionally, the gear modifications will have differing impacts on vessels depending on their size class. According to informational interviews held by the NEFMC the requirement that bottom trawl vessels use ground cables modified with elevating disks will have a more significant impact on smaller vessels that may not have enough horse power to pull the gear through rugged bottom. In contrast, the requirement for shorter ground cables or eliminating ground cables entirely may have greater impacts on larger vessels that are more difficult to operate with smaller cables.

The gear modification and exemptions apply differently to different fisheries with varying levels of restriction. Some options exempt hydraulic clam dredges, while the gear restrictions only apply to bottom trawl vessels. The differing levels of restrictions on different fisheries could have a negative social impact, exacerbating conflict between fisheries and negatively affecting the *Social Structures and Organizations* of a community, as well as having a negative impact on formation of *Attitudes and Beliefs* about management if users of particular gear types feel they are being unfairly restricted in comparison to others.

The magnitude and nature of the impacts of the gear restrictions under consideration in the Omnibus Amendment will depend on the cost and catch efficiency of the new gear, the current availability of the new gear, and vessels' choices as to whether or not to fish in the areas where the new gear is required. There are potential long-term positive social impacts of gear restrictions if they have significant benefits on habitat conservation, resulting in higher, sustained levels of catch, however these benefits are highly uncertain.

Some additional discussion of the impacts gear restrictions in specific areas proposed in this amendment is provided within the discussion of the various alternatives.

4.1.3.2.1 Eastern GOM

Table 77 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Eastern Gulf of Maine potentially impacted by the management alternatives.

Eastern Gulf of Maine		Alternative 2		Alternative 3	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**25**	**9**	**35**	**15**
	Boston	11		14	
	Gloucester	14		21	
	New Bedford	3	3	6	3
ME		**34**	**47**	**59**	**70**
	Beals		6		6
	Bremen				3
	Boothbay Harbor			3	
	Friendship			4	4
	Jonesport	12	3	12	3
	New Harbor			3	
	Port Clyde	6	3	8	3
	Portland	8	7	18	10
	South Bristol		3	8	5
	Westbrook		3		3
	Winter Harbor		4		4

The social impacts of the Eastern Gulf of Maine Spatial Management alternatives would most heavily impact port communities in Maine based on the location of registration of affected vessels (**Table** 77). With the exception of Portland, ME most of these communities are smaller coastal communities that have limited economic opportunities outside of fishing. Many of these communities are heavily dependent on lobstering. While lobster gear would not be affected by these closures, other gear types that allow fishermen in these areas to diversify their harvest would be impacted, thus reducing their level of resilience to future impacts by reducing their diversification. Although Portland, ME is a larger community with a more diverse economy, diversity of fishing opportunities has declined in recent years. The social impacts related to port of landing are concentrated in Boston, MA. None of the identified communities would benefit from the clam dredge exemption (option 2) as it does not apply to dry dredges which are typically used in this area (Stevenston et al 2004). Communities in downeast Maine using scallop dredges would benefit from the gear modification options (option 3, 4) however due to privacy concerns these communities are not detailed in the analysis.

4.1.3.2.1.1 Alternative 1 (No action/no HMAs

Because there are currently no year-round closed areas in this sub-region, the no action habitat management alternative in the eastern Gulf of Maine and Scotian Shelf region does not include any habitat management areas. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.2.1.2 Alternative 2

Alternative 2 would designate two new habitat management areas, the Large Eastern Maine Habitat Management Area and the Machias Habitat Management Area. The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be negative. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.1.3 Alternative 3

Alternative 3 would designate three new habitat management areas, the Small Eastern Maine Habitat Management Area, the Machias Habitat Management Area, and the Toothaker Ridge Habitat Management Area. The short-term social impacts of Alternative 3 in comparison to the no action alternative are expected to be negative. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish stocks and there are spillover benefits in open areas.

4.1.3.2.2 Central GOM

Table 78 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Central Gulf of Maine potentially impacted by the management alternatives.

Central Gulf of Maine		Alternative 3		Alternative 4	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**61**	**38**	**39**	**19**
	Boston	17		15	
	Gloucester	28	11	22	7
	New Bedford	21	22	8	7

ME		37	44	23	22
	Harpswell		4		
	Port Clyde	6	3	6	3
	Portland	28	11	19	10
	South Bristol		4		4
	Westbrook		3		3

The social impacts of the Central Gulf of Maine Spatial Management alternatives would most heavily impact port landings in Maine as well as Boston, Gloucester and New Bedford in MA. Impacts to permit owners residing in Midcoast and Southern, ME (Table 78). None of the identified communities included vessels using clam dredges or scallop dredges and therefore would not benefit from the clam dredge exemption (option 2) or the gear modification options (option 3, 4).

4.1.3.2.2.1 Alternative 1 (No action)

The no action habitat management alternative in the central Gulf of Maine region includes the Jeffreys Bank and Cashes Ledge habitat closure areas. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.2.2.2 Alternative 2 (No HMAs)

This alternative would remove the current Cashes Ledge habitat closure area and would not designate any additional habitat management areas in the region. The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as fishermen would gain access to new fishing areas. There are potential long-term negative social impacts if benefits to fish populations from the Cashes Ledge closure area are lost.

4.1.3.2.2.3 Alternative 3

Alternative 3 would modify the boundaries of the current Jeffreys Bank and Cashes Ledge habitat closures, and designate three new habitat management areas: Ammen Rock, Fippennies Ledge, and Platts Bank. The social impacts of Alternative 3 in comparison to the no action alternative are expected to be negative. In particular, the modification of Jeffrey's Bank and the addition of the Platts Bank closed areas will have a large impact on fishing vessels from the midcoast Maine area. These vessels are highly dependent on groundfish in these areas. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.2.4 Alternative 4

Alternative 4 would modify the boundaries of the current Jeffreys Bank and Cashes Ledge habitat closures, and designate a new habitat management area on Ammen Rock. The social impacts of Alternative 4 in comparison to the no action alternative are expected to be negative. The impacts of the modification of Jeffreys Bank are discussed in alternative 3. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.3 Western GOM

Table 79 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Western Gulf of Maine potentially impacted by the management alternatives.

Western Gulf of Maine		Alternative 3		Alternative4	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**108**	**78**	**103**	**71**
	Boston	18		17	
	Gloucester	65	33	61	31
	New Bedford	26	25	25	23
	Newburyport	4		3	
	Rockport	3	3		3
ME		**67**	**74**	**32**	**44**
	Boothbay Harbor	4			
	Cundys Harbor	3			
	Harpswell	7	11		
	New Harbor	3			
	Port Clyde	6	3		
	Portland	40	13	25	11
	South Bristol	7	5		4
	Westbrook		3		3
NH		**21**	**20**	**18**	**18**
	Hampton		4		4
	Portsmouth	7		6	
	Rye	5		4	
	Seabrook	10	5	9	5

None of the identified communities included vessels using clam dredges so would not benefit from the clam dredge exemption (option 2). Many of the communities identified have vessels using scallop dredges and would benefit from the gear modification options (option 3, 4).

4.1.3.2.3.1 Alternative 1 (No action)

The no action habitat management alternative in the western Gulf of Maine region includes the Western Gulf of Maine habitat closure area as well as the Western Gulf of Maine Groundfish closed area. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.2.3.2 Alternative 2 (No HMAs)

This alternative would remove the current Western Gulf of Maine habitat closure area and would not designate any additional habitat management areas in the region. The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as fishermen would gain access to new fishing areas. There are potential long-term negative social impacts if benefits to fish populations from the WGOM habitat closure area are lost.

4.1.3.2.3.3 Alternative 3

Alternative 3 would modify the boundaries of the current WGOM habitat closure to create the Large Stellwagen Habitat Management Area, and designate the Large Bigelow Bight Habitat Management Area. The social impacts of the implementation of the Large Bigelow Bight Habitat Management Area would affect ports of landing and city of registration from Maine to Massachusetts. Analysis of the impacts of the modification of the current WGOM habitat closure are difficult due to the fact that this area is currently closed.

The short-term social impacts of Alternative 3 in comparison to the no action alternative are expected to be negative. The addition of the Large Bigelow Bight HMA would most likely have negative social impacts on smaller vessels that are more likely to fish inshore and cannot easily adapt to fishing in other areas or easily access the areas of the WGOM closure that would be opened. The access to the northern part of the WGOM closure may have positive social impacts on larger vessels. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas, however due to the geographic range of the Large Bigelow Bight area it may be difficult for smaller vessels to adapt in the near-term. Additionally fishermen in informational interviews conducted by the NEFMC commented that this would disproportionately impact the shrimp fishery as well as voicing concerns about the current impact of fixed gears in this area and how this may increase if mobile gears are restricted thus limiting the benefits to habitat in the area.

4.1.3.2.3.4 Alternative 4

Alternative 4 would modify the boundaries of the current WGOM habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Large Bigelow Bight Habitat Management Area. The social impacts of implementing the Large Bigelow Bight Habitat Management Area are discussed in Alternative 3. Analysis of the impacts of the modification of the current WGOM habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas is difficult due to the fact that these areas are currently closed, however positive social impacts related to the modification of the WGOM closure are less likely to benefit the small vessels which will be highly impacted by the Large Bigelow Bight Habitat Management Area. The social impacts of Alternative 4 in comparison to the no action alternative are expected to be negative. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.3.5 Alternative 5

Alternative 5 would also modify the boundaries of the current WGOM habitat closure to create the Small Stellwagen and Jeffreys Ledge Habitat Management Areas, and designate the Small Bigelow Bight Habitat Management Area. The social impacts of implementing the Small Stellwagen and Jeffreys Ledge Habitat Management Areas are discussed in Alternative 4. The implementation of the Small Bigelow Bight HMA would likely have negative social impacts, particularly affecting smaller vessels that are not able to adapt and fish further offshore, however these impacts will be less significant in comparison to the impacts associated with the Larger Bigelow Bight HMA included in Alternatives 3 and 4. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas. The social impacts of Alternative 5 in comparison to the no action alternative are expected to be negative.

4.1.3.2.3.6 Alternative 6

Alternative 6 would modify the boundaries of the current WGOM habitat closure to create the Large Stellwagen Habitat Management Area. The social impacts of Alternative 6 are expected to be positive. Minor social impacts are associated with fishing vessels adapting to the new boundaries of the Large Stellwagen Habitat Management Area because modifications from the current WGOM closure are minimal. The positive impact on habitat and resulting benefit to fish populations are likely to create positive long-term benefits.

4.1.3.2.3.7 Alternative 7

Alternative 7 would implement roller gear size restrictions as a habitat management measure in the WGOM. This alternative can be implemented in addition to any of the other six alternatives. The social impacts of Alternative 7 will depend upon the other spatial alternatives selected. Generally, due to the large geographic coverage of the Gear Modification Area, the social impacts are expected to be negative in comparison to the no action alternative, however this is highly uncertain and depends largely upon the tradeoff between catch efficiency and habitat impact of gear modifications.

4.1.3.2.4 Georges Bank

Table 80 – Total number of vessels by port of landing or city of registration associated with at least 3 vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of Georges Bank potentially impacted by the management alternatives.

Georges Bank		**Alternative # 3**		**Alternative # 4**		**Alternative # 5**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**140**	**95**	**136**	**95**	**135**	**94**
	Boston	10		11			
	Fairhaven		17		17		15
	Gloucester	24	9	23	9	24	9
	New Bedford	107	60	53	59	103	61
	Peabody		3		3		
ME		**3**	**20**	**4**	**20**	**5**	**20**
	Portland	3	9	4	9	5	10
	Westbrook		3		3		3
NC			**6**		**5**		**4**
NJ			**10**		**6**	**3**	**11**
	Cape May		5		4		5
NY							**3**
RI		**6**	**12**	**6**	**12**	**7**	**12**
	Point Judith	6		6		6	6
	Wakefield		6		6		

Communities in New Jersey, including some which are not identified in this analysis due to privacy concerns include vessels using clam dredges which would benefit from the clam dredge exemptions (option 2). Many of the identified communities, particularly New Bedford and

Fairhaven, MA and those in New Jersey include vessels using scallop dredges which would benefit from gear modification options (options 3, 4).

4.1.3.2.4.1 Alternative 1 (No action)

The no action habitat management alternative in the Georges Bank region includes the Closed Area I and Closed Area II habitat closure areas. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.2.4.2 Alternative 2 (No HMAs)

This alternative would remove the current CAI and CAII habitat closure areas and would not designate any additional habitat management areas in the region. This alternative would not affect the HAPC designation. The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as fishermen would gain access to new fishing areas. There are likely to be negative impacts in the form of gear conflict with existing lobster effort in these areas. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost.

4.1.3.2.4.3 Alternative 3

Alternative 3 would remove the current CAI habitat closure areas from the multispecies and sea scallop regulations and would modify the CAII habitat closure to create the Northern Edge Habitat Management Area. There are positive social impacts associated with Alternative 3 and the access gained to new fishing areas. However there are large negative impacts associated with Alternative 3, particularly the Northern Edge HMA that are likely to impact the scallop fishery. This would be alleviated by options 3 and 4. The clam dredge exemption of option 2 would have positive social impacts on vessels out of New Bedford, MA and New Jersey. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.4.4 Alternative 4

Alternative 4 would remove the current CAI habitat closure areas from the multispecies and sea scallop regulations and would modify the CAII habitat closure to create the Northern Edge Habitat Management Area. In addition, this alternative would establish the Small Georges Shoal Gear Modification Area (GMA), which would mandate either the no ground cable or the raised ground cable trawl gear restrictions. The social impacts associated with the Northern Edge HMA are discussed in Alternative 3. The social impacts of the small Georges Shoal GMA are uncertain due to the uncertain effects of the gear modification on the habitat and catch rates.

4.1.3.2.4.5 Alternative 5

Alternative 5 would remove the current CAI and CAII habitat closure areas from the multispecies and sea scallop regulations. This alternative would establish the Georges Shoal mobile-bottom tending gear HMA and establish the Large Georges Shoal Gear Modification Area (GMA). The social impacts of Alternative 5 in comparison to the no action alternative are highly uncertain given the potential tradeoffs between decreased catch rates and increased fishing time when using the modified gear. There are likely to be negative impacts from gear conflicts created by opening the current closures, particularly with lobster gear in CAII. However there are also positive impacts to other gear types gaining access to these previously closed areas. Given these uncertainties, it is likely that the social impacts of Alternative 5 will be somewhat negative.

4.1.3.2.5 Great South Channel/SNE

Table 81 – Total number and percent of vessels by port of landing or city of registration associated with at least three vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Great South Channel/Southern New England Areas potentially impacted by the management alternatives.

Great South Channel/Southern New England		Alternative # 3		Alternative # 4		Alternative # 5		Alternative # 6	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
CT		**19**	**11**	**19**	**11**	**19**	**11**	**19**	**11**
	New London	5		5		5		5	
	Stonington	14		14		14		14	
MA		**382**	**237**	**364**	**226**	**337**	**215**	**341**	**216**
	Barnstable	13		13		13		15	
	Boston	18		17		17		18	
	Chatham	13	3	12	3	12	3	12	3
	Chilmark	6		6		6		6	
	Fairhaven	11	34	10	34	10	30	10	3
	Falmouth	4		4		5		5	
	Gloucester	10	15	10	13	27	14	28	14
	Harwich				3		3		
	Harwichport	38		29		6		6	3
	Hyannis	6		6		5		6	
	Mattapoisset			3					
	Nantucket	4		4		10		11	
	New Bedford	281	131	274	128	248	120	254	122
	Peabody		3		3		3		3
	Provincetown	5							
	South Dartmouth		3		3		3		3
	Westport		3		3		3		
	Woods Hole	7		7		6		7	
ME		**5**	**29**	**5**	**27**	**5**	**27**	**5**	**27**
	Portland	5	11	5	11	5	11	5	11
NC		**3**	**34**	**6**	**34**	**6**	**34**	**7**	**35**
	Bayboro		3		3		3		3
	Beaufort	46		4		3		3	
	Hobucken		4		4		4		4
	New Bern		8		8		8		8
	Newport		3		3		3		
	Oriental		4		4		3		4
	Wanchese		4		4		4		4
NH			**3**		**3**		**3**		**3**

Great South Channel/Southern New England		**Alternative # 3**		**Alternative # 4**		**Alternative # 5**		**Alternative # 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
NJ		**7**	**88**	**33**	**86**	**33**	**74**	**36**	**76**
	Barnegat/ Barnegat Light	28	7	7	7	5	4	5	4
	Cape May	9	44	26	44	20	40	21	3
	Cape May Courthouse		8		7		4		41
	Manahawkin		5		5		5		5
	Point Pleasant	19		8		6		7	
NY		**17**	**23**	**19**	**23**	**18**	**23**	**19**	**24**
	Hampton Bays		3		3		3	18	3
	Montauk	86	14	27	14	16	14	16	14
RI		**12**	**59**	**86**	**59**	**84**	**58**	**86**	**59**
	Charlestown		5		5		5		5
	Newport	71		12		10		11	
	North Kingstown		5		5		5		5
	Point Judith/ Narragansett	59	9	71	9	70	9	71	9
	South Kingstown		3		3		3		3
	Wakefield		22		22		21		22
	West Kingston		4		4		4		4
	Westerly		3		3		3		3
VA		**3**	**55**	**58**	**44**	**50**	**35**	**52**	**36**
	Chincoteague	10		3		3		4	
	Gloucester		3		3		3		
	Hampton	25	9	21	9	18	7	18	9
	Newport News	22	11	24	10	20	7	21	7
	Seaford	21	9	10	9	9	8	9	8

The communities of Fairhaven and New Bedford, MA (at the port of landing level) and Cape May, Manahawkin, NJ (at the registered city level) will benefit from Clam exemptions in alternatives 3-5. Many vessels in these communities use scallop dredges and would benefit from selection of the gear modification options (Option 3-4).

4.1.3.2.5.1 Alternative 1 (No action)

The no action habitat management alternative in the Great South Channel/Southern New England region includes the Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.2.5.2 Alternative 2 (No HMAs)

Alternative 2 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would not designate any additional habitat management areas in the region. The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as fishermen would gain access to new fishing areas. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost.

4.1.3.2.5.3 Alternative 3

Alternative 3 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel i.e. the Extended Great South Channel HMA. Two additional habitat management areas would also be designated on Cox Ledge. The social impacts of Alternative 3 in comparison to the no action alternative are expected to be negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.5.4 Alternative 4

Alternative 4 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel. Two additional habitat management areas would also be designated on Cox Ledge. The social impacts of Alternative 4 in comparison to the no action alternative are expected to be negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.5.5 Alternative 5

Alternative 5 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals. This Nantucket Shoals area overlaps with the areas proposed via Alternatives 3 and 4, but is generally further to the west. Two additional habitat management areas would also be designated on Cox Ledge. The social impacts of Alternative 5 in comparison to the no action alternative are expected to be negative. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. Positive social impacts are possible in the long-term, if new closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.2.5.6 Alternative 6

Alternative 6 would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals. An additional area further east in the Great South Channel would be designated as a gear modification area. Two additional habitat management areas would also be designated on Cox Ledge. The social impacts of Alternative 6 in comparison to the no action alternative are expected to be positive. Vessels from numerous communities are currently fishing in these areas therefore the negative impacts of these closures would be widespread. However, due to the smaller area affected by the modification of the Nantucket Lightship Closure Area (resulting in the new Nantucket Shoals Area) the benefits from protecting habitat in these new areas may be significant enough to surpass the negative social impacts of adjusting to new areas and changing behavior.

4.1.3.3 *Protected resources*

All of the proposed year-round habitat management alternatives, except for the no action alternatives, would result in gear capable of catch groundfish, most notably for protected resources concerns, fixed gear, being allowed into areas where they had previously been restricted. Gillnets and traps and pots have been documented as having the most interactions with whales and dolphins as compared to trawl or hook gear. Sea turtle sightings and interactions with gillnet and trawl gear in most of the areas under consideration in this amendment are rare, except for interactions with scallop dredges in the Great South Channel/Southern New England sub-region. The management measures currently in place for the NE multispecies, monkfish, and skate fisheries (i.e., the fisheries that utilize gillnets and bottom trawls) and the scallop fishery all limit the overall amount of fishing effort. As a result, the changes proposed in this amendment would not be expected to result in an increase in fishing effort overall. In addition, the Atlantic Large Whale Take Reduction Plan implements gear restrictions, spatial and seasonally, to minimize interactions between endangered and protected whales and vertical lines from fishing gear as well as to reduce serious injury or mortality, should an interaction occur. The Harbor Porpoise Take Reduction Plan primarily utilizes gear restrictions, including closures, and pinger requirements, seasonally and spatially, to prevent interactions with fishing gear. A draft Batch Biological Opinion for seven of the Northeast region's fishery management plans, including the NE Multispecies, Monkfish, and Northeast Skate Complex FMPs under the jurisdiction of the New England Council, as well as the Spiny Dogfish, Mackerel, Squid, and Butterfish, and Summer Flounder, Scup, and Black Sea Bass FMPs for the Mid-Atlantic Council, has been published and final version is expected in the spring. This batch Biological Opinion describes the impact that these fisheries have on various protected species.

For the reasons described above and in the draft Biological Opinion, the impacts discussed below will primarily focus on the impacts from shifting fixed gear into areas that were previously prohibited, allowing scallop dredges in areas where they were previously prohibited, and to a lesser degree, the impact of concentrating fixed gear in areas that were previously open to mobile gear. There may be increases in localized effort as a result of some of these alternatives and the impacts from those changes will be discussed as well.

The highest abundance of North Atlantic right, humpback, fin, and sei whale populations occur from March through November in New England waters, which is also the peak fishing period for gillnet and bottom trawl gear, with gillnet gear peaking in the summer months. Low numbers of whales are present in New England waters through the winter, although a portion of the right whale population appears to remain in the Gulf of Maine in winter. Large whales are primarily susceptible to entanglement in vertical or ground lines associated with gillnets and trap/pot gear. Their large size and mobility presumably allows them to avoid interactions with trawl gear. According to the Draft "batch" Biological Opinion for seven of the Northeast region's fisheries, there were 129 entanglement events of large whales from 2006-2010. However, only 28 of those events could be categorized to a specific gear, and four of those events resulted in serious injury or mortality. Of those 28 events from known gear, 7 were caused by gillnets, 12 by lobster or other pot/trap gear, 7 by hook and line, and one caused by bottom longline and purse seine.

Table 82 – Gear Analysis for Entangled Large Whale Events (2006-2010)

Gear Type	Entanglement Events	Serious Injury or Mortality
Sink Gillnet	5	
Unspecified Gillnet	2	1
Lobster Gear	10	2
Other Pot/Trap	2	2
Hook and Line	7	
Bottom Longline	1	
Purse Seine	1	
Unknown	101	30
Total	129	35

There have been few documented interactions between commercial fishing gear and sea turtles in the Gulf of Maine region, and only a handful of interactions on Georges Bank and the Great South Channel (Map 60). The majority of sea turtle interactions occur in the Mid-Atlantic region, south and west of the the proposed areas in this amendment. In mid-2006, NMFS finalized a rule (71 FR 50361, August 23, 2006) that required scallop fishermen operating south of 41º 9.0' N from May 1 through November 30 each year to equip dredges with chain mats. The intent of the dredge gear modification is to reduce the severity of some turtle interactions that might occur by preventing turtles from entering the dredge bag. Chain mats do not decrease the number of turtles in contact with the gear; rather they decrease the likelihood that turtles will suffer serious injuries. In addition, a more recent scallop action implemented a requirement that all vessels fishing with a scallop dredge greater than or equal to 10.5 feet use a "turtle deflector dredge". This requirement only applies from May through October and west of 71º W, which is west of all of the proposed management areas.

Waring *et al*. (2013) provides the following account of harbor porpoise distribution. During the summer months, harbor porpoises are concentrated in the northern Gulf Of Maine and southern Bay Of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al*. 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000). During the fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline out to deep waters (>1800 m deep) although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region.

Since the most recent amendment to the Harbor Porpoise Take Reduction Plan in 2010 when time/area closures and pinger requirements were expanded, harbor porpoise population abundance estimates have increased (
Table 82). At the same time, estimated harbor porpoise human-caused mortality due to interactions with New England gillnet gear have declined from 792 porpoises per year using data through 2009 down to 340 porpoises per year using data through 2012. Pingers, when used properly, have a 92 percent success rate at eliminating interactions. When examining the 5-year average U.S. gillnet bycatch, estimates are below the Potential Biological Removal level for harbor porpoise for preliminary estimates through the years 2011 and 2012.

Table 83 Recent Harbor Porpoise Bycatch Estimates

	Final Data *through 2009*[1]	Final Data *through 2010*[2]	Preliminary Data *through 2011*[3]	Preliminary Data *through 2012*[3]
Stock Abundance (Min-Max)	60,970–89,054	61,415-79,883	61,415-79,883	61,415-79,883
Potential Biological Removal	701	706	706	706
Annual U.S. Gillnet Bycatch	792	646	396	340
5-Year Average U.S. Gillnet Bycatch	877	786	671	630

[1] Waring *et al*. 2012
[2] Waring *et al*. 2013
[3] C.D. Orphanides, pers. comm., September 16, 2013

Sea turtle bycatch over Georges Bank and in the Gulf of Maine has been documented, but to a lesser extent than in the mid-Atlantic where hard-shelled sea turtles are more commonly found. If the areas are opened to groundfish gear when sea turtles are present, the impacts would depend on changes in the magnitude and distribution of fishing effort as a result of these openings. There are a number of ways that effort could shift. It could shift temporally, spatially, and potentially between the different gear types. In general, shifts in effort to areas farther south would likely increase impacts to sea turtles. Also, sea turtles are only present in the Northeast Region seasonally. Therefore, increases in effort from late spring through fall, when sea turtles are present in the area, would also be expected to increase the impacts to sea turtles. However, if effort were to shift from areas with higher bycatch rates to those with lower rates, there may be a benefit to sea turtles.

Opening the Western Gulf of Maine Closed Area would be of concern given its proximity to waters where Atlantic sturgeon are known to transit and where incidental takes have been documented. Similarly opening the Nantucket Lightship Closed Area would pose some concern, particularly for the western area. Opening Cashes Ledge Closed Area, Closed Area I, and Closed Area II pose less of a concern given that none are known to be a concentration area for sturgeon. Any action that increases gillnet gear in areas where Atlantic sturgeon are likely to occur would be of concern given bycatch mortality in this gear. That concern might be alleviated, however, if we knew effort was being shifted from an area where Atlantic sturgeon are more likely to occur.

4.1.3.3.1 Eastern GOM

The action alternatives (Alternative 2-3) proposed for the Eastern Maine region are likely to result in neutral impacts to protected resources compared to the no action alternative because none of the alternatives currently under consideration would shift fixed gear into areas previously prohibited. In addition, the Harbor Porpoise Take Reduction Plan seasonal gillnet closure (Northeast Closure Area; August 15-September 13) overlaps each of the potential habitat management areas in this sub-region, except for the Toothaker Ridge habitat management area. This closure, which was implemented in the original Harbor Porpoise Take Reduction Plan in 1998, was intended to minimize interactions with gillnets during the time of year with the highest concentration of harbor porpoises in the area. This closure is expected to continue to mitigate the impacts of gillnet fishing on porpoises. The Atlantic Large Whale Take Reduction Plan's "Other Northeast Waters" regulations also cover all of the proposed habitat management areas in this region and would be expected to continue to mitigate the impact of gillnet fishing on large whales in this region.

While none of the alternatives would restrict gillnets in the new areas, there may be some increased gear conflicts between fixed gear and trawl vessels, if the alternatives that would restrict mobile bottom tending gear are implemented. This may lead to some concentration of fixed gear into areas newly closed to mobile bottom tending gear. However, mobile gear fishing has been significantly decreased in this sub-region for several years, so the changes in fixed gear fishing are likely negligible.

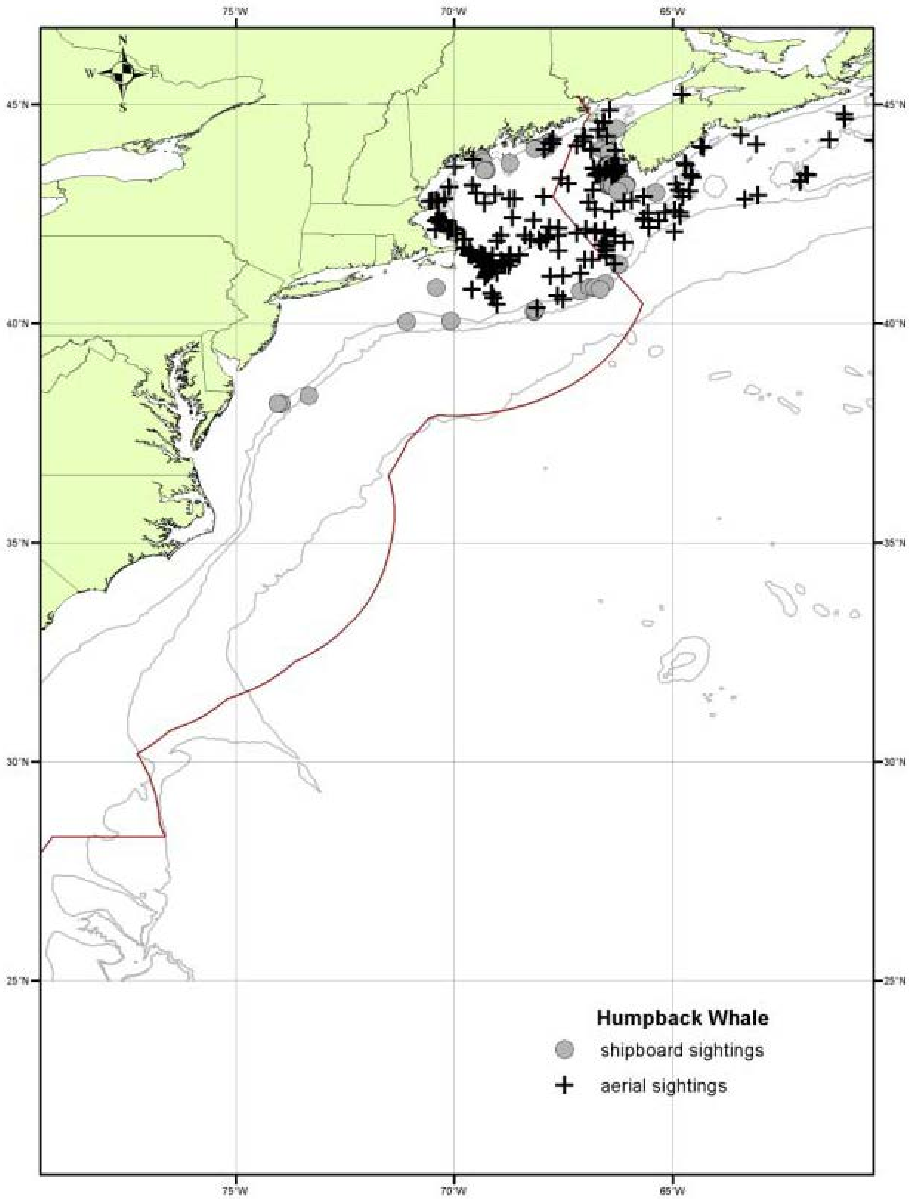
4.1.3.3.2 Central GOM

Sightings of large whales, particularly humpback, fin, and minke whales, are relatively common in the Central Gulf of Maine region (Map 56-Map 58). As a result, allowing gillnets into the Cashes Ledge Groundfish Closed Area, which would be the effect of implementing any of the action alternatives (Alternative 2-4) could have negative impacts on large whales in this region. However, the universal requirements under the Atlantic Large Whale Take Reduction Plan would still apply and would be expected to mitigate those impacts, or at least reduce the likelihood that an interaction would result in serious injury or mortality. Further, this region, including Cashes Ledge and Platts Bank, would remain subject to the seasonal pinger requirements of the Harbor Porpoise Take Reduction Plan (Offshore Management Area; November through May). In addition, the modified Cashes Ledge habitat management area (Central Gulf of Maine Alternatives 3 and 4) is completely within the Cashes Ledge Closure Area, which is closed to gillnet fishing in the month of February. As with the closure area described above, this closure was designed to minimize interaction of harbor porpoises with gillnet gear, which would likely help mitigate the negative impacts from the potential for increased interactions.

