DRAFT

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

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 February 13, 2014

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 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 *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.

2.1.1.2 *Alternative 2*

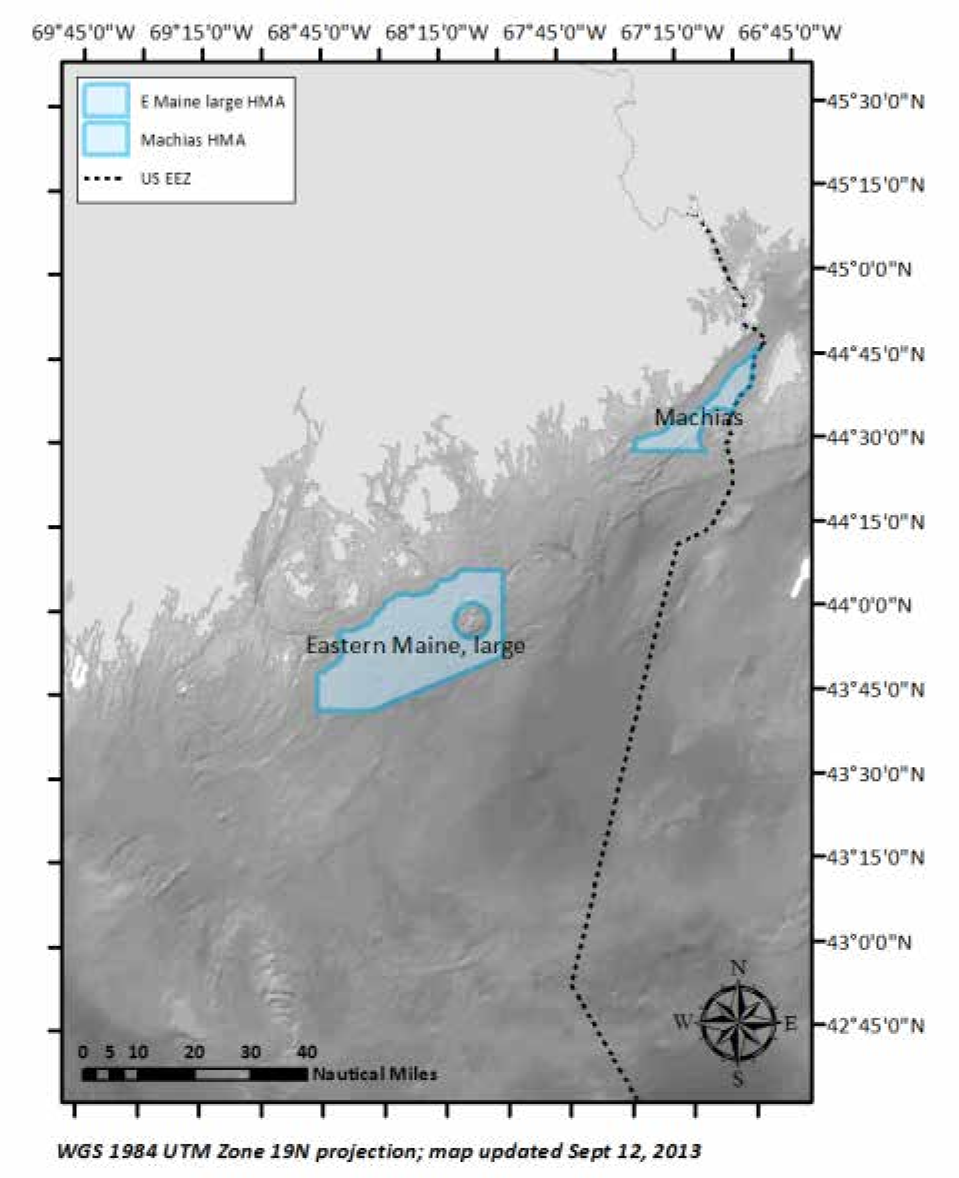
The alternative (Map 1) would designate two new habitat management areas, the Large Eastern Maine Habitat Management Area and the Machias Habitat Management Area, in all FMPs. Measures for both of these areas could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <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 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



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

2.1.1.3 *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:

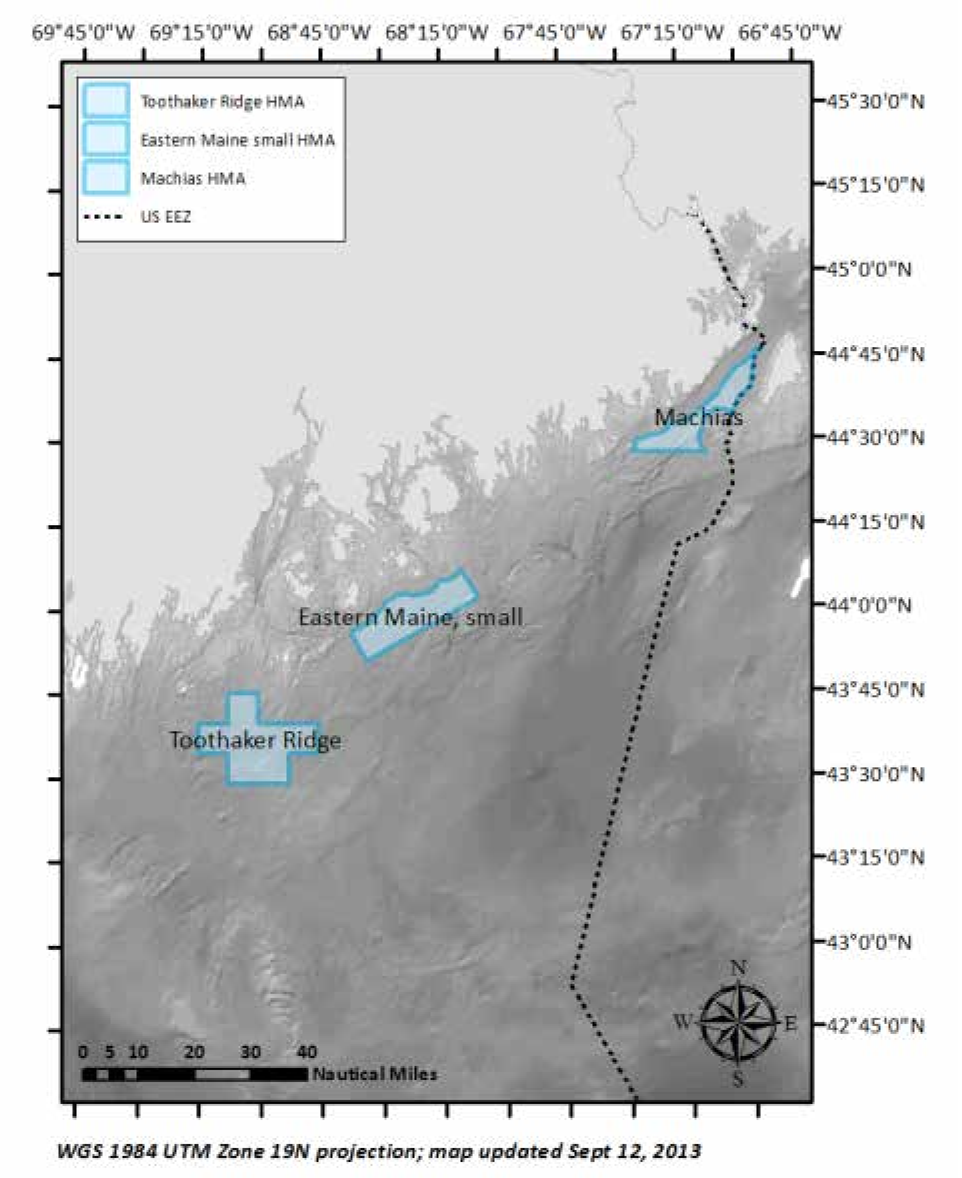
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- 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



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

2.1.2 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’

2.1.2.1 *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. Current restrictions for the three areas are summarized below.

Table 6 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Central GOM sub-region.

Area name	**Prohibitions**	**Exemptions**
Cashes Ledge Habitat Closure Area, Jeffreys Bank Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	None
Cashes Ledge Closure Area	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

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.

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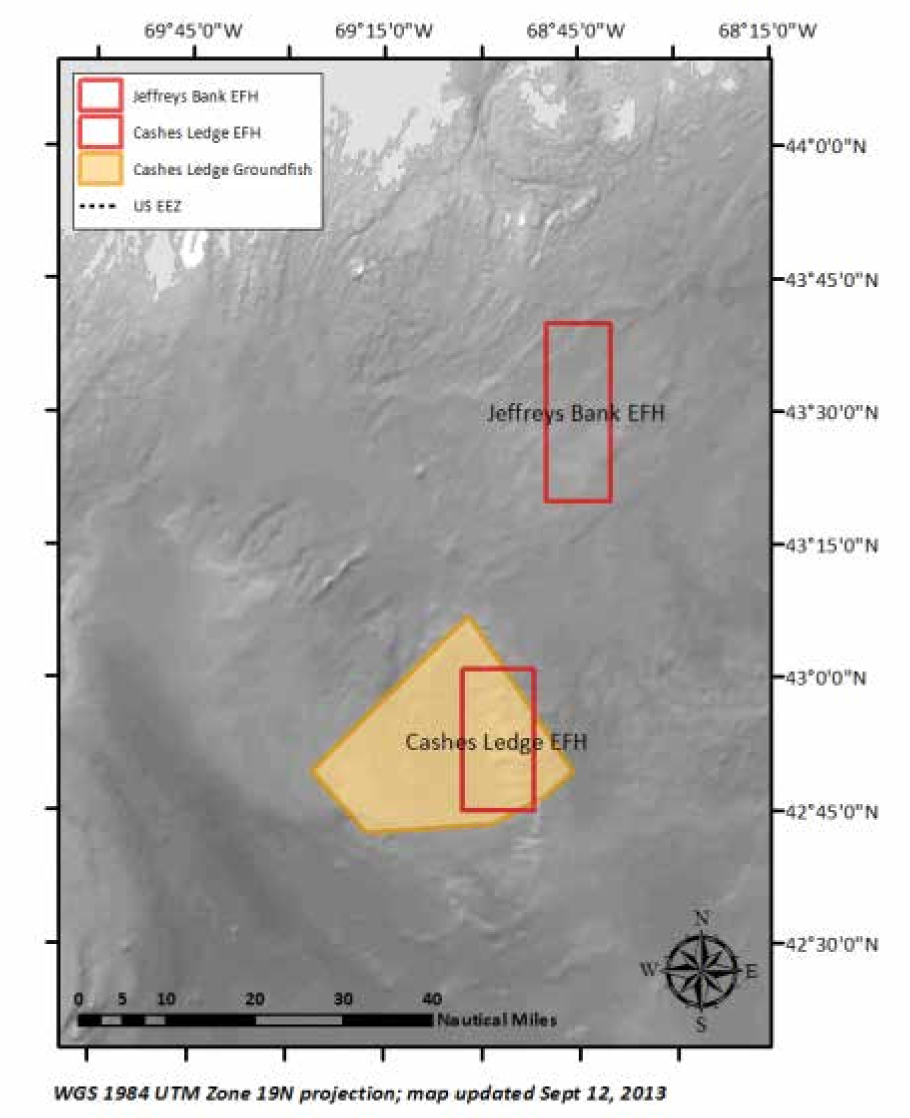
[1] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the WGOM and CL groundfish closures

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



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

2.1.2.2 *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.

2.1.2.3 *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.

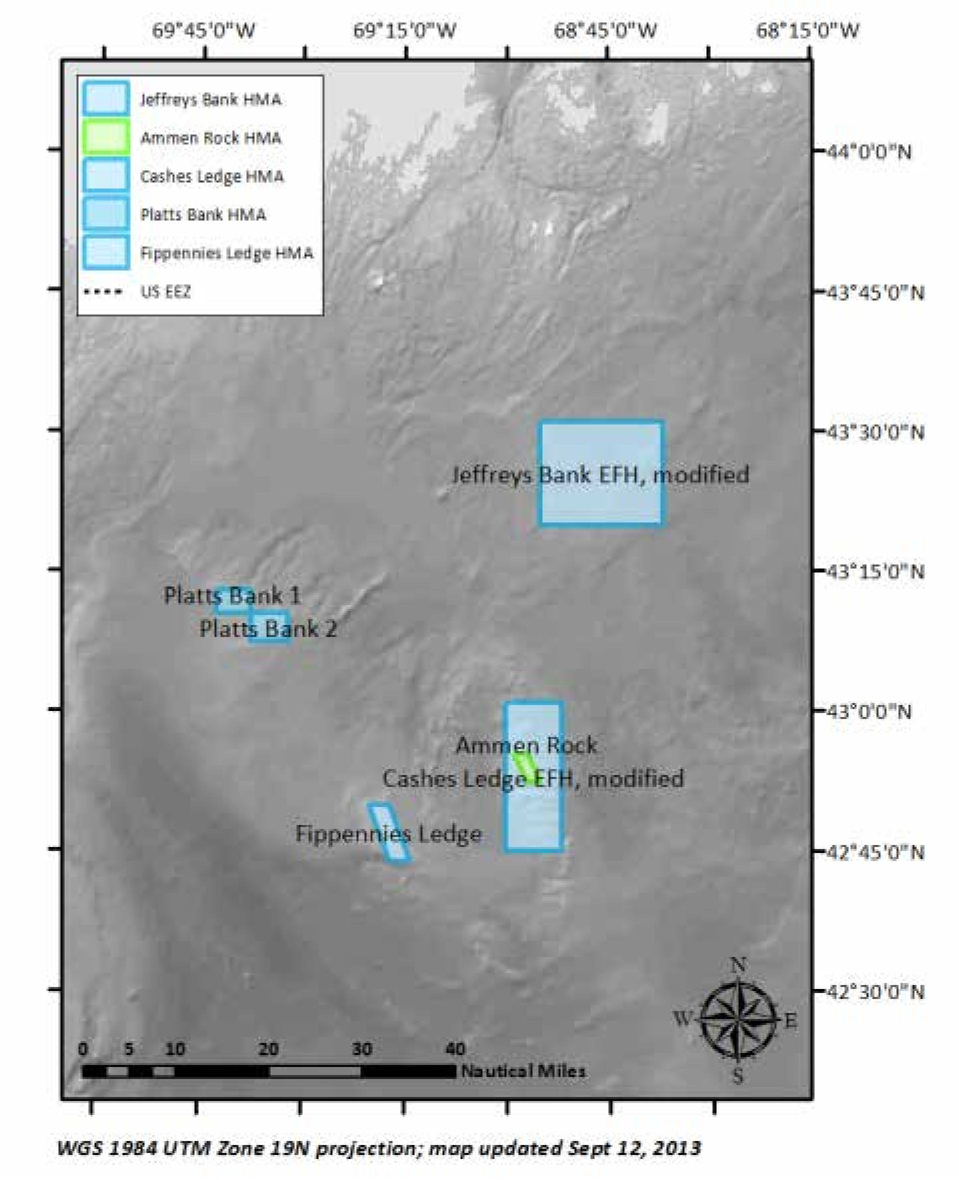
Most of the hard-bottom, shallower habitats on Cashes Ledge are included in the modified, smaller area, including all features shallower than 100 meters. The Ammen Rock pinnacle, which is the shallowest part of Cashes Ledge, represents a particularly unique and vulnerable kelp forest habitat type that 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

2.1.2.4 *Alternative 4*

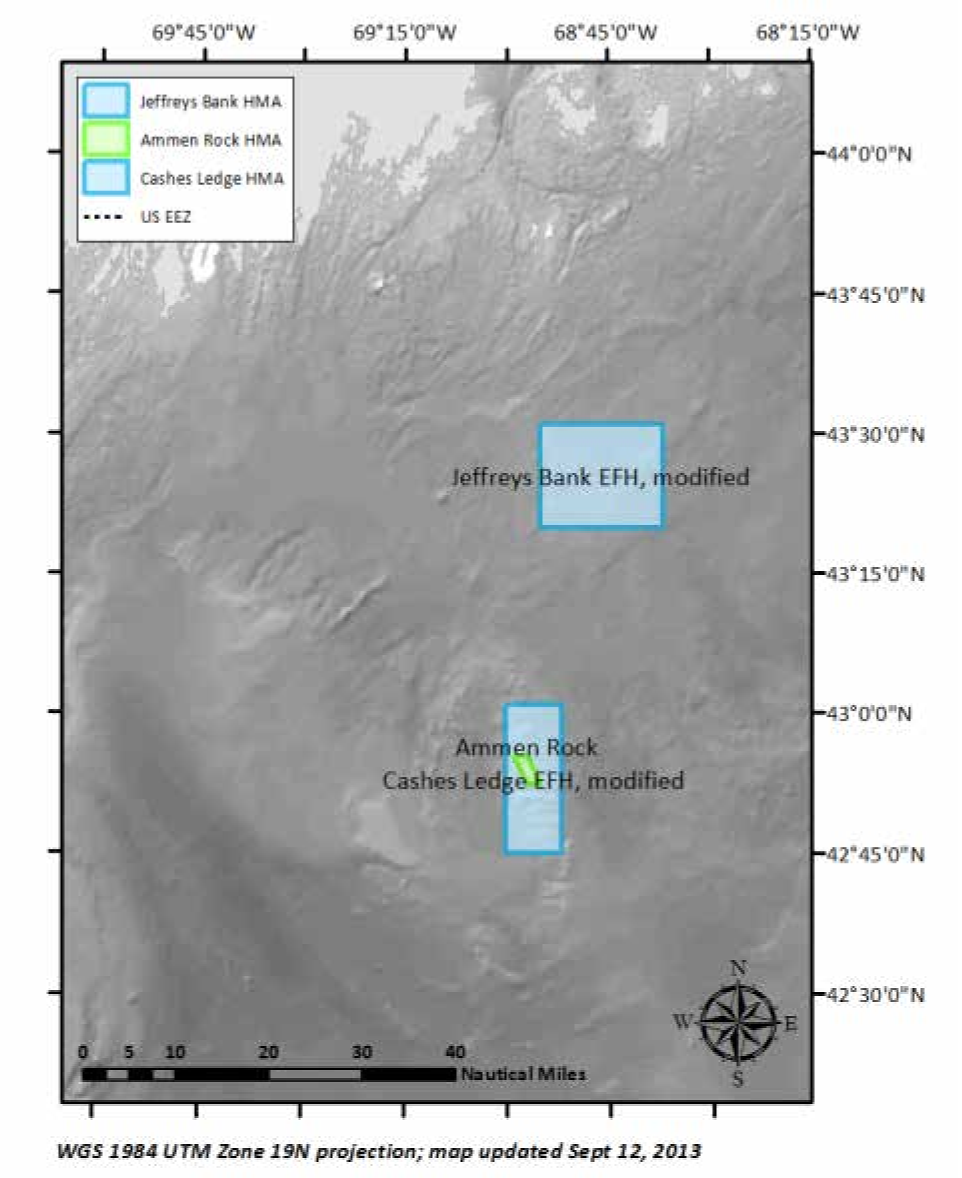
This alternative (Map 5) would modify the boundaries of the current Jeffreys Bank and Cashes Ledge habitat closures, and designate a new habitat management area on Ammen Rock. The Ammen Rock area would be closed to all fishing gears and activities except for lobster trapping. Measures for the modified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



2.1.3 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 7 – 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’

2.1.3.1 *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. Current restrictions for the three areas are summarized below.

Table 8 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Western GOM sub-region.

Area name	Prohibitions	Exemptions
Western Gulf of Maine Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	None
Western Gulf of Maine Closure Area	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[2] · Vessels participating in the mid-water trawl exempted fishery

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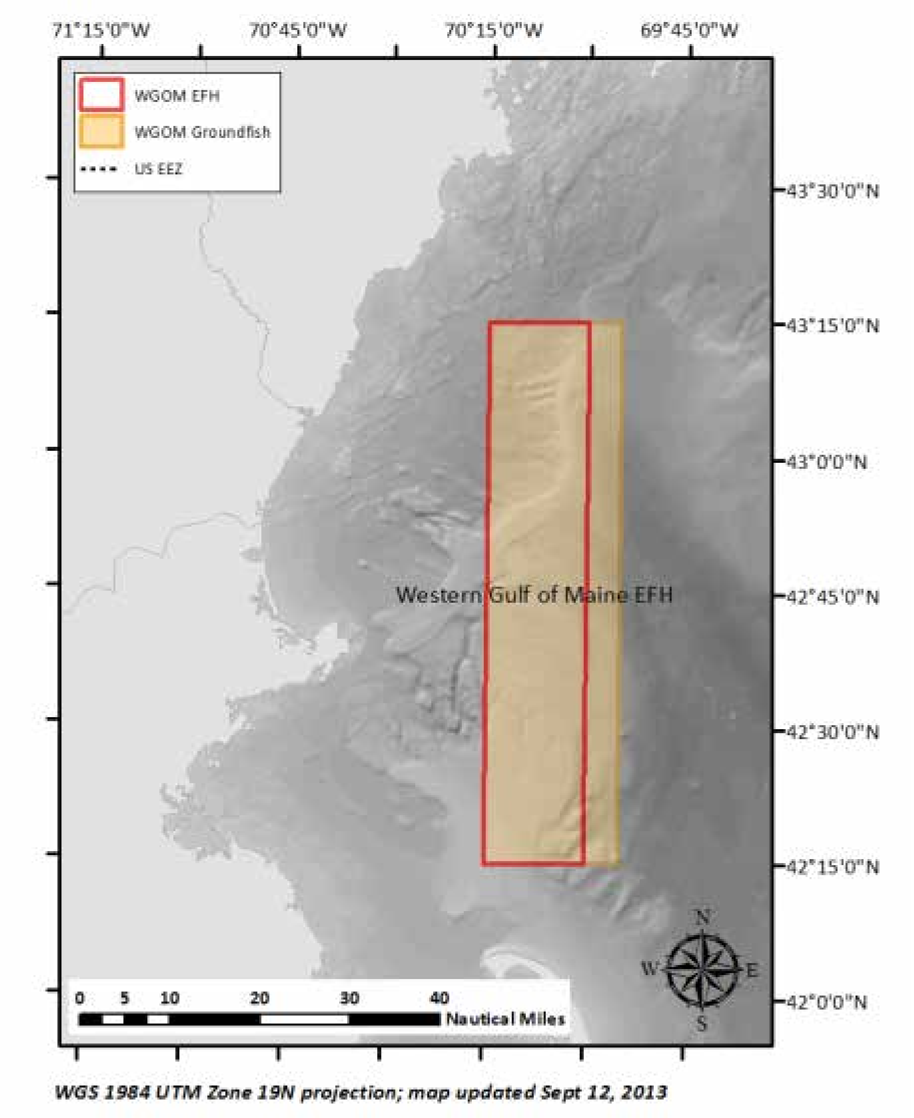
[2] Note that because they are a mobile-bottom tending gear, shrimp trawls are prohibited from the habitat closure areas that overlap the WGOM and CL groundfish closures

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).