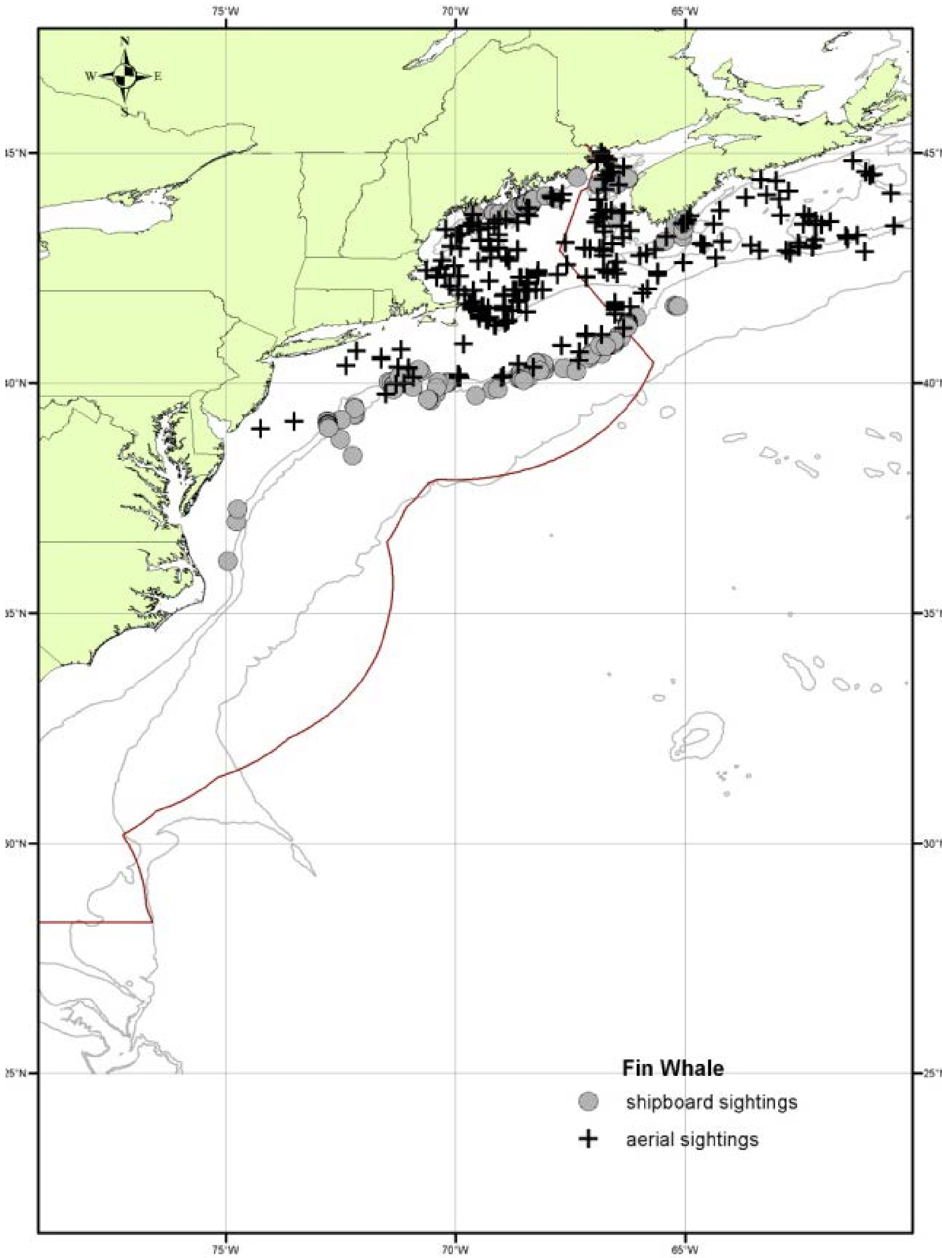
Unlike in the Eastern Maine sub-region which currently has no restrictions on mobile gear, the all of action alternatives in the Central Gulf of Maine would result in mobile gear being allowed into portions of the existing closed areas (Cashes Ledge and Jeffreys Bank). There have been a handful of interactions between trawl gear and marine mammals in the Central Gulf of Maine region and allowing increased access to trawl gear may result in increased interactions with cetaceans. However, large cetaceans are not generally impacted by trawls, as their large size and speed allows the animals to avoid the relatively slow moving trawl gear. In addition, there are few sightings of sea turtles in this region which would otherwise be more affected by increased trawling.

Therefore, the action alternatives in the Central Gulf of Maine sub-region would likely have slightly negative impact on protected resources.

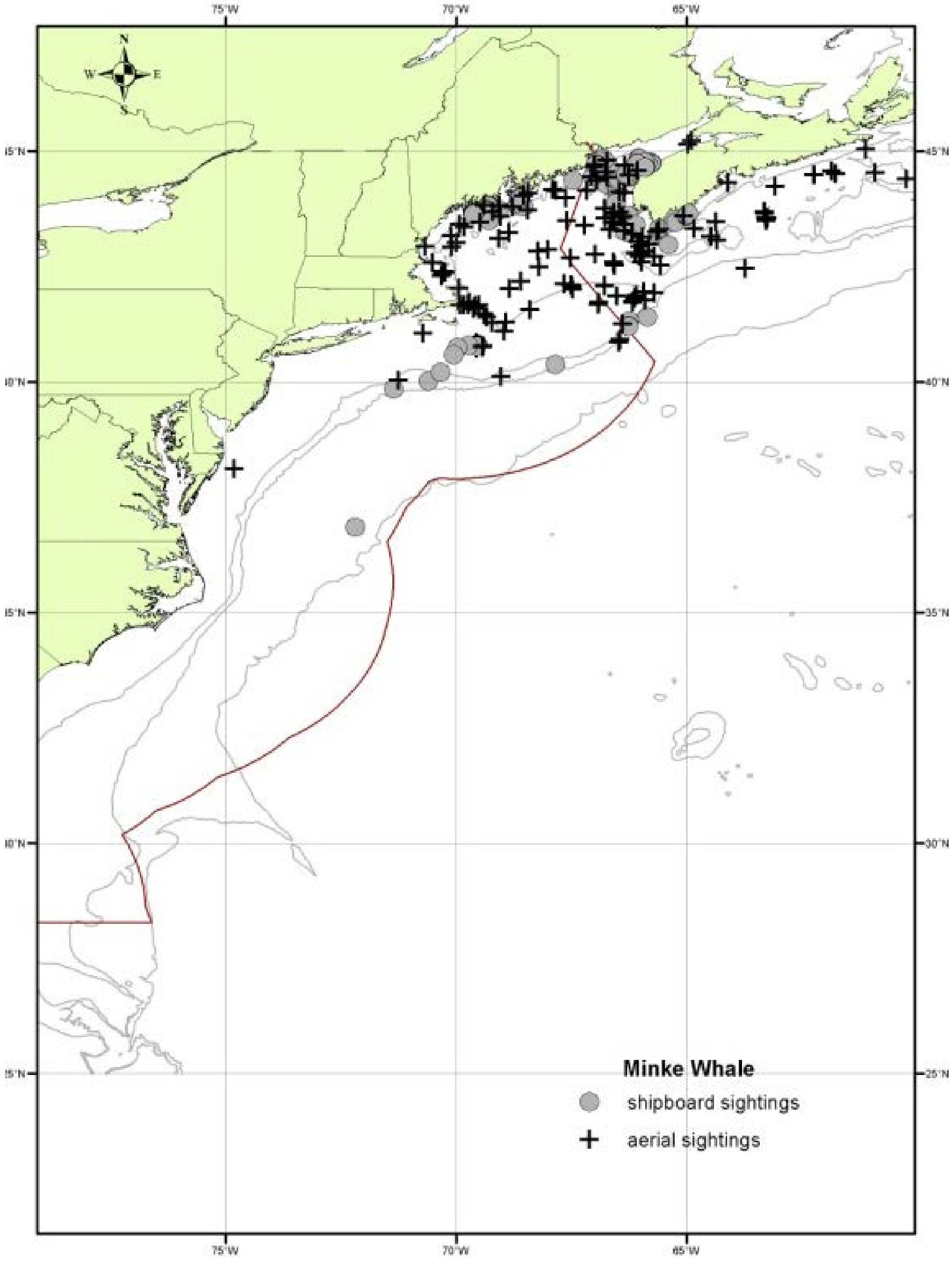
Map 56. Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



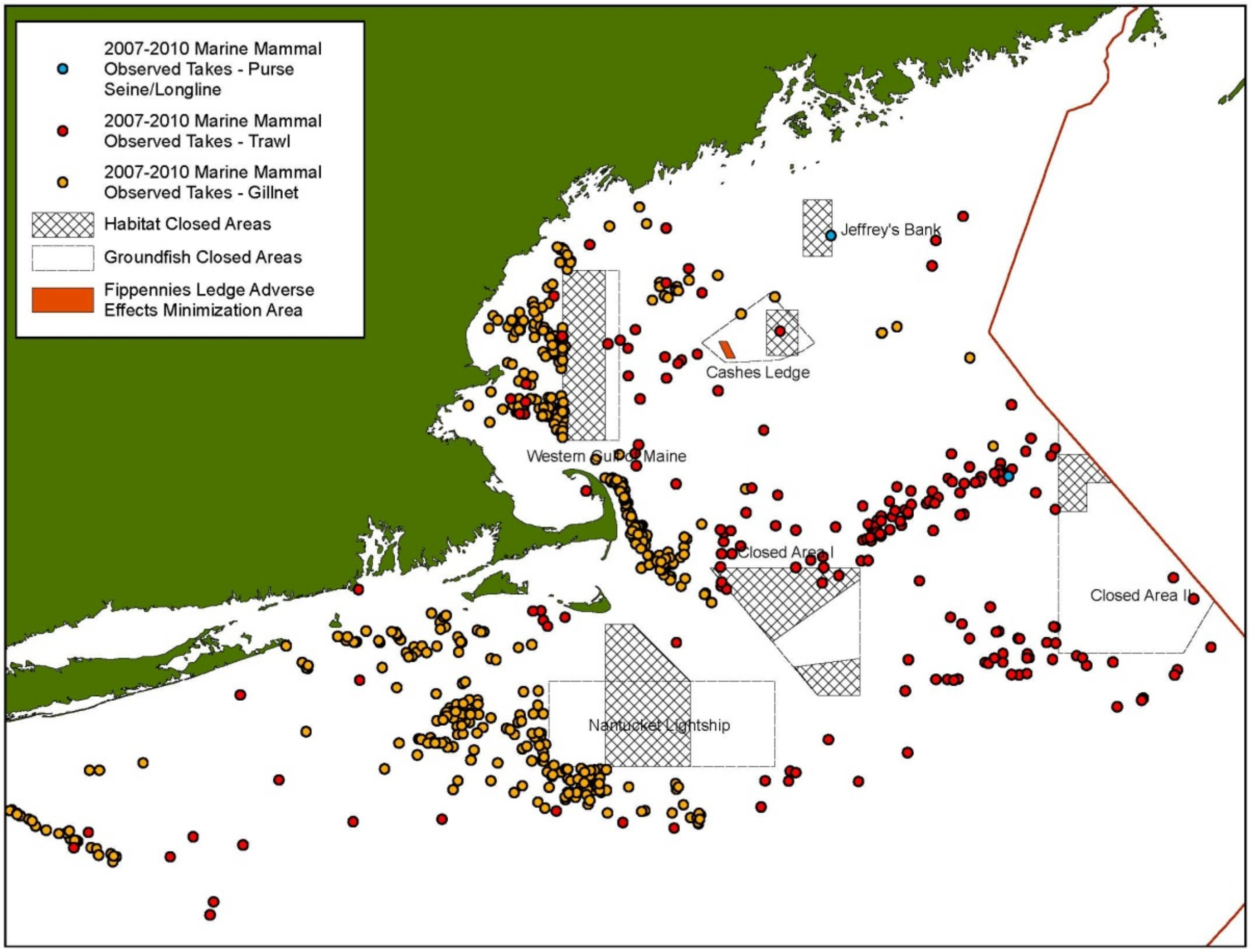
Map 57 Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



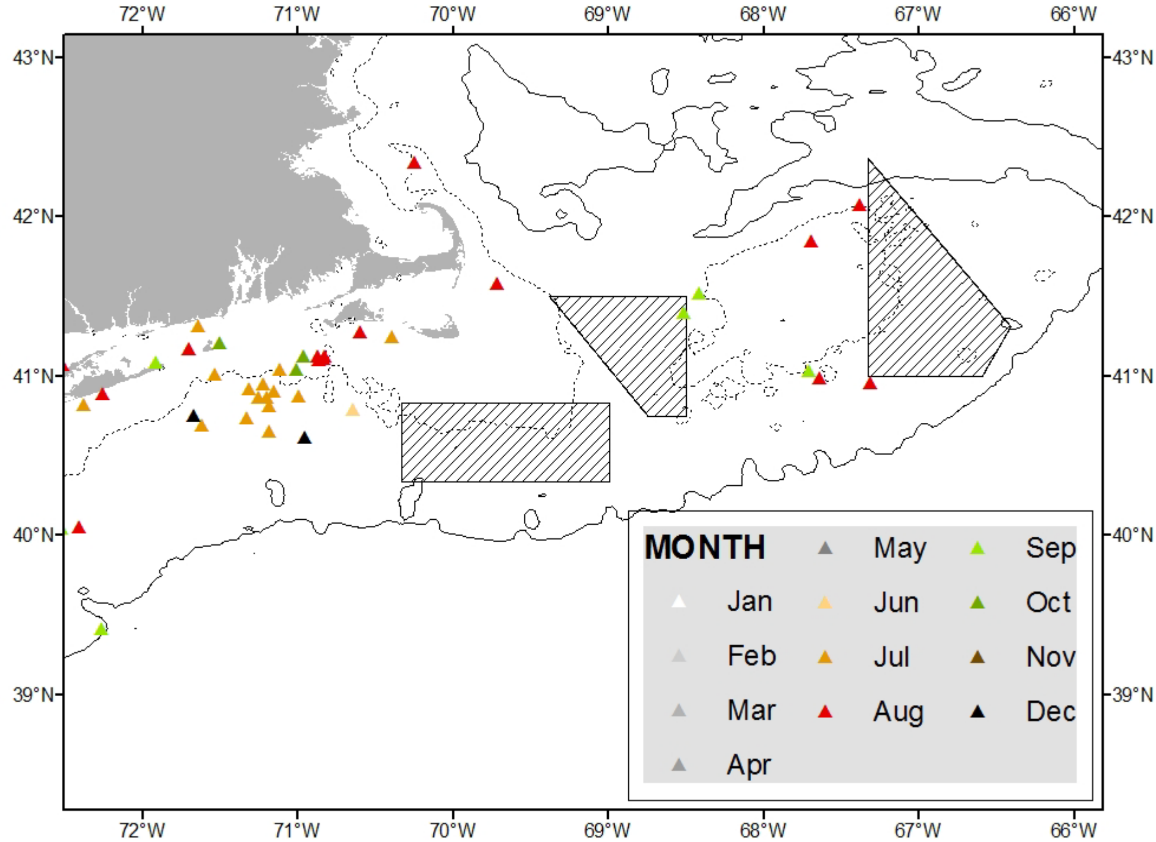
Map 58 Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



Map 59. Marine Mammal Takes 2007-2010



Map 60. Observed turtle interactions by month in gillnet, bottom trawl, and scallop dredge gears, 1989-2012



4.1.3.3.3 Western GOM

In general, shifting of effort in the Western Gulf of Maine region is likely to have the most impacts on protected resources. The action alternatives would result in mobile gear closures in Bigelow Bight (Large—alternatives 3 and 4; Small—alternative 5), the Stellwagen Bank portion of the existing Western Gulf of Maine Closed Area (Large—alternatives 3 and 6; Small—alternatives 4 and 5), the Jeffreys Ledge portion of the existing closed area (alternatives 4 and 5) or would only require modified trawl gear in the majority of the region. The action alternatives would all allow gillnets, at least seasonally, into an area where they have previously been prohibited. There is a significant amount of gillnet fishing along the western edge of the existing Western Gulf of Maine Closed Area (MAP??). Redistributing these gillnets, whose overall quantity would not be expected to change as a result of this action, may actually be beneficial for marine mammals by at least producing some gaps in the "wall" of gillnets. However, it is difficult to know how effort may shift; particularly if the Stellwagen Bank DHRA (Section 2.3.3) is implemented. This DHRA would continue the gillnet prohibition in a large part the southern portion of the existing closed area; resulting in no change from the no action alternative.

4.1.3.3.3.1 Impacts to Marine Mammals

The Western Gulf of Maine is an important forge area for dolphins and large whales. Shifting effort around this region is likely to have impacts on these protected species. As described above, the action alternatives in this sub-region would result in fixed gear, specifically gillnets, being allowed to fish in areas from which they were previously prohibited. Alternatives 2 (no closure areas) and 7 (mobile gear modifications) would result in no closure areas. It is difficult to predict how effort would shift under these circumstances, however, there would likely not be concentrations of gillnet fishing as there is now. This may have a slightly positive impact on marine mammals. Alternatives 3, 4, and 5 would implement a mobile gear closure in the Bigelow Bight area, which may result in concentrations of gillnet gear closer to shore. Mobile gear closures within portions of the existing closed area would result from alternatives 3, 4, 5, and 6, in either the large or small Stellwagen areas or the part of Jeffreys Ledge that is within the closed area. These alternatives may have impacts on marine mammals in this region; however, it is difficult to predict how effort may shift as a result. Increased gillnet activity in the existing closed area may have a slightly positive impact on marine mammals because the "wall" of gillnets along the western edge may be dispersed. If, however, the wall simply moves east, without breaking up significantly, there may be a negative impact because of the high concentrations of mammals in the area.

Mitigating all of the impacts in this region are the requirements for all vessels fishing with gillnets are subject to the Harbor Porpoise Take Reduction Plan requirements, including the seasonal pinger requirements, the seasonal gillnet closures in Massachusetts Bay and Eastern Cape Cod, and the gear requirements of the Atlantic Large Whale Take Reduction Plan's Stellwagen Bank Restricted Area. Pingers have a very high success rate (92 percent) of eliminating interactions, when used properly. Compliance has been an issue in the past; however, NMFS has been increasing assistance in this area.

Overall, impacts to marine mammals from the action alternatives in the Western Gulf of Maine range from slightly positive to fairly negative.

4.1.3.3.3.2 Impacts to Atlantic Sturgeon

Opening the Western Gulf of Maine would be of concern given its proximity to waters where Atlantic sturgeon are known to transit and where incidental takes have been documented. In addition, the potential to concentrate gillnet fishing in either of Bigelow Bight (large and small) areas would likely have negative impacts on Atlantic sturgeon because these areas are closer to shore. Alternatives 2 and 7 which would not prohibit mobile gear fishing in any portion of the region would not be expected to concentrate gillnet fishing in any portion of the Western Gulf of Maine. This would be expected to result in a neutral impact to Atlantic sturgeon. Alternatives 3 and 4 which would close the larger Bigelow Bight area to mobile gear would be expected to have the most impact on Atlantic sturgeon because gillnet gear may concentrate over this area. Similarly, Alternative 5 which would close small Bigelow Bight to mobile gear may result in concentrations of gillnet gear close to shore, although over a smaller area.

Therefore, the impacts to Atlantic sturgeon from the habitat management area alternatives in the Western Gulf of Maine range from neutral to negative.

4.1.3.3.3.3 Impacts to Sea Turtles

Sea turtle bycatch in the Gulf of Maine has been documented, but to a lesser extent than in the mid-Atlantic where hard-shelled sea turtles are more commonly found. If the areas are opened to groundfish gear when sea turtles are present, the impacts would depend on changes in the magnitude and distribution of fishing effort as a result of these openings. There are a number of ways that effort could shift. It could shift temporally, spatially, and potentially between the different gear types. In general, shifts in effort to areas farther south would likely increase impacts to sea turtles. Also, sea turtles are only present in the Northeast Region seasonally. Therefore, increases in effort from late spring through fall, when sea turtles are present in the area, would also be expected to increase the impacts to sea turtles. However, if effort were to shift from areas with higher bycatch rates to those with lower rates, there may be a benefit to sea turtles. Therefore, the expected impacts to sea turtles from any of the action alternatives within the Western Gulf of Maine sub-region are expected to be negligible.

4.1.3.3.4 Georges Bank Habitat Management Alternatives 1-5

4.1.3.3.4.1 Impacts to Marine Mammals

White-sided dolphins are present in in Southern Georges Bank from June through December, with lower presence from January through May. Common dolphins are found on Georges Bank from January through May and through mid-summer to the fall. Pilot whales move to Georges Bank in the late spring and remain until the late fall (Waring et al. 2012).

None of the action alternatives in the Georges Bank region would continue a year-round mobile gear closure in Closed Area I, except if a dedicated habitat management area is implemented in the southern portion (Section 2.3.4). Portions of Closed Area I are proposed to be closed to mobile gear seasonally (Section 4.2.4.2). Therefore, opening the existing Closed Area I area to trawl gear creates some concern, especially in light of recorded marine mammal takes in trawl gear in the northern habitat closure area. There is a corridor of observed marine mammal takes (observed throughout all months of the year) extending from within and above Closed Area I and diagonally to the east up toward the northern tip of Closed Area II (Map 59) through Georges Shoal. These takes are largely pilot whales and white-sided dolphins, with fewer recorded takes of common dolphins and gray seals. There is another corridor of takes (observed in nearly all months of the year) extending from the southeastern end of Closed Area I slightly diagonally and to the east to the southwestern corner of Closed Area II but also extending further along the southern edge of Closed Area II. Takes recorded here are mainly common dolphins, pilot whales, and gray seals.

Since these takes were recorded close to or within the boundaries of Closed Area I, it is possible that the likelihood of interactions could increase if effort were to shift into Closed Area I. Small cetacean takes in trawls have been recorded within the northern portion of the existing Closed Area I habitat area, so it could be likely that effort would shift into the newly opened portion. This would most likely impact pilot whales in this region. Currently, bycatch levels of marine mammals in trawl gear are not exceeding acceptable levels established under the MMPA (Waring et al. 2012).

Several species of marine mammals have been documented by fisheries observers as bycatch incidental to bottom trawl fishing around the region surrounding Closed Area II, especially along the northern and southern portions of the groundfish closure area, including white-sided dolphin, common dolphin, pilot whale, harbor porpoise, Risso's dolphin, and minke whales (Waring et al. 2012). There are documented marine mammal takes along the northern and southern edges of Georges Bank, and both the northern and southern portions of the existing closure are found on these banks. Takes have been recorded just outside the northern and southern edges of the closure, and there are two documented takes within the closure itself, likely within the yellowtail flounder/haddock Special Access Program, as one take was a white-sided dolphin in August and the other was two common dolphins taken in October. Since trawl takes were recorded close to or within the boundaries of Closed Area II, it is possible that an effort shift into Closed Area II could increase the likelihood of interactions.

Presence of these animals has been documented in the area around Closed Area II during the summer, winter, and spring months by dedicated shipboard and/or aerial protected species research surveys. From the Center's dedicated marine mammal abundance surveys and the observer program, we know that these animals are present in and around the region of Closed Area II year round to varying degrees of frequency depending on the species and time of year. Closed Area II is proposed to be closed for spawning purposes from February through April. However, it is unclear if bycatch levels will also remain consistent in the areas of historical takes or if these bycatch levels will be reduced or increased due to shifts in fishing effort.

Closed Area I overlaps with the Great South Channel Critical Habitat Area that has been designated for right whales (the overlapping portion is the northern habitat closed area portion). This area was designated as critical habitat based on the seasonally high abundance of right whales that aggregate in the area in order to feed. Closed Area I is proposed to become a seasonal, spawning closed area in the months of February through April (Section 4.2.4.2). The Great South Channel Restricted Gillnet Area covers the entirety of the Closed Area I N section (Section 2.2.2.3) and is closed to gillnets from April through June each year. While an increase in interactions would be likely in the summer and fall, the area would remain closed during the highest concentration of right whale activity under the regulations of the Atlantic Large Whale Take Reduction Plan, lessening the impacts to some degree.

4.1.3.3.5 Impacts to Atlantic Sturgeon

Based on the available NMFS observer data, observed captures of Atlantic sturgeon are low on Georges Bank relative to other areas. While Atlantic sturgeon may occur in these areas, distribution and incidental catch information suggests that these areas are not within the preferred depth range of Atlantic sturgeon. There are no known Atlantic sturgeon aggregation areas in or near any part of the existing closed areas. Observed mortality of Atlantic sturgeon captured in trawl gear is very low. We have no records of sturgeon bycatch on commercial hook gear. Lobster trap effort is not observed by the Northeast Fisheries Observer Program but there is no information to suggest that Atlantic sturgeon is reasonably likely to be captured in pot/trap gear (either the trap itself or entangled in lines). However, there is little lobster effort in these areas, and therefore, displacement is likely a small concern.

The most recent data concerning Atlantic sturgeon abundance together with the information as discussed above makes it likely that shifting effort among the no action and action habitat management areas in the Georges Bank sub-region would have a negligible impact with respect to any of the five Atlantic sturgeon DPSs.

4.1.3.3.6 Impacts to Sea Turtles

Hard-shelled sea turtles in the Northeast Region occur as far north as Canada, but are more commonly found south of Cape Cod. The leatherback sea turtle ranges farther north than any other species. As coastal water temperatures warm in the spring, sea turtles begin to migrate up the U.S. Atlantic coast, occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September, but some turtles may remain in Mid-Atlantic and Northeast areas until late fall.

Incidental captures of sea turtles in fishing gear over Georges Bank have been very rare (fewer than 10 takes have occurred in trawl gear over almost 25 years). Fisheries observers have documented captures around the region in bottom tending gears, including bottom otter trawls and scallop dredge gear. (Map 60). There is a slight risk to turtles from opening the Closed Area I to trawl gear as turtle interactions have been observed in the region in August and September.

There is a potential for increased scallop effort in the northern portion of Closed Area II. This would result in the potential for increased interactions between scallop dredges and turtles on Georges Bank; however, if effort were to shift from areas with higher bycatch rates to those with lower rates, there may be a benefit to sea turtles. In addition, interactions in the current scallop fishing grounds of Georges Shoal are rare. Therefore, the impacts to sea turtles from any of the action alternatives in Georges Bank are expected to be negligible.

4.1.3.3.7 Great South Channel/Southern New England Habitat Management Area Alternatives 1-6

4.1.3.3.7.1 Impacts to Marine Mammals

There have been documented interactions with marine mammals, primarily with gillnets, in this sub-region. (Map 59). Harbor porpoise bycatch information indicates harbor porpoises are present mainly from December through May; sightings data (not effort corrected) confirm this and confirm seasonal presence in this area. Monkfish gillnet gear is the primary gear interacting with porpoises (and seals) in this area. This type of gear has characteristics that have traditionally been associated with high marine mammal bycatch rates (e.g., 12 inch mesh, long soak durations, long gear lengths). However, the Harbor Porpoise Take Reduction Plan Southern New England Management Area, which overlaps the majority of the existing and proposed habitat management areas requires gillnets to have pingers from December through May. In addition, there is a seasonal harbor porpoise closure area in this sub-region, the Cape Cod South Closure Area, which is closed to gillnet in March, and overlaps the two small Cox Ledge habitat management areas. Further, the high level of gillnet interactions around the southwestern corner of Nantucket Lightship may be a result of the prohibition on gillnets within the area. Allowing gillnets to spread throughout the region, without increasing the overall amount of effort, may provide a benefit for protected species.

If large mesh (e.g. monkfish, skates) gillnet effort shifts into the newly opened areas (e.g., from the area to the west and/or south of Nantucket Lightship Closed Area or from effort that currently occurs to the east of Cape Cod), that could create additional interactions and/or shift interactions from the present location near the western/southwestern border into a new one (e.g., around Nantucket Shoals).

Gillnet effort shifts in this area could result in placing gear in the path of traveling whales. However, it is unknown to what extent effort/gear would shift and how that would impact relative risk to large whales. With many difficulties surrounding adequate documentation of large whale entanglements in fishing gear (e.g., nature of the interactions, where and how interactions occur and in what specific gear, etc.), if gillnet effort increases in this area, there could be an increase in right and humpback whale entanglement levels in fixed fishing gear.

In examining trawl gear interactions with marine mammals, there appear to be fewer recorded interactions around the Great South Channel than Georges Bank. A handful of documented trawl gear takes have been recorded just below the southeast corner of the existing groundfish closed area in the spring, mainly consisting of pilot whales, but also including common and white-sided dolphins. This is likely a product of a lack of trawl fishing effort in this particular area.

The risk of large whale entanglement with trawl or hook and line gear is extremely low. However, these animals are known to interact with fixed gear fisheries such as traps/pots and gillnet gear. There has been some concern raised related to the potential for lobster trap/pot gear effort to shift away from Nantucket Lightship Closed Area as a result of allowing trawl gear access to this area. It is unclear where this effort would shift, and if it would shift into areas with higher abundances of or interaction rates with endangered large whales (e.g., Great South Channel Critical Habitat Area). However, gillnets would be subject to the closure from April through June in the Great South Channel Restricted Gillnet Area. This would mitigate the impact, as this is the season when whales are most abundant in this region.

It is possible that a shift in localize effort in this particular area could result in an increase in interactions, particularly with the use of gillnets. The probability of interactions with harbor porpoises and large whales will be reduced because of the pinger requirements under the Harbor Porpoise Take Reduction Plan and gillnet gear modification requirements under the Atlantic Large Whale Take Reduction Plan.

Because of these reasons, the impacts from the habitat management alternatives in the Great South Channel/Southern New England sub-region are likely to be slightly negative.

4.1.3.3.7.2 Impacts to Sea Turtles

As mentioned in the previous sections, hard-shelled sea turtles in the Northeast Region occur as far north as Canada, but are more commonly found south of Cape Cod. The leatherback sea turtle ranges farther north than any other species. As coastal water temperatures warm in the spring, sea turtles begin to migrate up the U.S. Atlantic coast, occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September, but some turtles may remain in Mid-Atlantic and Northeast areas until late fall.

There may be an increase in interactions with sea turtles under these action alternatives; however, this is not expected to be substantial. There are few interactions in the currently open areas in the Great South Channel (Map 60) by any gear, including dredges in the Nantucket Lightship Scallop Access Area. The alternatives considered in this region would not likely result in an increase in scallop dredge activity in the region. Therefore, the impacts to sea turtles would likely be negligible.

4.1.3.3.7.3 Impacts to Atlantic Sturgeon

There is relatively limited distribution of Atlantic sturgeon in the Great South Channel area. There have been few observed interactions in this region, despite a heavy concentration of observer days. As result, the action alternatives in this region would be expected to have a neutral impact on sturgeon. *(This section needs additional review)*

4.2 Alternative to improve groundfish spawning protection

These alternatives, described in section 2.2, are designed to protect spawning groundfish and are based largely on existing management areas.

4.2.1 Physical and biological environment

Spawning protection alternatives generally restrict gears capable of catching groundfish. Some of the areas included in the no action alternatives are currently implemented on a year round basis, but all of the areas included in the action alternatives would be implemented seasonally. Seasonal areas generally have a negligible benefit in terms of increasing benthic habitat protection, because any restrictions on fishing would be temporary. Seasonal restrictions on fishing could afford some protection to the habitats used by invertebrate fauna that are a prey source for managed species. (Prey availability and the quality and quantity of prey habitat are elements of EFH).

In this way, seasonal closures could provide limited habitat benefits by temporarily increasing the abundance of prey. The amount of benefit would depend on whether episodic prey recruitment events coincided with the duration of the spawning closure. Such overlaps may exist in some areas and in some years since prey recruitment and spawning closures tend to occur in the spring time. There presumably could be a more lasting effect – extending beyond the end of the closure – if prey organisms that recruit to bottom habitats that are undisturbed by fishing during the closure survive in greater numbers than they would have if fishing had continued unabated.

However, recovery of more vulnerable structure forming habitat features from fishing impacts takes longer. Thus, continual protection from mobile bottom-tending gear fishing is needed to best protect structure-forming organisms such as sponges or bryozoans and geological features like sand waves and cobble piles. Overall, seasonal closures to gear capable of catching groundfish will provide limited if any benefits in terms of protecting seabed structures and enhancing the habitat value that those structures provide to managed resources.

4.2.1.1 *Gulf of Maine*

4.2.1.1.1 Alternative 1 (No action)

This alternative includes year round closure of the Cashes Ledge and Western Gulf of Maine closed areas, the sector and common pool rolling closures, and the GOM Cod Spawning Protection Area. Seabed habitat impacts of the year-round fishing restrictions in these areas are discussed in sections 4.1.1.1.2.1 (CL) and 4.1.1.1.3.1 (WGOM).

Because they are closed seasonally, the sector and common pool rolling closures and the GOM Cod Spawning Protection area do not provide positive seabed habitat protection benefits. To the extent that they preclude efficient capture of groundfish aggregated for spawning purposes, they could actually have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits in other locations during the closed season, or within the closure during another season. These impacts are highly uncertain. Further, the magnitude of any impact along these lines associated with the common pool rolling closure areas is likely negligible. The common pool rolling closures apply to relatively few vessels, and therefore have little effect on the overall distribution of fishing effort during the closure months. The sector rolling closures and the GOM cod spawning protection area affect more vessels and therefore have a greater effect on the overall distribution of fishing. The inshore GOM areas covered by these rolling closures have vulnerable habitat types, so the potential increases in fishing time could have negative effects. If these management areas were generally in low vulnerability habitats, the conclusion would be different.

In summary, positive seabed habitat impacts of the year-round closure of the Cashes Ledge and Western Gulf of Maine areas aside, this alternative has highly uncertain but possibly slightly negative impacts on seabed habitats.

4.2.1.1.2 Alternative 2, Options A and B

Impacts of the removal of the year-round fishing restrictions in the Cashes Ledge and Western Gulf of Maine groundfish closures are discussed in sections 4.1.1.1.2.3, 4.1.1.1.2.4, 4.1.1.1.3.3, 4.1.1.1.3.4, 4.1.1.1.3.5, and 4.1.1.1.3.6. Seabed impacts associated with maintenance of the existing sector rolling closures and GOM cod spawning protection area may be slightly negative, if these areas lead to increased fishing time because vessels cannot target spawning aggregations. As discussed above, these impacts are highly uncertain. To the extent such negative impacts exist, there would also be slightly negative impacts of designating the Massachusetts Bay Spawning Management Area.

No difference in impacts between Option A and Option B is expected because seabed impacts of recreational hook and line fishing are assumed to be negligible, such that their prohibition from the area vs. exemption from the prohibition would not influence the magnitude of habitat impacts.

In summary, negative seabed habitat impacts of removing the Cashes Ledge and Western Gulf of Maine areas aside, this alternative has highly uncertain but possibly slightly negative impacts on seabed habitats due to possible increased in fishing time.

4.2.1.2 *Georges Bank and Southern New England*

4.2.1.2.1 Alternative 1 (No action)

This alternative includes year round closure of the Georges Bank groundfish closed areas, Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area, as well as a seasonal closure during the month of May. Seabed habitat impacts of the year-round fishing restrictions in these areas are discussed in sections 4.1.1.2.1.1 (CAI and CAII) and 4.1.1.2.2.1 (NLCA).

Any impacts to seabed habitats resulting from the May seasonal closure are probably negligible. Restrictions on fishing in this area apply to a small number of vessels, such that the area has limited overall impact on the distribution of fishing effort in the Georges Bank region.

To the extent that year-round fishing restrictions in CAI, CAII, and NLCA preclude efficient capture of groundfish, scallops, or other fishery resources contained within the closed areas, they could have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits from other locations. For resources that are mobile, and move in and out of the closures, this may be less of a concern, as these fish could be harvested outside the closed area boundaries. For resources that are sedentary, particularly scallops, any increases in fishing time that result from application of these closures could have a greater impact. However, areas within the groundfish closures that have high concentrations of scallops and are not within existing habitat management areas are fishable by the scallop industry on a rotational basis (i.e. rotational access fisheries in central CAI, southern CAII, and eastern NLCA). Any impacts resulting from inability to efficiently harvest scallops within these habitat closures are more appropriately associated with the no action habitat management alternatives, even though the habitat areas overlap the groundfish areas. The same holds true for impacts associated with displacement of the clam fishery in the habitat closed area portion of the NLCA.

The analyses prepared for Framework 48 to the Northeast Multispecies FMP, as well as the analyses in the economic impacts sections of this document, evaluate the extent to which fishing might be more efficiently prosecuted if the groundfish areas were not closed. While such assessments are difficult to make, it appears that catch rates of groundfish would not be significantly higher inside the closed areas, such that you would expect their removal or conversion to seasonal areas to result in a large reduction in fishing time, area swept, and thereby seabed habitat impacts. However, more flexibility in fishing location would probably result in a reduction in fishing time, not an increase, if we assume that fishermen strive to operate efficiently to minimize their variable costs. Thus, keeping these areas in place year-round may have a small, highly uncertain, negative impact on seabed habitats.

4.2.1.2.2 Alternative 2

Direct impacts of the removal of year-round closed areas on the protection of seabed habitats in this region are discussed in 4.1.1.2.1.2, 4.1.1.2.1.3, 4.1.1.2.1.4, 4.1.1.2.1.5, 4.1.1.2.2.2, 4.1.1.2.2.3, 4.1.1.2.2.4, 4.1.1.2.2.5, and 4.1.1.2.2.6.

To the extent that seasonal implementation of CAI and CAII precludes efficient capture of groundfish, scallops, or other fishery resources contained within the closed areas, they could have negative impacts on seabed habitats as fishing time would increase to harvest these species up to their annual catch limits. In general, it is difficult to predict how spatial and temporal distribution of groundfishing effort would vary if these closures were kept in place seasonally, as this alternative specifies, vs. year-round, as in the no action alternative. However, removal of the Nantucket Lightship groundfish closure and the May closed areas, combined with limited seasonal application of CAI and CAII, probably would improve operational efficiency and therefore reduce fishing time, area swept, and seabed impacts. T

No difference in impacts between Option A and Option B is expected because seabed impacts of recreational hook and line fishing are assumed to be negligible, such that their prohibition from the area vs. exemption from the prohibition would not influence the magnitude of habitat impacts.

In summary, this alternative is expected to have slightly negative impacts on seabed habitats though continued restrictions on fishing locations that could preclude operational efficiency, but positive impacts on seabed habitats relative to no action, which closes additional areas, some on a year-round basis.

4.2.1.2.3 Alternative 3

This alternative is very similar to Alternative 2, except that only the northern part of CAI would be closed seasonally. Thus, this alternative is expected to have slightly negative impacts on seabed habitats though continued restrictions on fishing locations that could preclude operational efficiency, although less negative than Alternative 2, but positive impacts on seabed habitats relative to no action, which closes additional areas, some on a year-round basis.

4.2.1.3 *Species diversity considerations*

Species diversity indices described in the Affected Environment section were summarized by alternative. The average Shannon and Inverted Simpson diversity indexes are calculated for each alternative, using all random and non-random tows from the spring, fall, summer and winter survey data from 2002-2012. These values are then compared with the No Action alternative for the appropriate region. All other factors being equal, the alternative with the highest overall diversity may provide positive benefits to the most species.

Diversity values for each tow were averaged and displayed by spawning area alternative in Table 84. For this part of the analysis, the alternatives with the highest diversity values (75^{th} percentile of each season) for each diversity index were highlighted with a specific color. Groundfish diversity was highlighted in red, regulated diversity in yellow and all species in green. This is to determine which alternative areas are most diverse with respect to groundfish, regulated species and all species year-round. Diversity within the alternative areas and the no action alternative areas are then compared.

Table 84 - Average diversity indices by status quo and proposed spawning alternatives in the Gulf of Maine, Georges Bank and southern New England. The 75th percentile of diversity for each species group is highlighted.

	WINTER				SPRING			
	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
Gulf of Maine								
No Action	**338**	**0.629**	**0.584**	**1.246**	**1250**	**0.764**	**0.689**	**1.460**
Seasonal Spawning	3	0.699	0.684	1.606	16	0.773	0.737	1.630
Sector RC	338	0.629	0.584	1.246	1250	0.764	0.689	1.460
Comm Pool RC	641	0.621	0.577	1.227	2813	0.790	0.696	1.487
Alternative 2	346	0.627	0.583	1.244	1280	0.763	0.689	1.461
Georges Bank/Southern New England								
No Action	**73**	**0.914**	**0.624**	**1.299**	**1266**	**0.925**	**0.675**	**1.222**
Seasonal Spawning	27	0.832	0.698	1.383	631	0.962	0.716	1.290
Year Round	46	0.962	0.581	1.250	635	0.889	0.633	1.155
Alternative 2A	11	0.873	0.587	1.329	377	0.918	0.603	1.177
Alternative 2B	9	0.846	0.592	1.331	287	0.897	0.595	1.151

4.2.1.3.1 Gulf of Maine

The Gulf of Maine No Action alternative only affects sector rolling closures. Diversity in the different alternative areas varied only slightly each season, indicating an almost negligible difference in the positive benefits each alternative could have. In the winter, diversity in Alternative 2 areas is lower than the No Action sector rolling closures.

In the spring, regulated species diversity in Alternative 2 areas and No Action sector rolling closures are equal. Groundfish diversity is marginally lower and all species is slightly higher in Alternative 2 areas than No Action areas.

4.2.1.3.2 Georges Bank and Southern New England

The Georges Bank/Southern New England No Action alternative affects both seasonal and year-round areas. In the winter, diversity of groundfish and regulated species in Alternative 2A areas are both less than in No Action areas. All species diversity in Alternative 2A areas is higher than No Action. Diversity of groundfish and regulated species in Alternative 2B areas are all lower than in No Action areas. All species diversity is highest in Alternative 2B areas. In the spring, the No Action areas are more diverse with respect to each species group than either the Alternative 2A or 2B areas.

4.2.2 Managed species – impacts on large mesh groundfish stocks

The discussion below focuses on the expected direct effects of Groundfish Spawning Area measures on the 19 large-mesh groundfish stocks. In general, the proposed areas (described in Section 2.2.1 (GOM) and 2.2.2 (GB/SNE) are expected to reduce the effects of fishing on groundfish spawning success. While positive impacts are primarily focused on cod and haddock, the areas may also have benefits for other groundfish stocks.

The proposed alternatives (Alternatives 2 and 3) to the current closed areas (Alternative 1), however, reduce the spatial and/or seasonal scope of the current closed areas and rolling closures, and therefore by themselves the action alternatives do not reduce the effects of fishing on spawning populations in relation to the no action alternative.

A seasonal spawning area closure would apply to and prohibit the use of gears capable of catching groundfish by commercial (e.g. trawls, gillnets, longlines, and scallop dredges) or commercial and recreational (i.e. hook and line) gears. Section 2.2 describes certain exemptions that would apply, generally listing gears that do not capture groundfish. Certain types of mobile gears that might disrupt spawning would be exempted, including mid-water trawls and small-mesh trawls fishing for whiting in exempted areas.

As discussed in section **Error! Reference source not found.**, since fishing with mobile bottom-tending gear tends to have lasting effects on vulnerable bottom habitat, seasonal restrictions on spawning are unlikely to have positive impacts on local habitat condition, since damage to such habitat could occur during times when an area is otherwise open to fishing. However, some prey and fast-recovering benthic species may be important to why large mature fish congregate. Temporary reduction of fishing by mobile bottom-tending gear during a spawning closure could reduce impacts on these species. Therefore, seasonal implementation of spawning areas could provide some level of protection for prey and fast-recovering benthic species that might translate into benefits for spawning groundfish.

Fishing can interfere with spawning success and therefore productivity in a number of ways including:

1. Removal of spawning fish before they have had the opportunity to spawn
2. Dispersal of spawning fish
3. Disruption of spawning behavior

The first effect is simple – catching developing and ripe fish before they have had the opportunity to spawn reduces spawning biomass. These removals (i.e. catch of mature fish) have the same effect whether the fish were removed well before or during spawning season. Even though groundfish catches and fishing mortality are limited by ABCs, fish concentration associated with spawning tends to increase the availability of fish to the gear and increase CPUE. Hence there is an incentive to target spawning fish to reduce fishing costs and thus preferentially remove larger mature fish from the population. While potentially reducing bycatch of sub-legal immature fish (a positive effect), targeting large spawning fish would have a negative effect on groundfish productivity by removing mature spawners, which could have more viable eggs. Selective removal of the largest and oldest fish could also truncate the age structure.

Dispersal of spawning fish, i.e. fish avoiding or leaving areas where fishing activity is concentrated, may have negative impacts if dispersed fish may or may not find mates elsewhere, move to other less-preferred spawning locations, or come back to spawn later when or if fishing activity has declined. Any of these responses by spawning fish has the potential to reduce spawning success, negatively affecting productivity.

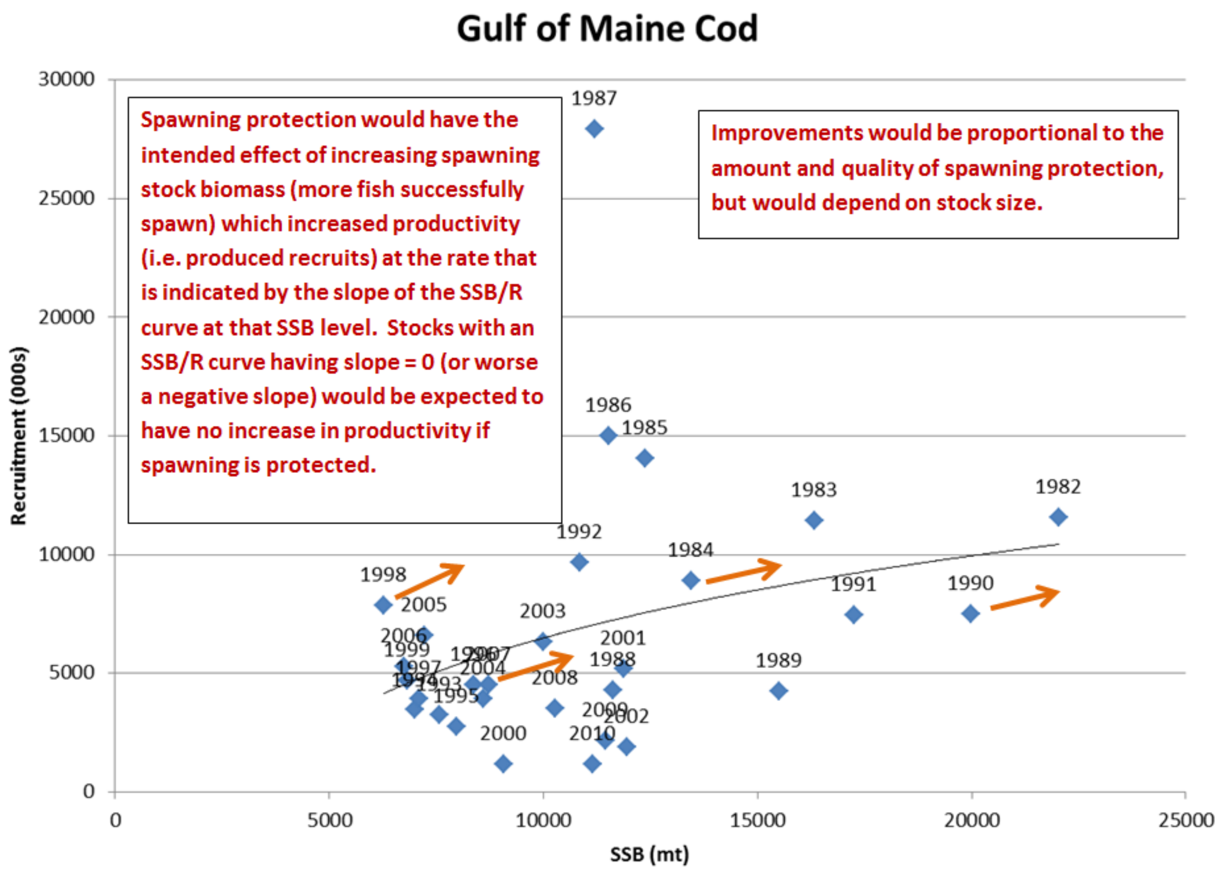
Some groundfish, particularly cod, have been observed to exhibit specific spawning behaviors (see discussion in the Affected Environment section of Volume 1). This behavior is sometimes manifested in diel separation and re-aggregation by sex. This type of behavior has been observed in acoustic cod tagging by Massachusetts Division of Marine Fisheries in the Saturday Night Ledge area of the Western Gulf of Maine, and in other areas (Dean et al ????). Existence of gillnet fishing gear appears to disrupt this behavior and it is possible that mobile fishing gear may have similar effects. In this case, spawning success and fertilization may be less successful as long as the fishing activity remains in spawning locations.

While specific cod spawning behavior has been observed in select locations, these informative but difficult to collect data are not available broadly where cod spawn. The extent and timing of cod spawning is generally not known at a very small scale. It is also generally not well known for non-cod stocks, including other related gadid species like haddock, pollock, and hakes.

Looking at groundfish spawning from a broad, multispecies perspective over all areas of the Gulf of Maine and Georges Bank/Southern New England regions, the Council relied on groundfish size and maturity data to identify potential hotspots where large mature fish are concentrated. The results are discussed in the Affected Environment section in Volume 1, and the methods are explained in detail in Appendix E. These results from spring, summer, fall, and winter survey data are used below to evaluate potential impacts on groundfish productivity.

The illustration below shows how increases in spawning success and effectiveness could affect productivity, using estimated Gulf of Maine cod spawning stock biomass (SSB) and recruitment. If a reduction in fishing in spawning locations and seasons improves spawning success and effectiveness, it is as if there were more spawning fish in the population. Generally, unless there is a high degree of density dependence (such as in a cannibalistic species), recruitment will be higher and would produce a larger stock size (assuming that density dependent effects on growth and survival of recruits don't negate the effect). The relationship between SSB and recruitment is indicative of the amount of higher recruitment and stock productivity that could be expected, but in all cases is expected to be positive if the measures improve spawning success and effectiveness.

Figure 34 – Illustration of potential effects of increasing spawning success and its effect on recruitment produced by that increase.



4.2.2.1 *Gulf of Maine*

4.2.2.1.1 Alternative 1 (No action)

No Action would retain the existing set of seasonal rolling closures for sector and common pool groundfish vessels and the April to June Gulf of Maine Cod Spawning Protection Area for commercial and recreational vessels fishing for groundfish. It would also retain the year-round Western Gulf of Maine and Cashes Ledge areas, which were partially intended to protect spawning cod and haddock.

The existing rolling closures, the Western Gulf of Maine Closed Area, and even to some extent the Cashes Ledge area have a high degree of overlap with the distribution of large spawning size groundfish hotspots in the Gulf of Maine (Map 61), in both spring and summer when many groundfish, and particularly cod and haddock, are known to spawn. Some winter spawning of cod occurs in the Massachusetts Bay area, where there is a state-waters seasonal closure area. The only seasonal closure in federal waters is an Oct-Dec closure that applies to common pool groundfish vessels, which are a small proportion of the total groundfish fleet. The sector rolling closures do not overlap this winter cod spawning and may in fact promote more intensive fishing during the winter since these areas are closed during April and May.

In the winter, the Western Gulf of Maine and Cashes Ledge Closure Areas contained 19 unweighted and 28.5 weighted hotspots[5] (Table 85). Although the Massachusetts state-waters Winter Cod Conservation Zone is closed from November 15 through January 31, it was not included in the No Action totals for federal area closures. In the spring, the sector rolling closures, Cashes Ledge, and the Gulf of Maine cod spawning protection area had 923 unweighted and 2086.8 weighted hotspots. Hotspots in the eastern sliver of the Western Gulf of Maine Closed area were not included in the total because they contained a negligible amount of large spawner size groundfish hotspots and overlapped with the common pool rolling closure areas. The additional hotspots in the Common Pool Rolling Closures were also not included in the total because they apply to a small fraction of fishing vessels and groundfish fishing effort. The 14 km^2 Gulf of Maine cod spawning protection area is simply too small for any hotspots at a 100 km^2 grid scale to fit inside.

Based on the hotspot results, literature based information on (primarily cod) spawning (see Section ???), the distribution of developing and ripe cod and haddock, and on the distribution of survey catches of mature sized cod (Map ??? in Section ???), the set of seasonal and year round closed areas in this alternative encompass a reasonably high proportion of groundfish spawning in the Gulf of Maine. They don't however include spawning of resident cod, halibut, and other species in central and eastern Maine.

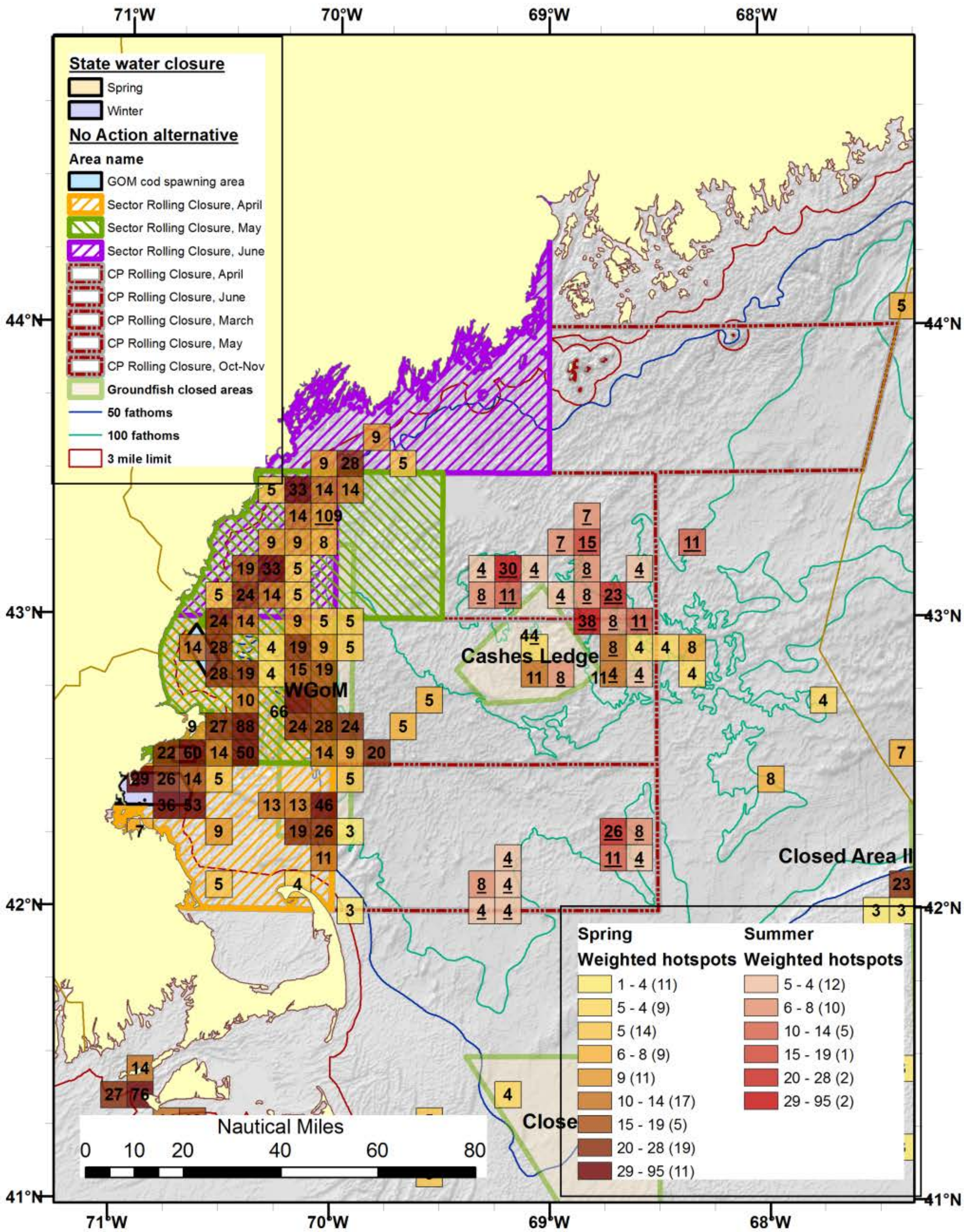
The impacts on groundfish habitat and productivity from the no action alternative is likely positive because these areas appear to protect a considerable amount of spawning activity in the Western Gulf of Maine and potentially affect groundfish productivity.

Table 85 – Summary of unweighted and weighted large spawner hotspots by Gulf of Maine spawning protection alternative. Seasonal spawning = GOM cod spawning protection area.

	Winter		Spring	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine				
No Action	**19**	**28.5**	**923**	**2086.8**
Seasonal spawning	0	0.0	0	0.0
Sector RC	51	121.2	909	2057.7
Comm Pool RC	102	224.5	1469	3566.7
Year round	19	28.5	111	406.4
Alternative 2	1	9.5	916	2071.8

[5] Hotspots were weighed more heavily for stocks with low biomass relative to the MSY target, stocks that formed sub-populations, and stocks that were known to have resident populations.

Map 61 – No Action rolling and year round closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the Western Gulf of Maine sub-region, using 2002-2011 spring NMFS, MADMF, ME-NH, and IBS cod survey data.



4.2.2.1.2 Alternative 2, Options A and B

Alternative 2 would retain the existing sector rolling closures as spring spawning closures, which would apply to all commercial fishing vessels capable of catching groundfish. Specific gears which do not catch groundfish would be exempt from the closure. Successive and overlapping areas from Massachusetts Bay, MA to Penobscot Bay, ME would close for one month each from April to June. The existing GOM cod spawning protection area that is closed from April to June to commercial and recreational fishing vessels that catch groundfish would remain. An additional winter spawning closure would apply in Massachusetts Bay during Nov-Jan to all commercial and recreational fishing vessels capable of catching groundfish.

Compared to other areas, cod in Massachusetts and Ipswich Bays have a fairly high proportion of developing and ripe cod (Map 63). The timing of the spring surveys has to be considered when interpreting maps showing the number or proportion of fish at each maturity stage, since maturation stages typically have unequal durations. The timing of when ripe and running ripe cod may or may not coincide with the timing of the survey, so a high proportion of developing fish is indicative of where spawning may occur soon, but an absence of developing or ripe fish does not mean that spawning will not occur there. The early spring survey probably misses some cod spawning that occurs in late spring from Ipswich Bay and to the north.

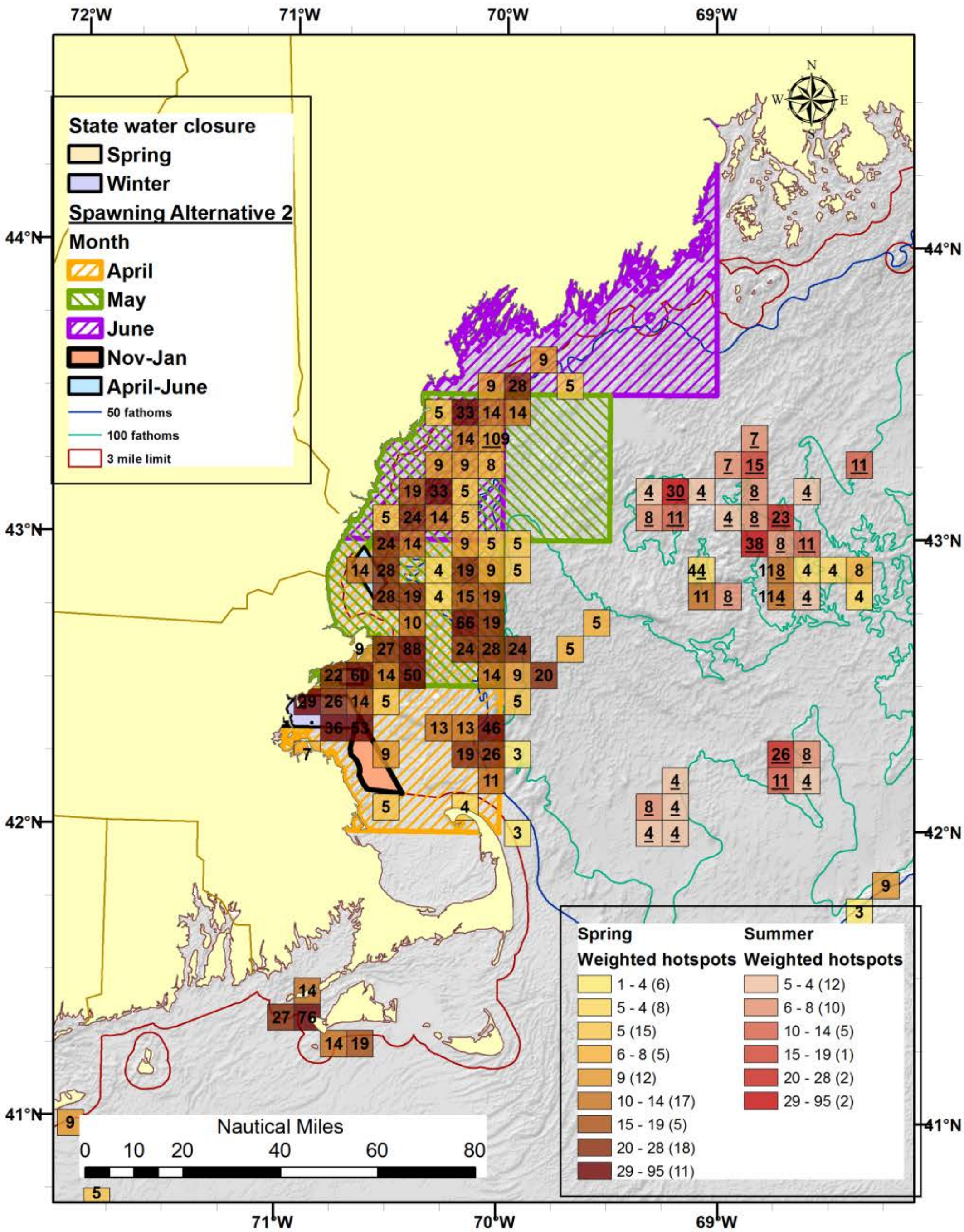
Winter cod spawning is known to occur in the middle and southern portions of Massachusetts Bay, and probably off the outer portion of Cape Cod as well. A new area where fishermen have reported intensive cod spawning off Scituate, MA is being investigated by MADMF scientists using acoustic tags. While this area appears to be important for immature cod in the spring (Map 63), the winter trawl surveys have caught few large cod in this area, compared to portions of the Western Gulf of Maine Closed Area and the southern portion of Jeffries Ledge (Map 64). Nonetheless, a winter spawning closure in this area could complement the existing Mass Bay spawning closure in MA state waters (Map 64) and potentially other spawning protection areas in state waters that will be identified from this research.

This alternative essentially protects spawning in the same areas and seasons as in Alternative 1 (No Action), but provides less protection to spawning around Cashes Ledge. Some additional spawning protection may be provided by the Mass Bay cod spawning protection area proposed by this alternative. Areas included in this alternative had about the same number of spawning hotspots as those for Alternative 1 (No Action) (Table 85 , Map 62).

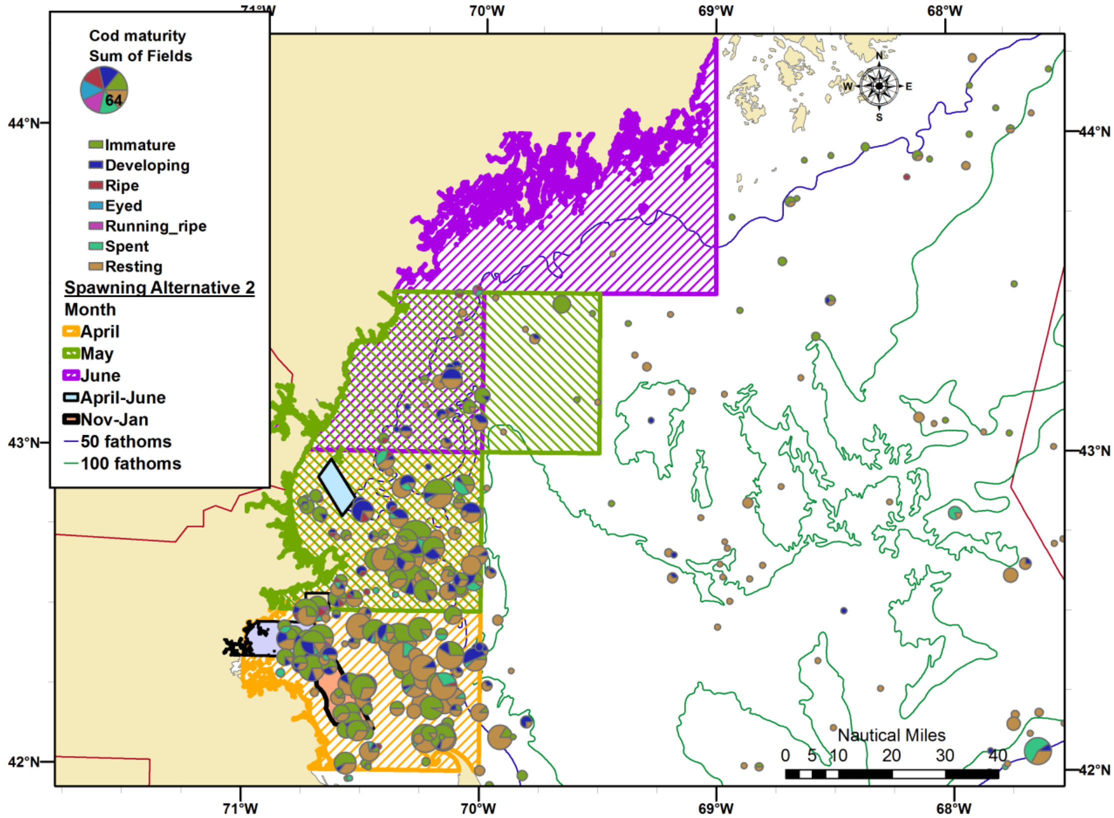
The only difference between Option A and B is that fishing by recreational vessels that catch groundfish would be prohibited during the April to June rolling closures. While there is no research that suggests that recreational fishing could interfere with spawning behavior, it could cause spawning fish to disperse or avoid areas with many recreational vessels and it certainly contributes to removals of large spawning fish from the population before they have been able spawn in that year.

Considering these effects described above, the impact on groundfish habitat is neutral or slightly negative compared to Alternative 1 (No Action) (which has year round closed areas). The impact on groundfish productivity is expected to be positive compared to Alternative 1 (No Action) and to Alternative 2, Option A.