2.1.3.2 *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.

2.1.3.3 *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:

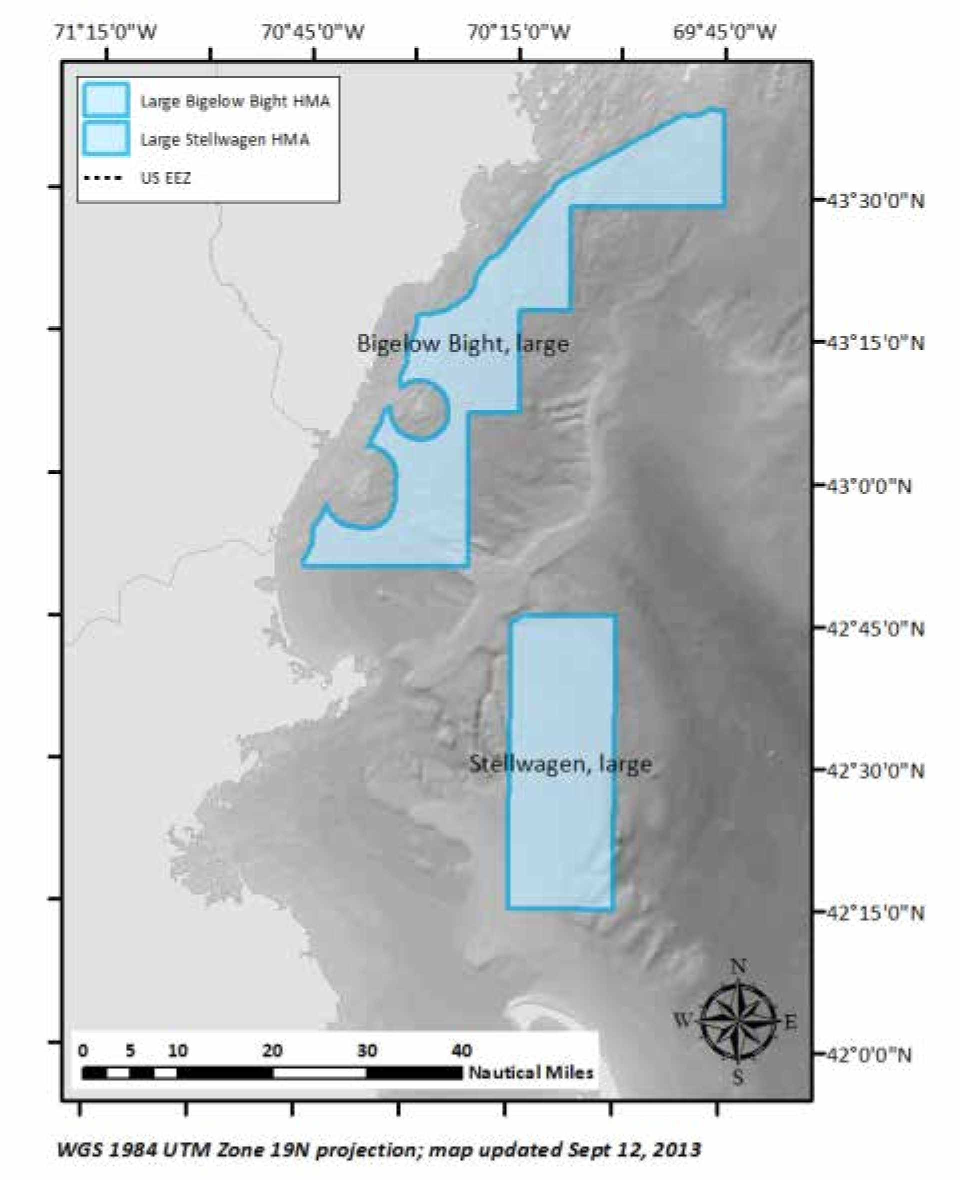
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks 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: 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.



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

2.1.3.4 *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:

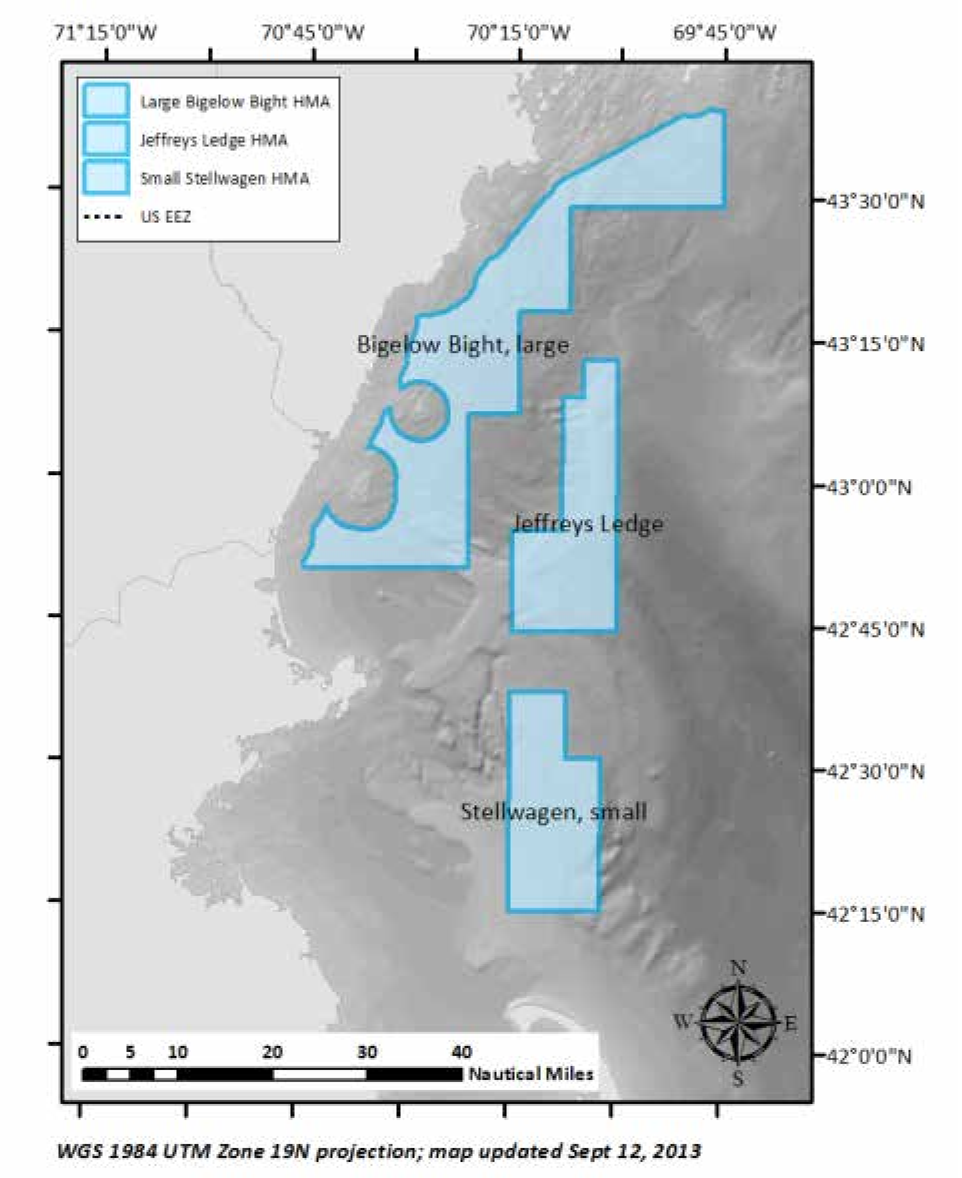
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- 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 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.



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

2.1.3.5 *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:

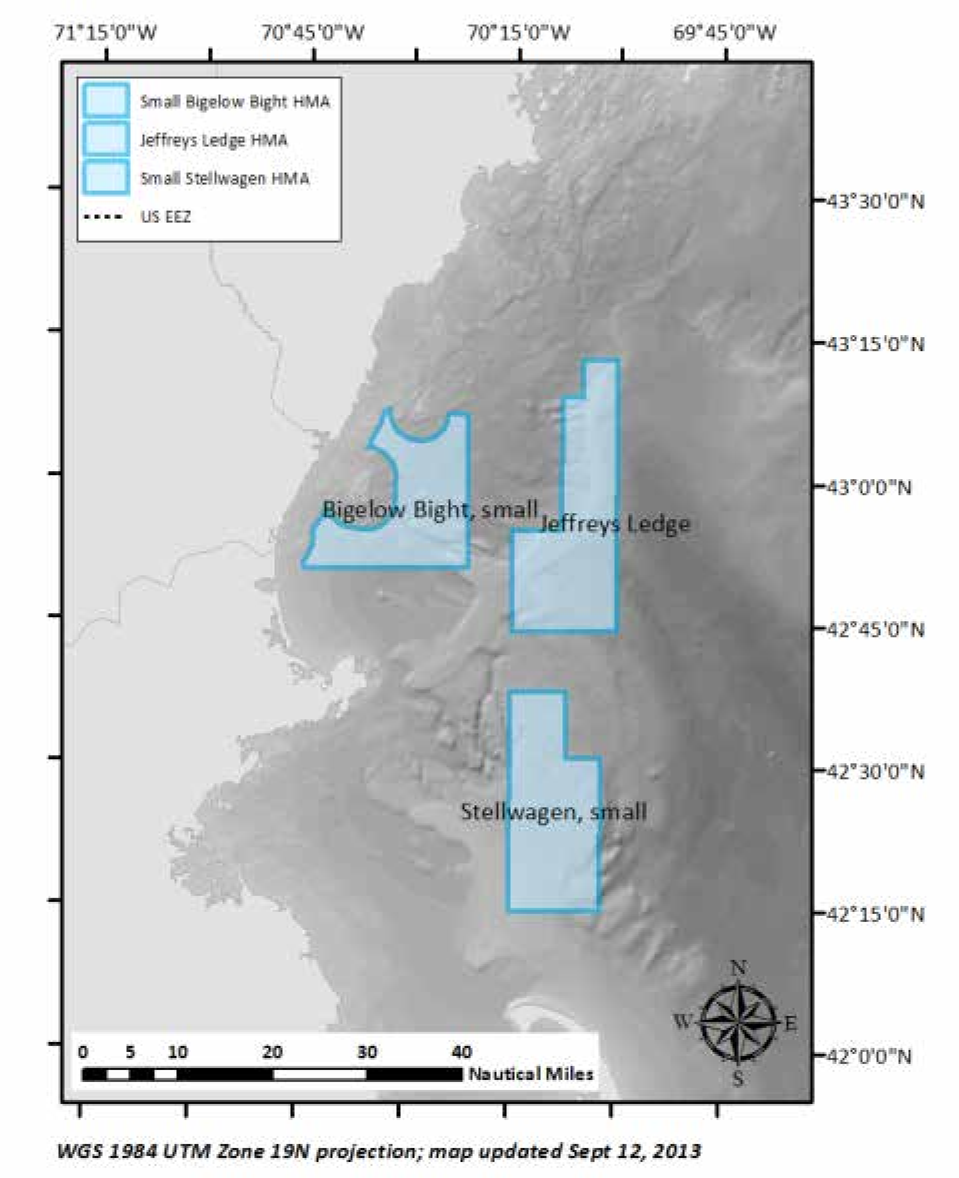
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>

- 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, <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 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.



2.1.3.6 *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:

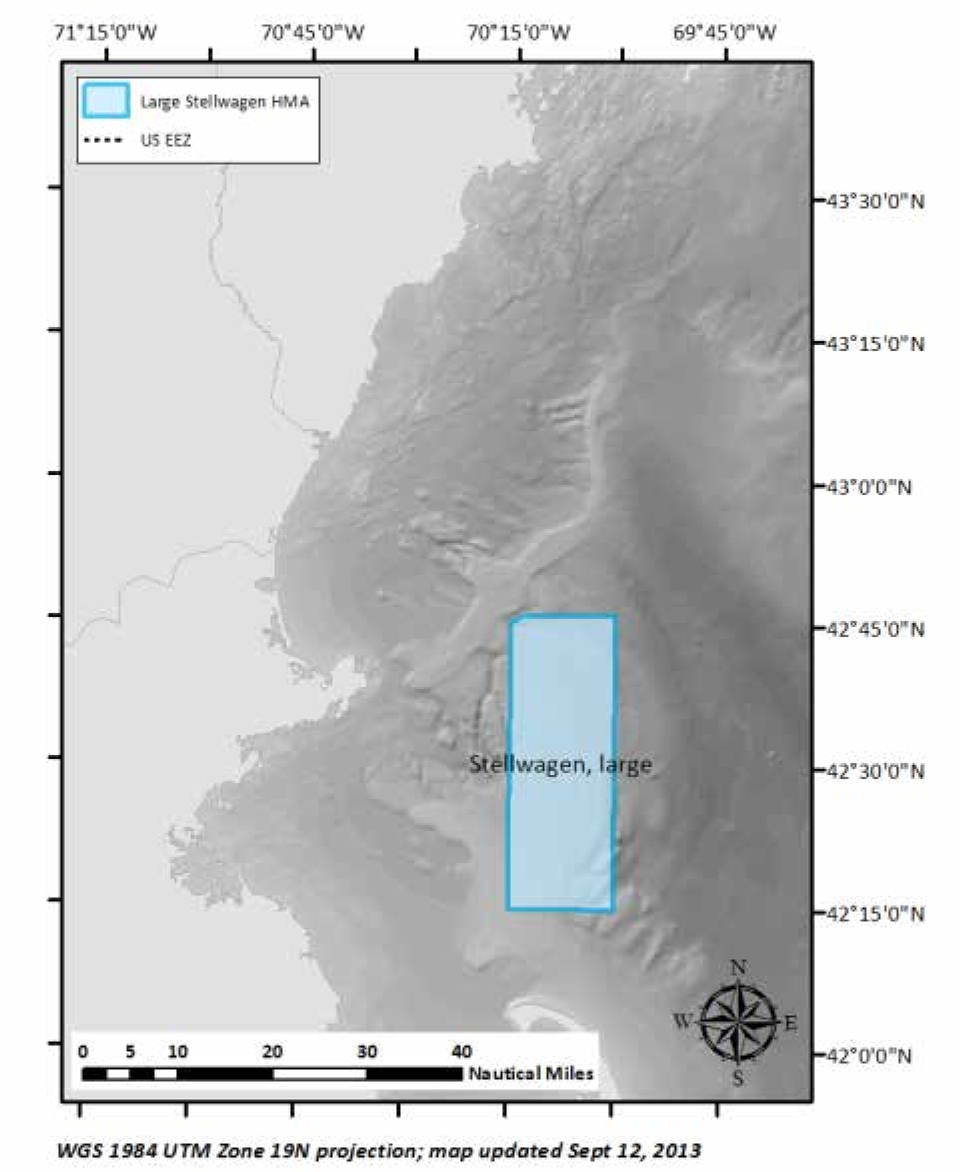
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, <u>or</u>
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks 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.



2.1.3.7 *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.

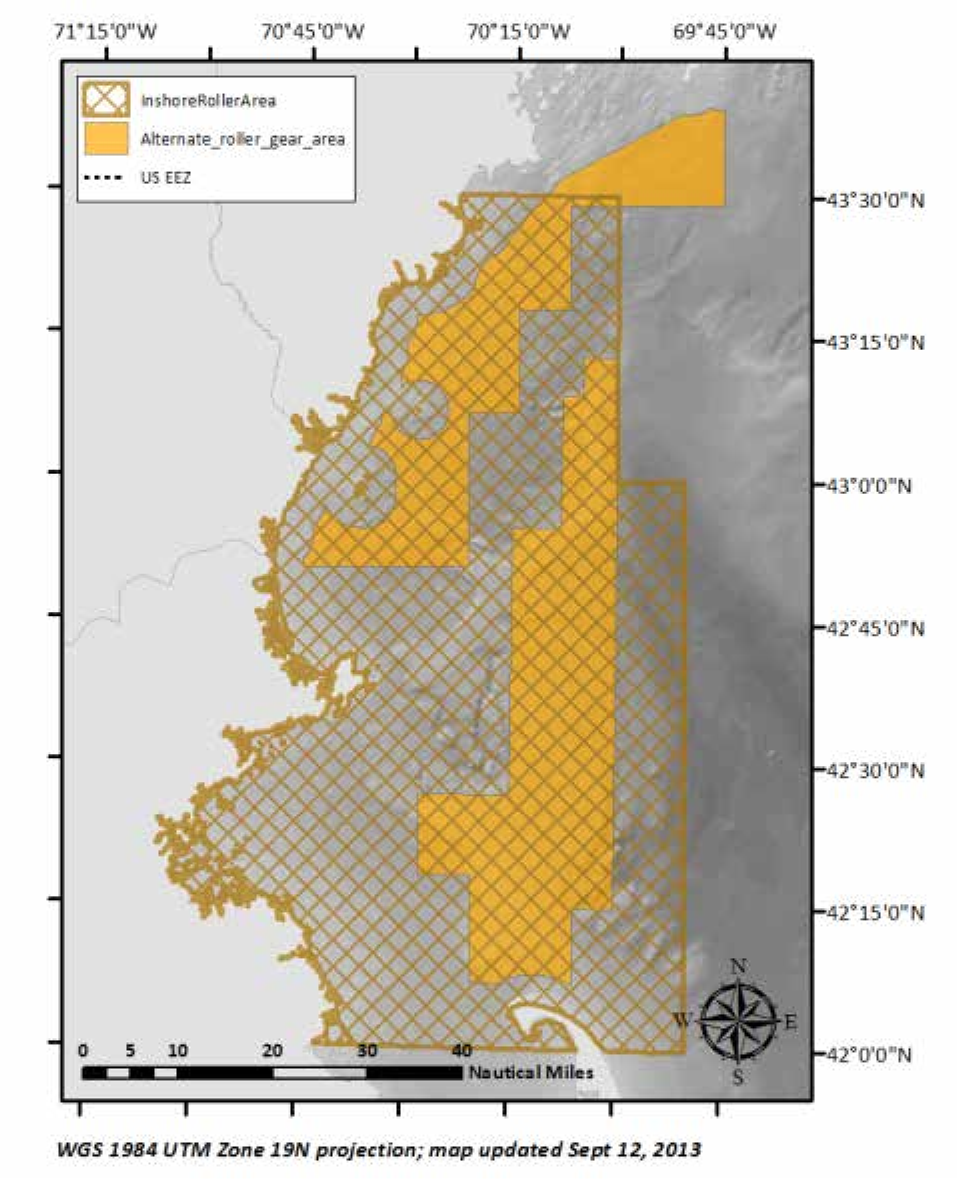
Option A would define the current Inshore Roller Gear Restricted Area, which limits trawl roller gear to a maximum diameter of 12 inches, as a habitat management measure.

Option B 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.