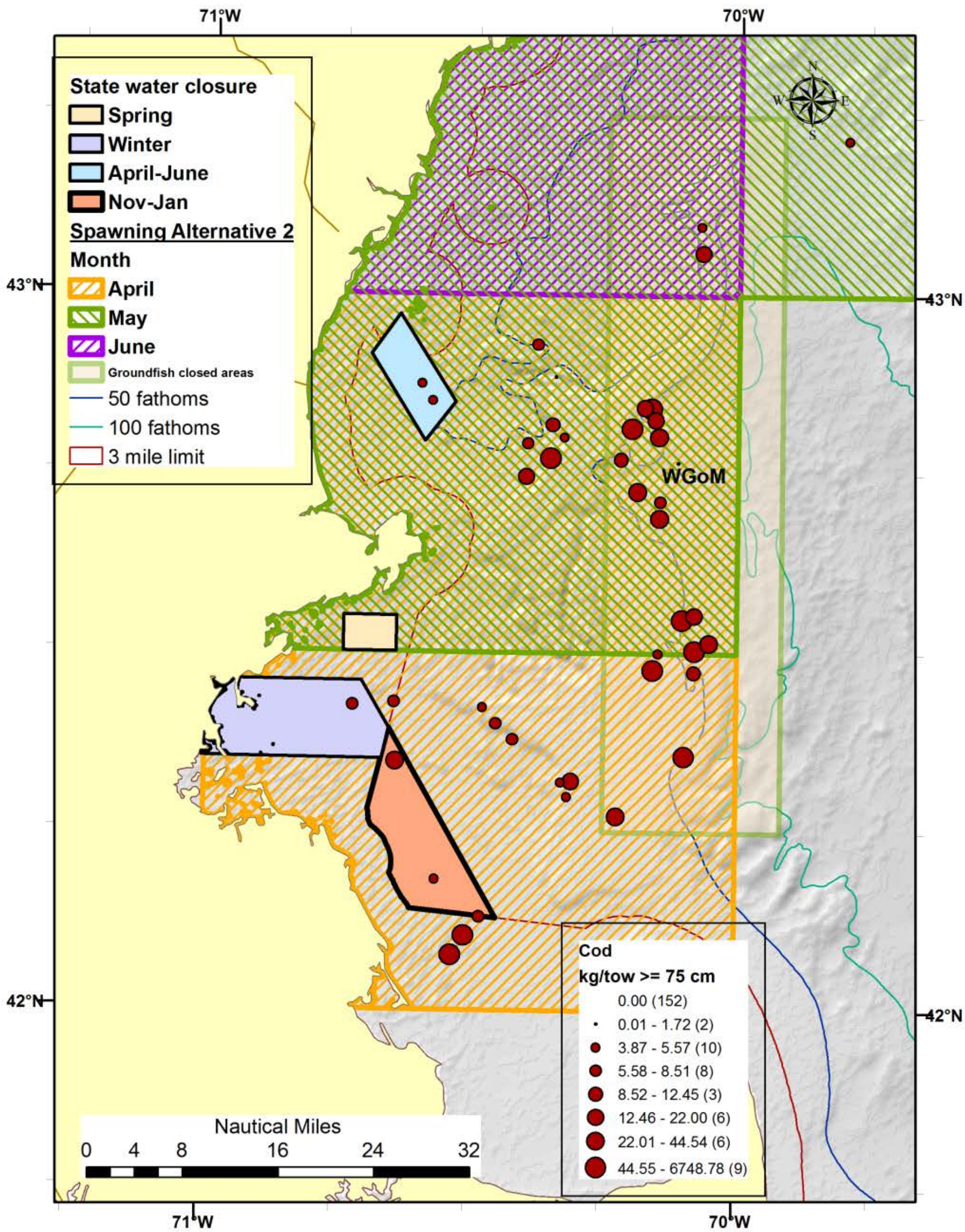
Map 62 – Alternative 2 spawning closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the Western Gulf of Maine sub-region, using 2002-2011 spring NMFS, MADMF, ME-NH, and IBS cod survey data.



Map 63 – Proportion of cod abundance by stage of maturation during NMFS and MADMF spring trawl surveys, 2002-2011.



Map 64 – Distribution of large mature cod during NMFS winter trawl and IBS trawl surveys, 2002-2007.



4.2.2.2 *Georges Bank and Southern New England*

4.2.2.2.1 Alternative 1 (No action)

No action would retain the existing year round groundfish closed areas, including Closed Area I, Closed Area II, and the Nantucket Lightship Area. It would also continue the Georges Bank seasonal closure area during May. The latter area is open to fishing to all but a few types of commercial fishing vessels. Vessels that operate under an approved sector operations plan may fish in this seasonal closed area. Recreational fishing vessels targeting groundfish or other species may fish in any of the areas.

Although cod and haddock spawning occurs primarily in the spring, groundfish spawning also occurs in other seasons. For example, data from Smolowitz et al. (2012) indicates that yellowtail flounder spawning in Closed Area II occurs during the summer, July and August. The added seasonal protection of spawning groundfish is reflected in the hotspot summary table below. Although hotspots for large mature groundfish stocks occur in any season to varying extents, the weighted hotspots were given a positive weight only during the seasons when that stock was known to spawn. Positive weights during the summer, fall, and winter, varying by factors accounting for stock biomass, subpopulations, and residency, were assigned by the Council's CATT include cod, winter flounder, witch flounder, pollock, redfish, halibut, ocean pount, and windowpane flounder.

Therefore the total weighted hotspots are an appropriate metric to evaluate the degree of spawning protection afforded to groundfish stocks by the year round closures for Georges Bank areas. It is also valid to make a comparison of these weighted hotspots with those for other alternatives only in the spring season when the proposed area closures would apply.

Most of the large spawner hotspots were identified in Closed Area II, totaling 549.8 (97 unweighted) in the spring (Map 65), with some hotspots (22.4) in the fall (Table 86). Closed Area I had a relatively low number of large spawner hotspots in the spring (Map 65) and fall (Map 66), while the Nantucket Lightship Area had 28.1 weighted hotspots in the winter, associated with windowpane flounder.

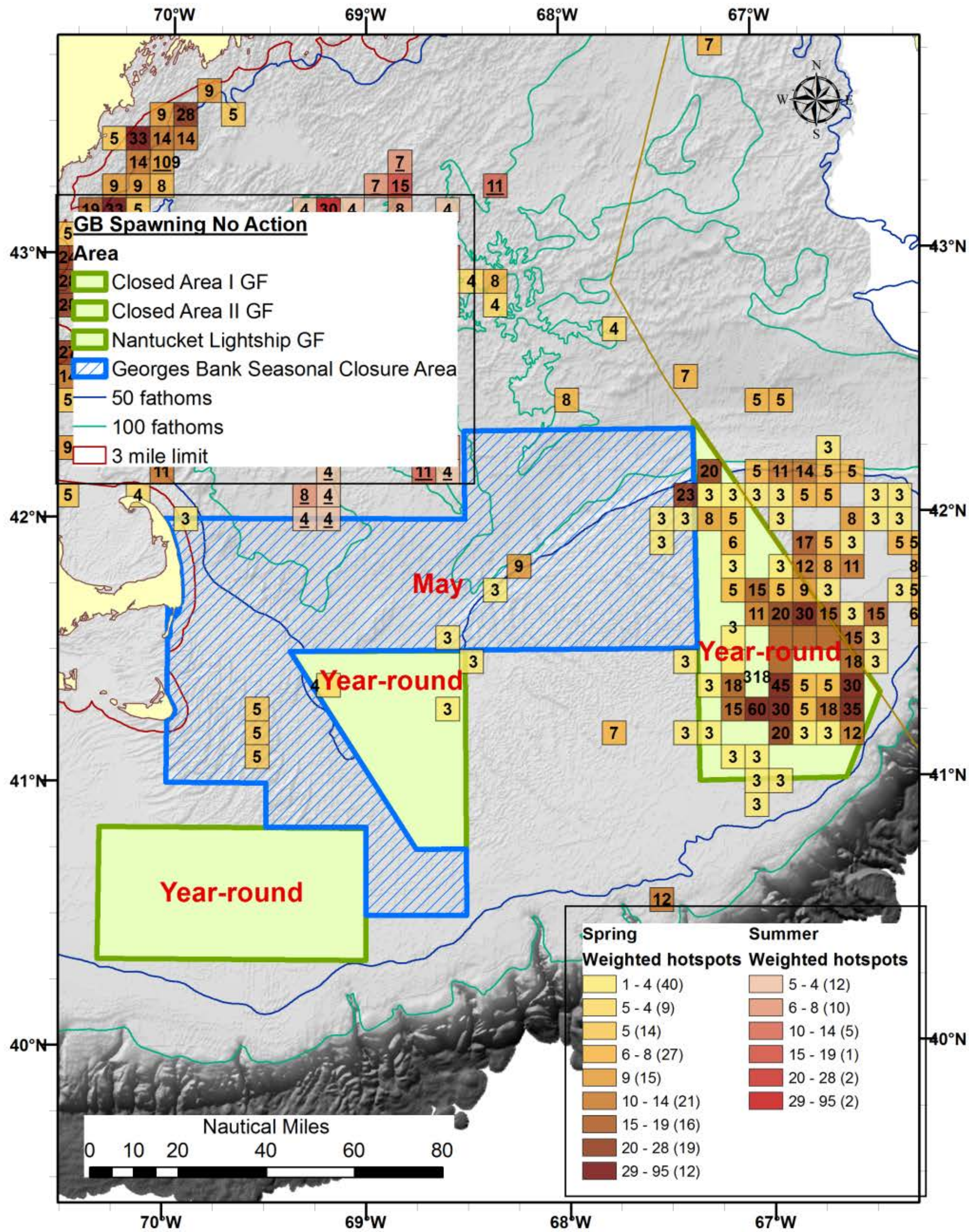
The existing year round groundfish closed areas provide a relatively high level of protection from spawning, except in areas that are open to fishing under specific groundfish and scallop access programs. The scallop access program currently allows scallop dredge fishing in these areas during the spring, which would continue under this No Action alternative.

The no action alternative likely has positive impacts on managed large mesh groundfish because the probable benefits to groundfish productivity are considered to be relatively high, especially for cod, haddock, winter flounder, yellowtail flounder (and probably a considerable number of non-groundfish species).

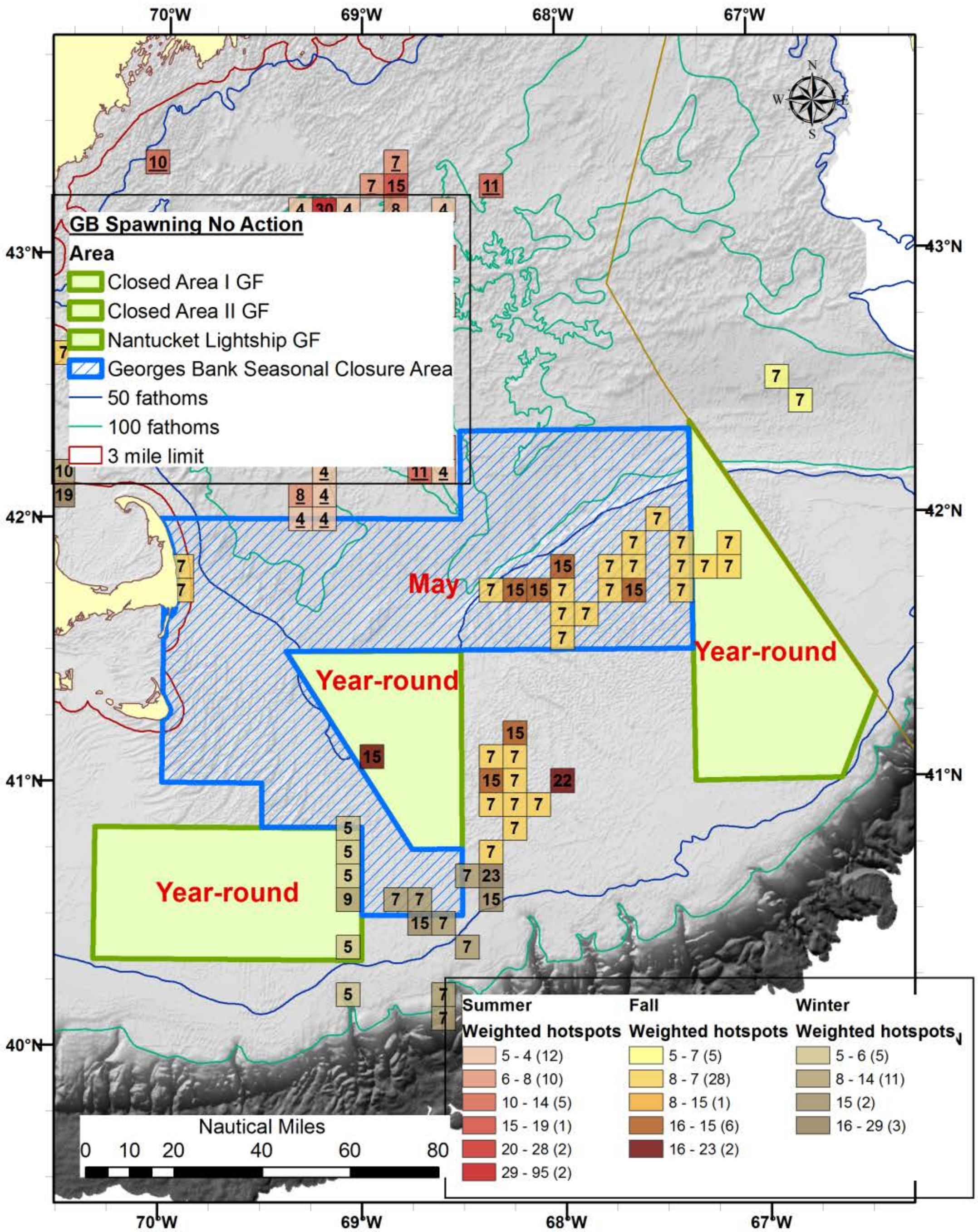
Table 86 – Seasonal summary of unweighted and weighted large spawner hotspots for the No Action alternative.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Georges Bank/Southern New England								
Groundfish closure	139	618.4	51	7.5	282	209.5	11	43.1
Closed Area I GF	2	6.5	15	0.0	23	15.1	0	0.0
Closed Area II GF	97	549.8	24	0.0	42	22.4	3	0.0
Nantucket Lightship GF	0	0.0	2	0.0	0	0.0	6	28.1
Georges Bank Seasonal Closure Area	40	62.2						

Map 65 – Distribution of weighted large spawner groundfish hotspots in spring compared to No Action alternative areas.



Map 66 – Distribution of weighted large spawner groundfish hotspots in summer, fall, and winter seasons compared to No Action alternative areas.



4.2.2.2.2 Alternative 2, Options A and B

During February 1 to April 30, this alternative (Option A) would close all of Closed Area I and II to commercial fishing with gears capable of catching groundfish, including trawls, gillnets, longlines, hook gear, and scallop dredges. Certain exemptions would apply and are described in Section 2.2.2. The intent is to reduce impacts on spawning groundfish, especially cod and haddock.

Most of the spring large spawner groundfish hotspots occur in Closed Area II (Table 87; Map 67), particularly for haddock and yellowtail flounder. A few cod hotspots occur, but most are in Canadian waters. Although there are relatively few hotspots located in Closed Area I, there are large cod and haddock caught there by surveys, particularly in portions overlapping the Great South Channel and in the deeper water in the northern half of Closed Area I (Map 68). Past observations indicated that cod and haddock spawn in this area during the spring and were the basis for the original Closed Area I (and Closed Area II) designations. During the spring surveys, few developing and ripe cod were caught on Georges Bank, except in the southern part of Closed Area I (Map 69, top). A considerable proportion of haddock were however in developing or ripe condition during the spring surveys in most areas of Eastern Georges Bank and in the northern 2/3rds of Closed Area I (Map 69, bottom).

Based on the number of large spawner hotspots as an indicator of groundfish spawning protection, this alternative has slightly positive impacts on groundfish productivity for spring spawners (due partially to the elimination of the scallop access program during Feb to Apr) and large negative impacts on fish that spawn during other seasons. Although larger cod and haddock tend to be able to avoid noisy 15’ dredges, much of the concern is disruption of spawning behavior and dispersion of spawning fish, which can reduce spawning efficiency (see discussion above). The lower number of hotspots in the spring is due to the elimination of the May Georges Bank seasonal closure area.

Although there are access programs that affect groundfish habitat in parts of the Nantucket Lightship Area and Closed Area I and II, this alternative would have a large negative impact on groundfish habitat because mobile gear is prohibited from major portions of these currently closed areas and they contain some vulnerable habitat.

Option B differs from Option A only because it would prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Area I and II during the spring when the fish spawn.

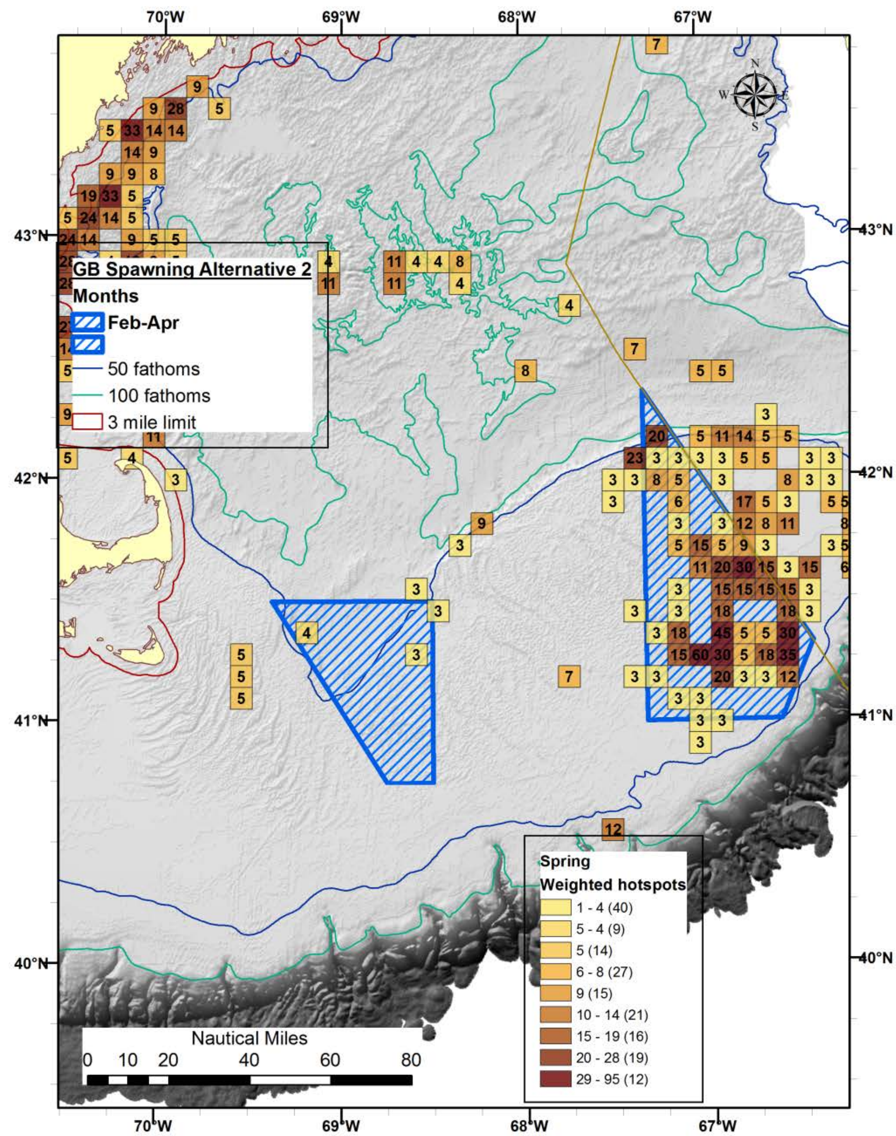
While a relatively small amount of recreational groundfish fishing effort occurs in Closed Area I and II during February and April, this alternative (Alternative 2 Option B) provides some added protection for spawning cod and haddock, both primary recreational target species.

Thus relative to Alternative 1 (No Action), this alternative has slightly positive impacts on groundfish productivity in the spring season (due partially to the elimination of the scallop access program during February to April and prevention of recreational fishing for spawning cod and haddock) and large negative impacts on fish that spawn in other seasons. Although there are access programs that affect groundfish habitat in parts of the Nantucket Lightship Area and Closed Area I and II, this alternative would have a large negative impact on groundfish habitat.

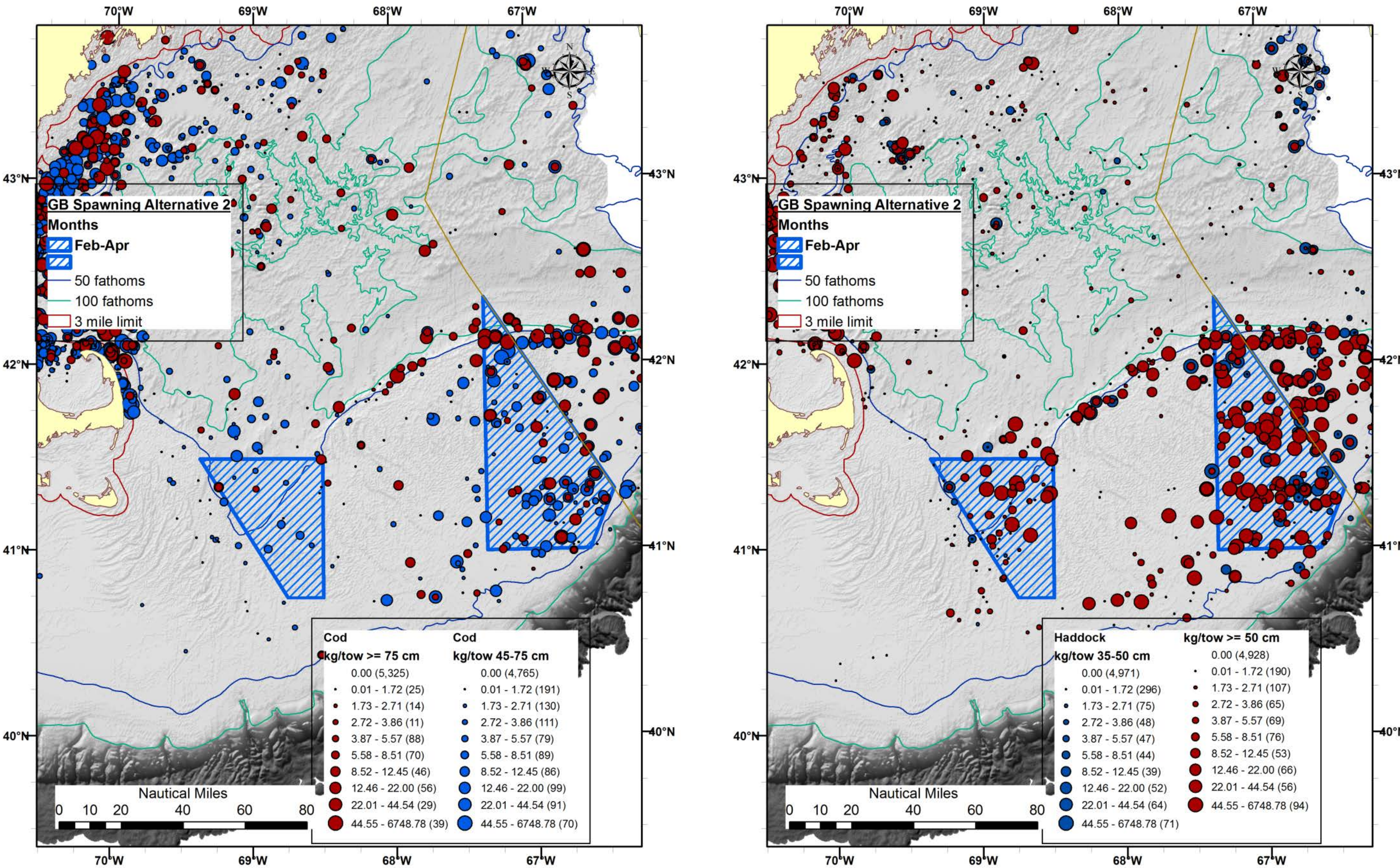
Table 87. Summary of unweighted and weighted large spawner hotspots during spring, comparing Georges Bank Alternatives 1 (No Action), 2, and 3.

	Spring	
	Total hotspots	Total weighted hotspots
Georges Bank		
No Action	**139**	**618.4**
Seasonal spawning	40	62.2
Year round	99	556.2
Alternative 2	99	556.2
Alternative 3	98	553.5

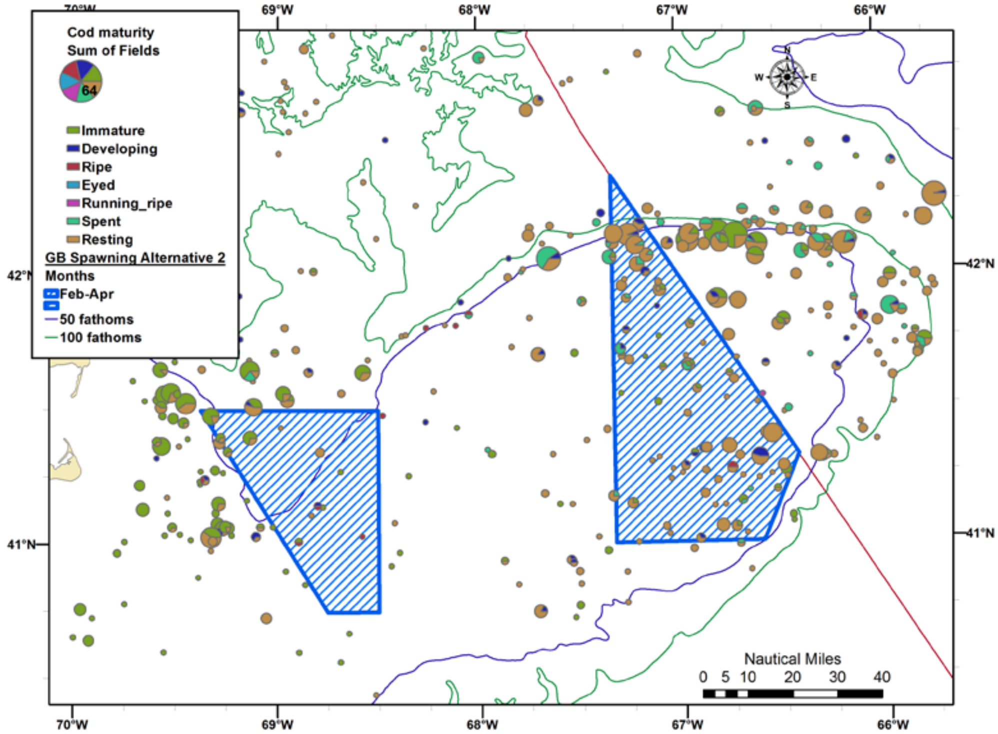
Map 67 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1 areas.

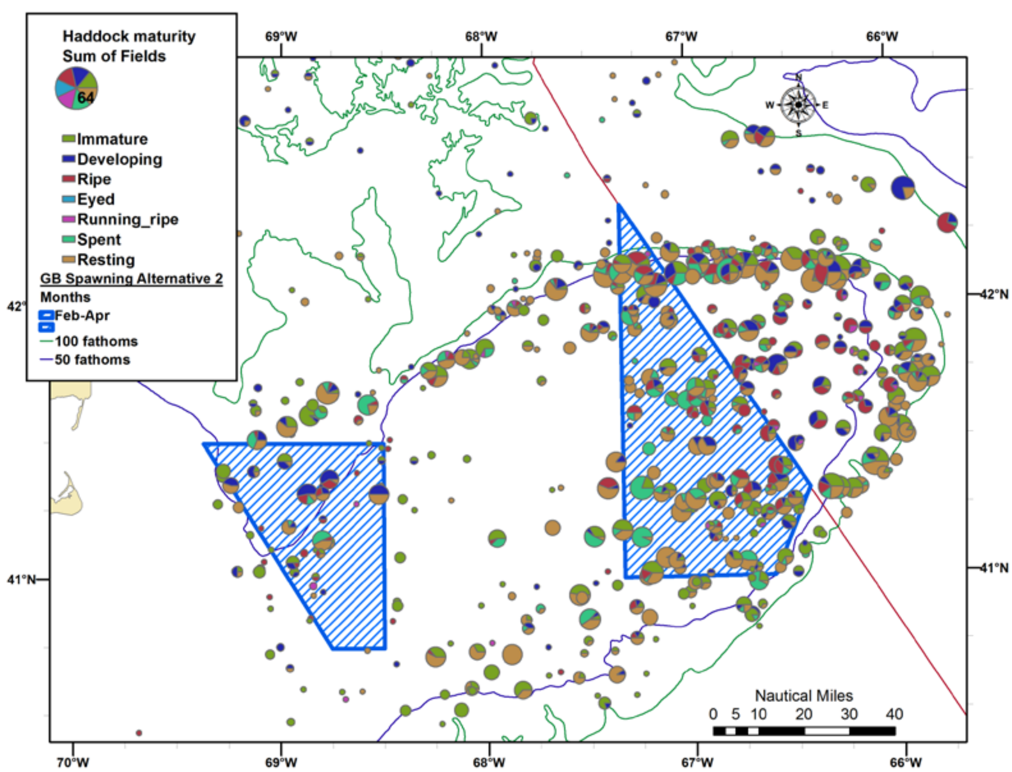


Map 68. Distribution of cod (left) and haddock (right) by small and large mature fish size classes during spring and summer surveys of Georges Bank during 2002-2011.



Map 69 – Distribution of cod (top) and haddock (bottom) by maturity stage during 2002-2011 surveys.





4.2.2.2.3 Alternative 3, Options A and B

Alternative 3 differs from Alternative 2 only because the south and central portion of Closed Area I would not be included as a spawning protection area closed during February to April. If Closed Area I South is however chosen as a DHRA (Section ???), the southern portion of this area would remain closed year round, having a very small positive effect on groundfish productivity through spawning protection.

There are few large spawner hotspots (553.5 weighted hotspots vs 556.2 for Alternative 1, TAB) and few large or mature cod and haddock in the south and central portions of Closed Area I during the spring surveys (
Option B differs from Option A only because it would prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Area I North and II during the spring when the fish spawn.

While a relatively small amount of recreational groundfish fishing effort occurs in Closed Area I and II during February and April (see Economic Section ???), this alternative (Alternative 3 Option B) provides some added protection for spawning cod and haddock, both primary recreational target species.

Thus relative to Alternative 1 (No Action), this alternative has slightly positive impacts on groundfish productivity in the spring season (due partially to the elimination of the scallop access program during February to April and prevention of recreational fishing for spawning cod and haddock) and large negative impacts on fish that spawn in other seasons. Although there are access programs that affect groundfish habitat in parts of the Nantucket Lightship Area and Closed Area I and II, this alternative would have a large negative impact on groundfish habitat. Relative to Alternative 2 (Option A and B), this alternative has a small negative impact on groundfish habitat because the bottom substrate in Closed Area I South is almost entirely high energy sand.
Map 70). The remaining portions, i.e. Closed Area I North and all of Closed Area II, have a considerable number of large spawner groundfish hotspots, large cod and haddock (Map 68), and haddock in developing or ripe condition (Map 69).

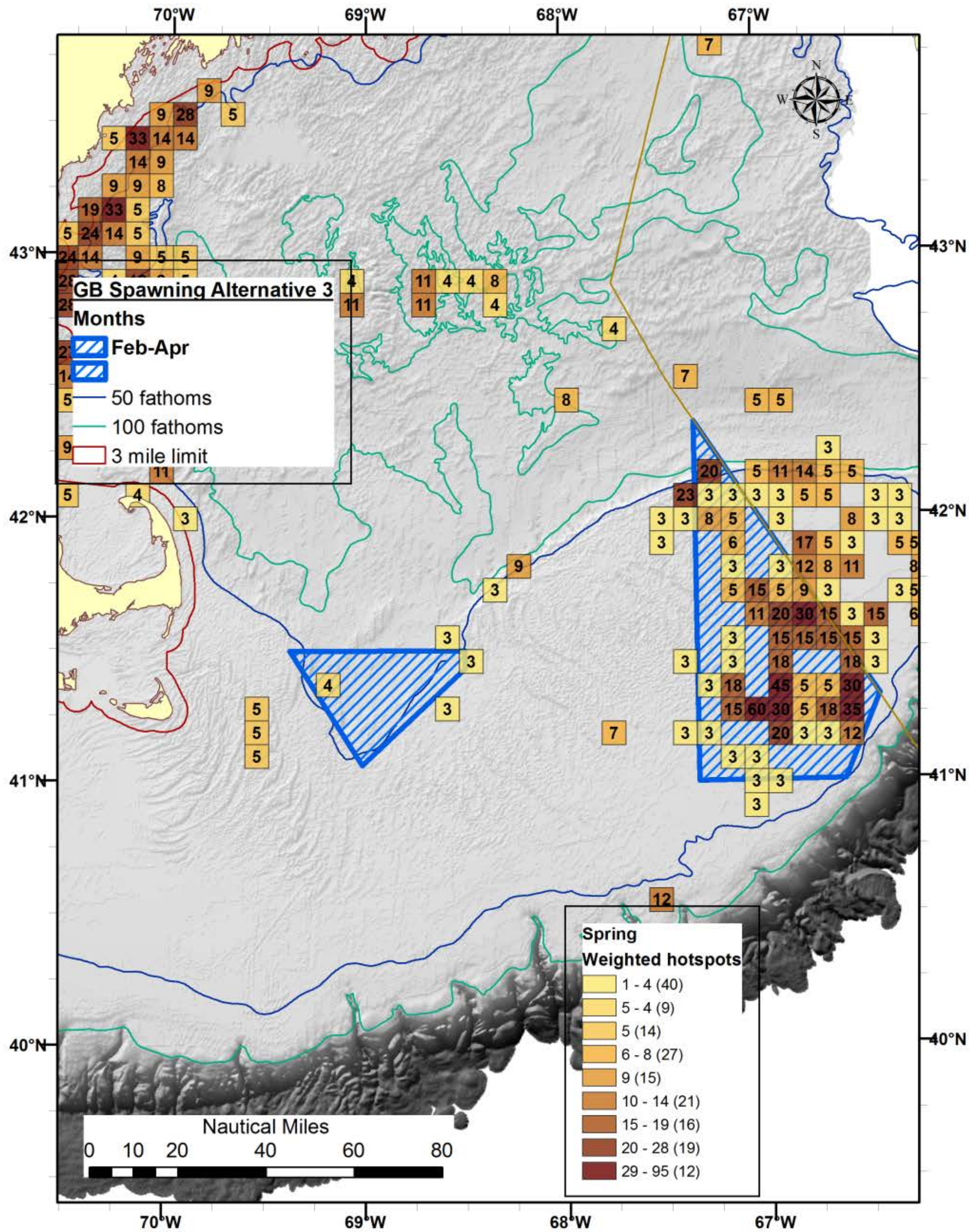
Therefore, this alternative has nearly the same impact on groundfish productivity through spawning protection as Alternative 2 Option A, slightly positive impacts on spring spawners and large negative effects on fish that spawn in other seasons. If Closed Area I South is also chosen as a DHRA, then it would also have a large negative impact on groundfish habitat as Alternative 2 Option A, since the central portion of Closed Area I is defined as an access area using scallop dredges. Relative to Alternative 2 (Option A and B), this alternative has a small negative impact on groundfish habitat because the bottom substrate in Closed Area I South is almost entirely high energy sand.

Option B differs from Option A only because it would prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Area I North and II during the spring when the fish spawn.

While a relatively small amount of recreational groundfish fishing effort occurs in Closed Area I and II during February and April (see Economic Section ???), this alternative (Alternative 3 Option B) provides some added protection for spawning cod and haddock, both primary recreational target species.

Thus relative to Alternative 1 (No Action), this alternative has slightly positive impacts on groundfish productivity in the spring season (due partially to the elimination of the scallop access program during February to April and prevention of recreational fishing for spawning cod and haddock) and large negative impacts on fish that spawn in other seasons. Although there are access programs that affect groundfish habitat in parts of the Nantucket Lightship Area and Closed Area I and II, this alternative would have a large negative impact on groundfish habitat. Relative to Alternative 2 (Option A and B), this alternative has a small negative impact on groundfish habitat because the bottom substrate in Closed Area I South is almost entirely high energy sand.

Map 70 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 2 areas.



4.2.3 Human communities and the fishery

4.2.3.1 *Economic impacts*

4.2.3.1.1 Gulf of Maine

Tables and figures related to analysis of the economic impacts of the Gulf of Maine spawning management alternatives are provided below. Discussion of impacts is provided under a separate heading for each alternative.

Figure 35 – Massachusetts Bay Groundfish Spawning management area alternative revenue by gear, as a percentage of the total average revenue Nov. 1 – Jan 31 within each year range given. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 582,110; 2008 – 2012 = $ 680,528; 2010 – 2012 = $ 651,690

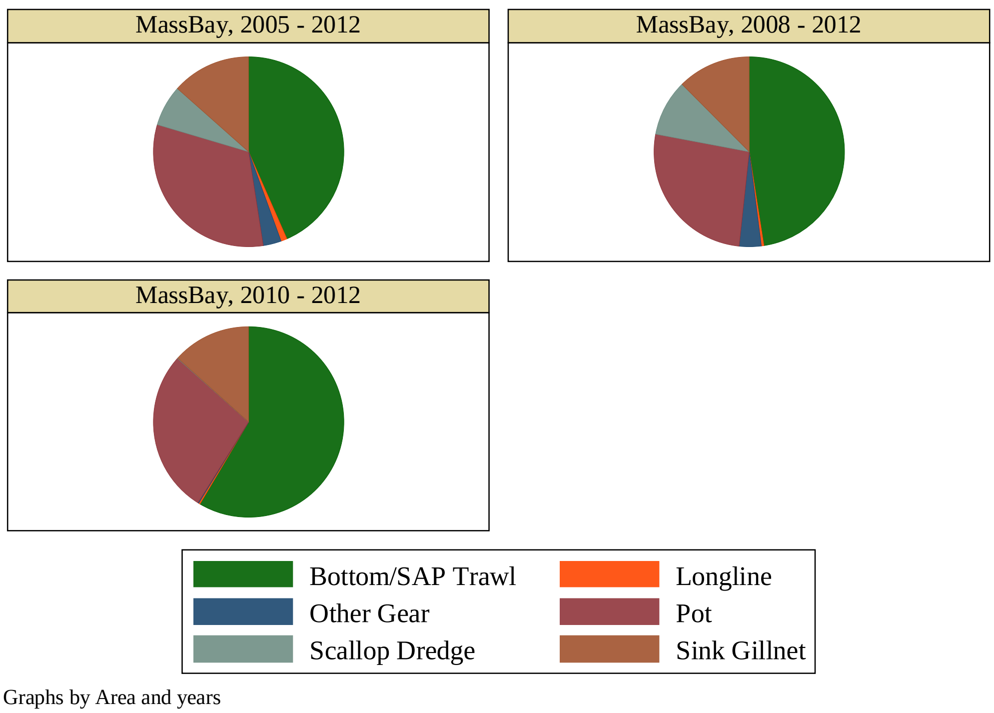


Table 88 – Gear in currently open portions of the Massachusetts Bay area of Spawning Alternative 2 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom/SAP Trawl	MassBay	L/U	36,579	20,799	35,281	99,572	5,023	28	120	2005 - 2012
Bottom/SAP Trawl	MassBay	L/U	52,190	58,534	36,618	99,572	8,846	27	139	2008 - 2012
Bottom/SAP Trawl	MassBay	L/U	60,390	58,534	38,287	99,572	23,065	29	158	2010 - 2012
Bottom/SAP Trawl	MassBay	M	139,095	102,792	81,450	292,076	66,471	37	315	2005 - 2012
Bottom/SAP Trawl	MassBay	M	172,780	169,320	87,767	292,076	73,085	31	314	2008 - 2012
Bottom/SAP Trawl	MassBay	M	207,165	221,715	93,043	292,076	107,705	24	220	2010 - 2012
Bottom/SAP Trawl	MassBay	S	77,127	75,371	38,127	140,730	32,892	34	422	2005 - 2012
Bottom/SAP Trawl	MassBay	S	98,399	76,757	31,485	140,730	74,719	29	377	2008 - 2012
Bottom/SAP Trawl	MassBay	S	113,752	123,767	33,141	140,730	76,757	21	248	2010 - 2012
Longline	MassBay	ALL	5,935	3,912	7,224	23,230	495	14	83	2005 - 2012
Longline	MassBay	ALL	3,286	3,060	2,387	6,653	495	12	62	2008 - 2012
Longline	MassBay	ALL	1,778	1,779	1,282	3,060	495	7	26	2010 - 2012
Scallop Dredge	MassBay	L	33,673	0	95,242	269,386	0	9	2	2005 - 2012
Scallop Dredge	MassBay	L	53,877	0	120,473	269,386	0	9	3	2008 - 2012
Scallop Dredge	MassBay	L	0	0	0	0	0		0	2010 - 2012
Scallop Dredge	MassBay	OTHER	7,089	593	17,885	-	-	4	12	2005 - 2012
Scallop Dredge	MassBay	OTHER	10,845	577	22,639	-	-	4	14	2008 - 2012
Scallop Dredge	MassBay	OTHER	785	577	826	-	-	4	11	2010 - 2012
Sink Gillnet	MassBay	ALL	77,865	71,254	34,722	144,568	41,906	32	503	2005 - 2012
Sink Gillnet	MassBay	ALL	84,808	74,097	43,726	144,568	41,906	32	522	2008 - 2012
Sink Gillnet	MassBay	ALL	86,857	74,097	52,507	144,568	41,906	21	263	2010 - 2012

Table 89 – Recreational fishing revenue associated with the Great South Channel Alternative 6 between November 1 and January 31. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents to Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
MassBay	2006 - 2012	185,770.82	7.29	998.14	5,703.49	5,029.83	3,839.85
MassBay	2008 - 2012	162,435.41	6.40	872.60	5,601.22	5,029.83	3,641.90
MassBay	2010 - 2012	162,817.46	5.00	874.00	5,956.74	5,681.85	3,489.34

4.2.3.1.1.1 Alternative 1 (No action)

To be completed later

4.2.3.1.1.2 Alternative 2, Options A and B

The gear currently employed within the bounds of the Massachusetts Bay area within Gulf of Maine Spawning Alternative 2 during the proposed Nov. 1 to Jan. 31 closure period is illustrated in Figure 35. Of particular interest for this alternative is the large portion of the revenue generated by Bottom/SAP Trawls and Sink Gillnet. Table 88 provides more detail to the fishing revenue being generated by vessels employing these gears in the Massachusetts Bay area during the relevant months of the closure. For Bottom/SAP Trawls, a mean per-trip revenue of $382 is estimated to fall within the area closure for the > 70 ft vessel category, for vessels between 50 ft and 70 ft the mean per-trip revenue potentially displaced is estimated to be $942, and for vessels < 50 ft it is $459. Vessels between 50 ft and 70 ft represent 54% of the total Bottom Trawl revenue estimated for the Massachusetts Bay area. The area is estimated to produce a per-trip revenue of $330 for vessels fishing with Sink Gillnets, with a relatively large number of trips estimated to have historically fished in the area. Less fishing is conducted using Longline, which has a mean per-trip revenue of $68, and Scallop Dredges, for which the < 70 ft vessels average per-trip revenue generated is estimated to be $71 and the > 70 ft vessels recently producing no revenue in the area although historically this was not always true.

The recreational revenue reported to have been generated in the Massachusetts Bay area is detailed in Table 89. The average annual revenue is consistently high, with a small number of vessels active in the area.

4.2.3.1.2 Georges Bank and Southern New England

4.2.3.1.2.1 Alternative 1 (No action)

To be completed later

4.2.3.1.2.2 Alternative 2, Options A and B

To be completed later

4.2.3.1.2.3 Alternative 3, Options A and B

To be completed later

4.2.3.2 ***Community impacts***

Many of the general social impacts of the groundfish spawning protection alternatives are similar to those discussed earlier regarding the impacts of habitat management alternatives (Section 4.1.3.2). Although the purpose of these actions differ (protecting habitat and spawning groundfish respectively) the effects on communities of closing and opening areas to different types of fishing are similar.

Additional social impacts specific to the groundfish spawning protection alternatives generally impact the *Values, Attitudes and Beliefs* of fishermen. Negative impacts on *Values, Attitudes and Beliefs* may be based on perceptions of differing levels of impact to particular gear types or fisheries. For example, the spawning protection areas are identified to improve groundfish spawning protection; however the restrictions impact all vessels capable of catching groundfish. This may cause resentment among gear types that are capable of catching groundfish and will be affected by the restrictions, but do not target groundfish and are thus unlikely to benefit from future groundfish spawning improvement, negatively affecting the *Social Structures and Organizations* of a community.

The options included which exempt recreational fishing may also have impacts on *Values, Attitudes and Beliefs* of fishermen. These are likely to be positive impacts on the recreational fishery and negative impacts on the commercial fishery. These differing impacts may also affect the *Social Structures and Organizations* of a community. The social impacts of the proposed alternatives that include recreational fisheries are difficult to discern, in part because many participants are not associated with a primary or secondary port group: passengers on party/charter vessels come from a wide area and are often not specifically associated with a fishing community.

There may also be positive impacts on the *Values, Attitudes and Beliefs* of members of the groundfish fishery related to the shift in management from focus on mortality closures, which are no longer needed due to output controls in the fishery, to spawning protection. However, members of the fishery that participated in informational interviews conducted by the NEFMC mentioned that due to these output controls there is no need for additional spawning protection.

4.2.3.2.1 Gulf of Maine

Table 90 – Total number and percent of vessels by port of landing or city of registration associated with at least three vessels conducting trips capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area.

State	Community	Port	City
MA		**98**	**74**
	Boston	13	
	Gloucester	50	30
	Marshfield	7	
	New Bedford	19	18
	Plymouth	3	
	Provincetown	3	
	Sandwich	3	
	Scituate	3	4
ME		**3**	**19**
	Portland	3	9
NH		**3**	**4**
RI			**3**

4.2.3.2.1.1 Alternative 1 (No action)

The No Action Alternative would retain (1) the Western Gulf of Maine Closure Area and the Cashes Ledge Closure Area, (2) the GOM Rolling Closures Areas that apply to sector and common pool vessels, and (3) the GOM Cod Spawning Protection Area, also known as the Whaleback area.

The social impacts associated with Alternative 1 are expected to be neutral as it would maintain the status quo. There may be some negative impacts on the *Values, Attitudes and Beliefs* of members of the groundfish fishery related to the lack of flexibility of management as this would maintain current mortality closures, which are seen as no longer needed due to output controls in the fishery.

4.2.3.2.1.2 Alternative 2, Options A and B

The social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive. There may be some negative impacts particularly to smaller vessels that fish inshore due to the implementation of the Massachusetts Bay Spawning Area. This will particularly impact the communities identified in Table 90. The overall reduction in closed as well as the positive long-term impacts, if new spawning closures effectively increase fish populations will likely offset the negative impacts.

4.2.3.2.2 Georges Bank and Southern New England

4.2.3.2.2.1 Alternative 1 (No action)

Alternative 1 would retain the existing year round closed areas on Georges Bank and in Southern New England, specifically Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area, and the May Georges Bank Seasonal Closure Area.

The social impacts associated with Alternative 1 are expected to be neutral as it would maintain the status quo. There may be some negative impacts on the *Values, Attitudes and Beliefs* of members of the groundfish fishery related to the lack of flexibility of management as this would maintain current mortality closures, which are seen as no longer needed due to output controls in the fishery.

4.2.3.2.2.2 Alternative 2, Options A and B

Alternative 2 would retain as spawning closures Closed Area I and Closed Area II during the months of February, March, and April. Under this alternative, the Nantucket Lightship groundfish closed area would be eliminated and the Georges Bank Seasonal Closures Area would be eliminated.

The social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive as they more effectively protect spawning groundfish while limiting impact on fishing vessels.

4.2.3.2.2.3 Alternative 3, Options A and B

Alternative 3 would retain as spawning closures the northern part of Closed Area I and Closed Area II during the months of February, March, and April. Under this alternative, the Nantucket Lightship groundfish closed area would be eliminated and the Georges Bank Seasonal Closures Area would be eliminated.

The social impacts of Alternative 3 in comparison to the no action alternative are expected to be positive as it more effectively protects spawning groundfish while limiting impact on fishing vessels.

4.2.4 Protected resources

4.2.4.1 *Gulf of Maine*

In general, the spawning alternative in the Gulf of Maine is a modification to the no action alternative. The alternatives under consideration would, generally, prohibit the use of gear capable of catching groundfish, including trawls, gillnets, dredges, and hook and line (Section 2.2.1.) The action alternative in this region would remove the "common pool" rolling closures and implement the "sector" rolling closures, which means there would be no rolling closure in March, and the April through June closures would be slightly smaller. The fall rolling closure (Rolling Closure V) would be removed, but a modification of that area (Massachusetts Bay Cod Spawning Protection Area) would be closed from November through January. The Gulf of Maine Cod Spawning Protection Area, known as the "Whaleback" area, would continue to be closed from April through June.

There are two options under consideration for these areas as well. Option A would exempt recreational and charter/party fishing from the rolling closure areas (recreational groundfish fishing would continue to be prohibited in the Whaleback Area, and would be prohibited in the Massachusetts Bay area.) The other option (Option B) would prohibit recreational groundfishing fishing in all of the spawning protection areas.

There may be an increase in effort in the rolling closure areas that would be opened under either of the action alternative options. However, there is an existing Harbor Porpoise Take Reduction Plan gillnet closure in the portion of the Western Gulf of Maine with the highest concentration of porpoises, known as the Massachusetts Bay Management Area, as well as seasonal pinger requirements throughout much of the region. As stated above, pingers have a 92 percent success rate at avoiding interactions of gillnet gear and porpoises. There may be a slightly negative impact to other protected resources from some increased availability to other gear capable of catching groundfish; however, the proposed alternatives are not significant changes from the no action. The majority (99 %) of the groundfish fleet participates in sectors and is already fishing under the action alternative's rolling closures. Further, there may be a slightly positive impact to protected resources from the Option B alternative that would prohibit recreational fishing in the rolling closure areas by reducing the number of lines in the water.

Therefore, the overall impact of the spawning alternatives in the Gulf of Maine are expected to be negligible.

4.2.4.2 *Georges Bank and Southern New England*

The Georges Bank Spawning Alternatives would result in either all of Closed Area I, or just the northern Closed Area I habitat closed area, and Closed Area II being closed to gear capable of catching groundfish from February through April. Both action alternatives have two options associated with them: (A) Exempt recreational and charter/party fishing; or (B) prohibit recreational and charter/party fishing. However, there is relatively little recreational fishing in this region, so the differences between the two options would be minimal.

Based on large whale sightings taken from the North Atlantic Right Whale Consortium Database and data obtained through OBIS-SEAMAP, few large whale sightings have been recorded in this region during December through March. In the spring months, sightings of large whales increase in the vicinity of Closed Area II with highest numbers here appearing to be in May and June. Right whales sightings diminish in the area by August. Humpback and fin whale sightings largely dwindle during the fall. However, it is important to note that these data should be treated as presence-only, and that an absence of sightings does not indicate an absence of animals from the area. Allowing groundfish fishing in Closed Area II outside of February, March, and April may result in increased interaction with large whales.

However, the impacts would be similar to those discussed above related to the habitat management area alternatives in Georges Bank (Section 4.1.4.4). That is, a slightly negative impact on marine mammals, as the spawning closures do not overlap with the times of highest known abundance; and negligible impacts to both sea turtles and Atlantic sturgeon. In addition, vessels would still be subject to the Great South Channel gillnet closure from April through June, which overlaps the northern portion of Closed Area I and would effectively close this area to gillnet gear from February through June.

4.3 Alternatives to designate Dedicated Habitat Research Areas

The Dedicated Habitat Research Areas proposed in this amendment (section 2.3) encompass areas also identified as no action Habitat Closure Areas or candidate Habitat Management Areas. Generally, the fishing restriction measures that would be applied within the DHRAs are similar to those that could be associated with an HMA designation, depending on the HMA option selected. Thus, the following sections may refer back to discussions presented in section 4.1 when discussing the impacts of the DHRA alternatives. Additional discussion presented in this section will focus on any the direct impacts of any additional restrictions associated with a DHRA alternative that were not discussed previously, as well as on the long term benefits that would be associated with the improved understanding gained through research conducted in the DHRAs.

4.3.1 Physical and biological environment

Impacts of DHRA designations on the physical and biological environment will mostly be long term, indirect, positive impacts that stem from an improved understanding of the relationship between habitats and fish survival, growth, and reproduction. This may lead to refined management strategies that promote habitat conservation and stock productivity as it relates to habitat. These positive impacts assume that the DHRAs are used to conduct research that relates to the agenda presented in the introduction to section 2.3; however if they are not, the Alternative 5 sunset provision, if selected by the Council, would trigger removal.

Because the DHRA boundaries are the same as some of the habitat management area boundaries, the figures, tables, and maps in the habitat management area sections of this document (4.1.1) can be referred to for understanding habitat type and vulnerability within each DHRA. Specifically, the Eastern Maine DHRA = Eastern Maine Small HMA, the Stellwagen DHRA = Stellwagen Large HMA, and the Georges Bank DHRA = CAI South Habitat Closure Area. Depending on the habitat management areas selected by the Council, and the fishing restrictions associated with those areas, the fishing restrictions associated with the DHRA designation could be more restrictive. In this case, then the benefits of DHRA designation might be more positive than the benefits associated with the HMA alternative.

Data describing dominant substrate and data support by high versus low energy for each area are provided in Table 91. A summary of diversity indices within each DHRA is provided in Table 92.

Table 91 – Summary of substrate distribution, data quality, and total size of dedicated habitat research areas. Percentages indicate the coverage by area of Substrate and data support values are listed in the text.

Area name, type, and region (number of overlapping unstructured grids)	Energy										Data support							Area, km^2
	Low energy					High energy					Low	Moderate			High			
	M	S	G	C	B	M	S	G	C	B	1	2	3	4	5	6	7	
Eastern Maine DHRA (50)	59%		19%	21%								26%	64%	10%				529
Stellwagen DHRA (639)	10%	70%	11%	1%			7%	1%				2%	52%	44%		1%	1%	1185
Georges Bank DHRA (607)		4%				2%	82%	12%				4%	6%	1%	3%	34%	51%	2028

Table 92 – Average diversity indices by DHRA alternative areas.

	SPRING				SUMMER				FALL				WINTER			
Row Labels	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI	Tows	LM Groundfish ISI	Regulated ISI	All Species SDI
No Action	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2	20	0.881	0.710	1.660	0	0.000	0.000	0.000	6	0.999	0.839	1.649	2	0.881	0.820	1.952
Alternative 3	59	0.640	0.573	1.261	10	0.945	0.908	1.555	17	0.908	0.802	1.892	23	0.590	0.559	1.143
Alternative 4	15	0.994	0.739	1.393	19	0.992	0.795	1.476	7	0.999	0.537	1.223	1	1.000	0.321	0.830

4.3.1.1 *Alternative 1 (No action)*

Currently there are no DHRAs designated. If none of the candidate DHRAs (Alternative 2, 3, and/or 4) are adopted by this amendment, then no action conditions would continue. DHRAs are expected to focus habitat-oriented research activities on particular topics and in particular locations. DHRAs should allow researchers requiring letters of authorization to obtain these documents more easily if the proposed research is in line with the DHRA research objectives. Finally, measures associated with the DHRA designations could afford additional research opportunities that may not be available without DHRA designation. Specifically:

- If the Eastern Maine Small area is not designated as a Habitat Management Area with the Option 1 mobile bottom-tending gear prohibition, the DHRA designation would be the only mechanism for establishing these conditions
- If the Western Gulf of Maine Groundfish Closure Area is removed, the DHRA designation would be the only mechanism for maintaining no action fishing restrictions on gear capable of catching groundfish and on mobile bottom-tending gear use. The reference area element of this DHRA designation is the only mechanism for creating a no-groundfishing area in the New England region.
- If the Closed Area I South Habitat Closure Area is removed and the CAI Groundfish Closure Area is converted to a seasonal spawning area, the DHRA designation in this area would be the only mechanism that would maintain the year-round prohibition on the use of mobile-bottom tending gear in this area.

Thus, depending on the other overlapping management areas selected, and the measures applied within those areas, selecting no action could have indirect negative impacts on seabed habitats and greatly impact both ongoing research and opportunities for future targeted research because the appropriate conditions for conducting research will not be created.

4.3.1.2 *Alternative 2*

Designation of the Eastern Maine DHRA is expected to have positive, indirect benefits to seabed habitats, via facilitation of research that will improve resource management over the long term. Also, as explained above, if a DHRA is created in this area in the absence of an overlapping Habitat Management Area, there would be a positive habitat impact.

4.3.1.3 *Alternative 3*

Designation of the Stellwagen DHRA is expected to have positive, indirect benefits to seabed habitats, via facilitation of research that will improve resource management over the long term. Also, as explained above, if a DHRA is created in this area in the absence of an overlapping Habitat Management Area, there would be a positive habitat impact.

The research area is appropriately sited for this purpose, and research in this area would build on a large number of previous studies. Due to its close proximity to shore, a diversity of habitat types and marine species, and designation as the Stellwagen Bank National Marine Sanctuary, there have been numerous geologic and ecological studies to serve as a baseline for future work.

With funding support from the Sanctuary, USGS has mapped the area with continuous coverage multibeam acoustics (Valentine et al 2005a) and identified boulder ridges using various types of information including topographic and backscatter data, terrain ruggedness index values, and thousands of video and photographic stations (Valentine et al 2005b). Some of the boulder ridges are quite large, with the largest tens of meters wide and hundreds of meters long, with a maximum height of 18 m (Valentine et al 2005b). The ridges are composed of cobbles and boulders interspersed with voids, and harbor an array of attached organisms as well as various fish species (Valentine et al 2005b).

Other studies have focused on the ecology of fishes, their relation to variation in habitat, patterns and variation in biological diversity and the ecological effects of fishing (e.g. Auster et al. 1996, 1998, 2001, 2003a, 2003b; Auster and Lindholm 2005; Grannis 2005, Kropp et al. 2000, Lindholm et al. 2001, 2007, Lindholm and Auster 2003, Nenadovic 2009, Tamsett et al. 2010). In summary, fishes of a diversity of species, including those managed by NEFMC, exhibit associations with habitat features at multiple spatial scales (i.e., biologic and geologic structural features of the environment from short lived hydroids to long lived sponges as well as textural elements in fine grain mud and sand to boulders, sediment types based on grain size, and regions and seasons defined by temperature and depth). Direct observation demonstrated that in general, the impacts of fishing gear reduce the structural complexity of biologic and geologic habitats and smooth sedimentary bedforms. Removal of habitat features reduce survival of juvenile fishes in laboratory experiments and can have population level effects if such results are scalable to larger areas. Further, these observations suggest the potential for match-mismatch dynamics between short-lived species that function as habitat or principal prey for juvenile fishes in fine-grain sedimentary habitats. While a good deal is known in regards to habitat associations of fish in this area compared to others in the Northeast Shelf Large Marine Ecosystem, actual linkages between habitat attributes and survivorship, growth and productivity of managed species at the scale that management operates remain to be conducted.

Grannis (2005), Nenadovic (2009) and Tamsett et al. (2010) contain detailed results from the Seafloor Habitat Recovery Monitoring Program (SHRMP) that began in 1998 at the time of designation of the Western Gulf of Maine Closure (WGOMC). Time series photographic observations of emergent and epifaunal species in mud, sand, gravel and boulder reef habitats, as well as grab samples of infaunal species in fine grain sediments, from inside and outside the WGOMC were collected (infaunal samples 1998-2004, imagery 1998-2010). Overall, species composition was dynamic across years, habitats and fishing treatments (i.e., inside and outside WGOMC). That is, while community composition was dynamic due to natural variation, the effects of fishing remain clear. While communities inside the closed area are recovering from disturbance due to fishing, the recovery is not progressing as expected from studies conducted elsewhere. Communities to date have not reached a stable “climax” community state, so it is unclear if communities exhibit succession, like old farm fields returning to forest on land, or are stochastic such that disturbances produce recovery to a new or different state. In regard to fine grained sedimentary habitats, sand infauna appeared to be most resilient to fishing disturbance in contrast to mud infauna, although both mud and sand epifaunal community structure was statistically different between fished and unfished sites. This project has been (and continues to be) funded by SBNMS, which is planning on the project’s long-term implementation.

Benthic habitats in this area have also been surveyed with still and video imagery using various ROVs and submersibles from 1984-2010 (NURTEC video archive), the USGS SEABOSS system, the SMAST video and still camera pyramid, and the WHOI HabCam system (Howland et al. 2006). Coverage from these image sets and associated data sets varies but these can establish baseline conditions across a diverse set of habitats and over time.

The reference area component specifically will allow research that investigates the ecosystem implications of a no-groundfish-take area. In general, aside from the Ammen Rock HMA which is more restrictive, **the most restrictive Habitat Management Area designations proposed in this amendment would prohibit the use of all mobile bottom-tending gear, allowing all other forms of fishing**. **While logical in regards to minimizing adverse effects on EFH based on the assumptions and direction inherent to this OA2 process, this prohibition alone greatly constrains the utility of DHRA designations in regards to developing knowledge of use in future fishery management decisions.** The current management regime in WGOM limits bottom tending mobile gear as well as fixed gear capable of significant catch of groundfish (i.e., gillnet, longline). Changing the fishing regime in the research area would confound our understanding of this ecological process that is fundamental to our assumptions about recovery used in the SASI model and in a qualitative fashion throughout the EFH management process.

In addition, there is no opportunity in such a regime to assess and compare impacts of fixed gears with mobile gears under a range of effort and across habitats (or the synergistic effects of different gears in particular habitats) or assess the effects of removal of species that exert effects on seafloor communities in regards to habitat and prey. Fixed gear impacts, and the effects of fish removals, can be significant based on general understanding from current research, at least at small spatial scales (e.g. Steneck et al 2004). Research that parses effects to particular gears, levels of effort and links responses to community state would produce relatively unambiguous results for use in decision-making in regards to habitat conservation for fisheries objectives. Allowing significant removals only by fixed gears and recreational catch would greatly impede work to link habitat condition to productivity of managed species. Despite more than 15 years since the passage of the EFH provisions under Magnuson, we have not significantly improved our knowledge linking the state of seafloor habitats to the productivity of managed species.

Note that existing time series of recovery dynamics in this area are ongoing (after 12 years of continuous monitoring) with no obvious ecological endpoint as yet to understand the dynamics of seafloor habitat recovery in the Gulf of Maine region.

4.3.1.4 *Alternative 4*

Designation of the Georges Bank DHRA is expected to have positive, indirect benefits to seabed habitats, via facilitation of research that will improve resource management over the long term. Also, as explained above, if a DHRA is created in this area <u>in the absence of an overlapping Habitat Management Area</u>, there would be a positive habitat impact.

4.3.1.5 *Alternative 5*

This alternative would implement a sunset provision whereby any DHRA designations implemented by the amendment could be removed administratively after a three year period if specific conditions are not met. To the extent that the possibility of administrative removal encourages earlier and/or more active investment in the research areas, it could lead indirectly to positive impacts on seabed habitats. If the sunset provisions are used to remove a DHRA, this could result in a relaxing of fishing restrictions in the area, which might have negative impacts on seabed habitats. **Importantly, however, if the Council wishes to actively conserve seabed habitats within one of these three areas, they should not use the DHRA designation solely as an indirect approach to implement conservation measures.**

4.3.2 Managed species – impacts on large mesh groundfish stocks

The discussion below focuses on the expected direct effects of Dedicated Habitat Research Area measures on the 19 large-mesh groundfish stocks. The amendment proposes three areas which would be established to enable dedicated habitat research (DHRAs, details described in Section 2.3). Special fishing gear restrictions in the DHRAs would affect groundfish habitat and potentially groundfish productivity.

Since many of these areas also overlap proposed habitat management areas whose impacts are discussed in Section **Error! Reference source not found.**, only the potential incremental effects of special measures for the DHRAs and how the DHRA proposal potentially impacts groundfish productivity are discussed below. These impacts could arise from the following three special measures that could apply in the DHRAs.

- Prohibitions on additional gears, such as longlines, gillnets, and recreational gears (Alternative 3)
- DHRA removal if no research is underway (Alternative 5)

The focus of the research agenda identified for the DHRAs is primarily to assess some of the assumptions and processes applied in the SASI model, i.e. to what extent specific fishing gears impact habitat (gear impacts), how quickly does habitat recover (habitat recovery), the effects of natural disturbance on various types of habitat, and measurement of how habitat changes and recovery impact fish productivity. Research on these topics is expected to have positive impacts on groundfish resources, since better science is expected to translate into better, more effective management.

4.3.2.1 *Alternative 1 (No action)*

The effects of No Action are difficult to evaluate distinctly from potential Habitat Management Area impacts discussed in Section**Error! Reference source not found.**. Depending on the habitat management alternatives selected, management conditions appropriate to conducting habitat research may already apply in these areas, such that DHRA designation would not be necessary for creating appropriate conditions.

If the current EFH closures remain in place and new habitat management areas are not adopted, the current impacts on groundfish productivity could continue, possibly with better data if additional monitoring measures are adopted (see description of Monitoring Measures in Section 2.4). However, no newly closed areas would be created to study the initial and sequential recovery of habitat types. If alternative habitat management areas replace current EFH closure areas, the effects of gear impacts in the newly opened EFH closures and groundfish habitat recovery in newly closed habitat management areas could be studied. Whether action or no action habitat management alternatives are selected, the effects of habitat condition and closed area management on groundfish productivity could be studied given additional monitoring (see Section 2.4). However, it may be more difficult to conduct comparable research in adjacent and similar habitat types and oceanographic conditions.

While possibly not as beneficial as one or more of the DHRA alternatives, the impact of not deliberately designating DHRAs (i.e. No Action) on groundfish habitat and productivity may only be slightly negative.

4.3.2.2 *Alternative 2*

This alternative would close the Eastern Maine DHRA to vessels using mobile bottom-tending gear, the same as Eastern Maine HMA Alternative 3, Option 1 (Section 2.1.1.1.3). The impacts of this alternative on groundfish habitat and productivity are summarized in Section 4.1.2.1.2.2. As one measure of the importance of groundfish habitat in this area, the majority of hotspots are for silver hake, white hake, redfish, and windowpane flounder. Weighted hotspots from groundfish observed in the fall surveys (Table 93, Map 38 in HMA section) arise from redfish, windowpane flounder, winter flounder, and witch flounder (Table 94).

It is thought that the effects of habitat management in this area will be synergistic with the effects of dam removal and restoration projects on the Penobscot River. These projects are expected to allow recovery of diadromous prey which could improve groundfish productivity. The interaction between better quality groundfish habitat and improvements in prey availability could be very important.

Setting aside this area for dedicated habitat research, particularly on those projects focusing on groundfish productivity changes, would be beneficial and have positive impacts on groundfish resources compared to Alternative 1 (No Action). The impacts on groundfish habitat would be the same as Alternative 1 (No Action) if the Eastern Maine Small habitat management area already prohibits the use of mobile bottom-tending gear, but positive if no habitat management area is designated or if the restrictions in that area are ground cable modifications only. These impacts could be very positive and important for groundfish stocks in Eastern Maine and related fisheries in neighboring communities, in particular.

Table 93 – Total number of unweighted and weighted age 0/1 groundfish hotspots by season and DHRA alternative.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
No Action	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
Alternative 2	41	0	0	0	110	229.8	0	0
Alternative 3	24	112.9	6	6.8	17	123.5	1	6.7
Alternative 4	0	0	0	0	0	0	0	0

Table 94 – Total number of age 0/1 groundfish hotspots by species and DHRA alternative.

	Acadian redfish	American plaice	Cod	Haddock	Pollock	Red hake	Silver hake	White hake	Windowpane flounder	Winter flounder	Witch flounder	Total
Alternative 2	34	0	0	0	0	0	62	36	13	3	3	151
Alternative 3	23	4	7	1	0	6	5	1	0	1	0	48
Alternative 4	0	0	0	0	0	0	0	0	0	0	0	0

4.3.2.3 *Alternative 3*

This alternative would close a Stellwagen DHRA to mobile bottom-tending gear and prohibit sink gillnets and demersal longline gears. In addition, it would establish a reference area that would also be closed to recreational and party/charter groundfish fishing. The Stellwagen DHRA has the same boundaries as the Stellwagen Large area included in Western Gulf of Maine HMA alternatives 3 and 6 described in Section 2.1.1.3. The impacts on groundfish habitat and productivity by HMA Alternatives 3 and 6 are evaluated in Sections 4.1.2.1.4.2 and 4.1.2.1.4.5, respectively.