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

2.1.4 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 9 – 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’
CAII EFH extended to the west		
Point	N Latitude	W Longitude
1 (same as CIIH2)	42° 10’	67° 09.3’
2 (same as CIIH3)	42° 00’	67° 0.5’
3 (same as CIIH4)	42° 00’	67° 10’
4 (same as CIIH5)	41° 50’	67°10’
5	41° 50’	67°30’
6	42° 10’	67°30’
CAII EFH extended to the west, with buffer removed along EEZ		
Point	N Latitude	W Longitude
1	42° 10’	67° 22’ 16”
2	41° 56’ 1”	67°10’
3 (same as CIIH5)	41° 50’	67°10’
4	41° 50’	67°30’
5	42° 10’	67°30’

2.1.4.1 *Alternative 1 (No Action)*

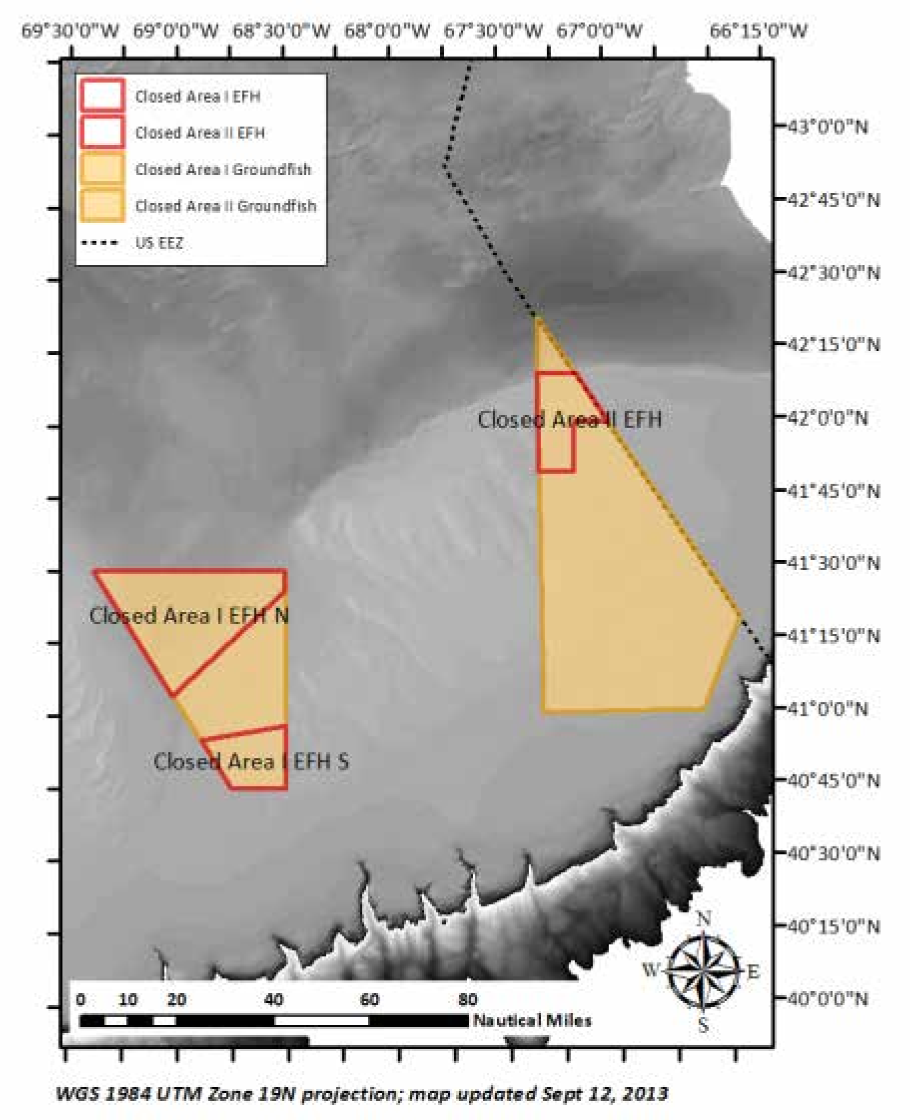
The no action habitat management alternative in the Georges Bank region (Map 12) includes the Closed Area I and Closed Area II habitat closure areas. These areas were initially implemented via Amendment 13 to the Northeast Multispecies FMP as areas closed to all mobile bottom-tending gears, regardless 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. Current restrictions for the three areas are summarized below.

Table 10 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Georges Bank sub-region.

Area name	Prohibitions	Exemptions
Closed Area I and Closed Area II Habitat Closure Areas	Closed year round to all vessels using mobile bottom-tending gears	None
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
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

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)



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

2.1.4.2 *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.

2.1.4.3 *Alternative 3*

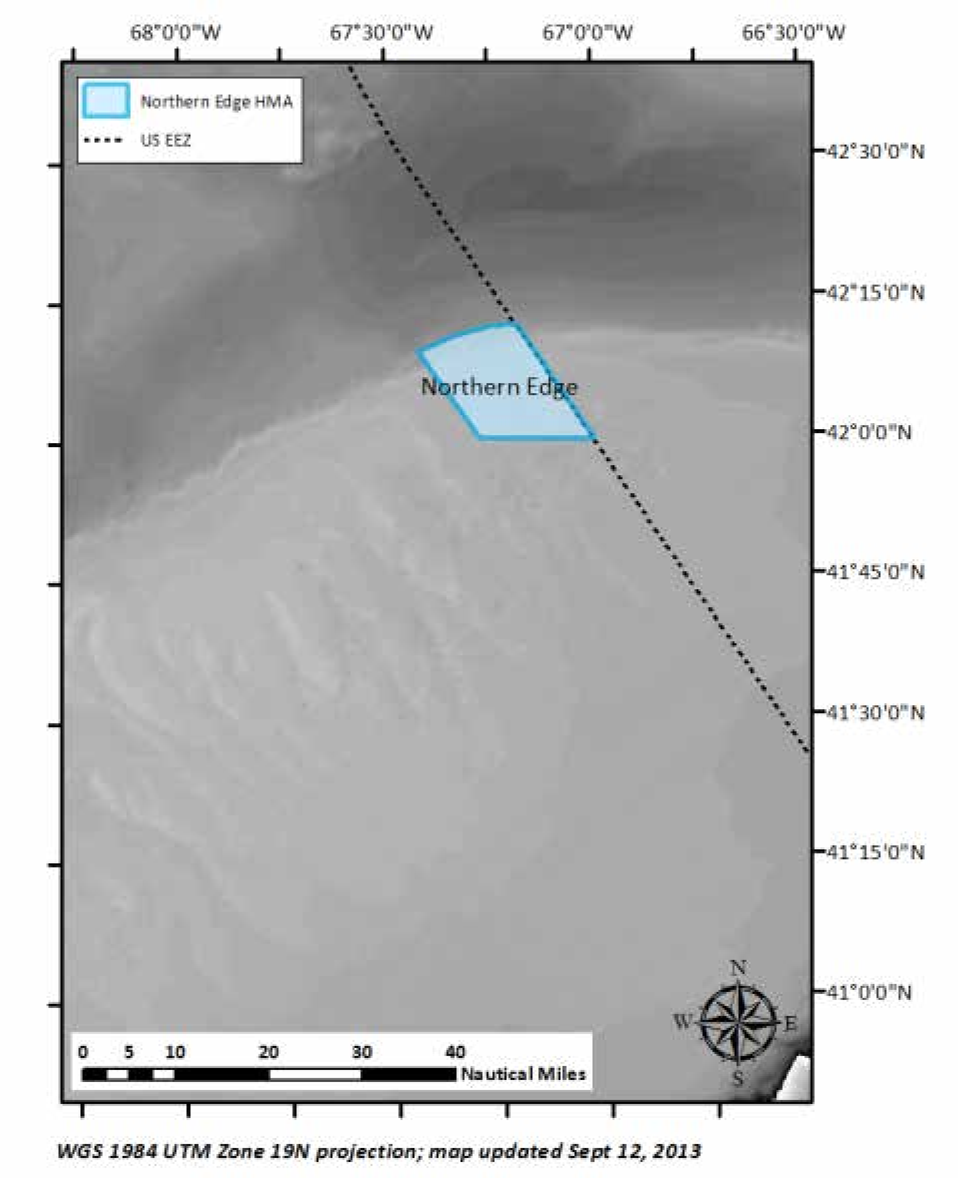
This alternative (Map 13) would remove the current CAI habitat closure areas and would modify the CAII habitat closure to create the Northern Edge Habitat Management Area, and implement it in all NEFMC FMPs. Measures for the Northern Edge area could include:

- Option 1, complete restrictions on use of mobile bottom-tending gears, <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 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.



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

2.1.4.4 *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:

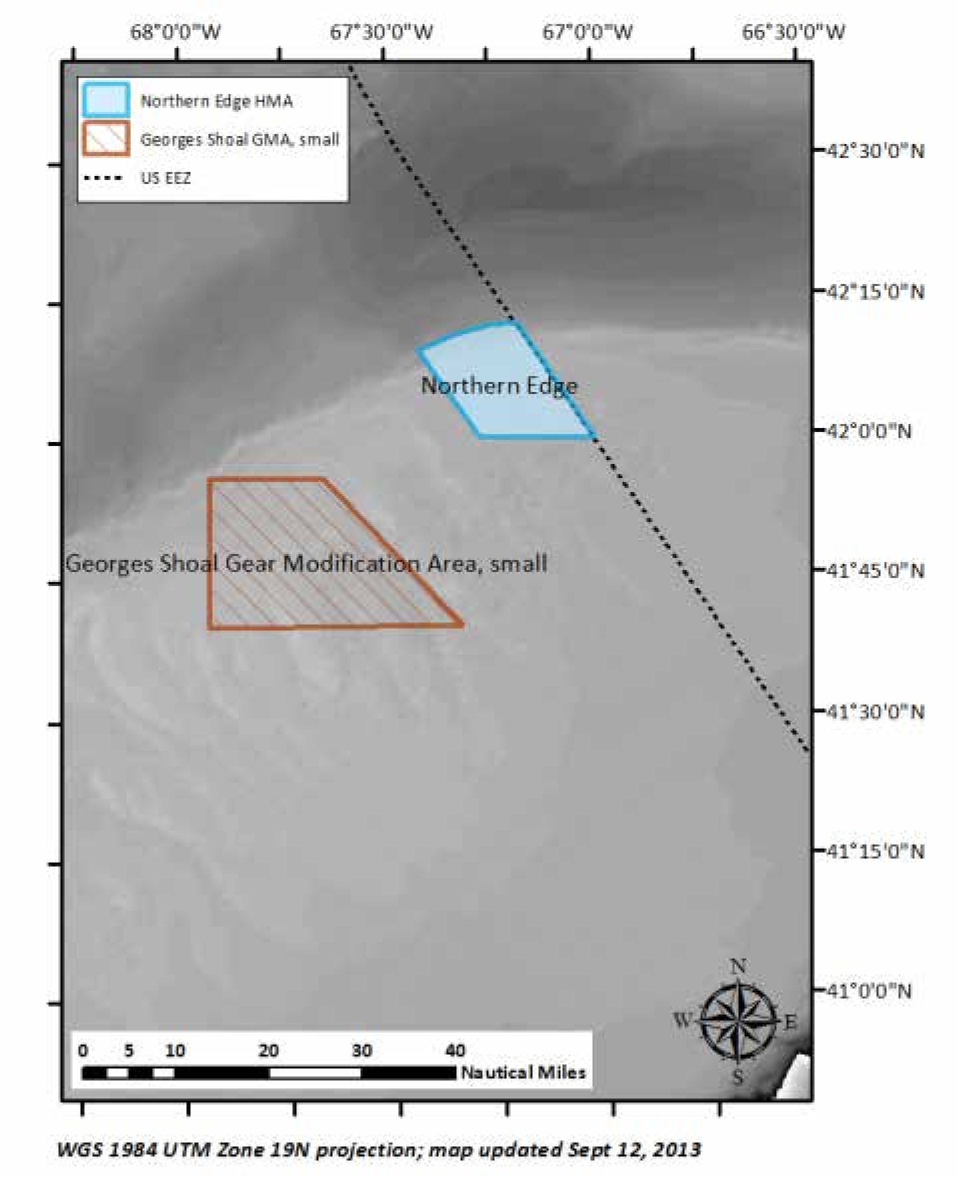
- Option 1, complete restrictions on use of mobile bottom-tending gears, or
- Option 2, restrictions on the use of mobile bottom-tending gear with an exemption for hydraulic clam dredges, or

- 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.

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.



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

2.1.4.5 *Alternative 5*

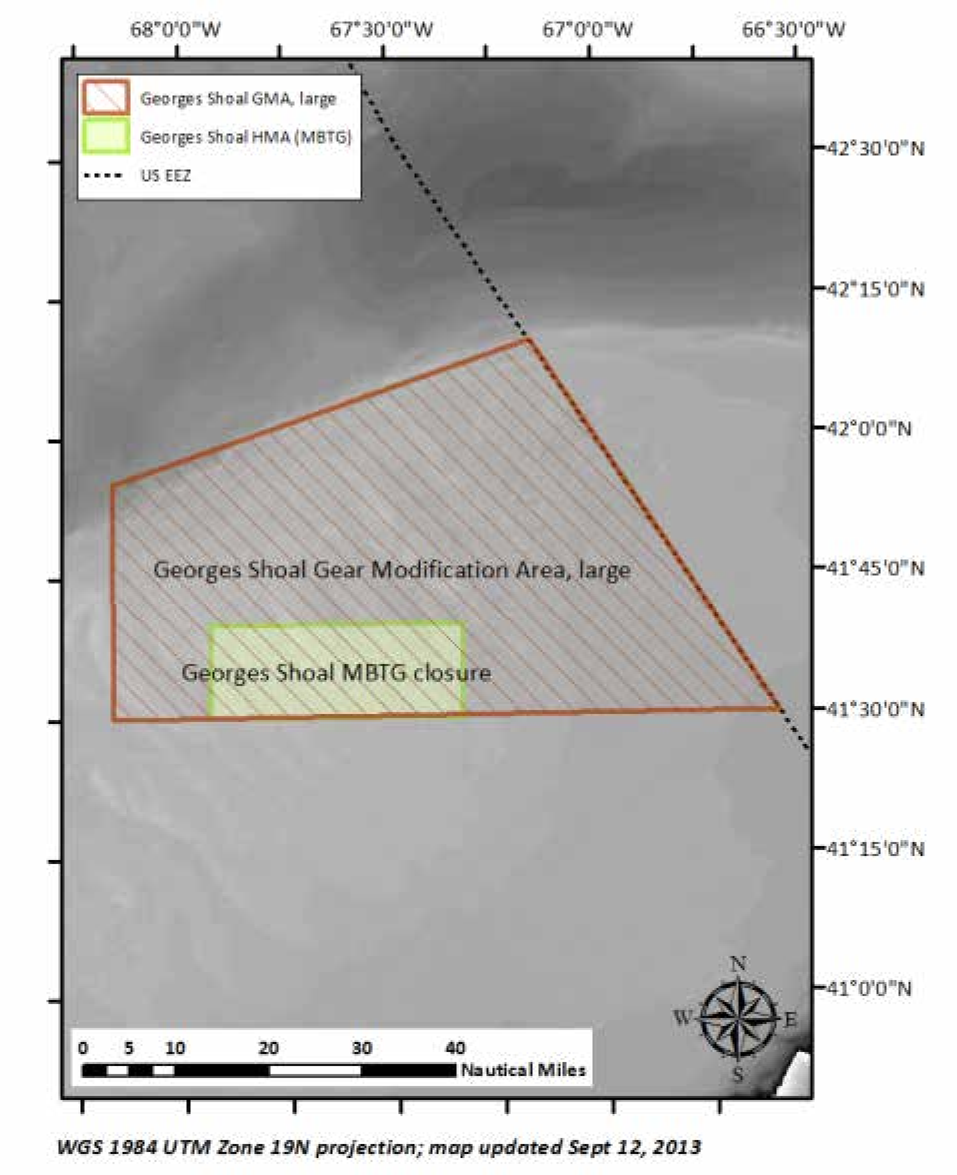
This alternative (Map 15) would remove the current CAI and CAII habitat closure areas from the multispecies and sea scallop regulations. This alternative would establish the Georges Shoal mobile-bottom tending gear HMA, and close it to mobile bottom-tending gears. In addition, this alternative would 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.



2.1.4.6 *Alternative 6*

This alternative (Map 13) would remove the current CAI habitat closure areas and would modify the CAII habitat closure and implement it in all NEFMC FMPs. There are two boundary options described below. Measures for this 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

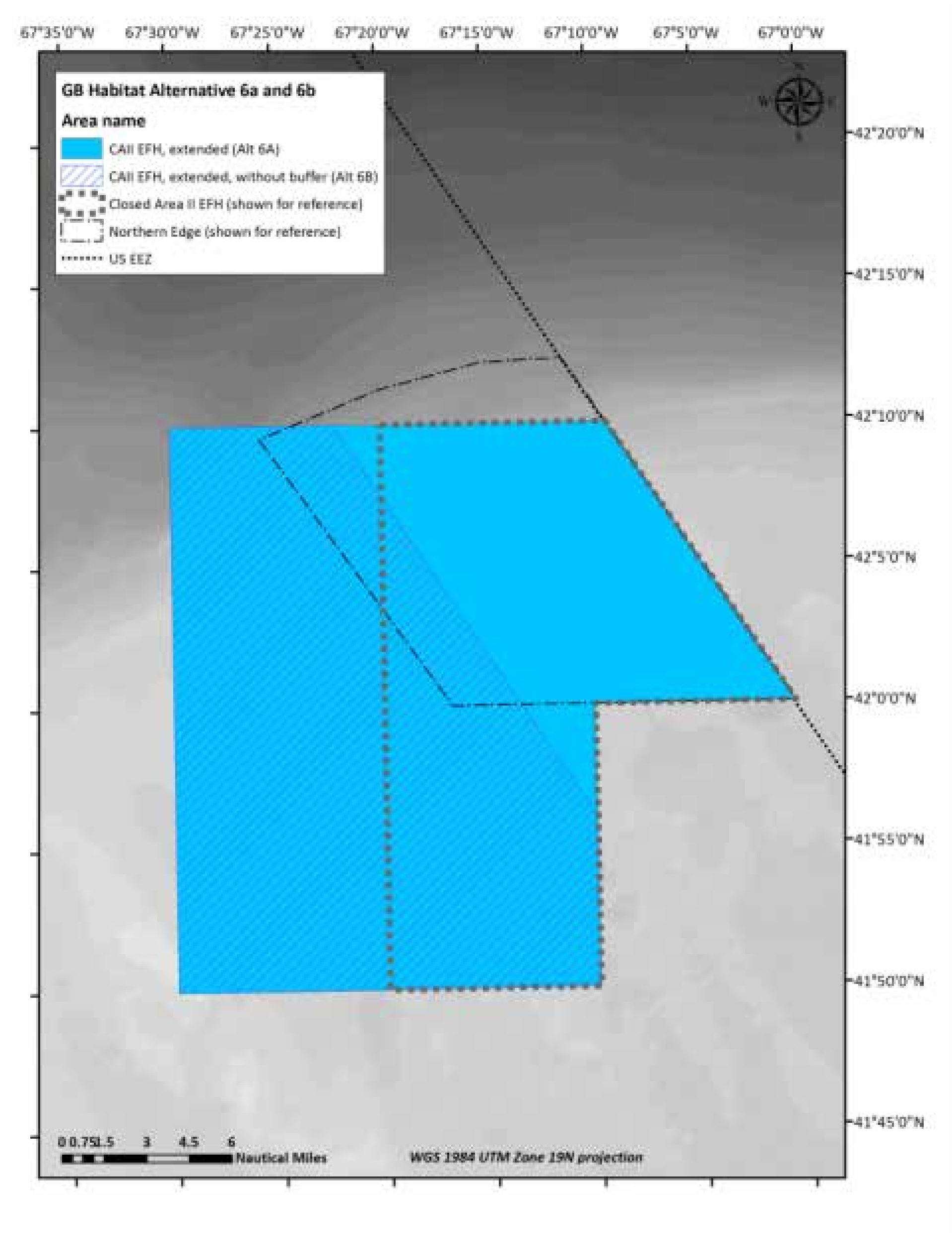
- Option 3, a requirement that bottom trawl vessels use ground cables modified with elevating disks with a length per side capped at 45 fathoms. Use of dredges would be permitted, <u>or</u>
- Option 4, a requirement that bottom trawl vessels eliminate ground cables entirely and cap bridle lengths at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

Option A would designate all of CAII extended west to 67° 30’ W longitude as a habitat management area.

Option B would designate all of CAII extended west to 67° 30’ W longitude as a habitat management area, except that there would be an 8 nm open area buffer along the EEZ.

Map 16 – Georges Bank Habitat Management Alternatives 6a and 6b.



2.1.5 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 11 – 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’

2.1.5.1 *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 (Map 17). 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. Current restrictions for both areas are summarized below.

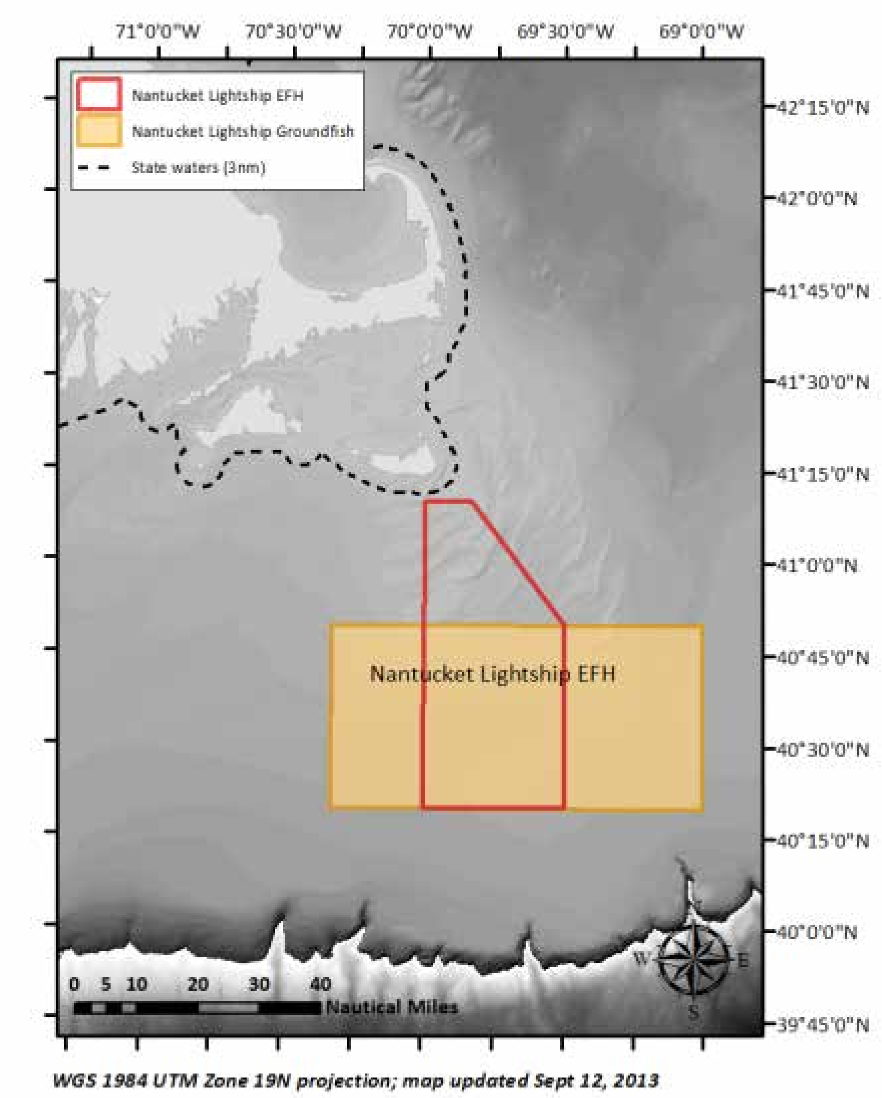
Table 12 – Fishing restrictions and exemptions associated with habitat and groundfish closures in the Great South Channel/Southern New England sub-region.