These measures are more restrictive than habitat management area measures which could prohibit or place restrictions on mobile bottom-tending gears. Therefore to the extent that the DHRA and/or reference area overlaps the age 0/1 groundfish weighted hotspots (as a measure of groundfish habitat location) and/or distributions of juvenile cod and haddock, this alternative could have positive impacts on groundfish habitat and productivity.

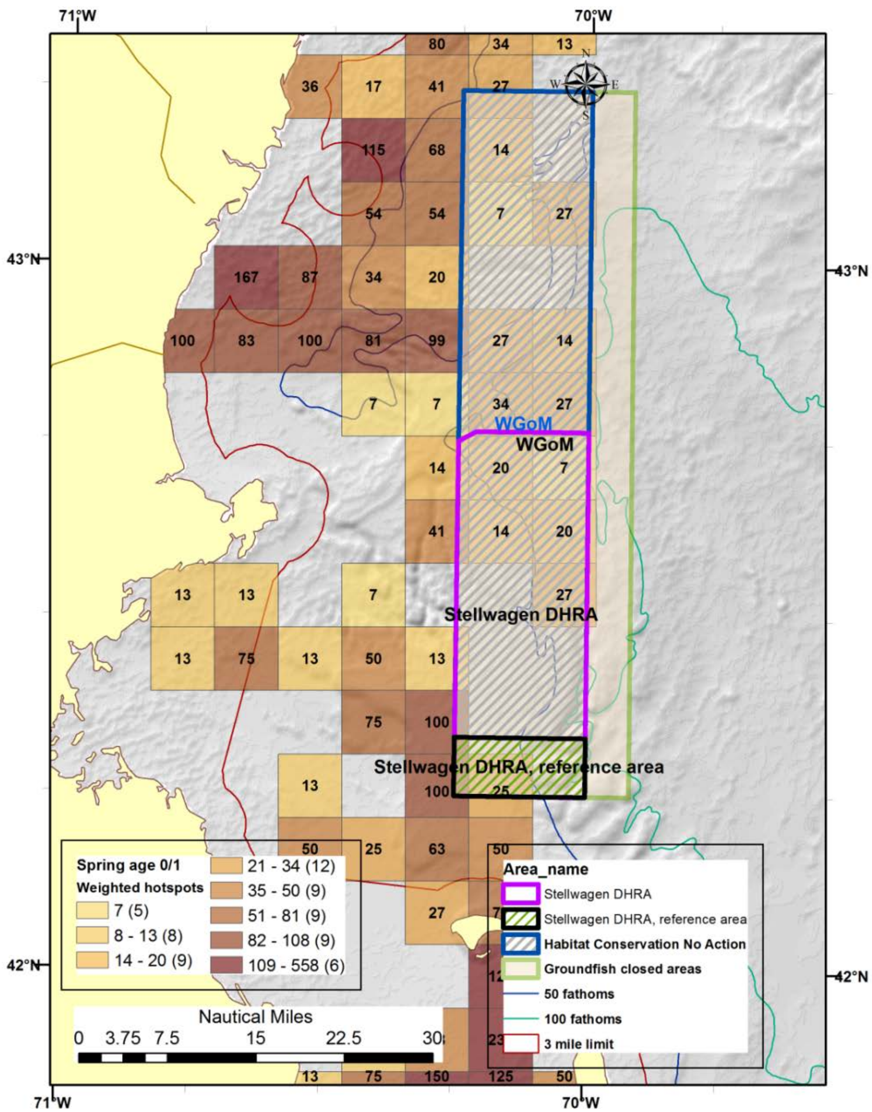
Although gillnets, longlines, and recreational fishing gears are estimated to have fewer impacts on coarse and hard substrates that are vulnerable to fishing damage, they would otherwise be able to capture groundfish in these areas which have benefited from habitat improvement. The higher amounts of juvenile groundfish may either be caught and discarded in the area, be caught at legal size and landed, or (if no or less groundfish fishing occurs in a DHRA) may continue to survive and grow to older age. As a result of the added restrictions, more of the fish would contribute to stock productivity and biomass rebuilding for a longer time until they become exposed to fishing elsewhere.

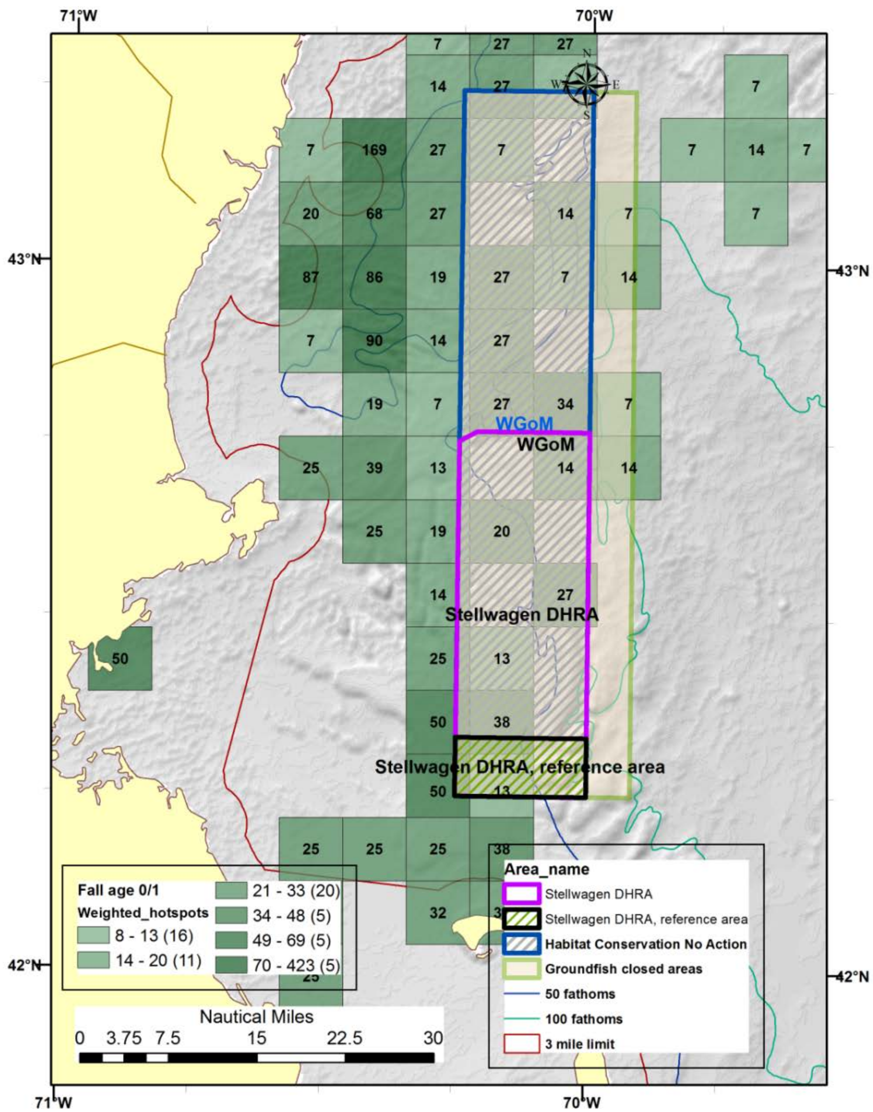
Although there are more age 0/1 groundfish hotspots inshore of the Stellwagen DHRA (Table 93; Map 71), some groundfish hotspots occur in the proposed area. Although offshore of most of the small juvenile cod and groundfish, the reference area is closer to the hotspot concentrations of groundfish associated with coarse and hard substrates. Selective research with separate control and experimental areas might address this presumed association between age 0/1 groundfish hotspots and habitat types, like it is meant to address some of the assumptions in the SASI model.

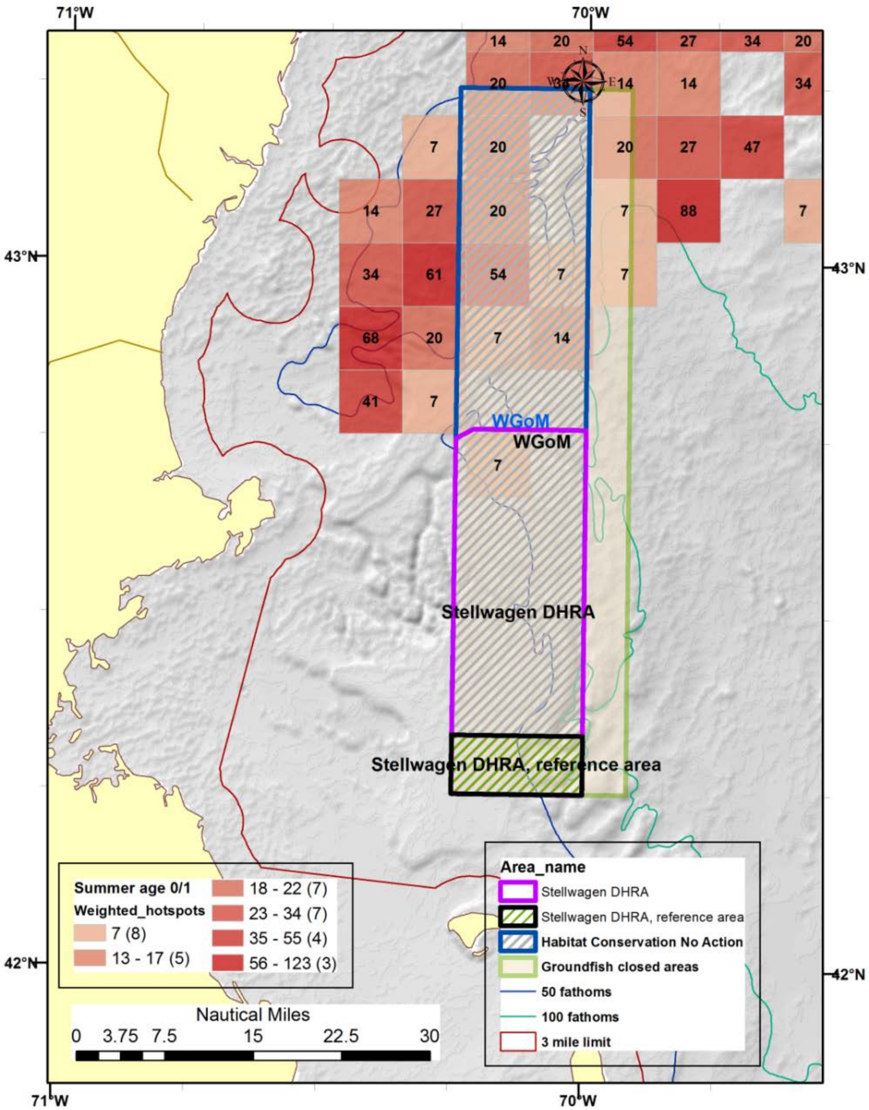
Moreover, such research may address the habitat use by different cohorts of sublegal cod and possibly other groundfish. Many of the smaller age 0/1-sized cod are typically well inshore of the larger sublegal cod in both the spring and fall surveys (Map 72). To a lesser extent, the same is true for juvenile haddock (Map 73). The inshore half of the reference area appears to contain a higher biomass of legal size cod in both the spring and fall (Map 74), although similar to the amounts of legal size cod found elsewhere in the Stellwagen DHRA (and elsewhere inshore of the Western Gulf of Maine Closed Area). These DHRA areas appear to be ideally suited for comparative research with control and experimental designs, although the effects on overall stock productivity may be difficult to detect in small areas.

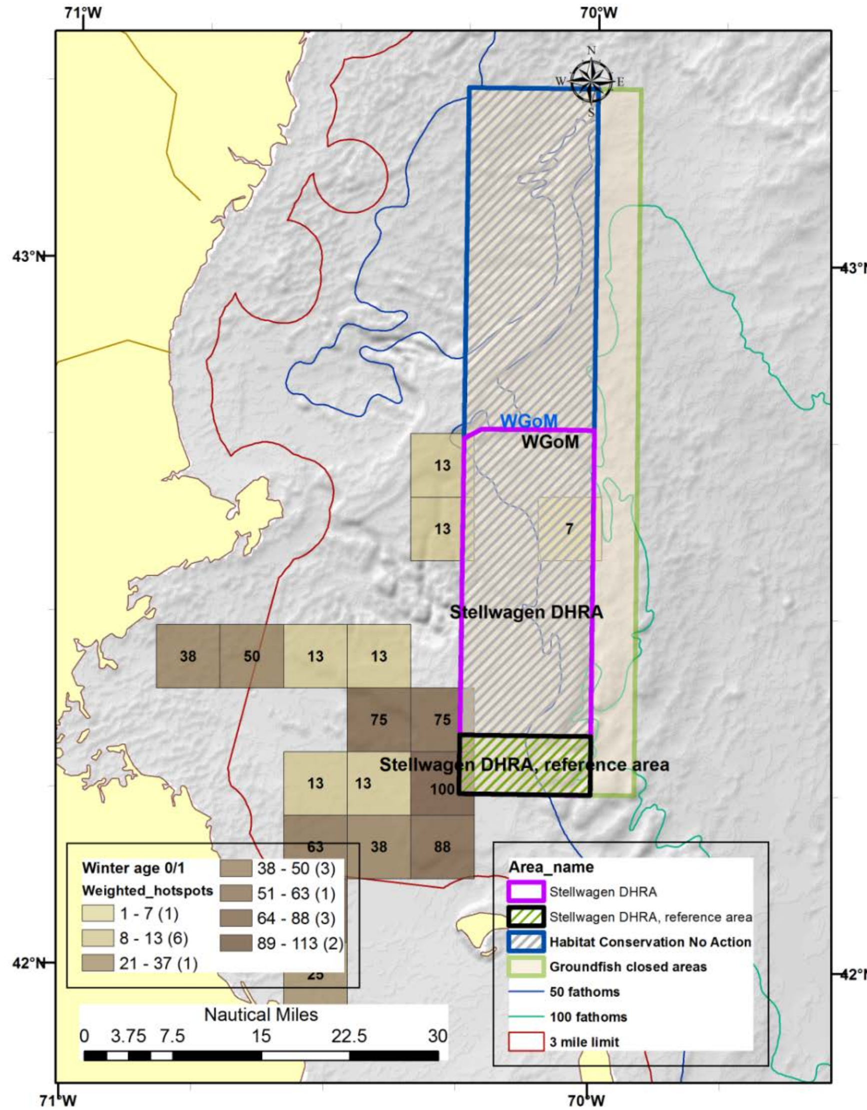
Compared to Alternative 1 (No Action) which would have no specific habitat research areas, but would have either existing EFH Closures or new habitat management areas, Alternative 3 would provide considerable opportunity to test habitat model assumptions and refine future management. This alternative therefore would have positive impacts overall, and relative to Alternative 1 (No Action).

Map 71 – DHRA Alternatives 3 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.

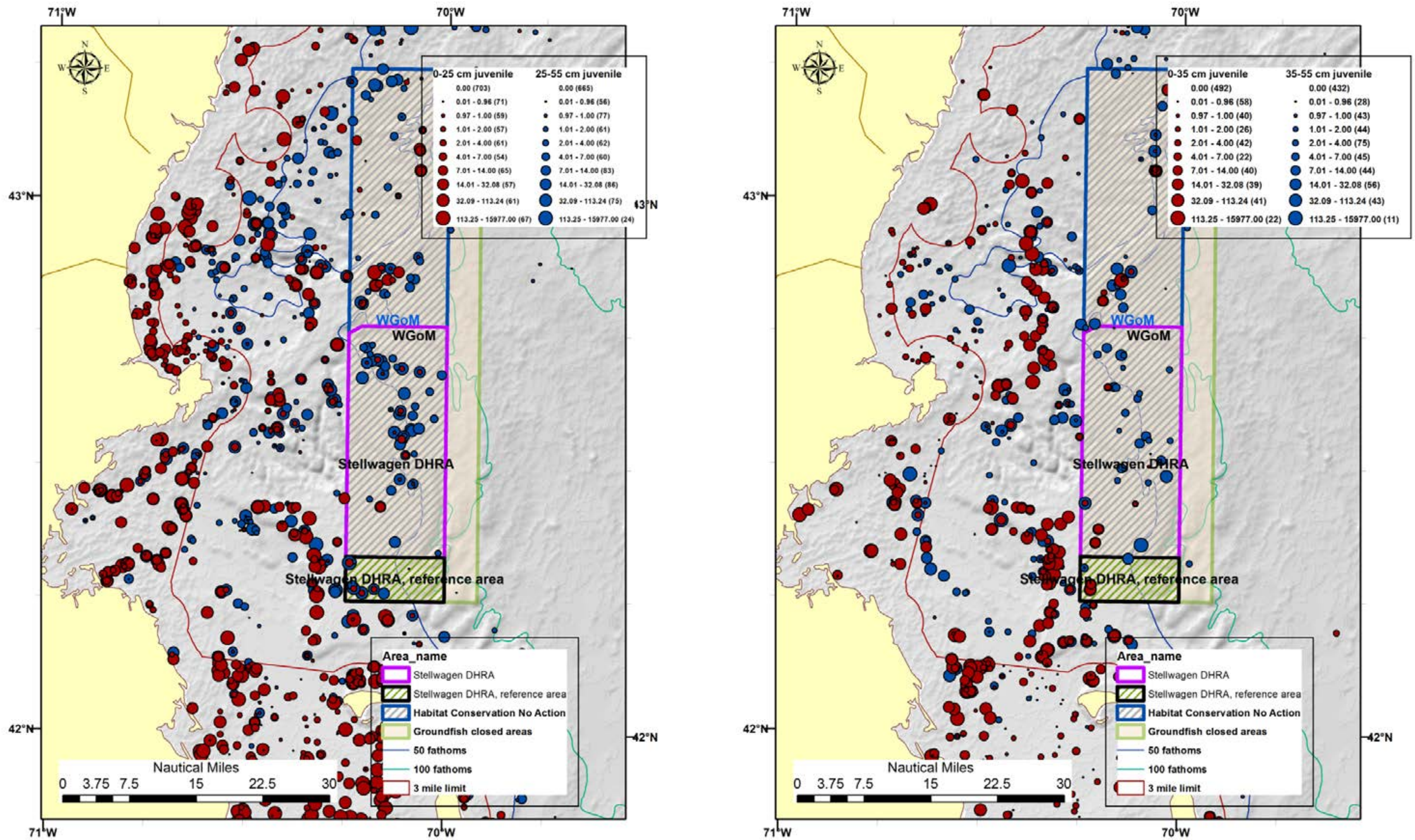




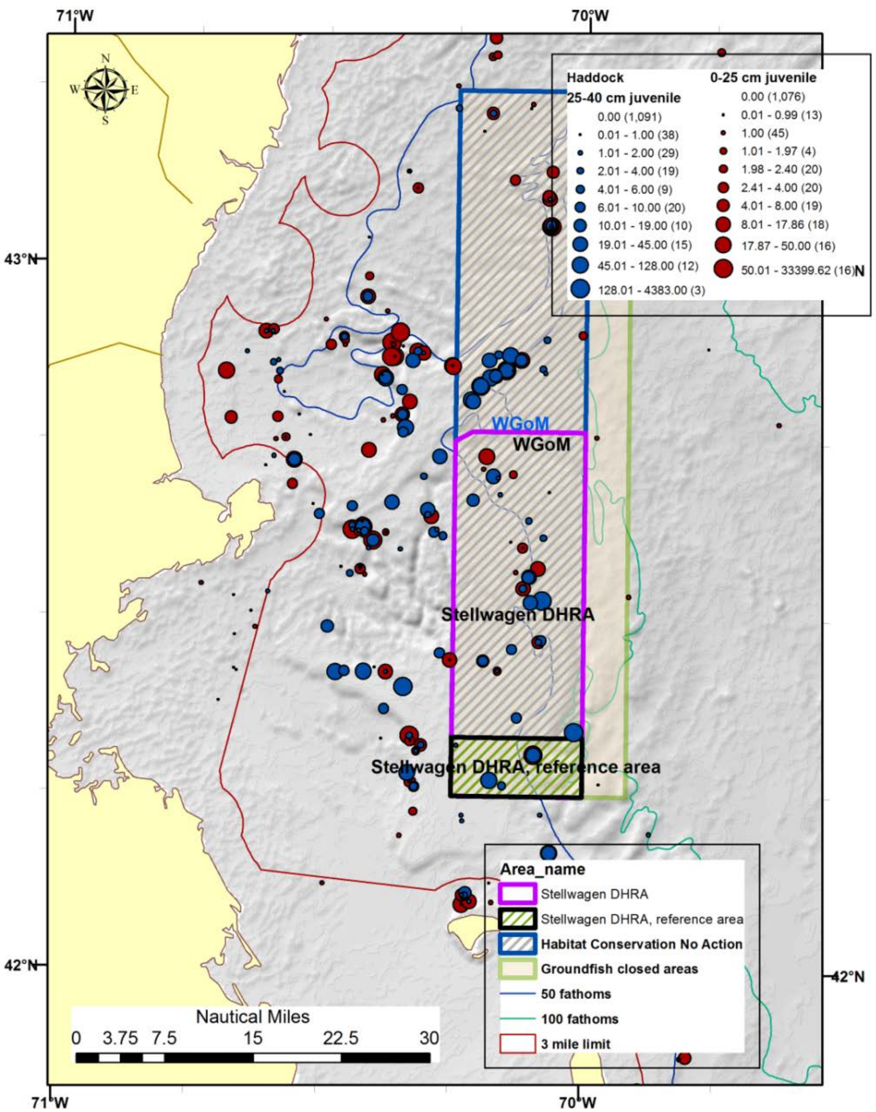

71°W
70°W
43°N
42°N
14
20
54
27
34
20
20
14
14
34
7
20
20
27
47
14
27
20
7
88
7
34
61
54
7
7
68
20
7
14
41
7
WGoM
WGoM
7
Stellwagen DHRA
Stellwagen DHRA, reference area
Summer age 0/1
Weighted_hotspots
7 (8)
13 - 17 (5)
18 - 22 (7)
23 - 34 (7)
35 - 55 (4)
56 - 123 (3)
Area_name
Stellwagen DHRA
Stellwagen DHRA, reference area
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 3.75 7.5 15 22.5 30

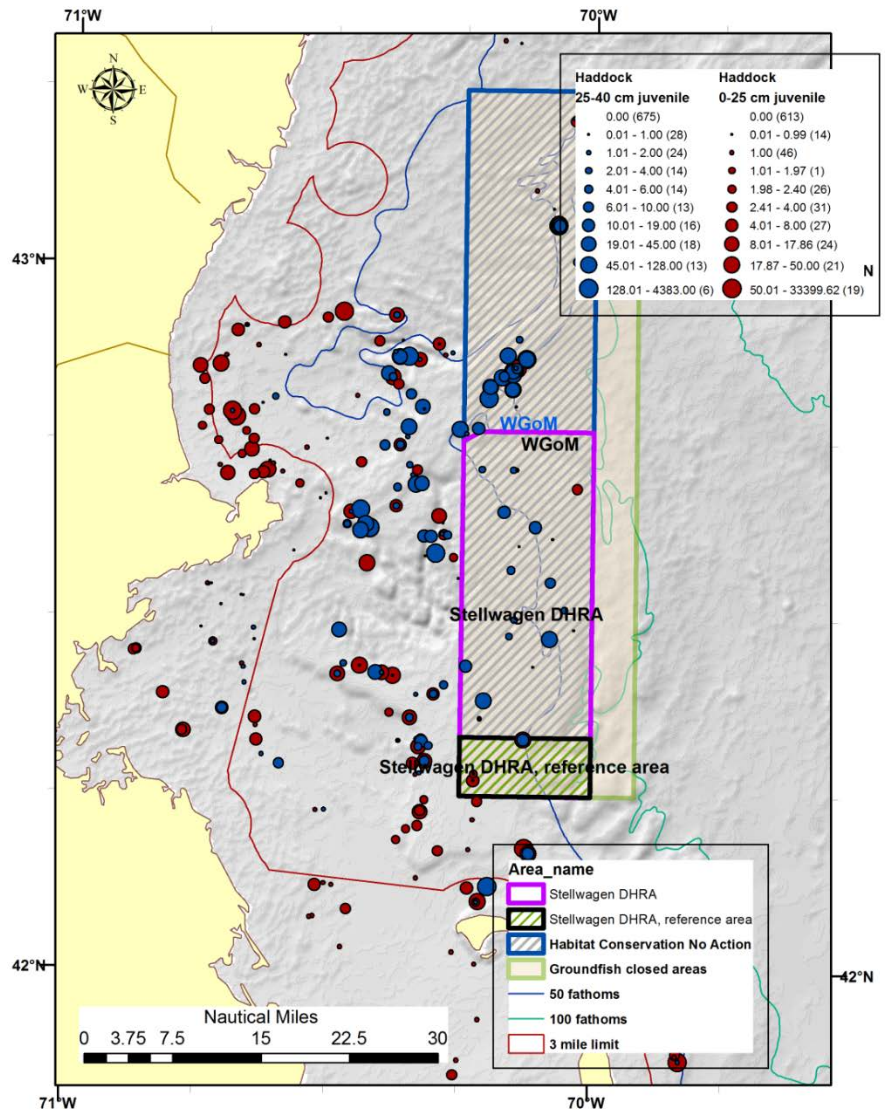

71°W
70°W
43°N
42°N
WGoM
WGoM
13
13
7
Stellwagen DHRA
38
50
13
13
75
75
Stellwagen DHRA, reference area
13
13
100
63
38
88
Winter age 0/1
Weighted_hotspots
1 - 7 (1)
8 - 13 (6)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Area_name
Stellwagen DHRA
Stellwagen DHRA, reference area
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 3.75 7.5 15 22.5 30

Map 72 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.

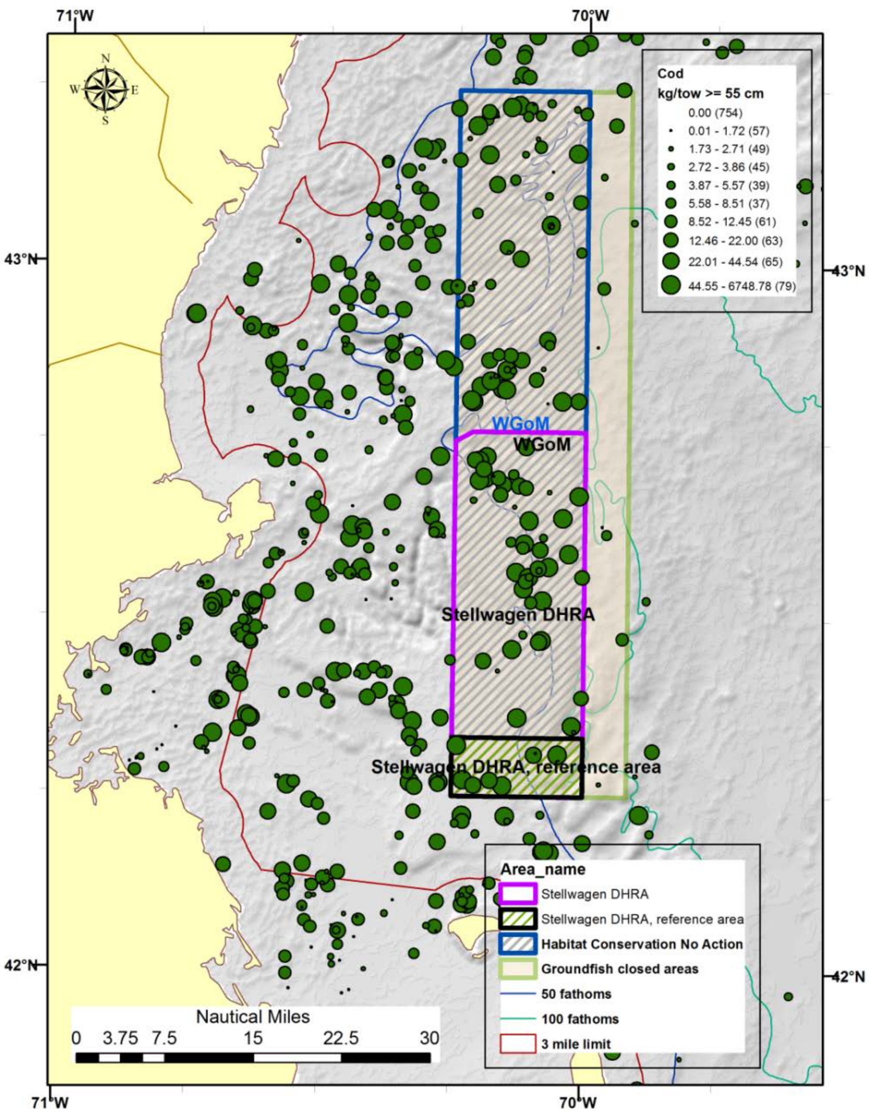


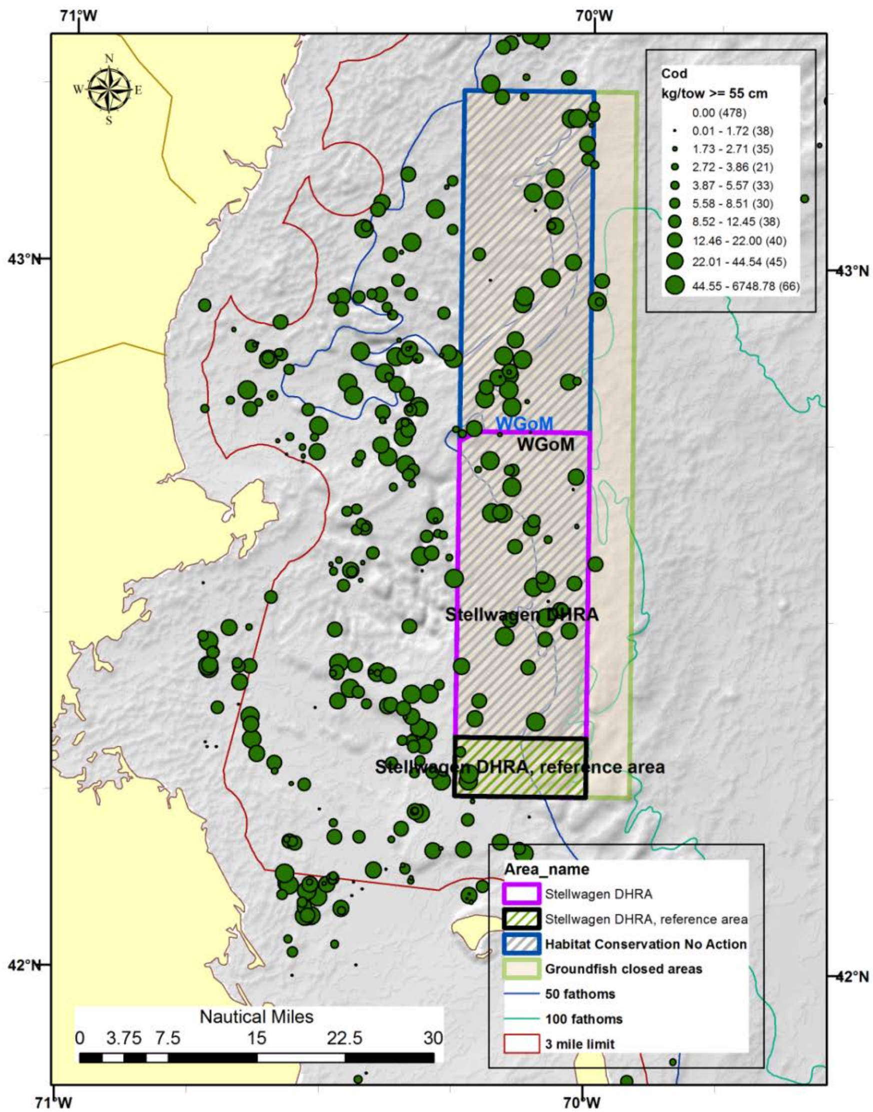
Map 73 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.





Map 74 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal cod weight per tow from 2002-2012 NMFS, MADMF, ME-MH, and IBS survey data.





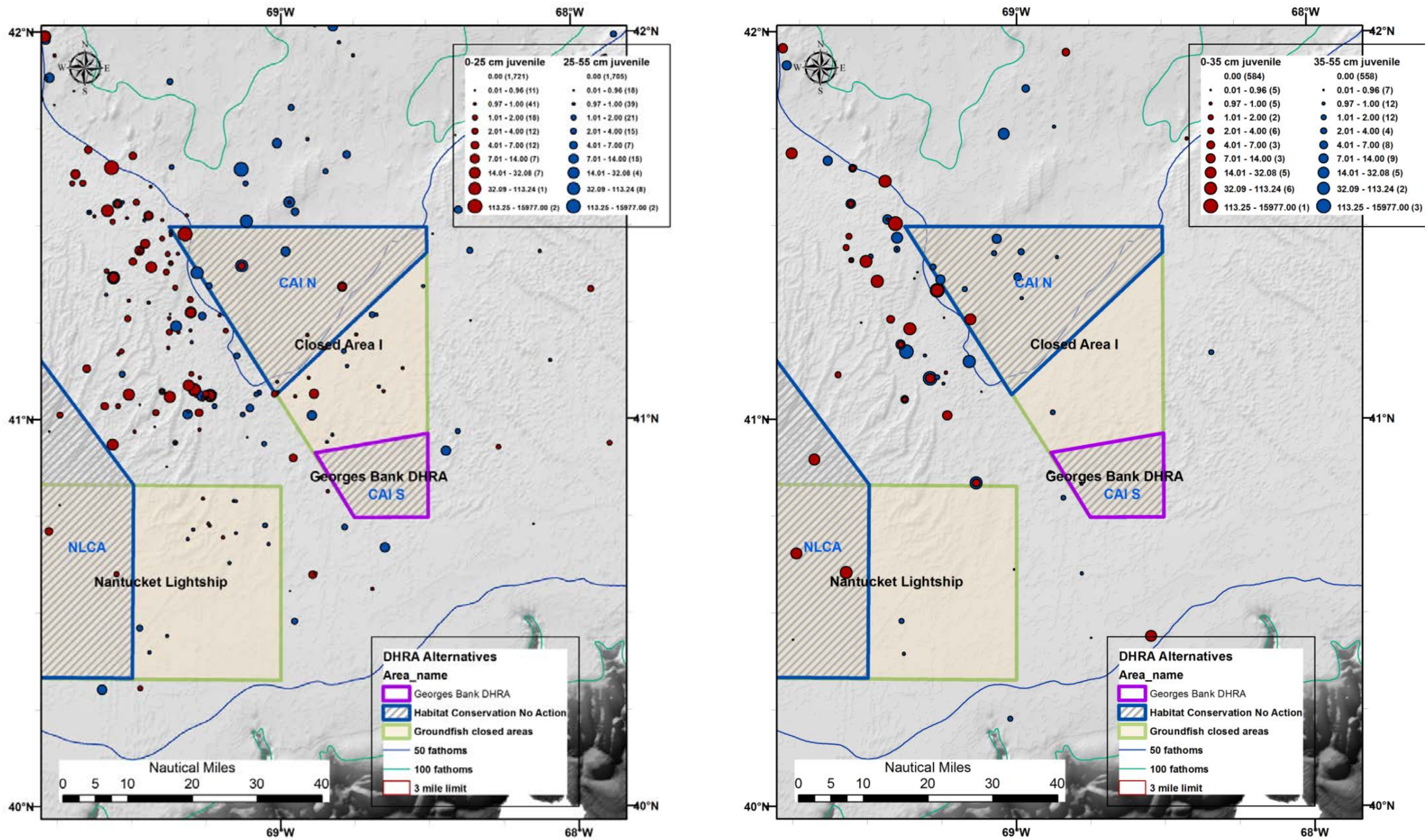
4.3.2.4 *Alternative 4*

This alternative would establish a DHRA in the southern portion of Closed Area I that does not overlap with any of the proposed habitat management alternatives in Section 2.1.2. It does overlap with an existing EFH closure and is in fact the only DHRA alternative that overlaps a portion of one of the existing year round closed areas on Georges Bank. This area has been closed year round to commercial gears capable of catching groundfish since 1995 (Framework Adjustment 9; 60 CFR 19364) and to all mobile bottom-tending gear since 1999 (Amendment 11; 64 CFR 19503). Unlike other closed areas, fishing has not been allowed here as part of a special access program or a scallop access area.

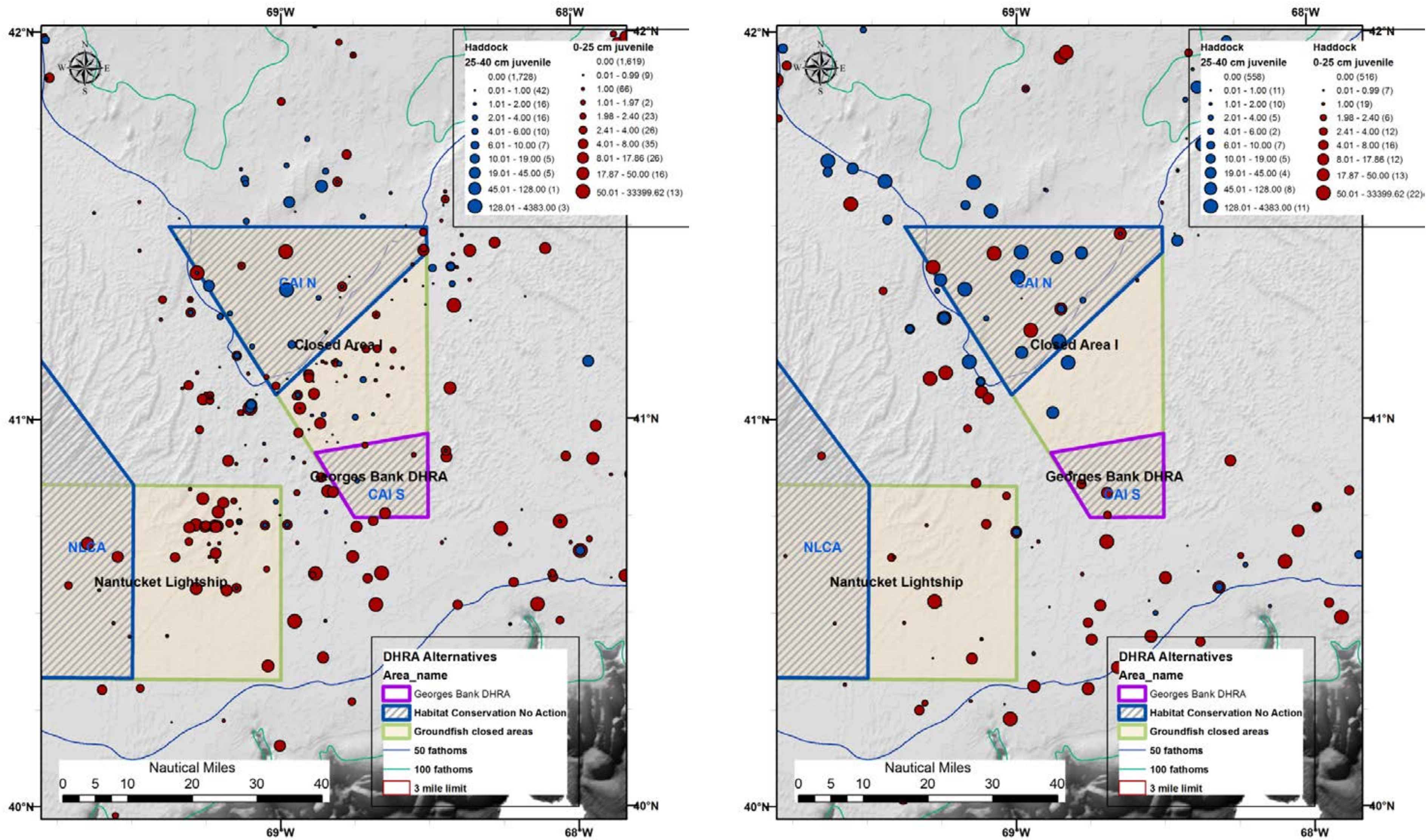
However, this area had no age 0/1 groundfish hotspots (Table 93) which suggests that any positive impact on groundfish habitat and productivity may be low. Looking more broadly at all levels of survey catch of cod and haddock for both age 0/1 and sublegal fish, this DHRA does not appear to be well suited to evaluate the effects of fishing (or not fishing) on groundfish habitat and productivity. The abundance of age 0/1 and large sub-legal cod (Map 75) and haddock (Map 76) are less abundant in this area than in other portions of Closed Area I or in the open fishing areas of the nearby Great South Channel.

Relative to Alternative 1 (No Action), the impacts on groundfish habitat and productivity are slightly positive, but do not compare well with Alternative 2 and 3.

Map 75 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS survey data.



Map 76 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS survey data.



4.3.2.5 *Alternative 5*

This alternative would implement a sunset provision whereby any DHRA designations implemented by the amendment could be removed administratively after a three year period if specific conditions are not met.

This alternative would only have direct impacts on groundfish habitat or productivity if the fishing restrictions associated with the DHRA designation better protect groundfish stocks than restrictions associated with habitat or spawning management areas, which presumably would remain in place longer than three years. In these cases, gear restrictions would be lifted, presumably having a negligible impact on groundfish habitat and a negative impact on groundfish productivity. In the Stellwagen DHRA, resuming fishing with sink gillnets, longlines, and recreational gears could reverse any gains in productivity that had been achieved through the DHRA. More importantly, long term monitoring of how groundfish habitat is affected by fishing and how recovered/recovering habitat translates into productivity improvements could be compromised.

Relative to Alternatives 2 and 3, this alternative has a negative impact, but relative to Alternative 1 (No Action), it has a positive impact because there would be at least a three-year opportunity to conduct groundfish habitat research.

4.3.3 Human communities and the fishery

4.3.3.1 *Economic impacts*

4.3.3.1.1 Alternative 1 (No action)

To be completed later

4.3.3.1.2 Alternative 2

To be completed later. See discussion in habitat and spawning alternatives sections for a discussion of fishing in and around these areas.

4.3.3.1.3 Alternative 3

To be completed later. See discussion in habitat and spawning alternatives sections for a discussion of fishing in and around these areas.

4.3.3.1.4 Alternative 4

To be completed later. See discussion in habitat and spawning alternatives sections for a discussion of fishing in and around these areas.

4.3.3.1.5 Alternative 5

To be completed later

4.3.3.2 *Community impacts*

Many of the general social impacts of the alternatives to designate Dedicated Habitat Research Areas are similar to those discussed earlier regarding the impacts of habitat and spawning management alternatives (4.1.3.2 and 4.2.3.1.1). Although the purpose of these actions differ (protecting habitat and researching the effects of fishing across habitats respectively) the effects on communities of closing and opening areas to different types of fishing are similar.

Additional social impacts associated with the DHRA alternatives include impacts on *Values, Attitudes and Beliefs*. Fishermen generally have an inherently different view of the ocean and its fisheries than the views held by federal ocean/fisheries scientists. Closing access to fishing areas in the name of science and research which many fishermen consider flawed could create further mistrust in management. Alternatively, many fishermen feel that scientists know little about the effect of closed areas and gear modifications on habitat and groundfish. Conducting research to better understand these effects may improve the perceptions of spatial management in the future, having positive impacts on the formation of *Values, Attitudes and Beliefs* about management.

The specific impacts of each alternative will be discussed in the following sections. These are very uncertain and will depend upon the other spatial management alternatives selected.

4.3.3.2.1 Alternative 1 (No action)

Currently there are no DHRAs designated in the region. Under No Action, this would continue and DHRAs would not be designated as part of this amendment. The social impacts of Alternative 1 are expected to be neutral. There may be positive impacts on the formation of *Values, Attitudes and Beliefs* about management if new research is conducted to better understand the effect of closed areas and gear modification on habitat and juvenile groundfish, however this research could be undertaken in currently closed areas without implementing any closed DHRAs and less social impact on fishing communities.

4.3.3.2.2 Alternative 2

Alternative 2 would designate a Dedicated Habitat Research Area in the eastern Gulf of Maine. The social impacts of Alternative 2 in comparison to the no action alternative are expected to be slightly positive. While there will be negative impacts in the short-term particularly to communities in Maine from closing access to this inshore area, the potential benefits of researching this area given current dam removal and restoration projects on the Penobscot River are expected to have positive social impacts in the long-term if there is a better understanding of the interaction between better quality groundfish habitat and improvements in prey availability.

4.3.3.2.3 Alternative 3

Alternative 3 would designate a Dedicated Habitat Research Area in the western Gulf of Maine. The social impacts of Alternative 3 in comparison to the no action alternative are expected to be negative. These impacts are mainly related to the recreational fishery which is heavily reliant on this area. This will particularly impact communities on the South Shore and Cape Cod, MA.

4.3.3.2.4 Alternative 4

Alternative 4 would designate a Dedicated Habitat Research Area on Georges Bank. The social impacts of Alternative 4 in comparison to the no action alternative are expected to be positive. Because the Georges Bank DHRA is in a currently closed area the social impacts are expected to be minor. There may be a small positive impact on the *Values, Attitudes and Beliefs* regarding management flexibility because no new areas will be closed to fishing activities for this research to occur.

4.3.3.2.5 Alternative 5

Alternative 5 would create a sunset provision for DHRAs that would allow administrative removal without further Council action three years after implementation, if no research had been initiated. The social impacts of Alternative 5 in comparison to the no action alternative are expected to be positive. The creation of a sunset provision will ensure that if DHRAs are not providing a research benefit they will be open to fishing activities. This will have a positive impact on the *Values, Attitudes and Beliefs* regarding management flexibility.

4.3.4 Protected Resources

4.3.4.1 *Alternative 1 (No action)*

To be completed later

4.3.4.2 *Alternative 2*

Implementing a DHRA in the small Eastern Maine area would result in mobile gear being restricted in that habitat management area, either for the short-term, or indefinitely. There is relatively little mobile gear activity in this region. As a result, there is not expected to be a significant change in the location of fishing effort. Therefore, the impacts on protected resources would likely be negligible.

4.3.4.3 *Alternative 3*

The Stellwagen Bank DHRA would maintain the existing restrictions on mobile and fixed gear within the southern portion of the existing Western Gulf of Maine Closed Area. In addition, recreational or charter/party fishing would be prohibited in the small reference area in the southern most portion of the DHRA. There may be some concentration of recreational gear outside of the reference area, which may have some negative impacts on large whales. Overall, however, the impacts from implementing the DHRA in this region would be negligible.

4.3.4.4 *Alternative 4*

To be completed later

4.3.4.5 *Alternative 5*

To be completed later

4.4 Framework adjustments and monitoring

These alternatives are described in section 2.4.

4.4.1 Physical and biological environment

4.4.1.1 *Alternative 1 (No Action)*

To be completed later

4.4.1.2 *Alternative 2 – Planned, strategic framework adjustment and monitoring*

To be completed later

4.4.2 Managed species

4.4.2.1 *Alternative 1 (No Action)*

No Action would use existing ad hoc framework adjustment procedures scattered across five FMPs, each having a different set of specification on measures that may be adjusted. While the Council could initiate at any time one or more (omnibus framework adjustment?) actions to evaluate the performance of habitat management and spawning protection areas, there would be no certainty about when such an action would be initiated. Also it would be unclear what information would be needed, how it would be evaluated, or how it would affect future management decisions.

Because it is not an ideal process for a coordinated review of management area performance, this alternative has negative impacts on managed species, including the large-mesh groundfish species for which the habitat management and spawning management alternatives were designed.

4.4.2.2 *Alternative 2 – Planned, strategic framework adjustment and monitoring*

This alternative would establish a habitat management and spawning protection review and adjustment procedure that would have the following three elements. More specific details about how this strategic framework adjustment process and monitoring program are given in Section 2.4.2.

- Specify additional spatial management measures as frameworkable in various NEFMC FMPs,
- Develop a regular, strategic process to review the effectiveness of spatial management measures, and
- Define a series of research priorities related to the review and development of spatial management measures.

This new process would have several advantages over the existing ad hoc framework adjustment mechanism (Alternative 1, No Action). First, it would set up an expectation that after an appropriate period of time, the performance of habitat and spawning areas would be re-evaluated and adjustments would be made. It would also establish a consistent set of measures that could be adjusted by framework action in each FMP, making the process clearer. Third, and possibly most important, it would establish an understandable and more comprehensive performance monitoring program that researchers can use to address management priorities and more successfully seek funding for their related research.

As this process begins early, the Council may learn new information to make mid-term adjustments as needed, while waiting for long enough to collect sufficient performance data to make more comprehensive changes and adjustments. We may even learn more about the linkage between habitat quality and stock or ecosystem productivity, enabling better general management of our fisheries.

Compared to Alternative 1 (No Action), this alternative is likely to be somewhat positive on groundfish habitat and productivity in the short term as preliminary information is gathered and analyzed, allowing for some mid-term ad hoc adjustments and informed general fisheries management decisions. In the long term, this alternative is likely to have large positive impacts on both groundfish habitat and productivity as better and more efficient conservations measures are identified and become effective.

4.4.3 Human communities and the fishery

4.4.3.1 *Alternative 1 (No Action)*

To be completed later

4.4.3.2 *Alternative 2 – Planned, strategic framework adjustment and monitoring*

To be completed later

4.4.4 Protected resources

4.4.4.1 *Alternative 1 (No Action)*

To be completed later

4.4.4.2 *Alternative 2 – Planned, strategic framework adjustment and monitoring*

To be completed later

4.5 Impacts of all spatial management alternatives on non-large mesh groundfish species and fisheries

4.5.1 Small mesh multispecies: silver and red hake

4.5.1.1 *Biological impacts*

Juvenile red and silver hake, the target species in the small-mesh multispecies fishery, are not known to associate with coarse and hard substrates, which are vulnerable to adverse impacts from mobile bottom tending fishing gear. Habitat Management Area (described in Section 2.1) and Dedicated Habitat Research Area (described in Section 2.3) measures could restrict or prohibit mobile bottom tending gear fishing, including small-mesh trawls used to target red and silver hake[6]. No Dedicated Habitat Research Areas overlap with existing small-mesh exemption areas. Spawning area alternatives could also restrict trawling during specific seasons, but these seasons and areas do not overlap with the existing small mesh-exemption areas.

In habitat management areas that overlap concentrations of small juvenile red and silver hake (Map 77 to Map 79), the mobile bottom-tending gear restrictions could reduce fishing mortality on young fish, improve selectivity, and increase yield-per-recruit. Small-mesh trawls do not however retain many age 0/1 red and silver hake, which are less than 20 cm[7] (Figure 36 and Figure 37, respectively), so only a limited reduction in catch and discards of age 0/1 red and silver hake would be expected from a reduction in fishing where there are large concentrations of age 0/1 red and silver hake.

Note that the distribution of offshore hake, the other small mesh species, has limited if any overlap with the proposed management areas, so impacts to this species are expected to be neutral.

WGOM, CGOM, and EGOM Habitat Management and Dedicated Habitat Research Area alternatives

During the spring and fall trawl surveys, the major concentration of age 0/1 silver hake hotspots overlap with the Bigelow Bight, Toothaker Ridge, and Eastern ME Habitat Management Areas (Map 77 and Map 79). Age 0/1 silver hake appear to be concentrated in deeper water according to the summer shrimp trawl and scallop dredge survey data (Map 78), which have a limited geographical range. No hotspots that overlap with the proposed Habitat Management Areas were detected in winter trawl surveys.

During the fall, age 0/1 red hake hotspots appear to have a similar geographical distribution as silver hake (Map 79), with significant overlap with the Bigelow Bight, Toothaker Ridge, and Eastern ME Habitat Management Areas. During the spring and summer surveys (Map 77 and Map 78) appear to be concentrated in deeper waters and do not have significant overlaps with any of the Habitat Management Areas. No hotspots that overlap with the proposed Habitat Management and Dedicated Habitat Research Areas were detected in winter trawl surveys.

Biological impacts on red and silver hake, targets of the small-mesh multispecies fishery, appear to be minimal, but slightly positive, particularly for alternatives that include the Bigelow Bight, Toothaker Ridge, and Eastern ME Habitat Management Areas. Alternatives that do not include these proposed Habitat Management Areas and Dedicated Habitat Research Areas would have a neutral or slightly negative impact due to potential effort shift into the small-mesh multispecies fishery.

Georges Bank and Great South Channel Habitat Management and Dedicated Habitat Research Area alternatives

[6] Small-mesh multispecies trawls are also used to target offshore hake, but the proposed Habitat Management and Dedicated Habitat Research Areas do not overlap the distribution of offshore hake.
[7] During 2002-2012 spring trawl surveys, all age 0 and 90% of age 1 fish were less than 20 cm.

Georges Bank and Great South Channel Habitat Management and Dedicated Habitat Research Area alternatives to not overlap with age 0/1 red and silver hake hotspot distribution to any appreciable degree (Map 77 to Map 79). Thus biological impacts of these alternatives on red and silver hake appear to be neutral.

Gulf of Maine and Georges Bank Spawning Management Alternatives

It is not known whether and how fishing affects red and silver hake spawning, or where this spawning activity takes place. Therefore, the effects of the proposed spawning protection areas on red and silver hake are uncertain.

Figure 36 – Length frequency distribution of kept and discarded red hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls.

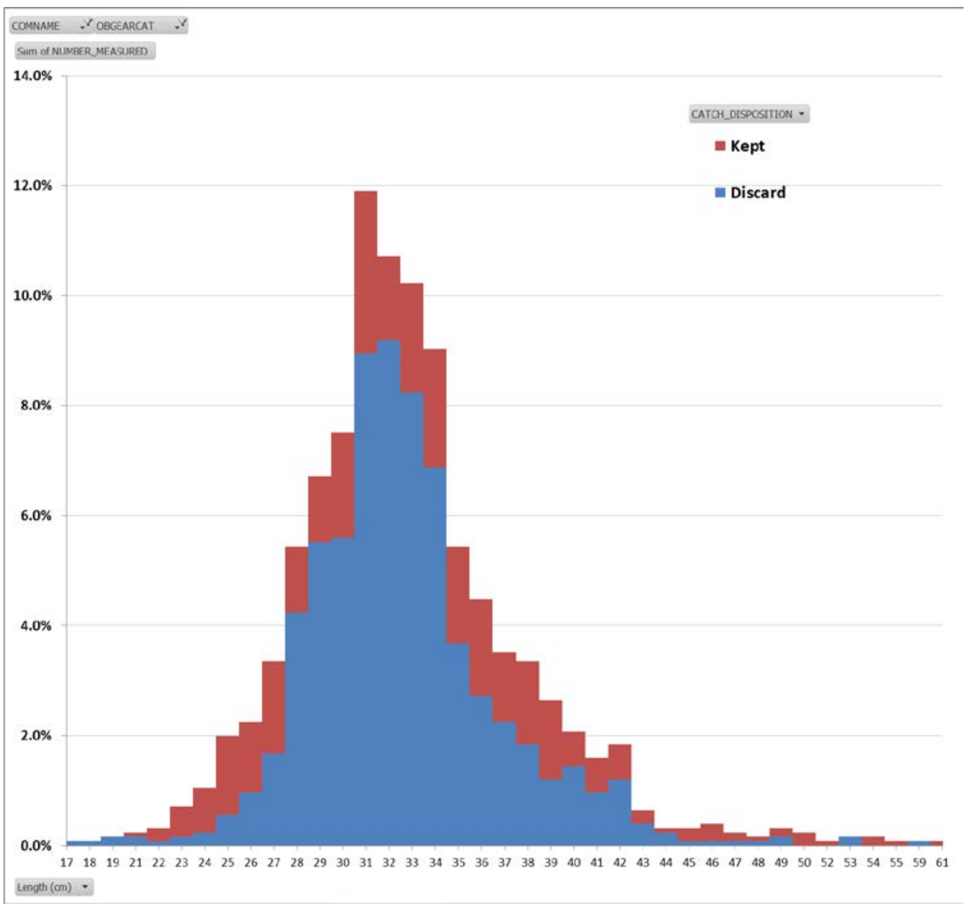
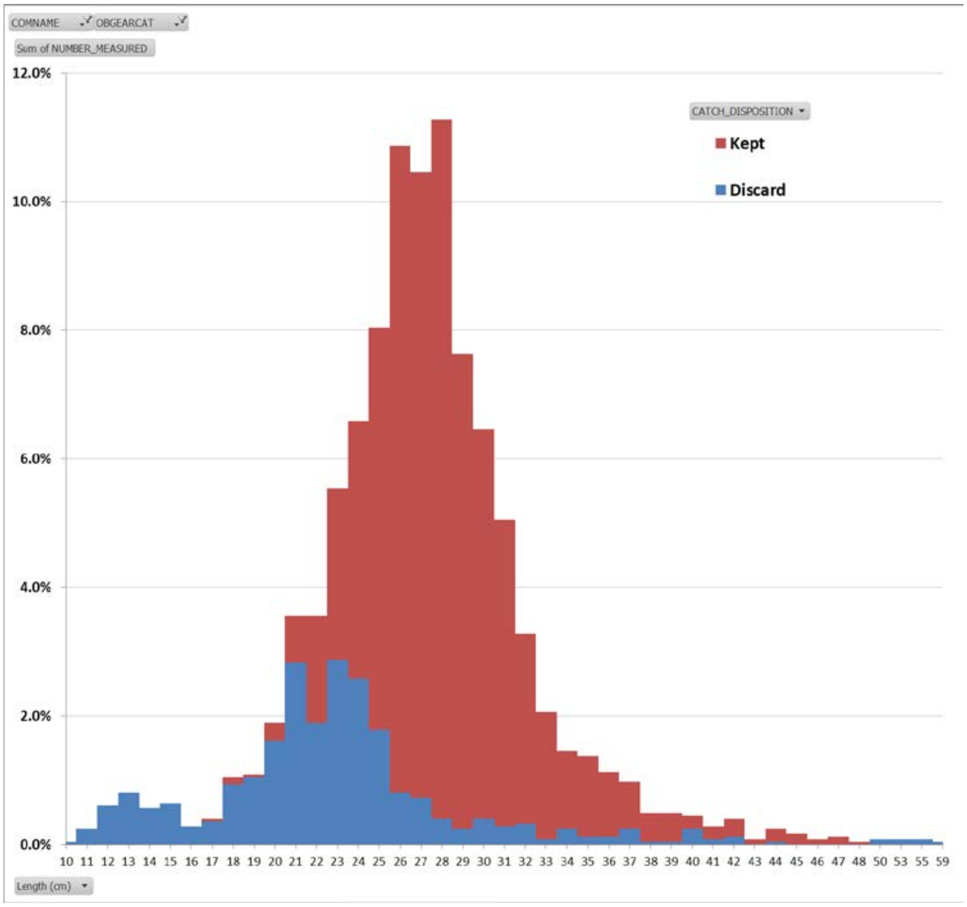
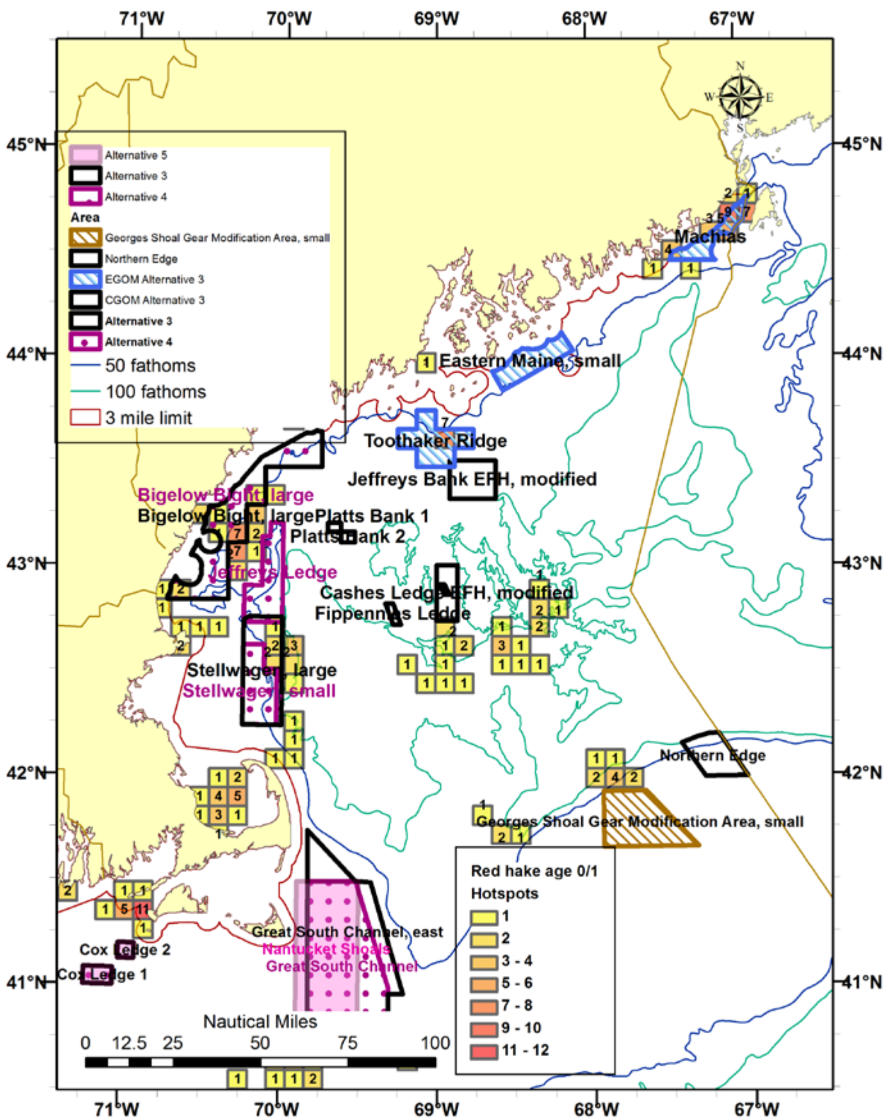


Figure 37 – Length frequency distribution of kept and discarded silver hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls.

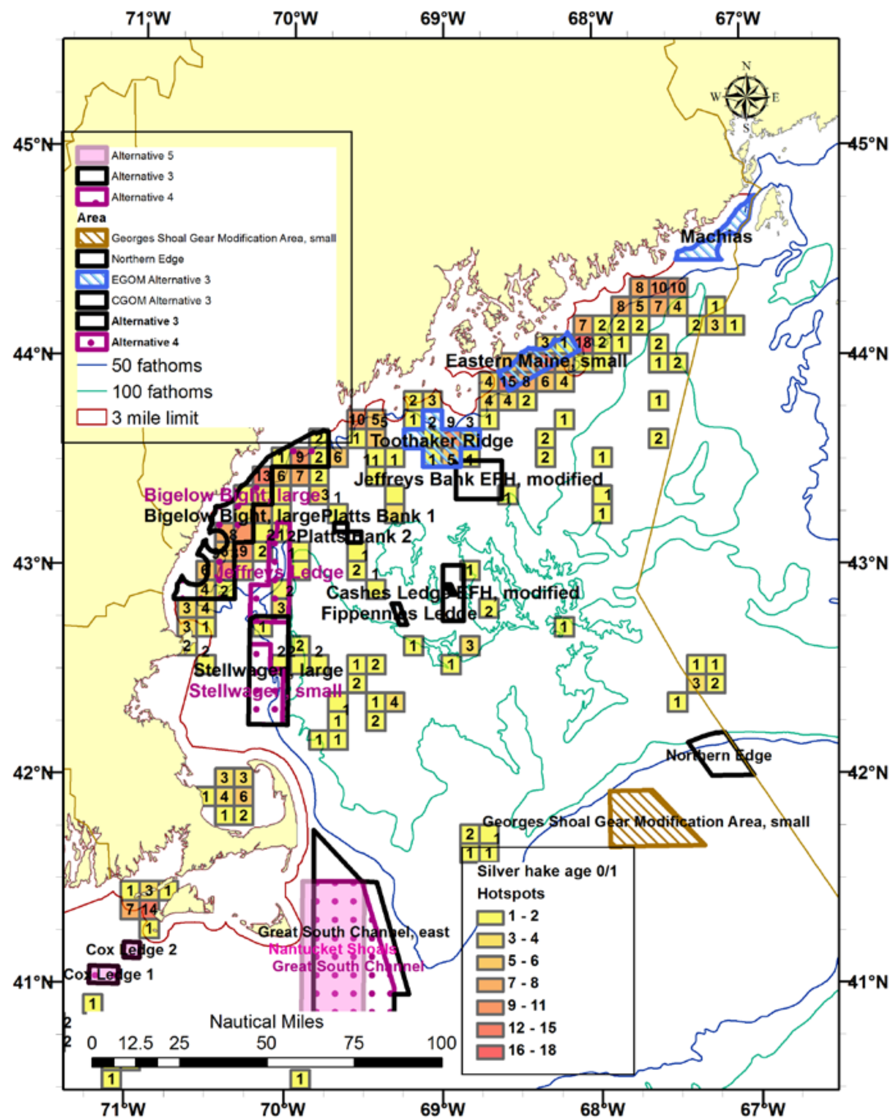


Map 77 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 spring trawl surveys.