Area name	**Prohibitions**	**Exemptions**
Nantucket Lightship Habitat Closure Area	Closed year round to all vessels using mobile bottom-tending gears	None
Nantucket Lightship	No fishing vessel or person on a fishing	· Pot gear for lobsters or hagfish · Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear

Area name	**Prohibitions**	**Exemptions**
Closure Area	vessel may enter, fish, or be in the area	· 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

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



2.1.5.2 *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.

2.1.5.3 *Alternative 3*

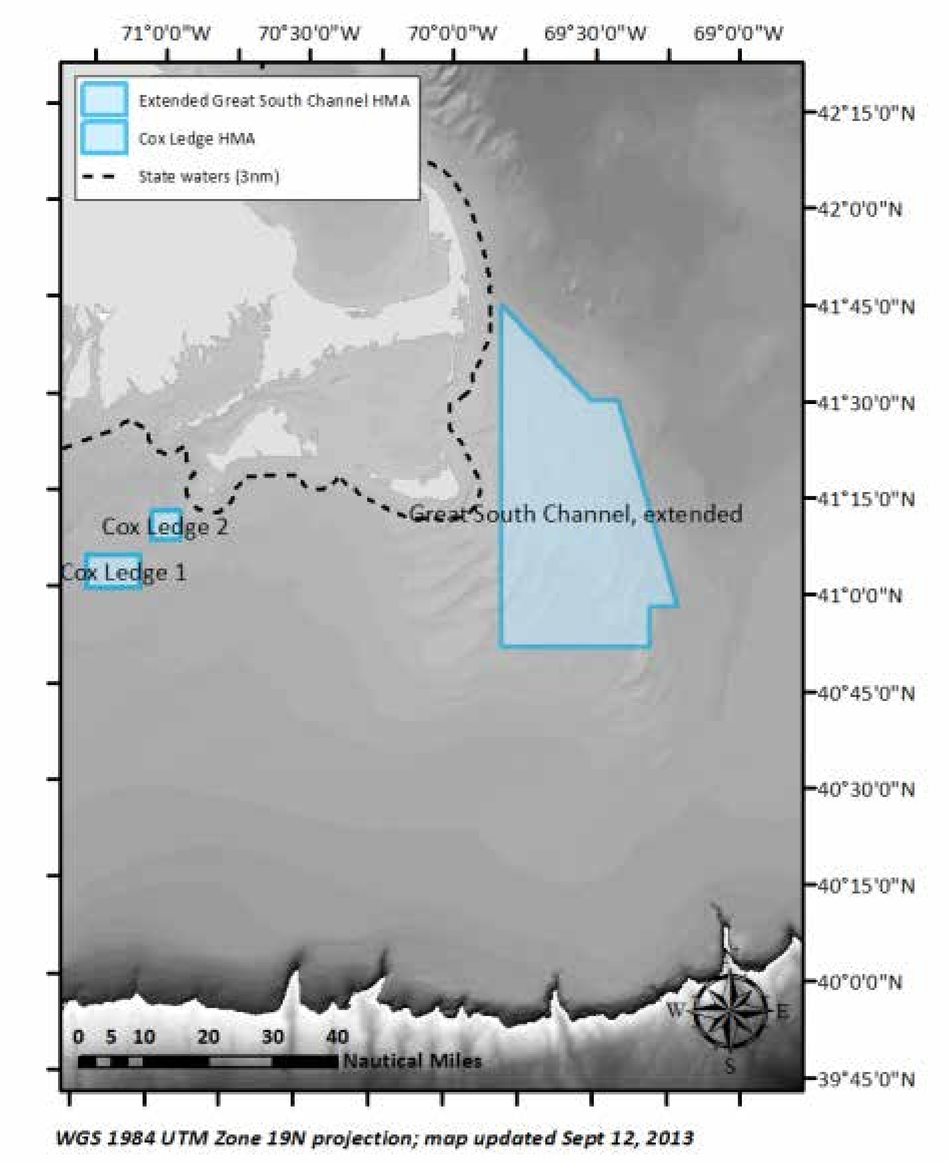
This alternative would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area, and would designate a new habitat management area further north and east in the Great South Channel as shown in (Map 18), i.e. the Extended Great South Channel HMA. An 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, 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 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 18 – Great South Channel/SNE Habitat Management Alternative 3.



2.1.5.4 *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 19), 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:

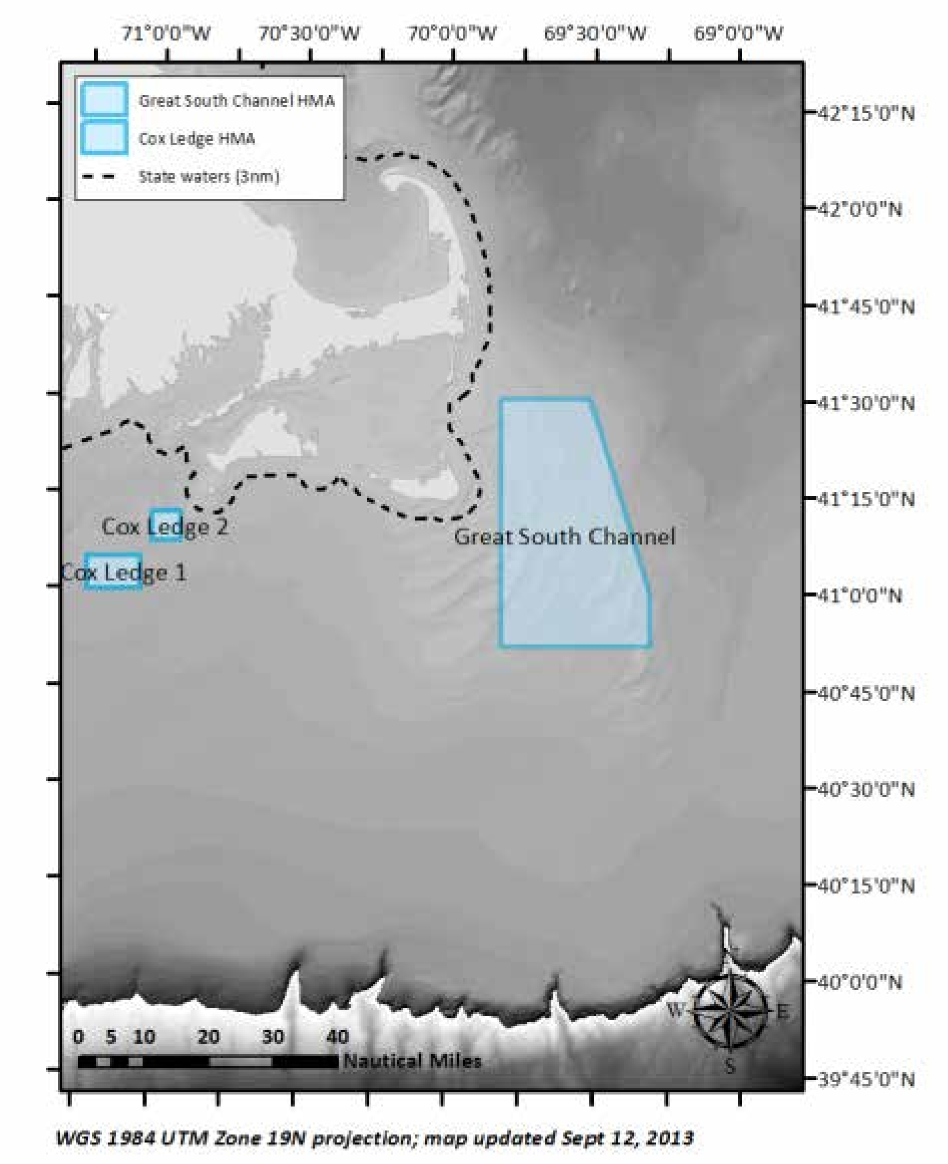
- Option 1, complete restrictions on use of mobile bottom-tending gears, <u>or</u>

- 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 19 – Great South Channel/SNE Habitat Management Alternative 4.



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

2.1.5.5 *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 20). 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:

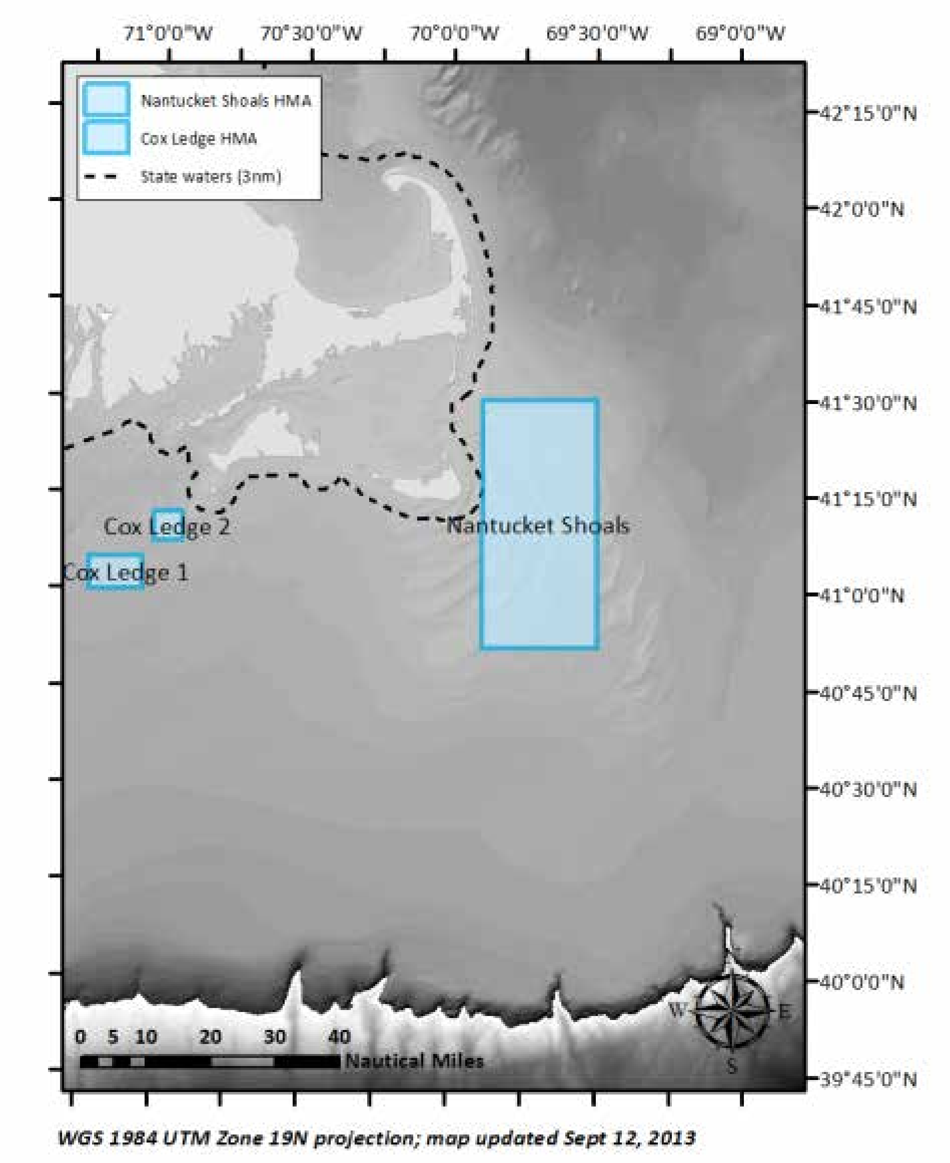
- Option 1, complete restrictions on use of mobile bottom-tending gears, or

- 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 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 20 – Great South Channel/SNE Habitat Management Alternative 5.



2.1.5.6 *Alternative 6*

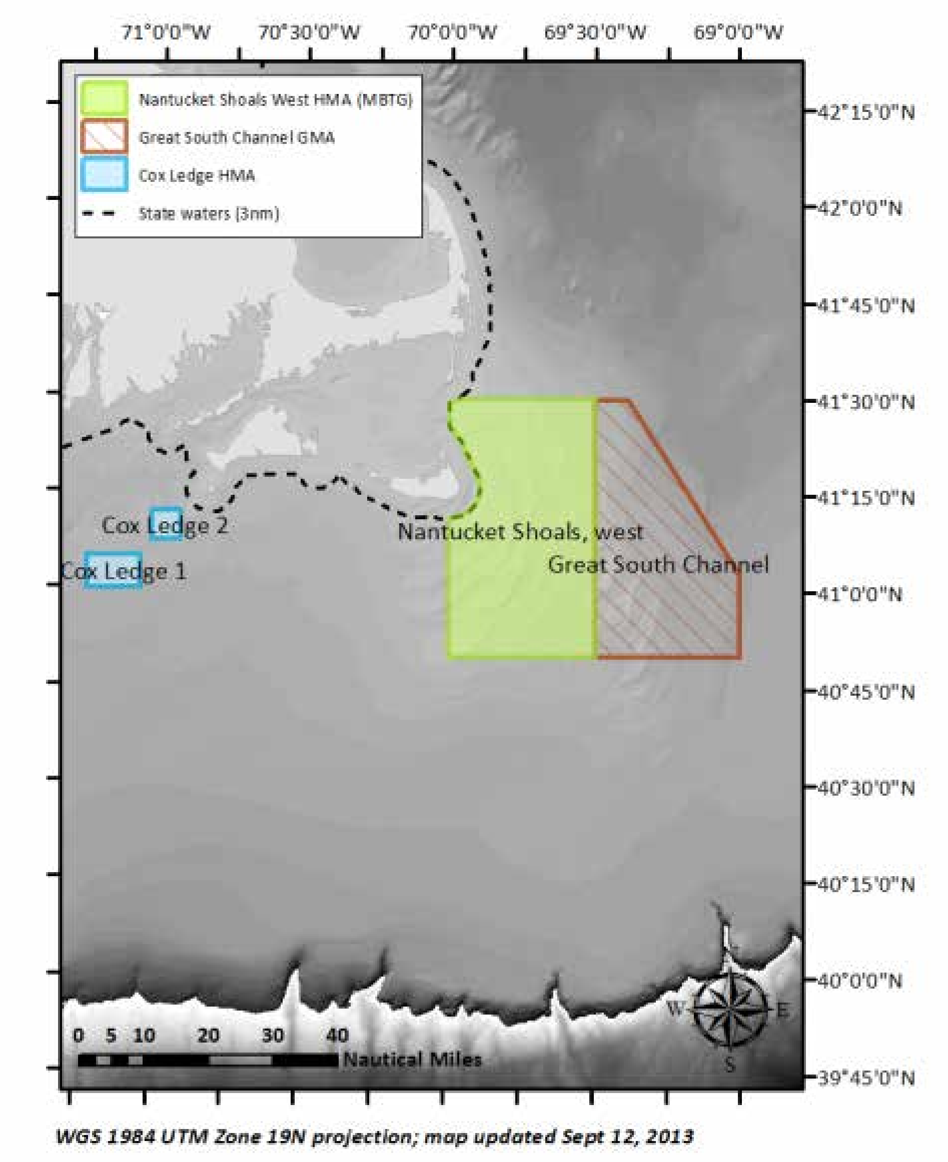
This alternative (Map 21) would remove the current Nantucket Lightship Habitat Closure Area and the Nantucket Lightship Groundfish Closed Area and would designate a new habitat management area further north on Nantucket Shoals, which is similar to the area proposed via Alternative 5. This area would 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, 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 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 21 – 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 22). Measures for the areas are listed in Table 13, and the coordinates for these areas are listed in Table 14.

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 13 – 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[3] · 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 closed to sector 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 · Vessels participating in the mid-water trawl exempted fishery · Vessels fishing under a scallop DAS or in a scallop dredge exemption area

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[3] 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**
		· 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

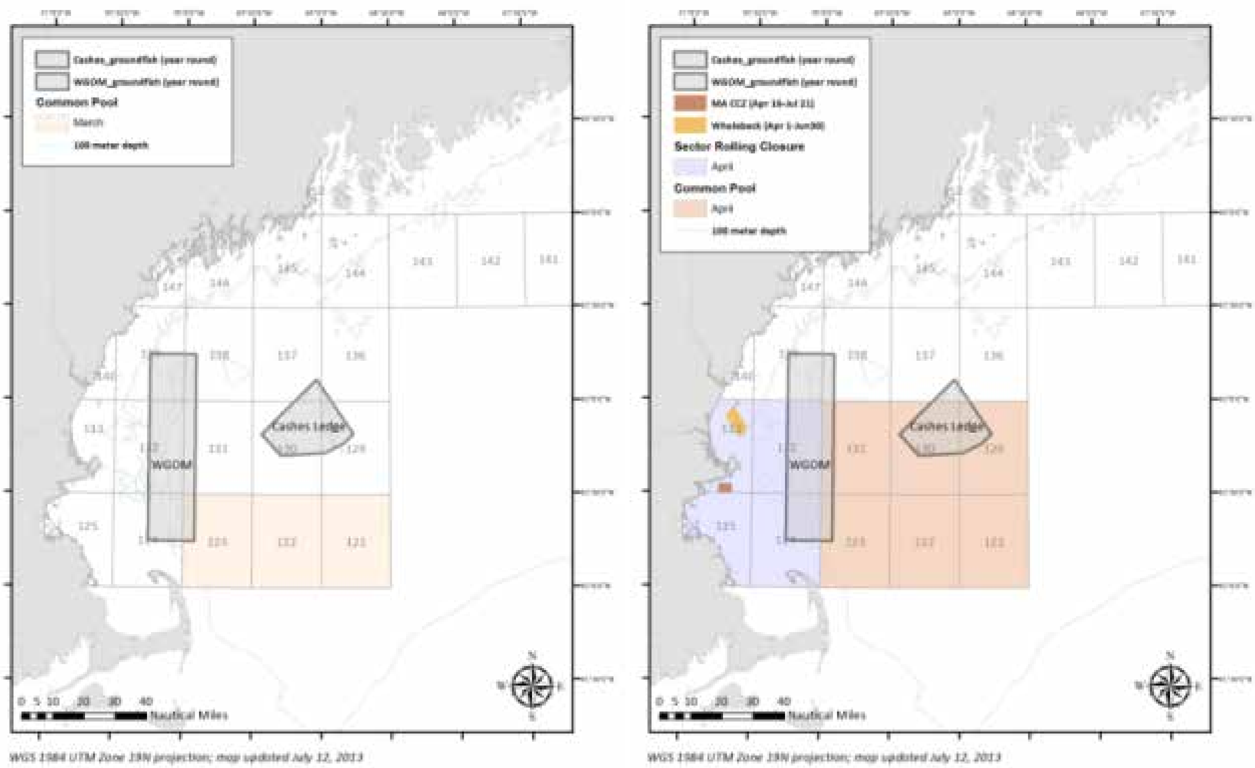
Table 14 – Coordinates for Gulf of Maine year round and seasonal closed areas