Red hake

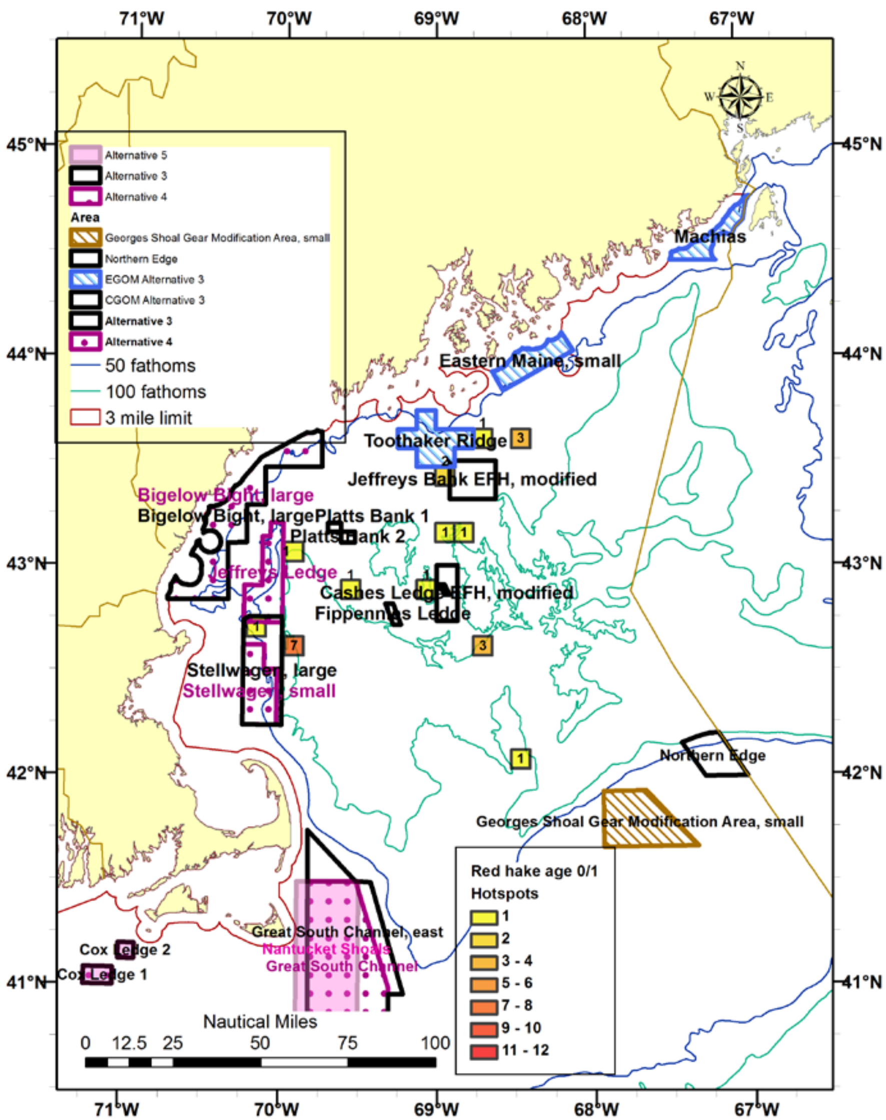


Silver hake

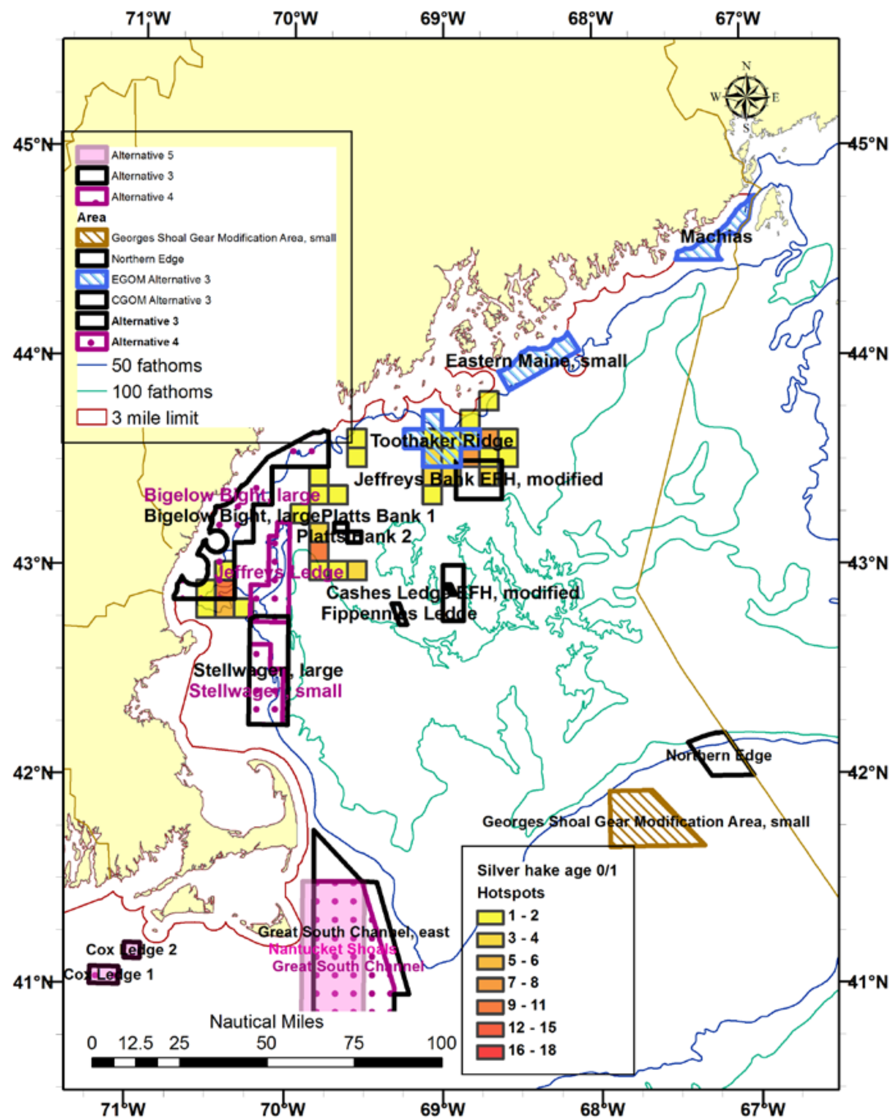


Map 78 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 summer shrimp trawl and scallop dredge surveys.

Red hake

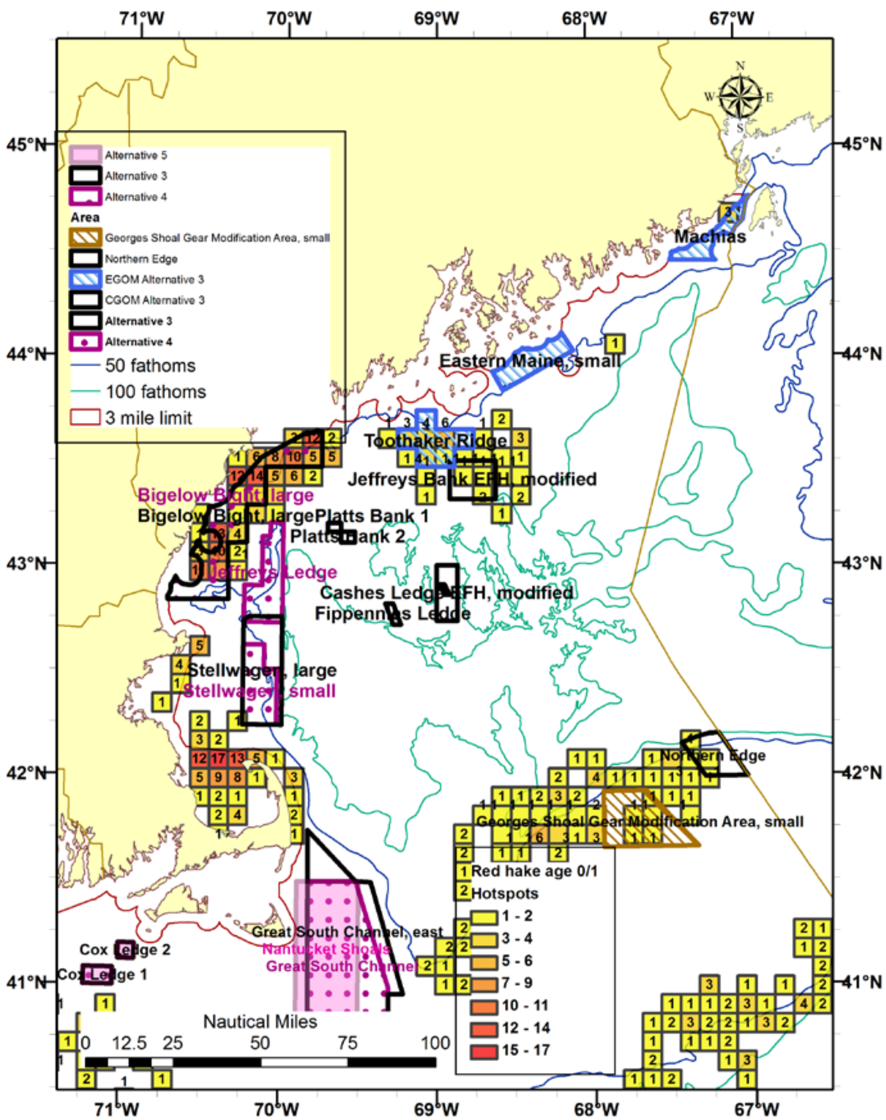


Silver hake

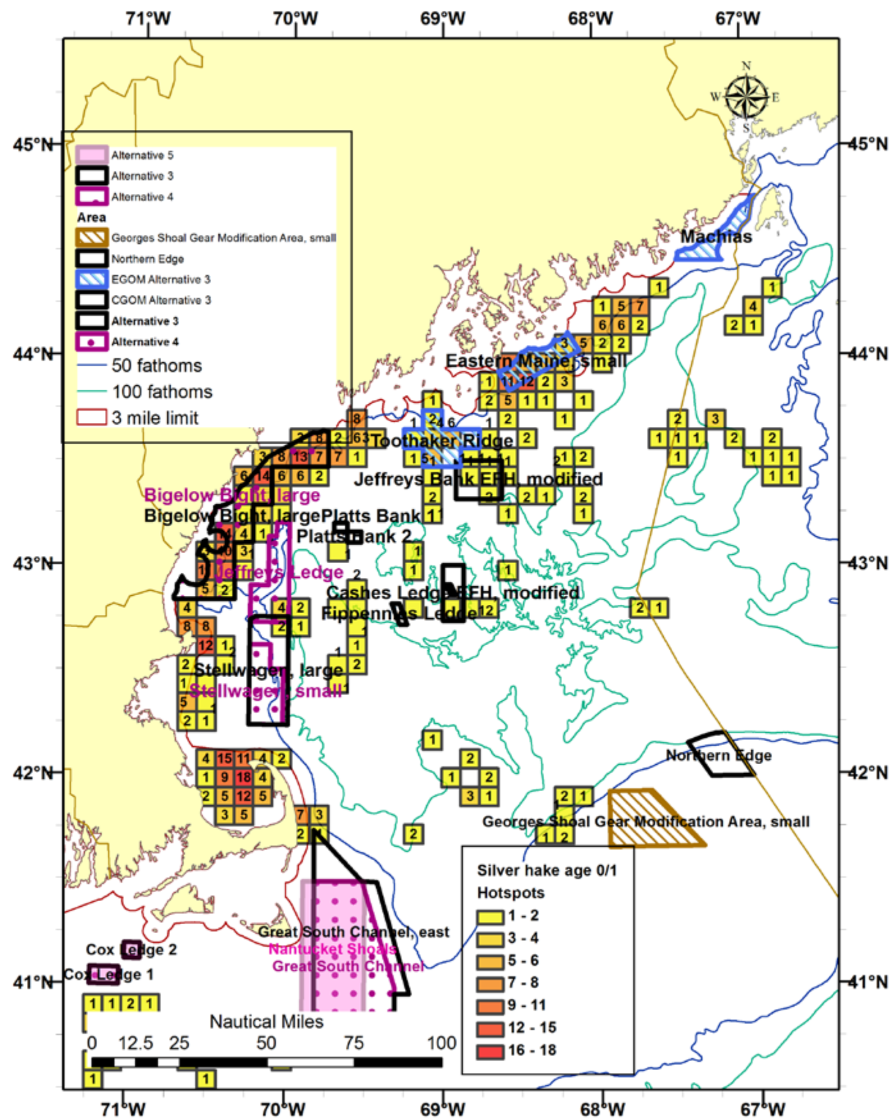


Map 79 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 fall trawl surveys.

Red hake



Silver hake



4.5.1.2 *Fishery impacts*

Fishing with small-mesh trawls to target red and silver hake in the Northern Management Area (grey-shaded area in Map 80 to Map 83) is restricted compared to other fisheries, limited to well-defined exemption areas and seasons. Fishing in exemption areas that have a high amount of overlap with proposed Habitat Management Areas will of course be highly impacted by alternatives that include those specific areas if mobile bottom-tending gears are prohibited. These impacts may be quite local and acute for vessels that cannot fish in remote exemption areas.

All of the Habitat Management Area and Dedicated Habitat Research Area alternatives will have the potential to shift fishing effort, between areas and between fisheries, particularly for the small-mesh multispecies fishery which does not currently have any limited access restrictions. Vessels that use mobile bottom tending gear to target other species may find it more attractive to target small-mesh multispecies in the exempted areas. While catches and mortality are limited by ABCs and ACLs, such effort shifts into the small-mesh multispecies fishery, if they occur, could have negative impacts on existing fishery participants.

Most of the proposed Habitat Management Area alternatives include options that limit or restrict mobile bottom-tending gear within their boundaries. It is more straightforward to assess the impacts in areas where mobile bottom-tending gear would be prohibited (with or without an exemption for hydraulic clam dredges). For the proposed gear modifications to restrict ground cable length or require cookies, it is more difficult to assess probable impacts, since the proposed gear modification s have not been tested in fisheries targeting red and silver hake with small-mesh trawls. If the modification is incompatible with the fishery, then the impact would be the same as a total prohibition on mobile bottom-tending gear. If the modification can be accommodated, there would be a small negative impact from the cost of the new fishing gear plus any loss in gear efficiency to catch target species.

Since the small-mesh exemption areas were configured to accommodate the existing year-round groundfish closed areas and do not overlap with the existing EFH closures, Alternative 1 (No Action) is expected to have a neutral impact on the small-mesh fishery. The no habitat management alternative for any sub-region (typically Alternative 2) does not propose any habitat management areas, and therefore would have no overlap with the small-mesh exemption areas, leading to a neutral impact on the fishery. The absence of habitat management areas in a particular sub-region may however open new opportunities for small-mesh exemption areas, thus this alternative could have a small positive impact on the fishery.

Western Gulf of Maine Habitat Management Area and Dedicated Habitat Research Area Alternatives

In particular, the Bigelow Bight Large Habitat Management Area proposed in WGOM Alternatives 3 and 4 have a substantial amount of overlap with the Small-Mesh Area I and the GOM Raised Footrope Trawl Area (Map 80 and Map 81). WGOM Alternative 5 includes a Bigelow Bight Small Habitat Management Area which has a substantial (but not complete) overlap with the Small-Mesh Area I (Map 82). WGOM Alternative 6 has no overlap with the existing small-mesh multispecies exemption areas (Map 83).

Thus, Alternative 6 is expected to have negligible impact on the small-mesh multispecies fishery. Alternative 5 is likely to have a small negative impact, but this impact may be acute for vessels that fish in the Small-Mesh Area I fishery. Alternatives 3 and 4 are expected to have the most negative impact on the small-mesh multispecies fishery, locally acute for vessels that fish in Small-Mesh Area I and the Gulf of Maine Raised Footrope Area, but overall a small negative impact on vessels that are able to fish in other small-mesh exemption areas.

Eastern and Central Gulf of Maine Habitat Management Area and Dedicated Habitat Research Area Alternatives

Platts Bank and other CGOM or EGOM proposed Habitat Management Areas do not overlap with either the Small-Mesh Area II or the GOM Raised Footrope Area (Map 80). None of the Habitat Management Areas proposed for the CGOM, EGOM, and GSC overlap with the small-mesh fishery exemption areas.

Thus, all EGOM and CGOM Habitat Management Area and Dedicated Habitat Research Area Alternatives are likely to have a neutral impact on the small-mesh multispecies fishery.

Georges Bank Habitat Management Area and Dedicated Habitat Research Area Alternatives

Alternative 3 proposes no Habitat Management Areas that overlap with any of the small-mesh exemption areas (Map 80). Alternative 4 has a proposed gear modification area that may affect vessels fishing in the Cultivator Shoals Area small-mesh fishery (Map 81). Since no specific measures for ground cables have yet been defined, it is not possible to determine the amount of impacts this area would have on the small-mesh fishery, except that most fishing in the Cultivator Shoals Area does not overlap with this proposed restricted gear area in Alternative 3.

Alternative 5 proposes a larger gear modification than Alternative 4 and it has a much greater and meaningful overlap with the Cultivator Shoals Area small-mesh fishery, although the majority of fishing occurs along the boundary with and to the NE of Closed Area I. Like Alternative 3, since no specific measures for ground cables have yet been defined, it is not possible to determine the amount of impacts this area would have on the small-mesh fishery. The proposed Georges Shoal Habitat Management Area has only a negligible overlap with the Cultivator Shoals Area.

Thus, if the proposed gear modification areas are incompatible with fishing for small-mesh multispecies, Alternative 5 will have a substantial negative impact on the fishery, Alternative 4 will have a minor negative impact, and Alternative 3 will have a neutral impact. If the proposed gear modifications are compatible with gears currently used to target small-mesh multispecies, then the GBx alternatives are unlikely to have an impact on the fishery.

Great South Channel Habitat Management Area Alternatives

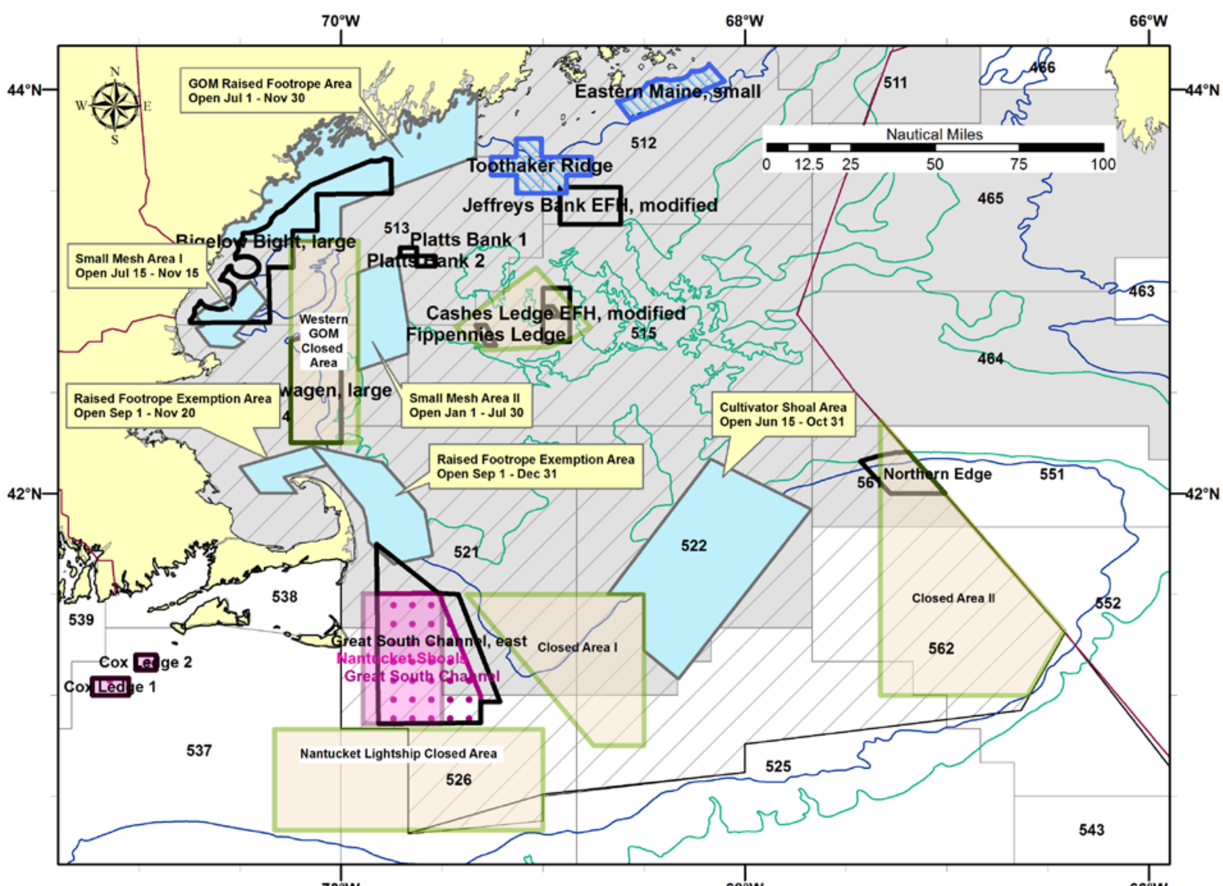
None of the Great South Channel alternatives overlap with the small-mesh multispecies raised footrope exemption areas. Thus other than the potential effort shift discussed above, all of the

Great South Channel Habitat Management Area and Dedicated Habitat Research Area alternatives are likely to have negligible impacts on the small-mesh multispecies fishery.

Spawning Management Area Alternatives

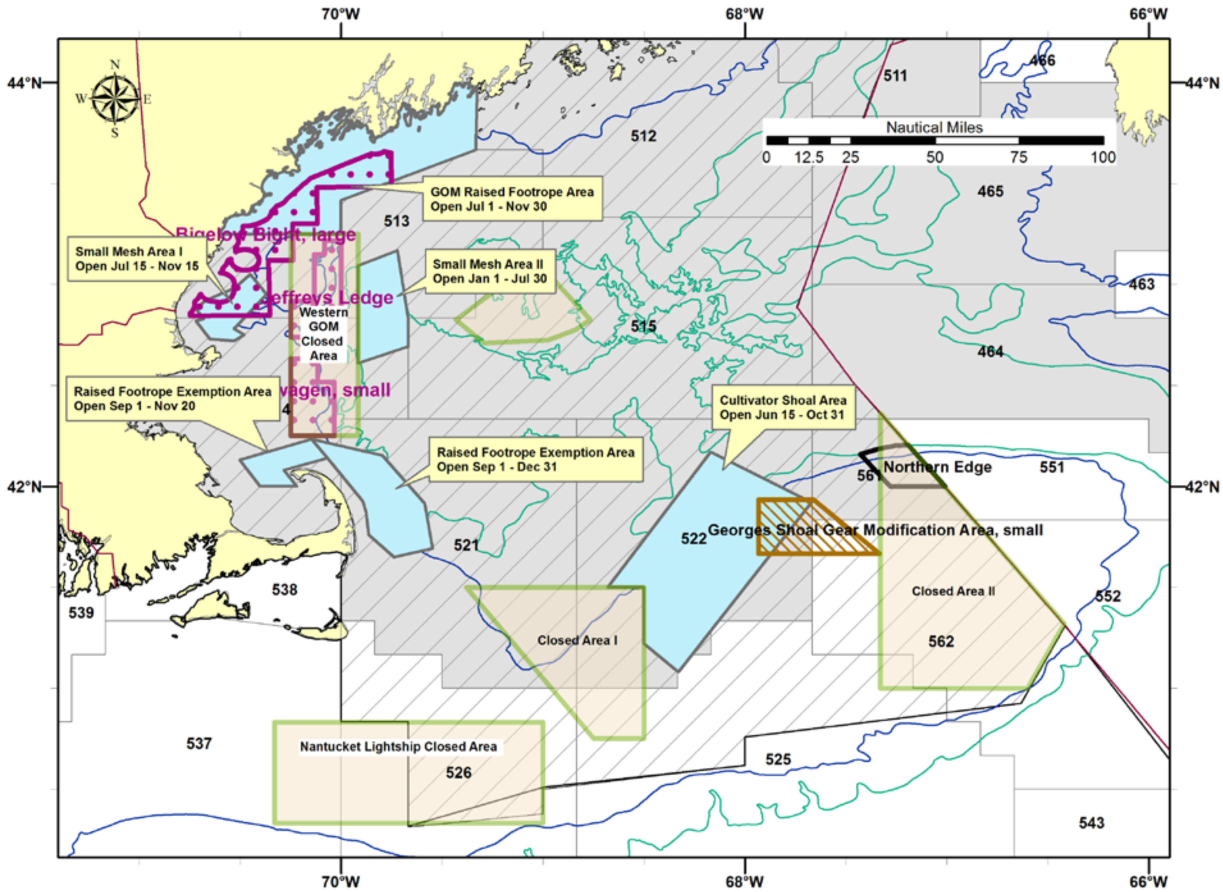
The proposed seasons when specific areas would be closed to gears capable to catching groundfish do not conflict with the open fishing seasons for the small-mesh exemption areas. Thus the Spawning Management Area alternatives are unlikely to have any impact on the small-mesh multispecies fishery.

Map 80 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 3 in WGOM, CGOM, EGOM, and GB sub-regions, and Alternatives 3-5 in the GSC sub-region. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.

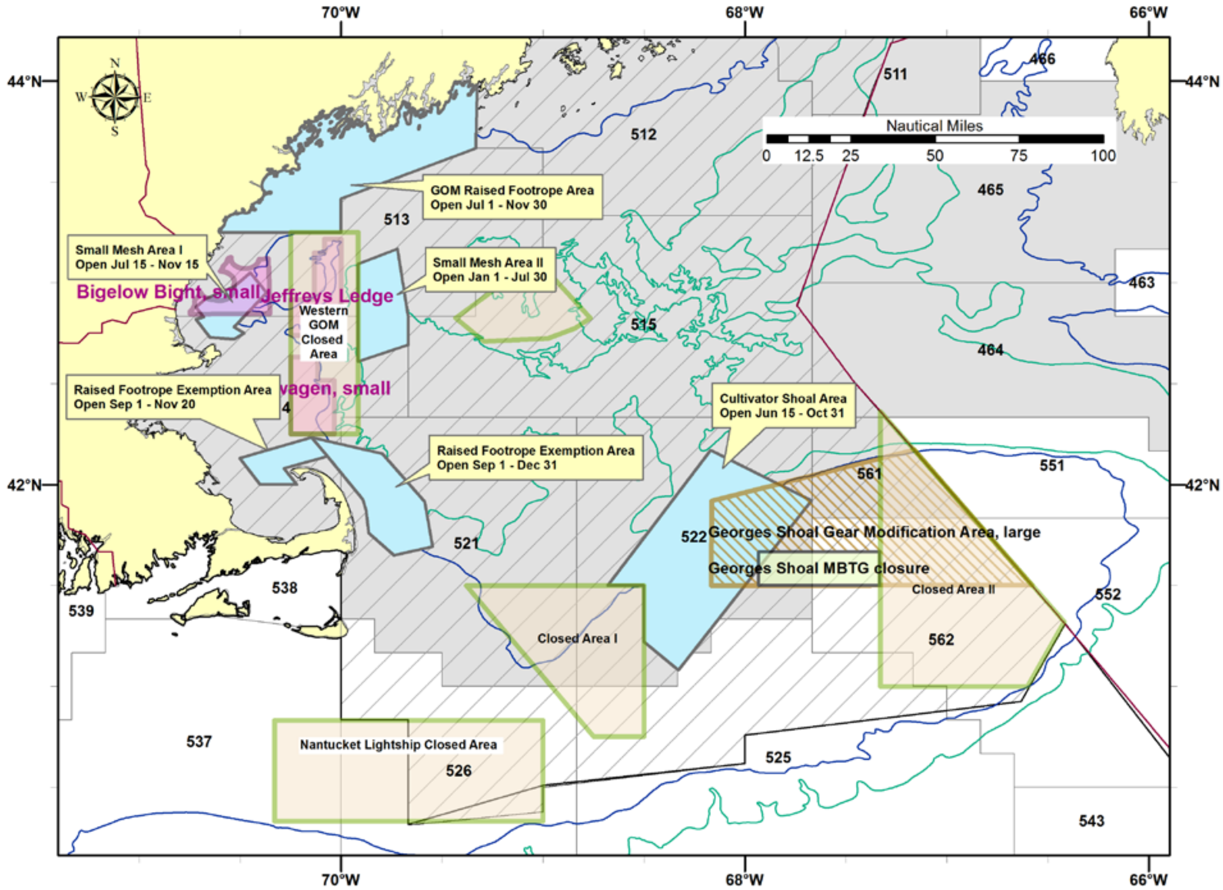


Map 81 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 4 in WGOM and GB sub-regions. Grey-shaded region

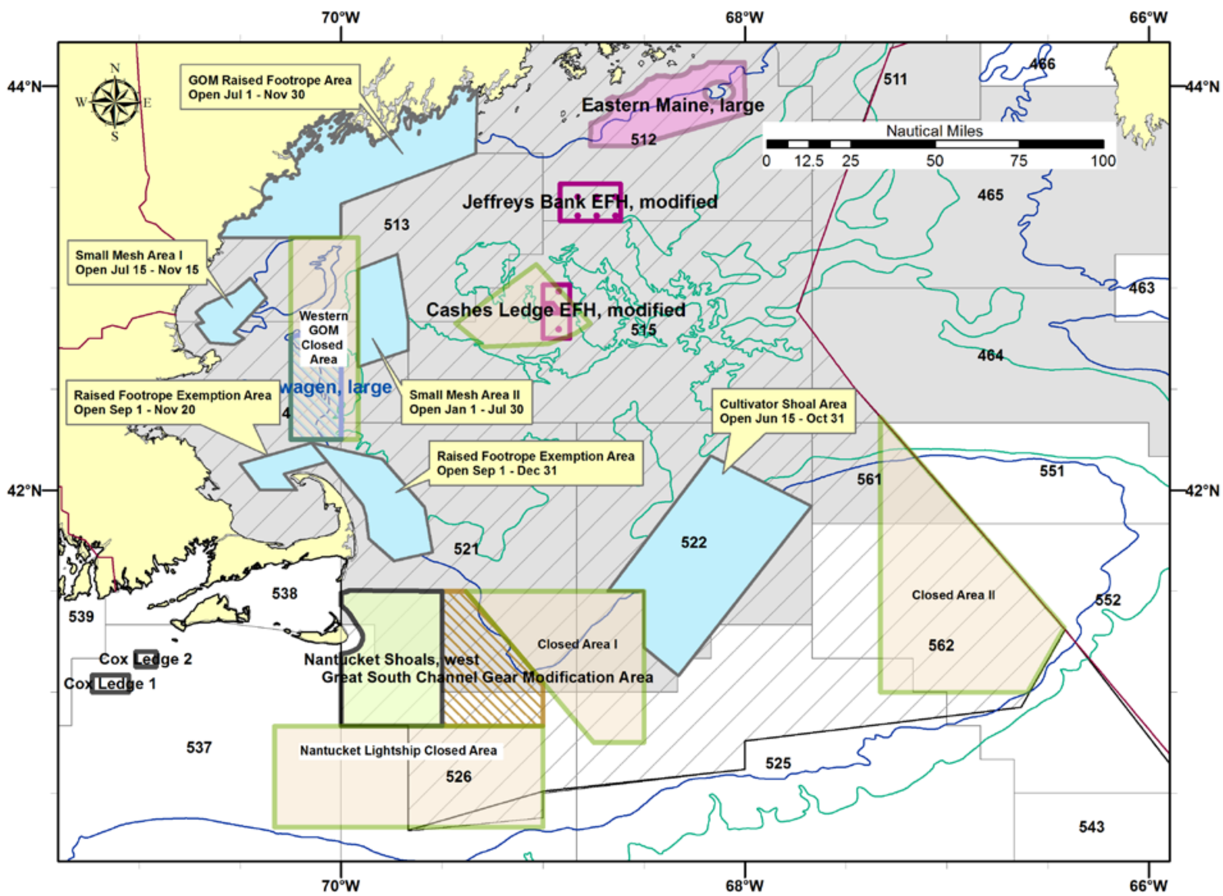
represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



Map 82 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 5 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



Map 83 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 6 in WGOM, GB, and GSC sub-regions, with EGOM Alternative 2 and CGOM Alternative 4. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



4.5.2 Monkfish

4.5.2.1 *Biological impacts*

To be completed later

4.5.2.2 *Fishery impacts*

To be completed later

4.5.3 Skates

4.5.3.1 *Biological impacts*

To be completed later

4.5.3.2 *Fishery impacts*

To be completed later

4.5.4 Atlantic sea scallop

4.5.4.1 *Biological impacts*

See separate memo from scallop PDT to habitat PDT

4.5.4.2 *Fishery impacts*

See separate memo from scallop PDT to habitat PDT

4.5.5 Atlantic herring

4.5.5.1 *Biological impacts*

To be completed later

4.5.5.2 *Fishery impacts*

To be completed later

4.5.6 Deep-sea red crab

4.5.6.1 *Biological impacts*

To be completed later. Probably minimal impacts due to limited spatial overlap between red crab resource and fishery and measures proposed in this amendment.

4.5.6.2 *Fishery impacts*

To be completed later. Probably minimal impacts due to limited spatial overlap between tilefish resource and fishery and measures proposed in this amendment.

4.5.7 Surfclams and ocean quahogs

4.5.7.1 *Biological impacts*

To be completed later

4.5.7.2 *Fishery impacts*

To be completed later. Some discussion of this fishery included in the economic impacts sections.

4.5.8 Northern shrimp

4.5.8.1 *Biological impacts*

To be completed later

4.5.8.2 *Fishery impacts*

To be completed later. Some discussion of this fishery included in the economic impacts sections.

4.5.9 American lobster

4.5.9.1 *Biological impacts*

To be completed later

4.5.9.2 *Fishery impacts*

To be completed later. Some discussion of this fishery included in the economic impacts sections.

4.5.10 Atlantic bluefish

4.5.10.1 *Biological impacts*

To be completed later

4.5.10.2 *Fishery impacts*

To be completed later

4.5.11 Atlantic mackerel, squid and butterfish

4.5.11.1 *Biological impacts*

To be completed later

4.5.11.2 *Fishery impacts*

To be completed later

4.5.12 Spiny dogfish

4.5.12.1 *Biological impacts*

To be completed later

4.5.12.2 *Fishery impacts*

To be completed later

4.5.13 Summer flounder, scup, and black sea bass

4.5.13.1 *Biological impacts*

To be completed later

4.5.13.2 *Fishery impacts*

To be completed later

4.5.14 Golden tilefish

4.5.14.1 *Biological impacts*

To be completed later. Probably minimal impacts due to limited spatial overlap between tilefish resource and fishery and measures proposed in this amendment.

4.5.14.2 *Fishery impacts*

To be completed later. Probably minimal impacts due to limited spatial overlap between tilefish resource and fishery and measures proposed in this amendment.

5 Cumulative effects analysis

To be completed later