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′

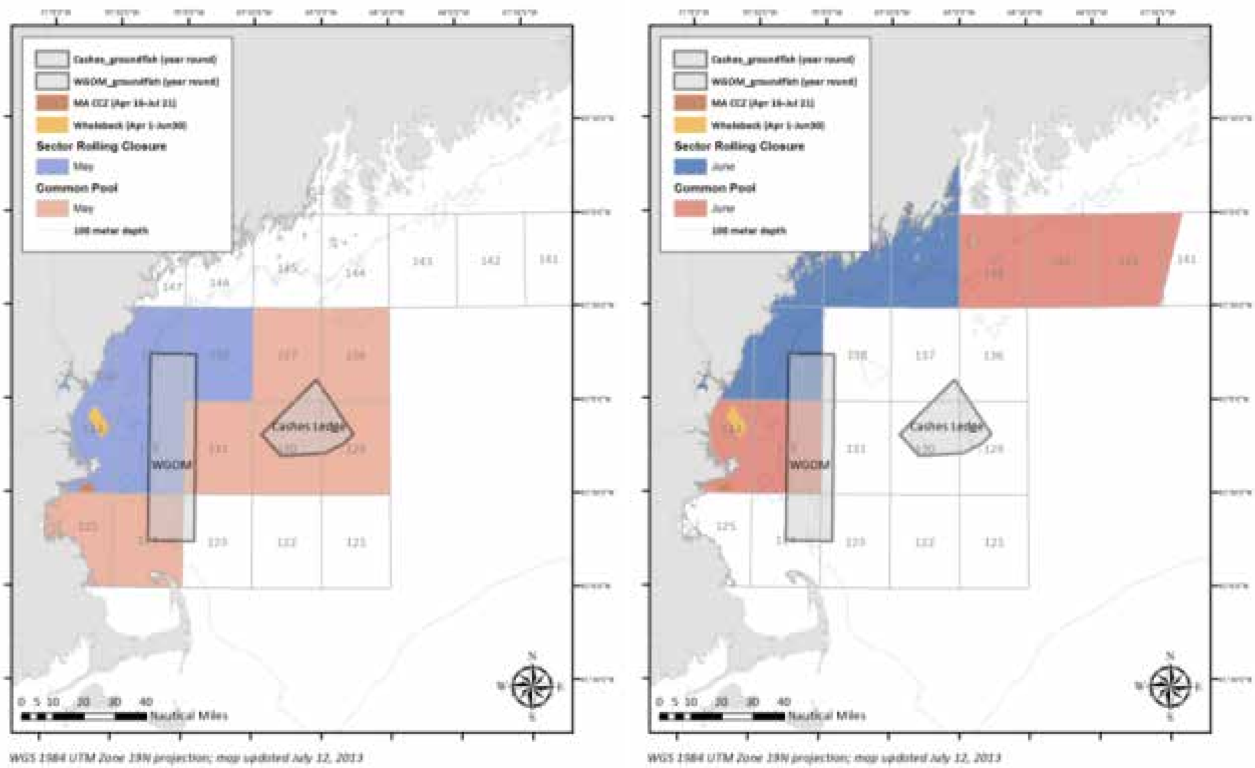
	GM14	43°30′	68°30′
	GM18	43°30′	Maine shoreline
Sector Rolling Closure Area III - May	SGM4	42°30′	Massachusetts shoreline
	SGM5	42°30′	70°00′
	SGM6	43°00′	70°00′
	SGM7	43°00′	69°30′
	SGM8	43°30′	69°30′
	GM18	43°30′	Maine shoreline
[Common Pool] Rolling closure Area IV – June	GM9	42°30′	Massachusetts 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′

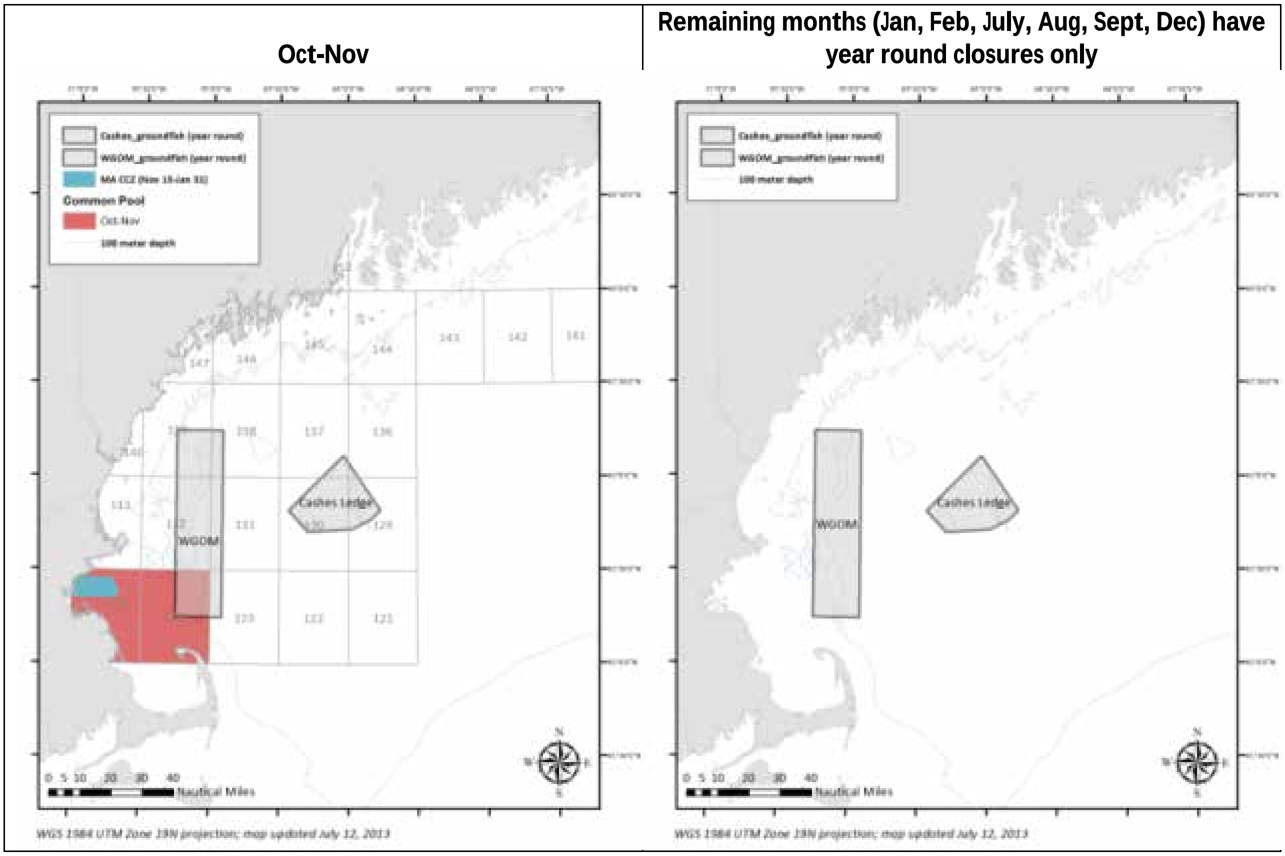
Map 22 – Gulf of Maine Spawning Alternative 1 (No Action)

March **April**



May **June**





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

This alternative (Map 23) 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 2.1.2 and 2.1.3. 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.

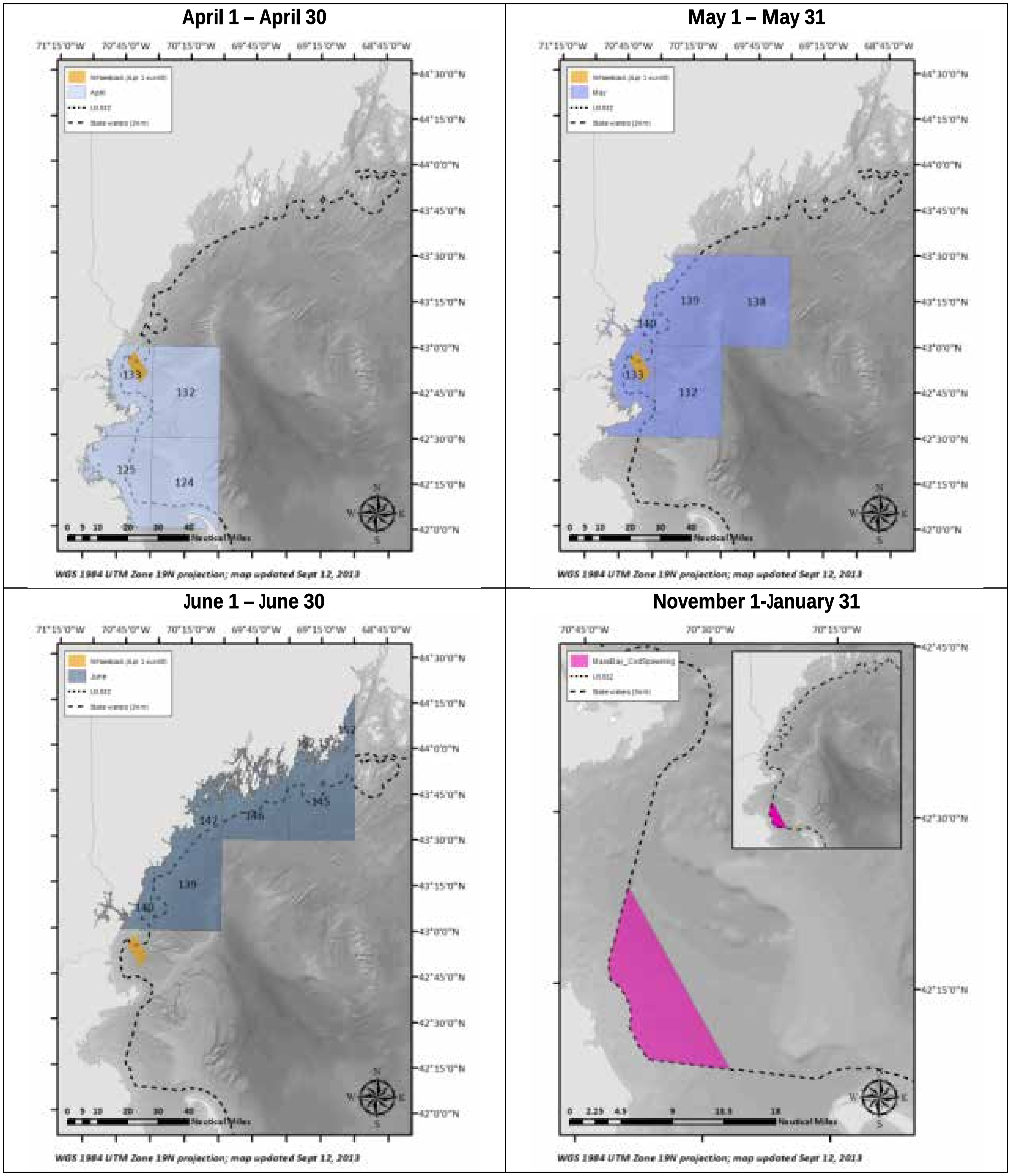
Rationale: New science and published research show a large degree of overlap between the sector rolling closures and groundfish spawning, particularly for cod and haddock. The Council had anticipated developing more precise spawning closure areas based on these data and analyses, but rejected novel area 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 15 – 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 23 – 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.



April 1 – April 30

May 1 – May 31

June 1 – June 30

November 1-January 31

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 23) 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[4]
- 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

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[4] 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 23) 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 24). Measures for these areas are summarized in Table 16 and coordinates for these areas are shown in Table 17.

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 16 – 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

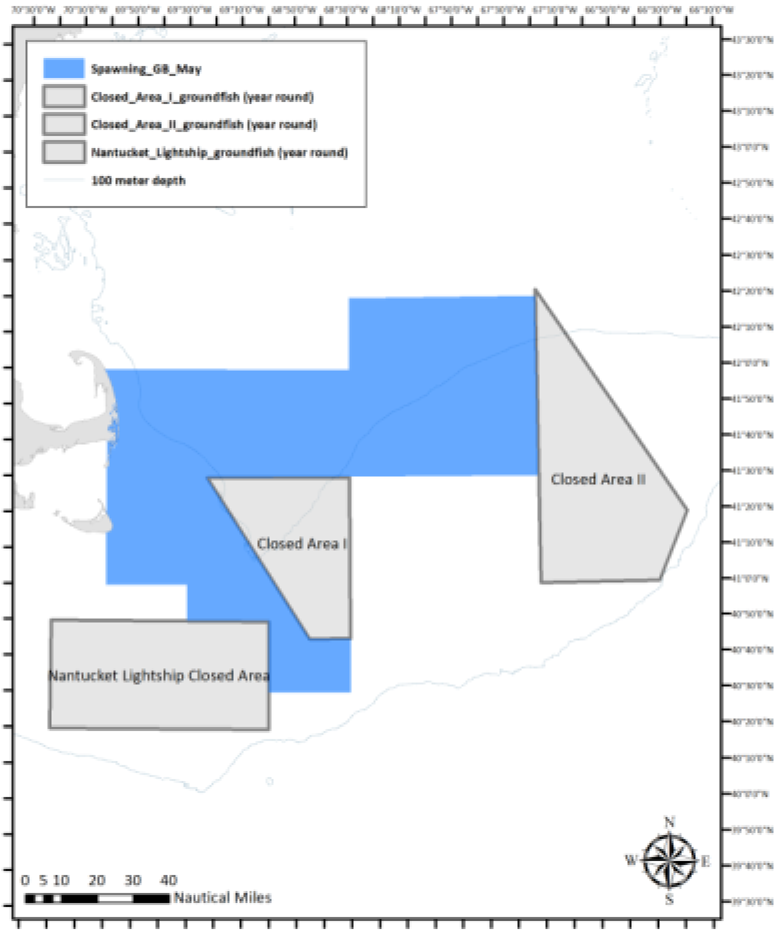
Area name	**Prohibitions**	**Exemptions**
Closed Area II	No fishing vessel or person on a fishing vessel may enter, fish, or be in the area	· Pot gear for lobsters or hagfish · Pelagic longline gear or pelagic hook-and-line gear, or harpoon gear · Pelagic midwater trawl gear, with bycatch limits · Fishing 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 17 - 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 24 – 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*

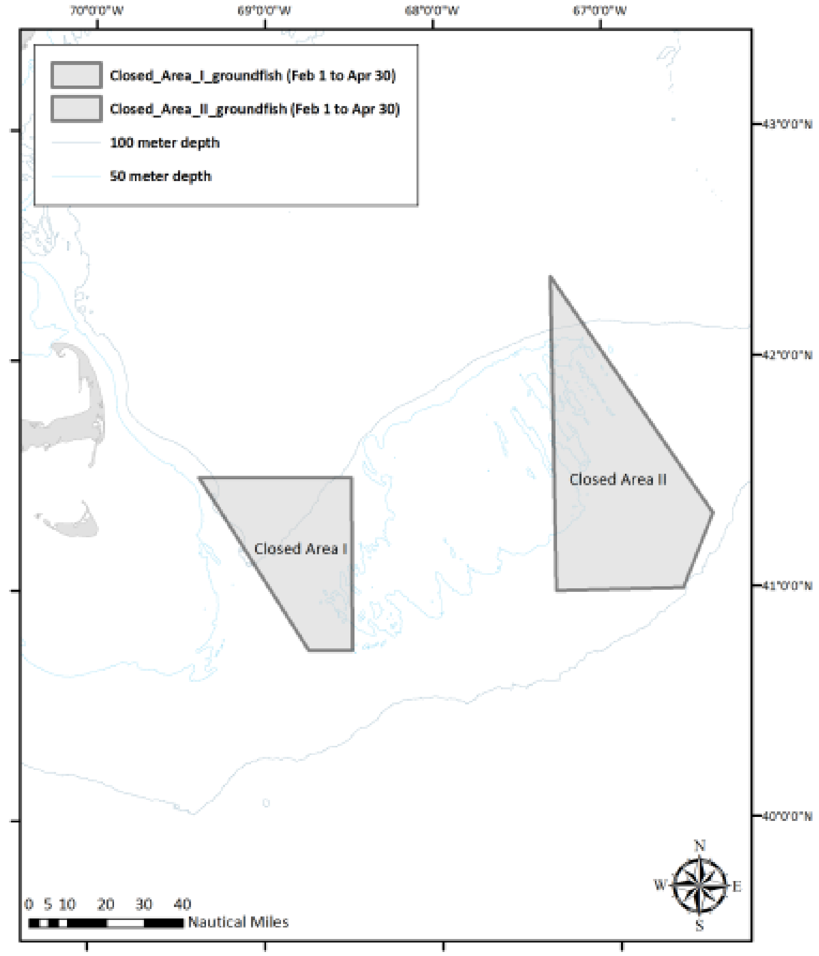
This alternative would retain as spawning closures Closed Area I and Closed Area II (Table 18) during the months of February, March, and April (Map 25). Under this alternative, the Nantucket Lightship groundfish closed area would be eliminated and the Georges Bank Seasonal Closure Area would be eliminated. The options consider closures to just commercial gears (Option A) or commercial and recreational gears (Option B).

Table 18 – 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 25 – 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
- 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 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.

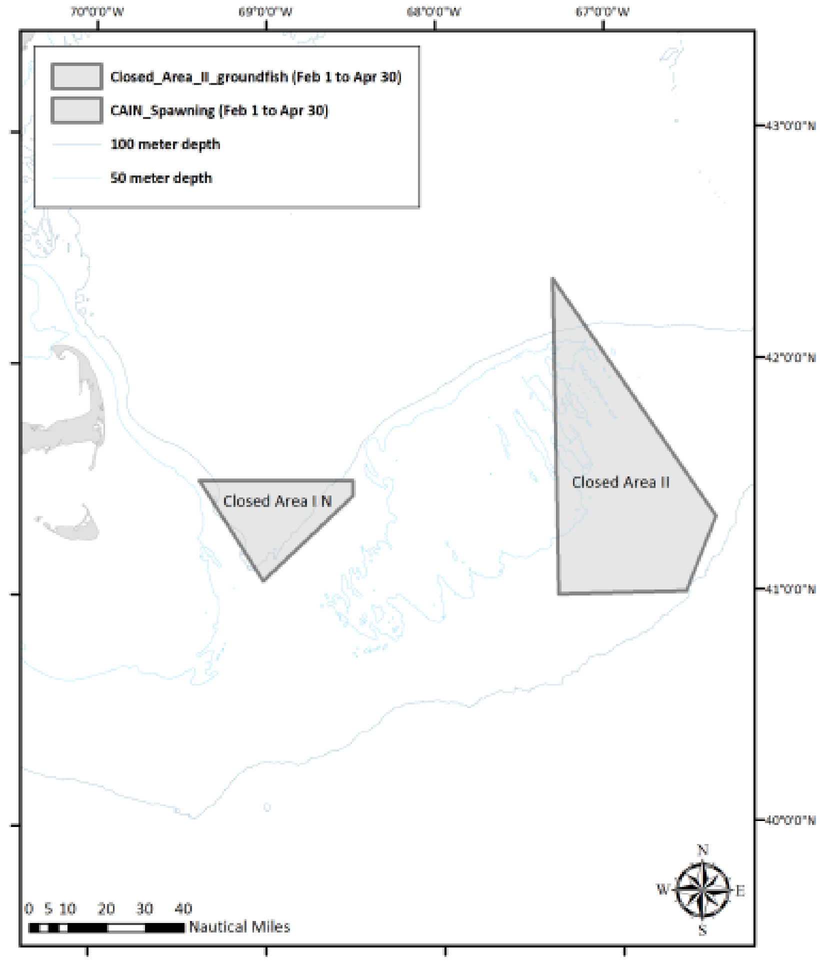
2.2.2.3 *Alternative 3 Spawning Protection Areas using Closed Area I and Closed Area II*

This alternative would retain as spawning closures the northern part of Closed Area I and Closed Area II (Table 15) during the months of February, March, and April (Map 25Map 25). 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 19 – 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 26 – Georges Bank Spawning Alternative 3. 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

2.2.2.3.1 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
- 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 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 of fishing on essential fish habitat to the extent practicable. In order to better inform managers about trade-offs associated with minimization of adverse effects, the Habitat 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 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.

There are five management alternatives in this section. 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. All of the dedicated habitat research areas described in this section would be defined on a year-round basis. Alternative 5, if selected, would implement a sunset provision for all of the designated DHRAs. The measures for each DHRA restrict certain types of fishing to create appropriate reference conditions in the research area, in order to facilitate scientific study.

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 and/or spawning areas that they overlap with.

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.

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?[5] 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?

We need to know what seafloor habitat and communities look like in the absence of 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 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 addresses impacts to habitat in a generic way without and assuming that one area is more important than another from a productivity standpoint. Integrating SASI-derived habitat vulnerability with a better understanding of which habitats influence the productivity of managed species will greatly enhance management efforts. Without

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[5] See Auster and Langton 1999 for a discussion of this issue.

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.

Design and implementation elements common to all DHRAs

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 20.

Table 20 – 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 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.	· Limit all comparisons of recovery to the 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 27. 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:

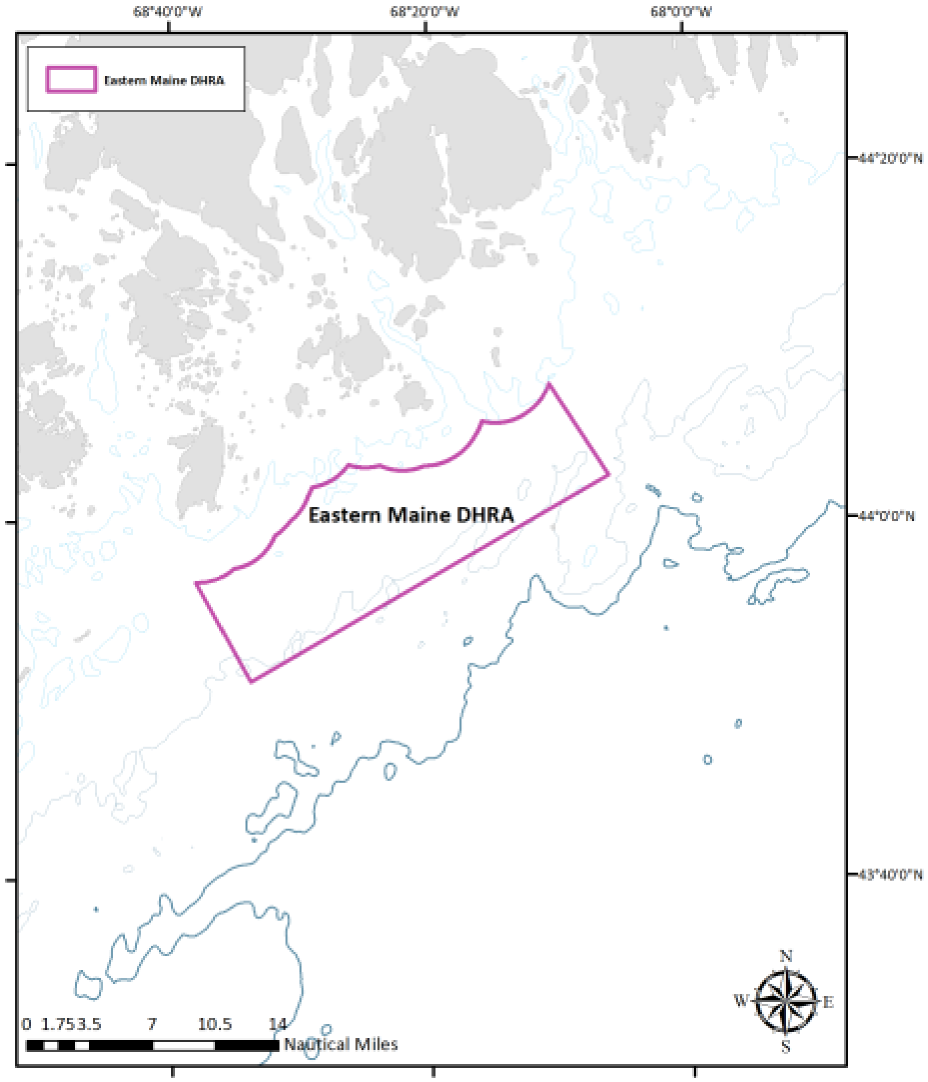
- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources.

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.

Table 21 – Coordinates for Eastern Maine DHRA

E. Maine DHRA (Same as Small E. Maine HMA)		
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’
A. Western boundary state waters; eastern boundary state waters/EEZ *B. Landward boundary at state waters. Only endpoints provided.*		

Map 27 – 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 28. 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. Mid-water and pelagic gears would be permitted throughout. This alternative includes an optional reference area that would additionally be closed to recreational and party/charter groundfish fishing. 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.

The purpose of the reference area is to create a site where removals of groundfish are limited, in order to be able to study how the ecology of the reference area may change under such conditions. The two reference area options sub-divide an area of relatively high recreational fishing effort. Siting the reference area in a location with relatively large amounts of recreational fishing will best ensure a contrast in before vs. after conditions. If there are significant ecosystem effects of limiting groundfish removals from the major sources, they will be more likely to be detected with a substantial before/after contrast.

2.3.3.1 *Option A – Southern reference area*

Option A includes the southern reference area.

2.3.3.2 *Option B – Northern reference area*

Option B includes the northern reference area.

2.3.3.3 *Option C – No reference area*

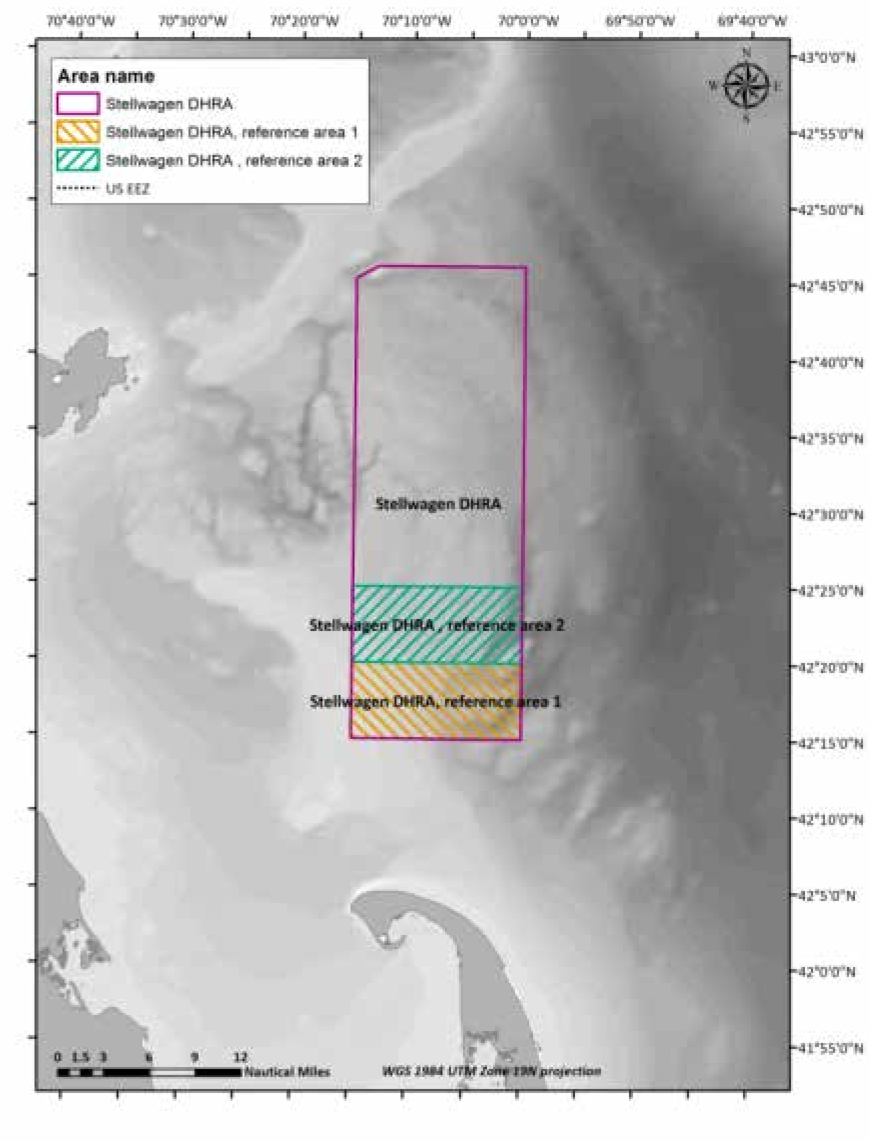
Option C would designate the DHRA without the reference area.

Table 22 – Coordinates for Stellwagen DHRA and reference areas

Stellwagen DHRA (Same as 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’
Southern reference area		
1	42° 20’	70° 00’
2	42° 15’	70° 00’
3	42° 15’	70° 15’
4	42° 20’	70° 15’
Northern reference area		
1	42° 25’	70° 00’
2	42° 20’	70° 00’
3	42° 20’	70° 15’
4	42° 25’	70° 15’

Map 28 – Stellwagen Dedicated Habitat Research Area with two possible reference area options.



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 29. 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:

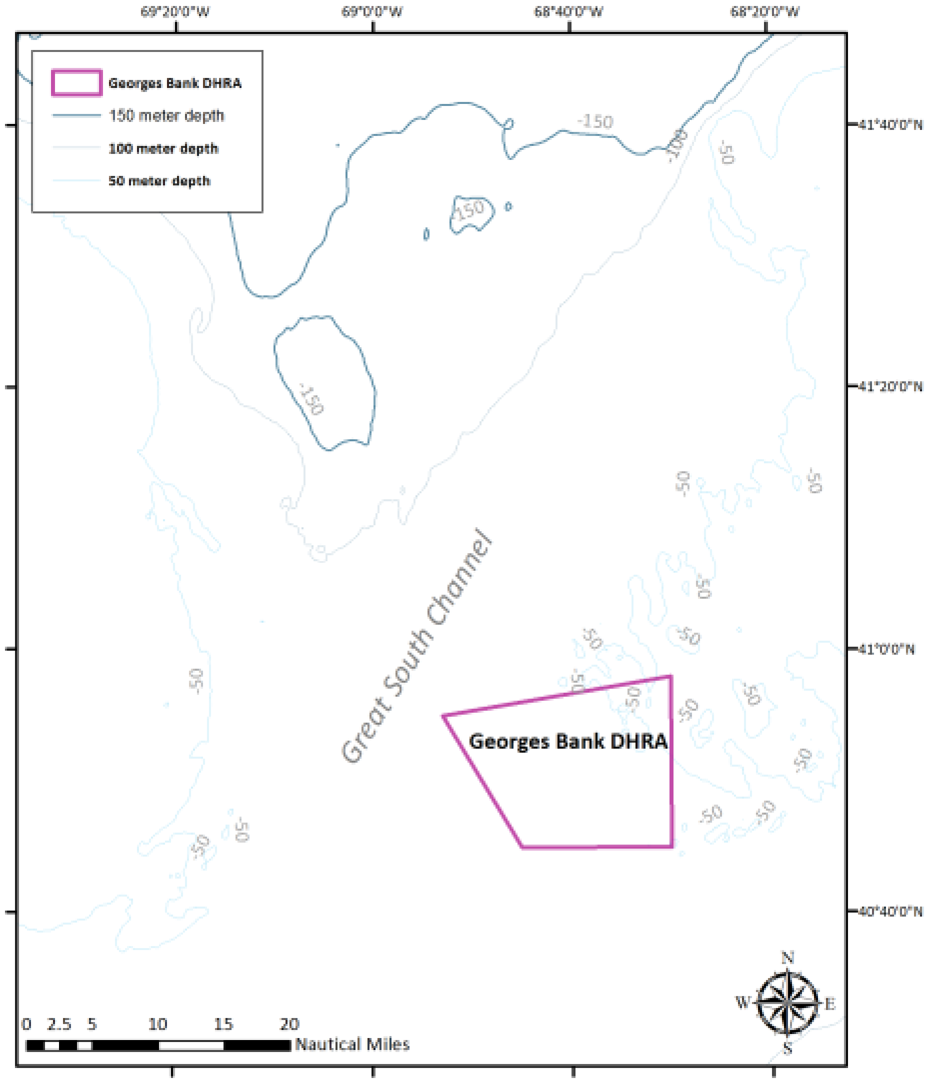
- fishing gear impacts on benthic habitats,
- habitat recovery,
- the effects of natural vs. anthropogenic disturbance on fish habitats, and
- the effects of fishing and habitat type on the productivity of managed resources, especially the relationships between scallop distribution, abundance, growth,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

Table 23 – Coordinates for Georges Bank DHRA

Georges Bank DHRA (Same as CAI S EFH Closure Area)		
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’

Map 29 – 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 that is designed to evaluate habitat effects of fishing had been initiated (see introduction to section 2.3 for a list of possible research topics). 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 24). 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 24 – 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

This section discusses alternatives developed by the technical teams and Committees that were not formally included by the Council for analysis in the amendment.

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 30 depicts the areas developed mainly within the Habitat PDT and Committee process as adverse effects minimization areas. Map 31 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.

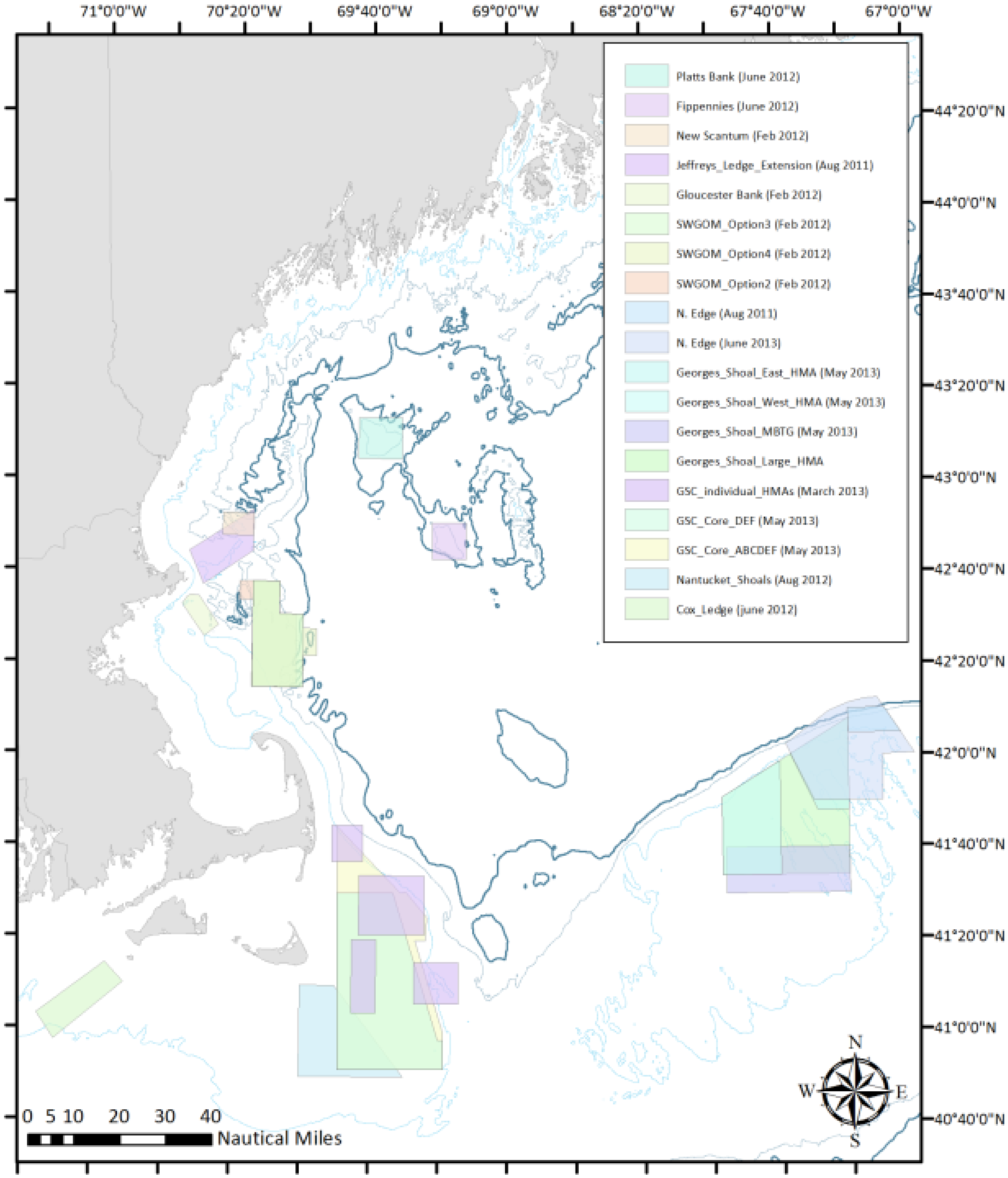
Concerned about the practicability of Georges Bank Habitat Management Alternatives 3 and 4, both NMFS NERO and Council staff (at the Committee's request) developed additional alternatives for the northern edge region that were provided to the joint Habitat/Groundfish Committee (NERO area) and the Council (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).

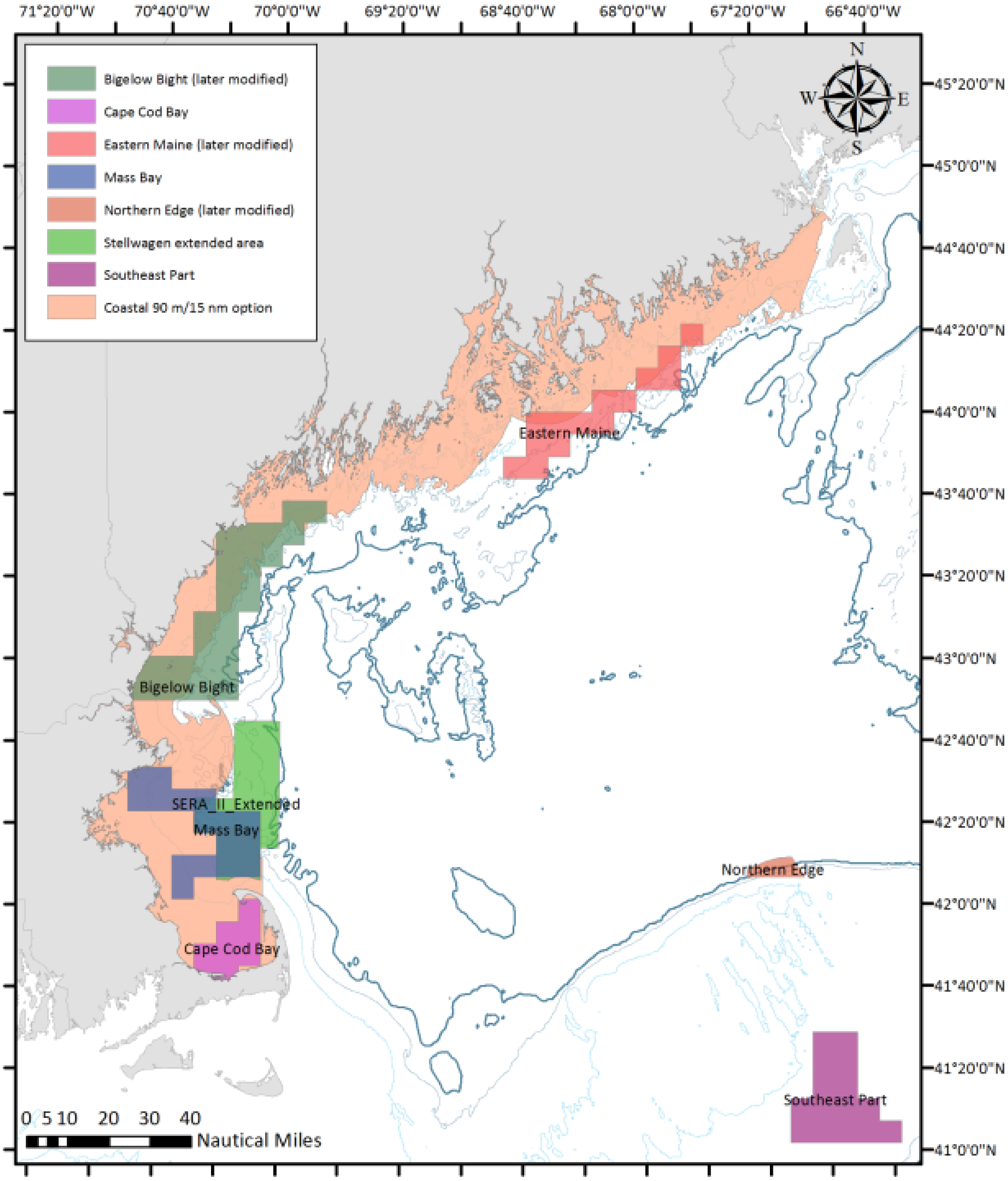
In a similar fashion to the revisions of the original Fippennies and Platts areas, the original Cox Ledge area was reduced in size to focus on areas with documented cobble habitat.

Map 30 – Considered and rejected adverse effects minimization habitat management areas



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

Map 31 - Considered and rejected juvenile groundfish habitat management areas



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

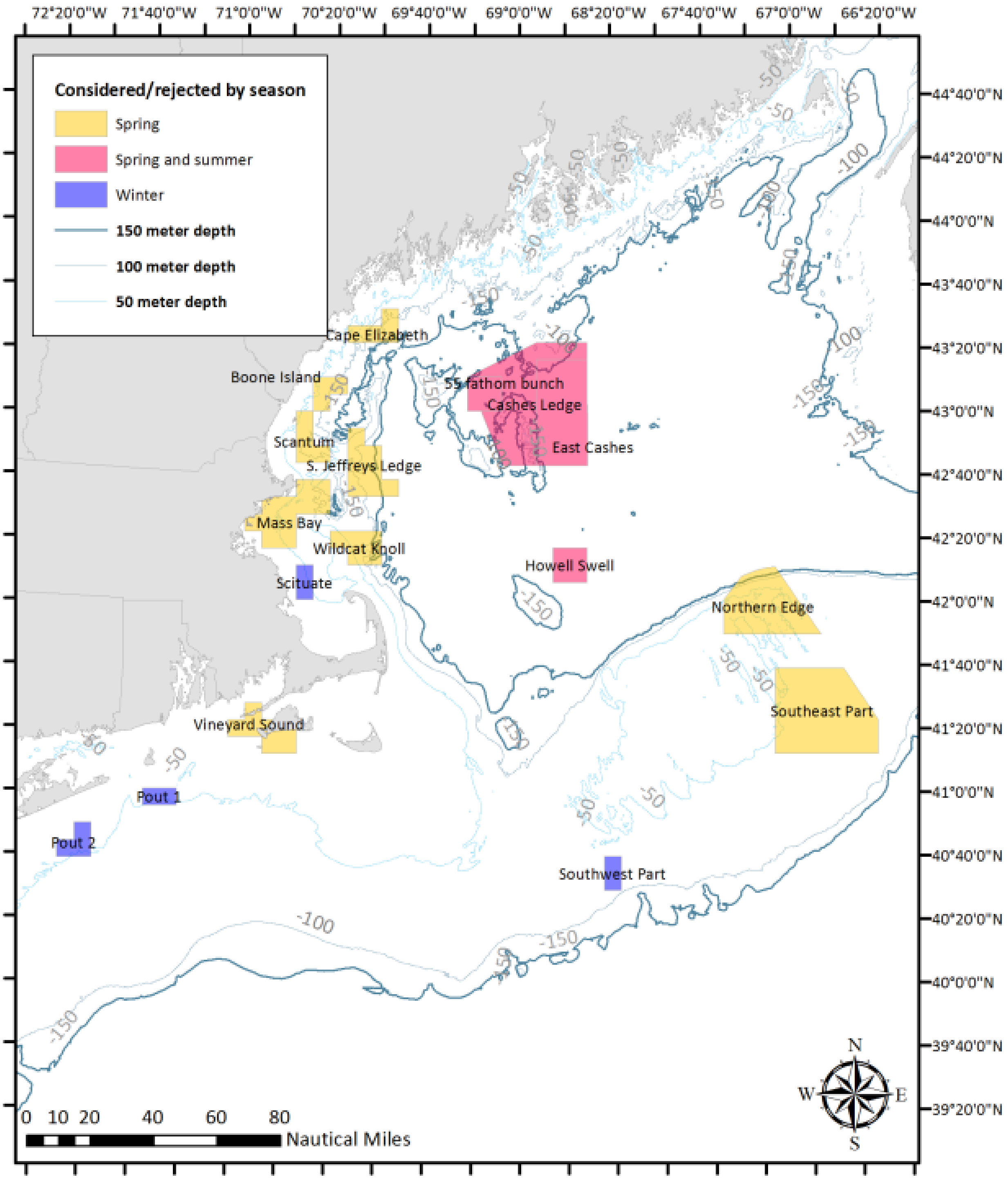
3.2 Spawning

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 32). 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 32 – 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. The section also includes impacts of alternatives related to framework adjustment procedures and monitoring (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. Large-mesh groundfish are the focus of the managed species analysis in sections 4.1, 4.2, 4.3, and 4.4. Section 4.5 analyzed impacts specific to other managed resources and their fisheries.

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 <u>alternatives</u> consist of combinations of <u>individual management areas</u>.

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 evaluate how fishing effort may shift under the various alternatives, and assess the costs and benefits of such shifts. These potential changes in fishing effort are challenging to evaluate for several 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. Since fisheries characteristics and stock biomass 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 are often lacking and may not be representative of the fishery under current circumstances. Nonetheless, these older data provide some insight into how fishing effort may change as existing closed areas become available to fishing and new areas close to fishing using mobile bottom-tending gear. 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 other cases, the current distributions of a stock may provide better insight to potential shifts in fishing effort, which is the approach taken with the sea scallop-related analyses.

General approach to analysis of vulnerable habitat

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

The vulnerability assessment and literature review concluded that cobble-boulder dominated seafloors are most vulnerable to the adverse effects associated with fishing due to the occurrence of biota that is susceptible to injury and has long recovery times.

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, since individual mobile gear fishing events contact more of the seabed than individual fixed gear fishing events and there is more overall fishing effort by mobile gears than 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 within that area.** Thus, the habitat management options focus on mobile bottom-tending gears.

Options 1 and 2 – restrictions 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. **In terms of protecting vulnerable seabed habitats from the adverse effects of fishing, the greatest local reduction in adverse effects to the seabed will be achieved if all mobile 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 (according to the SASI habitat map and other substrate maps), 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 can 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. The difference in impacts between options 1 and 2 is noted for each alternative.

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. Figures in the affected environment section provide a comparison across all ten gears evaluated in SASI. Hydraulic clam dredge area swept per trip values range from 0.07 km^2 to 0.20 km^2 from 2000-2010. Over that same time period, generic otter trawl values range between 5.64 km2 and 8.98 km^2 per trip, while limited access scallop dredge values range from 2.01 km^2 to 5.85 km^2 per trip. These lower per trip values contribute to lower overall area swept by hydraulic dredges relative to other mobile bottom-tending gears. Annual totals for hydraulic dredges between 2000-2010 ranged from 371 km^2 to 860 km^2, while totals for generic otter trawls and limited access scallop dredges ranged from 125,694-297,954 km^2 and 19,523-

26,525 km^2, respectively, over that same period. Annual values are provided in the affected environment section for all gears.

Despite lower aggregate impacts from hydraulic dredges, 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 – ground cable modifications

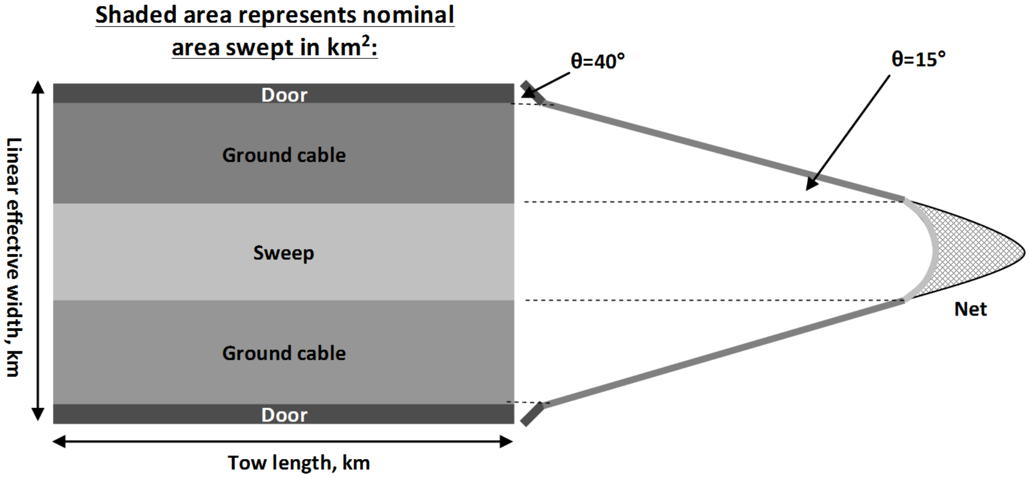
Options 3 and 4 would allow mobile bottom-tending gear use, but restrict ground cable configuration and length (Option 3) or prohibit ground cable use (Option 4). Ground cables are defined as wire ropes extending along the seabed between the trawl doors and the bridles or net; they serve to herd fish 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 shown below; 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 2 – 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 (The figure below 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 3 – 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 **<u>net benefit</u>** 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 literature) 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 as a result of ground cable adjustments 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 net 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 will have negative impacts on seabed habitats as compared to Options 1 and 2. However, the magnitude of the difference in impacts 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. Option 4 will have negative impacts on seabed habitats as compared to Options 1 and 2, but it is not possible to quantify the magnitude of the difference between the options.

General approach to analysis of juvenile groundfish habitat

Following standard practices for conducting a GIS hotspot analysis, trawl and dredge survey data from 2002-2012 were used to identify concentrations juvenile groundfish. Annual survey data included the NMFS spring, fall, and winter trawl surveys, the MA Division of Marine Fisheries spring and fall trawl surveys, the ME/NH spring and fall surveys, and the NMFS scallop dredge survey. Several periodic Industry Based Surveys for cod, yellowtail flounder, and monkfish were also included. Canadian spring and fall trawl survey data were not used due to difficulties getting the data in a compatible format for the analysis. Methods, assumptions, and parameter choices are given in Volume 1 and Appendix E of this document.

Survey data from 2002-2012 was chosen for the analysis because on one hand it provided a sufficient number of observations for the data intensive hotspot analyses. On the other hand, observations during the most recent decade are more likely to represent current and near term future conditions that may influence fish distribution and habitat utilization. These conditions include warming oceanic temperatures and differences in stock size of various groundfish species, their prey, and their predators.

Several choices were intentionally made that weighed the results in favor of critical life stages of groundfish species most associated with bottom habitat. Overall, the analysis was restricted to fish estimated to be age 0 (i.e. spawned in the year observed by the survey) or age 1. The Council's Closed Area Technical Team recognized that the smaller fish were more likely to be associated with and dependent on habitat structure for survival and growth. While many species do not mature until a larger size, the older juvenile groundfish, in many cases, are thought to assume different diets and survival strategies that are often less associated with structured bottom habitat.

After the analysis identified hotspots for age 0/1 groundfish, the number of hotspots were weighted by a variety of factors and binned into 10 km^2 grids, compatible with other information including estimates of vulnerability of bottom substrates to fishing. These factors included affinity for hard substrates, degree of residency, evidence of formation of sub-populations, and stock status (ratio of B_{msy} to current biomass). Groundfish stocks that were associated with mud or sand substrates, stocks that were migratory, stocks that were not known to form distinct sub-populations, and stocks that were near or above B_{msy} were downweighted relative to other stocks. Weights that were applied to each stock based on the above factors are given in the juvenile hotspot analysis section in Volume 1.

Contiguous areas of grids that had high weighted hotspot scores were further evaluated as potential candidates for groundfish habitat management areas. In the following sections, the number of weighted hotspots and the species composition of the total number of hotspots in various Habitat Management Areas were used to evaluate the relative positive or negative impacts that the proposed alternatives would have on the groundfish resources. Proposed habitat management alternatives with a greater amount of weighted hotspots of age 0/1 groundfish were considered to have more favorable characteristics and have a more positive impact on groundfish habitat and groundfish stocks.

General approach to analysis of groundfish spawning

A similar approach to identifying hotspots of large spawner groundfish was taken to evaluate impacts on groundfish spawning using the same survey data as used in the groundfish habitat analysis above. Instead of using the number of age 0/1 groundfish, the analysis used the survey weight per tow of the largest fish contributing to 20% of total biomass for each species during 2002-2012[6]. The hotspots totals were also summed into grids and weighted in favor of more critical stocks. Stocks that were at low biomass relative to B_{msy}, stocks that exhibit a higher degree of residency, and stocks that form sub-populations were given more weight. Weights that were applied to each stock based on the above factors are given in the spawner hotspot analysis section in Volume 1.

Contiguous areas of grids that had high weighted hotspot scores were further evaluated as potential candidates for groundfish spawning management areas. In the following sections, the number of weighted hotspots and the species composition of the total number of hotspots in various Spawning Management Areas were used to evaluate the relative positive or negative impacts that the proposed alternatives would have on the groundfish resources. Proposed spawning management alternatives with a greater amount of weighted hotspots of large spawner groundfish were considered to have more favorable characteristics and have a more positive impact on spawning and groundfish stocks.

Where relevant, additional information about observed spawning was also considered, particularly for spawning condition of cod and haddock, i.e. the distribution of developing and ripe groundfish. While these data are sometimes informative, the results are influenced by the match (or mismatch) of spawning activity and the timing of the seasonal surveys. Many times, the surveys will catch high amounts of large mature groundfish, but they are not yet in a ripe condition or have already been spent (i.e. post-spawning). Thus analysis of spawning activity distributions via a data intensive hotspot analysis was impossible. Sea sampling data from commercial trips also could not be used because 1) biological data other than lengths are not collected and 2) observations of commercial catches in closed areas are rare and these areas may also correspond to where groundfish spawning occurs.

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 this amendment. 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

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[6] The size at which larger fish contributes to 20% of total biomass changes over time due to variations in recruitment and trends in fishing mortality.

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, a statistical approach was developed for this amendment 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 25th, 50th, 75th, and 90th 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 25th, 50th, 75th, and 90th 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 (NS 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 this amendment.

It is important to note that the current interpretation of NS 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 NS 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).

The analyses in this amendment consider and evaluate 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, it is more 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).

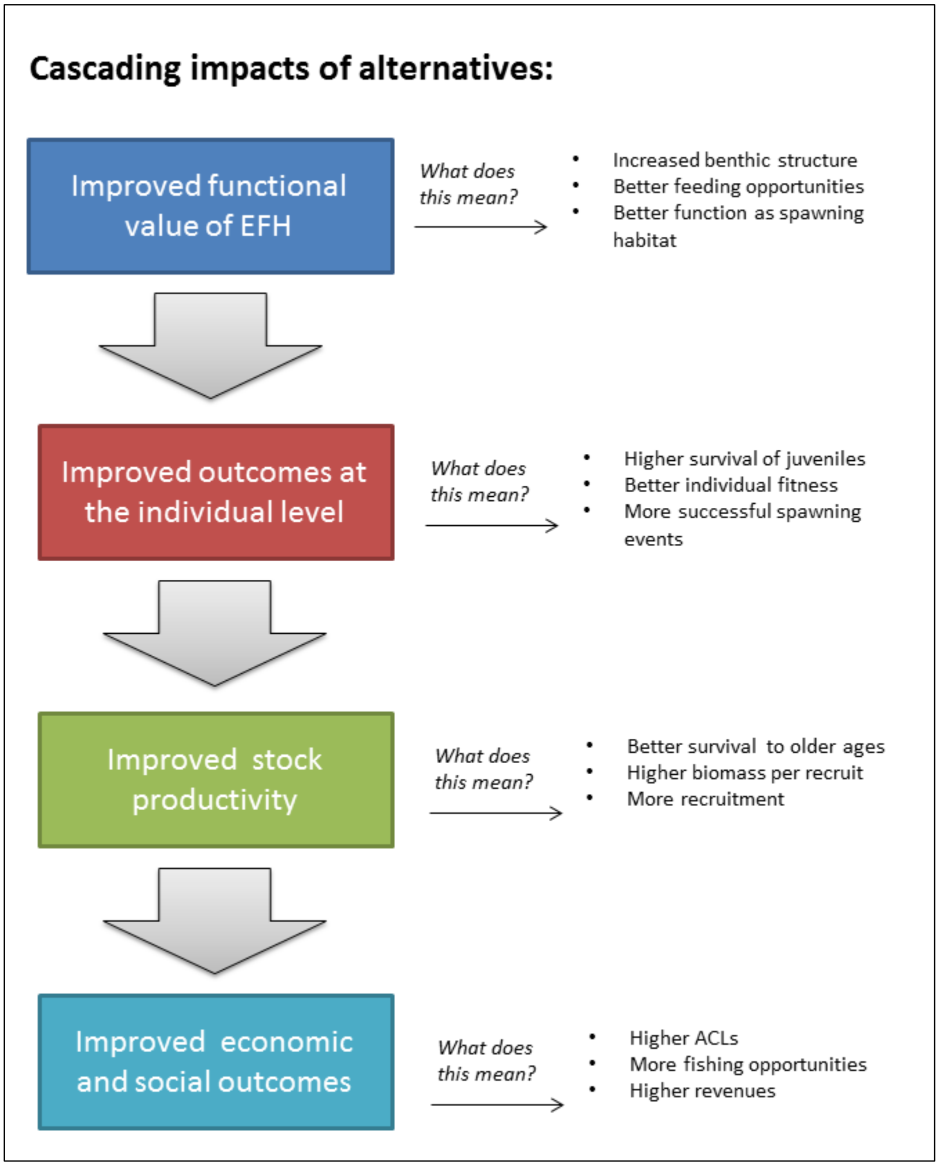
Also changes to the human environment often occur in small, incremental amounts and the character of a particular impact can be hidden by the gradual nature with which it occurs. As such there is high uncertainty in the relative strengths of the impacts. Therefore the discussion of social impacts for 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

This section evaluates the impacts of the habitat management alternatives on the physical and biological environment, large mesh groundfish stocks and their habitats, human communities and the fishery, and protected resources. Additional discussion of the impacts of these alternatives on non-large mesh groundfish resources, and fishery-specific human impacts, are discussed in section 4.5.

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 4).

Figure 4 - Linkages between VECs and impacts



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 generally 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, 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 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 (mobile bottom-tending gear closures) or just Option 3 and 4 (gear modifications).

A few general assumptions are made in the analyses relative to how fishing effort will be redistributed, 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. Further, it is not really possible to harvest some species (e.g. scallops, clams) with fixed gears.

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 restrictions. 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. Also, note that 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 (generally Alternative 2, except in the Eastern GOM). 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 locations may be only 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. Specifically, fixed commercial and recreational gear use could increase in areas where mobile bottom-tending gear use is prohibited (option 1), or limited to hydraulic dredges only (option 2).

4.1.1 Physical and biological environment

The tables, figures, and maps in the sections below summarize habitat vulnerability and habitat type by management area. These results can be used to evaluate the impacts associated with habitat management measures. All of these data are described in greater detail in the affected environment section, and in the SASI appendix.

The first table in each section shows the percent coverage of each dominant substrate (mud, sand, granule-pebble, cobble, and boulder) as a percentage of total area, according to the unstructured SASI substrate grid. Coverage is grouped by high and low energy. The second table shows the level of data support/data quality associated with those substrate grids. Higher percentages for the larger data support values (5-7) indicate full sampling of all substrate types and progressively smaller grid sizes. Lower data support values (1-4) indicate sampling of only mud, sand, and granule-pebble size classes, with values of 1 indicating the largest cell size.

The third table 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. A grid was considered overlapping if its center point (centroid) fell inside the management area. The associated 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 some management areas are not shown on these plots. 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 maps show the spatial distribution of (1) dominant substrate, (2) data support, and (3) trawl vulnerability scores and LISA clusters, overlaid by the various alternative areas.

Mobile gear results are the focus of these tables, figures, and maps 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.

4.1.1.1 *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 management options.

Table 25 – EGOM: dominant substrate coverage within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
Habitat management areas											
Eastern Maine, large (112)	85%		8%	7%							1697
Eastern Maine, small (50)	59%		19%	21%							529
Machias (48)			27%			34%	34%	3%	1%		322
Toothaker Ridge (8)	79%		21%								748

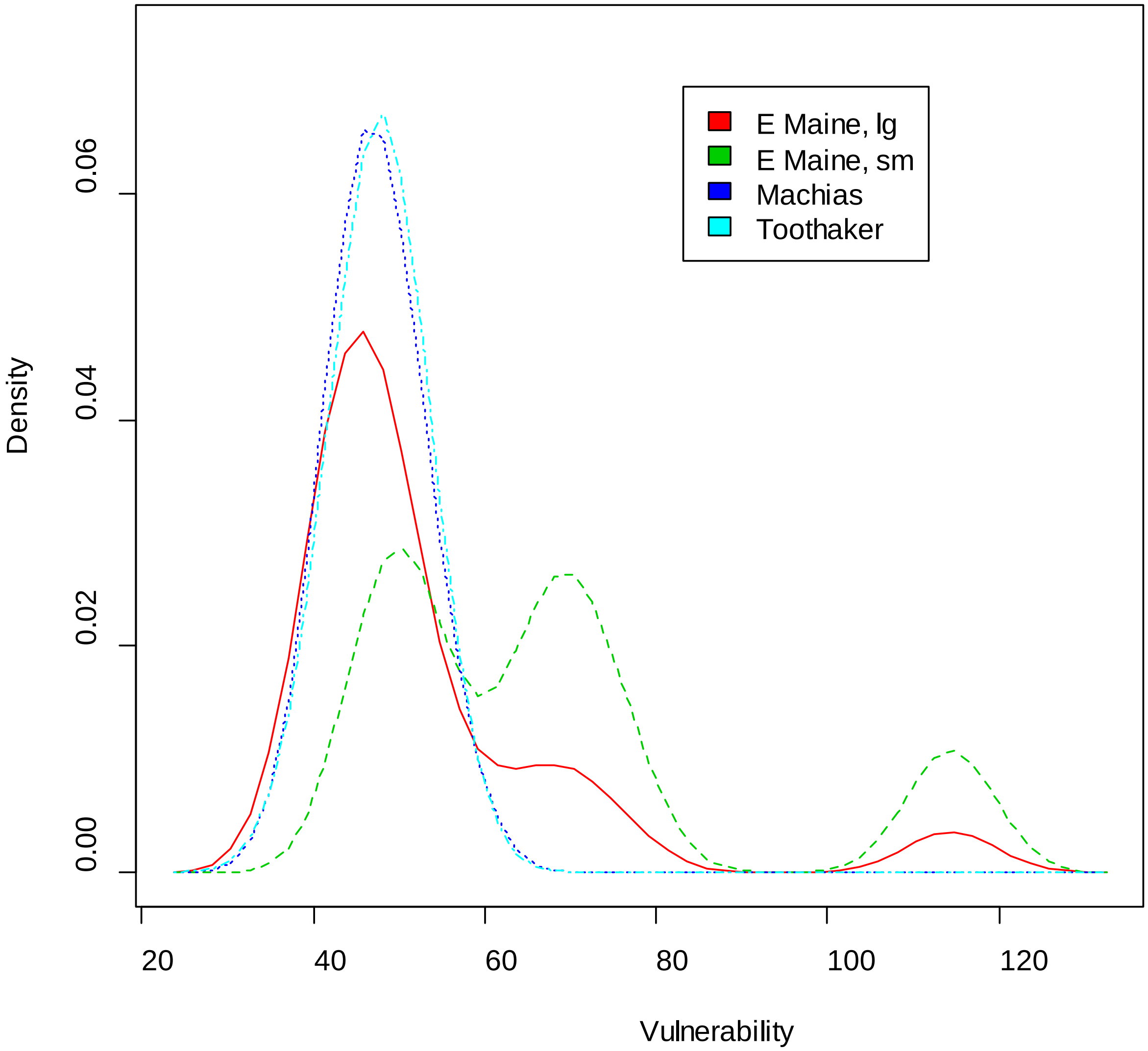
Table 26 – EGOM: data support within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
Habitat management areas								
Eastern Maine, large (112)		38%	54%	8%				1697
Eastern Maine, small (50)		26%	64%	10%				529
Machias (48)		8%	79%	13%				322
Toothaker Ridge (8)	50%	50%						748

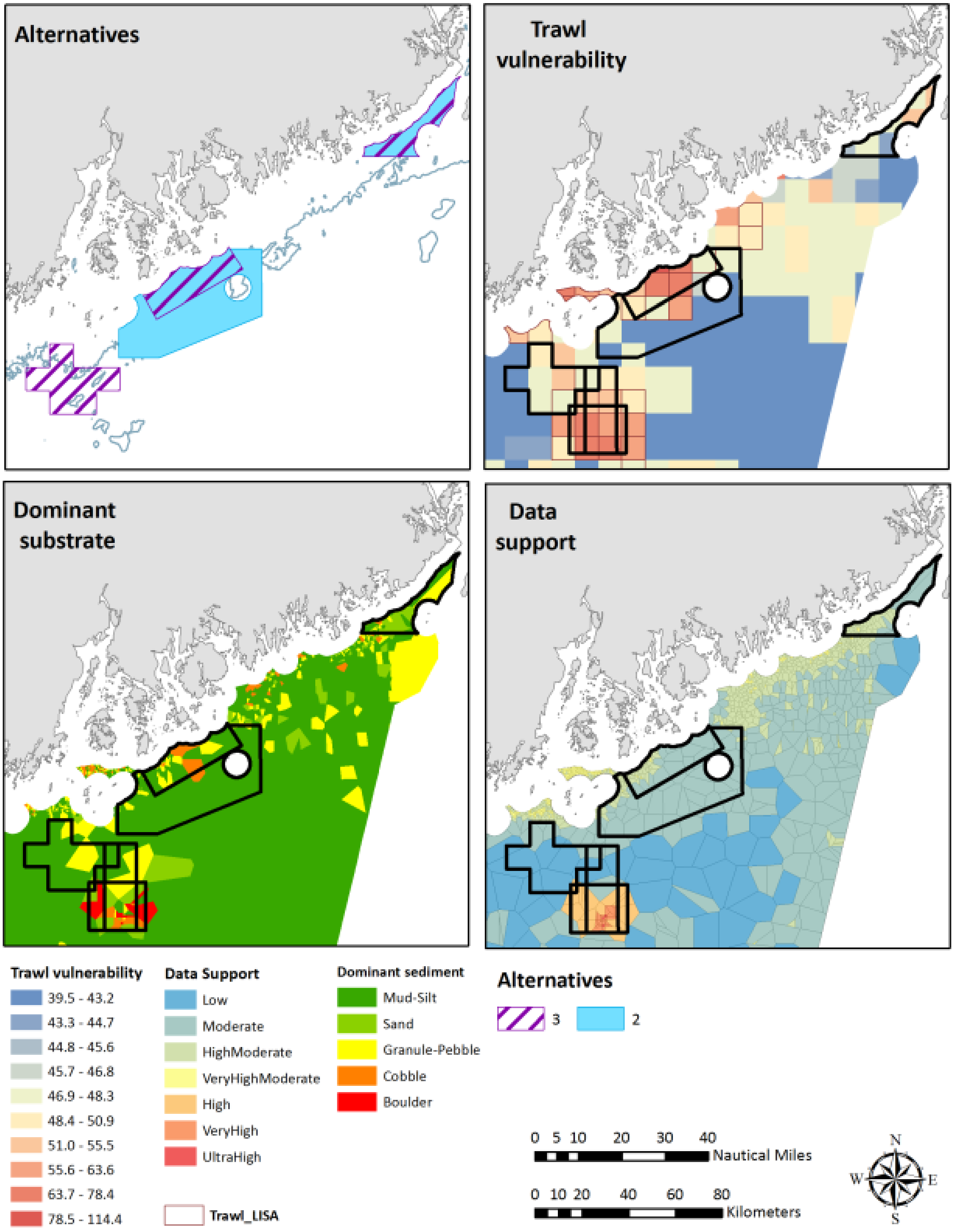
Table 27 – EGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear (83m).

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	**Max**	***N***	**Min**	**Max**	***N***	**Min**	**Max**	***N***
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*

Figure 5 – EGOM: distribution of vulnerability scores for trawl gear displayed as density plots. 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.



Map 33 – EGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



4.1.1.1.1 Alternative 1 (No action/no Habitat Management Areas)

Under this alternative, mobile bottom-tending gear fishing would continue in the region without any restrictions related to adverse effects minimization. There would be no specific protection provided for benthic habitats through limits on the use of these gears.

4.1.1.1.2 Alternative 2

Alternative 2 includes the Large Eastern Maine and Machias HMAs. Both of the Eastern Maine areas cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 33). Based on these substrate distributions and the SASI vulnerability results (Table 27, trawl vulnerability panel in Map 33) , the Large Eastern Maine HMA is less efficient at encompassing vulnerable habitats as compared to the Small Eastern Maine HMA that is part of Alternative 3. Although the absolute amount of complex habitats encompassed could be larger, the additional area covered by the Large Eastern Maine HMA as compared to the Small Eastern Maine HMA generally consists of less vulnerable seabed types. However, this assessment is uncertain because data quality in this region is relatively poor (data support panel in Map 33). 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 25). According to the SASI vulnerability assessment, this means habitats in the Machias area are likely somewhat less vulnerable to accumulating adverse effects of fishing.

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 Alternative 1. The impacts of Options 1 and 2 are equivalent in this sub-region because there is no hydraulic clam dredging, although there is dredging with toothed clam dredges in this part of the Gulf of Maine. In terms of mobile bottom-tending gear activity, there is relatively limited use of generic otter trawls, shrimp trawls, scallop dredges, and clam dredges in this sub-region as compared to other sub-regions (see the realized adverse effects maps in the affected environment section). Therefore, the magnitude of this positive impact may be somewhat less than in other areas where mobile bottom-tending gears generate more adverse effects.

Alternative 2 Options 1 and 2 are expected to have fewer positive impacts on seabed habitats than Alternative 3 Options 1 and 2. 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.

The impacts of Alternative 2 Options 3 and 4 are uncertain. They could be slightly negative relative to Alternative 1 if catch efficiency declines with the modified gear (Option 3 or 4). Alternately, impacts could be slightly positive if some trawl effort is displaced from the areas (Option 3 or 4) or if the ground cables with rollers effectively reduce contact of the gear with the seabed.

4.1.1.1.3 Alternative 3

Alternative 3 includes the Small Eastern Maine, Machias, and Toothaker Ridge HMAs. All of the Eastern Maine areas cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 33).

Similar to Alternative 2, Alternative 3 Options 1 or 2 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.

As noted in the previous section, Alternative 3 is expected to have a greater positive impact on seabed habitats as compared to Alternative 2.

4.1.1.2 *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.

Table 28 – CGOM: dominant substrate coverage within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Cashes Ledge EFH (90)	36%	29%	22%		9%					4%	392
Jeffreys Bank EFH (35)	41%	20%	21%	14%	5%						504
No action groundfish											
Cashes Ledge GF (188)	65%	20%	10%		3%					1%	1428
Habitat management areas											
Ammen Rock (14)		7%		7%	7%		8%		7%	65%	14
Cashes Ledge EFH, modified (86)	37%	22%	25%		11%					4%	335
Fippennies Ledge (41)		40%	32%	11%	16%						41
Jeffreys Bank EFH, modified (39)	9%	36%	20%	13%	22%						521
Platts Bank (54)		34%	15%	9%	14%		11%	5%	5%	8%	63

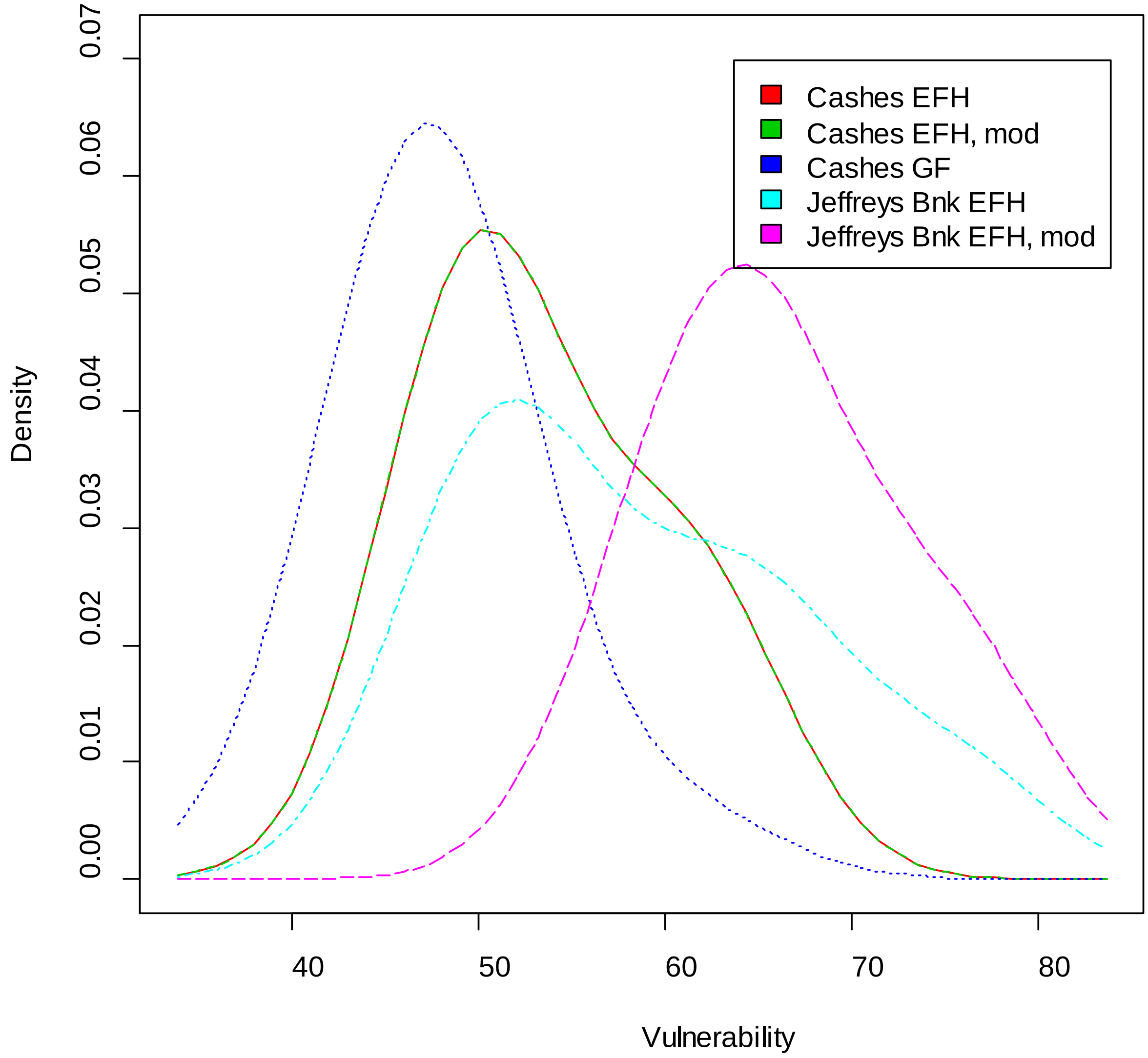
Table 29 – CGOM: data support within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Cashes Ledge EFH (90)		11%	10%	14%	2%	40%	22%	392
Jeffreys Bank EFH (35)	3%	9%			14%	66%	9%	504
No action groundfish								
Cashes Ledge GF (188)	1%	11%	7%	8%	4%	43%	27%	1428
Habitat management areas								
Ammen Rock (14)						29%	71%	14
Cashes Ledge EFH, modified (86)		10%	10%	15%		41%	23%	335
Fippennies Ledge (41)				5%		37%	59%	41
Jeffreys Bank EFH, modified (39)		3%			31%	59%	8%	521
Platts Bank (54)						65%	35%	63

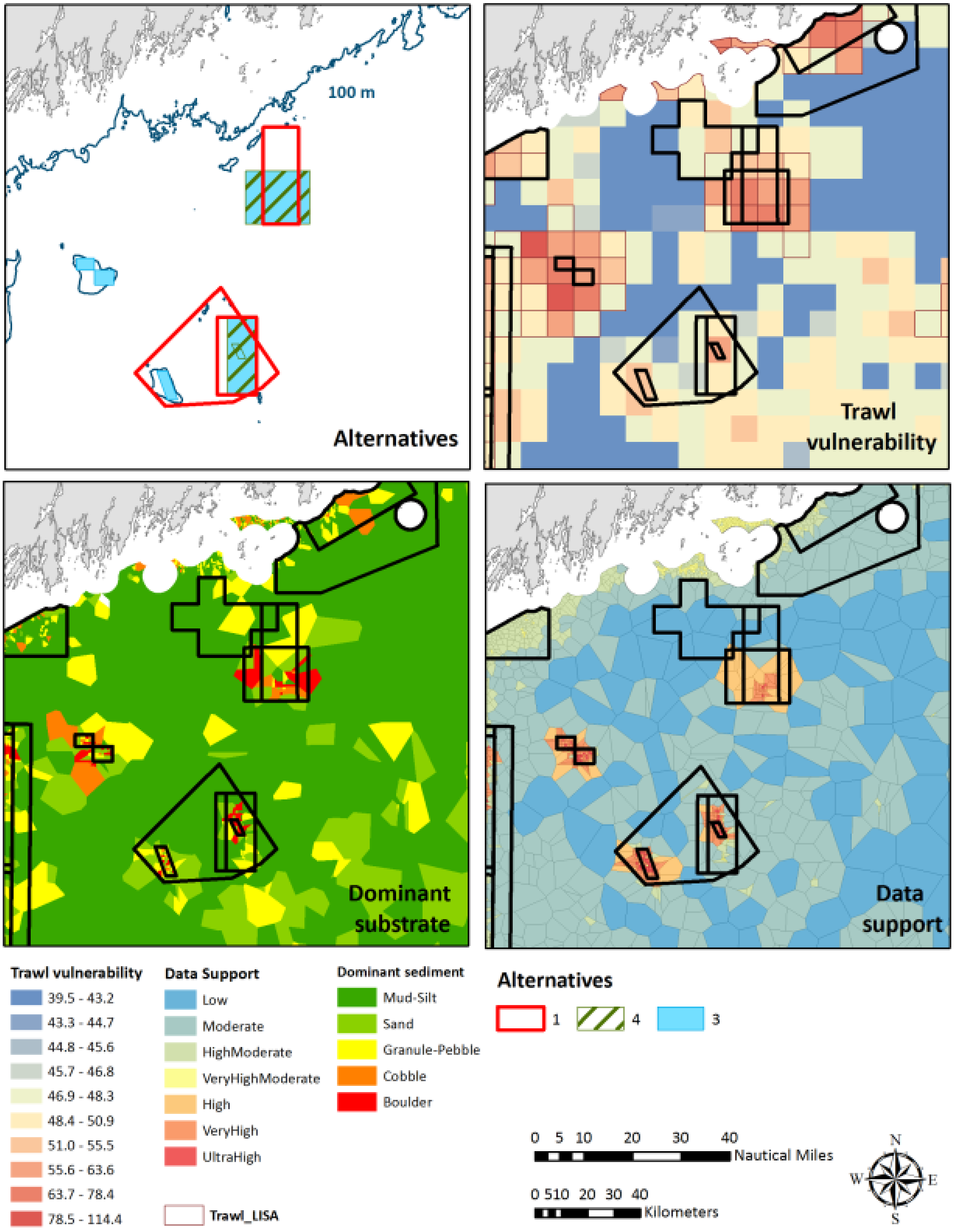
Table 30 – CGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	Max	*N*	Min	Max	*N*	Min	Max	*N*
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*

Figure 6 – CGOM: ddistribution of vulnerability scores for trawl gear displayed as density plots. 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. The Ammen Rock and Platts Bank areas are not shown because only a single grid overlaps them and therefore a density distribution cannot be generated.



Map 34 – CGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



4.1.1.2.1 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 (Map 34). 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 34). The deep mud habitats were sampled at a relatively low rate, and data support was classified as low or moderate (Map 34). 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 34) that is imprecise.

The ledge and bank features included in this alternative contain habitat types highly vulnerable to fishing (Map 34, Table 30). However, some of the large cobble, and boulder grids at the edges of Jeffreys Bank have an influence on the vulnerability results, such that the vulnerability scores for this area are probably biased high, and the size and shape of the highly vulnerable area is somewhat inflated. This is obvious on Map 34, and also in the density plot (Figure 6), where the curves for Jeffreys Bank (both the existing EFH area and especially the modified area in Alternatives 3 and 4) are shifted to the right as compared to the other areas in this region. The deeper mud habitats are estimated to be less vulnerable than the cobble- and boulder-dominated habitats (i.e., see the lower vulnerability scores for the Cashes Ledge GF area (Table 30, Figure 6), which includes a greater proportion of mud than the Cashes Ledge EFH area (Table 28).

<u>Overall, No Action/Alternative 1 reduces adverse effect on seabed habitats.</u> Because these areas cover vulnerable seafloor and are currently closed to fishing, they reduce the potential for adverse effect associated with MBTG fishing effort. Although it is difficult to assess the extent to which they displace the fishing effort to other vulnerable areas, these areas are among the most highly vulnerable in the sub-region. Historically, there was a greater magnitude of generic otter trawl fishing effort and adverse effects in the central GOM region, including within these areas, but it seems unlikely that effort would return quickly to pre-closure levels under current conditions. Sea scallops and scallop dredge adverse effects are limited in their distribution in the Central GOM. Clam dredge adverse effects are probably non-existent within these management areas; in the Central GOM, clam dredging appears to only occur in areas closer to shore.

4.1.1.2.2 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. <u>Alternative 2 would be expected to increase adverse effects relative to no action.</u> Alternative 2 would allow trawling effort over vulnerable habitats. It is expected that otter trawling would be the primary fishing activity since the scallop and clam fisheries are fairly limited in extent in the Central GOM.

4.1.1.2.3 Alternative 3

The HMAs included in Alternative 3 were designed to efficiently encompass areas of vulnerable seabed while allowing fishery access to adjacent habitats. This alternative includes modified versions of the Cashes Ledge and Jeffreys Bank areas that were designed to encompass areas shallower than approximately 100 m depth known to contain gravel (granule-pebble, cobble, and boulder) substrates. Generally, the portions of the ledge and bank features included in Alternative 3 have high data support values of 5, 6, or 7 (Table 29). Ammen Rock, Fippennies Ledge, Modified Jeffreys Bank, and Platts Bank have 95-100% areal coverage of high data support grids. The areal coverage of high data support grids is lower (65%) for the Modified Cashes Ledge HMA, as the southern part of the ledge was not sampled with video gear.

Because the sampling resolution around these bank and ledge features tends to drop off rapidly moving into deeper water, the shapes of the bank and ledge features are not well resolved spatially in the sediment map. Knowing these limitations, the Habitat PDT identified 100 m as the approximate depth at which the shallow gravel habitats transition to soft sediment types. This depth was used to define the modified Cashes Ledge and Jeffreys Bank HMAs. The Platts Bank and Fippennies Ledge HMAs are narrower subsets of the gravel habitats shallower than 100 m, focusing on just the shallowest parts of the features with cobble- and boulder-dominated grids. The Ammen Rock area was defined based on bathymetry, and based on a survey of benthic macroalgae (McGonigle et al 2011).

Vulnerability estimates for the modified and existing Cashes Ledge habitat areas are equivalent because the same set of structured SASI grids overlap both areas. Values for the Cashes Ledge habitat areas are intermediate between those for the Cashes Ledge groundfish closed area and the Jeffreys Bank areas. Some large unstructured boulder substrate grids within the Jeffreys Bank areas result in inflated vulnerability scores for these areas, especially the modified area. There is no reason to think that seabed vulnerability is substantially different between the modified Cashes and Jeffreys areas. Given the resolution of the vulnerability maps (10 km x 10 km grids), it is difficult to draw conclusions about the Platts Bank and Fippennies Ledge areas based on these results, and the presence of cobble- and boulder-dominated unstructured grids is a better metric for inferring the presence of vulnerable benthic habitats in these areas.

All of these areas are considered low energy, with the exception of the shallower portions of Platts Bank and Ammen Rock, which were identified as high energy on the basis of depth. Structure-forming organisms adapted to high energy habitats were estimated to have somewhat shorter recovery times, and therefore slightly lower vulnerability to fishing impacts. That being said, Ammen Rock is a unique feature, being the only offshore kelp habitat in the Gulf of Maine, which is why it was singled out for increased protection via closure to all types of fishing.

Overall, the HMAs included in Alternative 3 encompass a large fraction of the highly structured, gravel habitats in the central GOM sub-region, and closing these areas to mobile-bottom tending gears (all gears in the Ammen Rock HMA) would have a positive impact on seabed habitats in this sub-region. Much of Alternative 3 overlaps with the No Action/Alternative 1 areas, but Platts Bank and additional portions of Jeffreys Bank would be protected with this alternative, and some deeper water mud habitats estimated to have lower vulnerability to fishing would not be included. 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. Options 3 and 4 would have a negative impact relative to No Action/Alternative 1 because mobile bottom-tending gears would be allowed to operate in previously closed areas vulnerable to fishing. These options would likely have a neutral impact on Platts Bank, which is currently open to fishing.

4.1.1.2.4 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, Options 1 and 2 would have a positive impact on seabed habitats overall, and a slightly negative impact relative to Alternative 1/No Action or Alternative 3 because these areas are not included. Alternative 4 Options 3 and 4 would have negative impacts relative to Alternative 1/No Action.

4.1.1.3 ***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/7B) 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.

Table 31 – WGOM: dominant substrate coverage within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Western Gulf of Maine EFH (848)	33%	43%	13%	1%	1%	1%	5%	1%	1%	1%	2256
No action groundfish											
Western Gulf of Maine GF (876)	39%	36%	16%	1%	1%	1%	4%	1%	1%	1%	2941
Habitat management areas											
Bigelow Bight, large (471)	53%	8%	13%	4%		2%	7%	10%	4%		1696
Bigelow Bight, small (146)	56%	8%	16%	3%		1%	8%	6%	2%		560
Jeffreys Ledge (158)	36%	26%	18%	3%	2%	4%	4%	2%	3%	2%	714
Stellwagen, large (639)	10%	70%	11%	1%			7%	1%			1185
Stellwagen, small (540)	2%	68%	14%				13%	3%			650
Inshore Roller Gear Area (3480)	42%	25%	11%	1%		2%	12%	5%	1%		8384
Alternate Roller Gear Area (2376)	31%	29%	11%	2%		1%	17%	5%	2%		4107

Table 32 – WGOM: data support within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

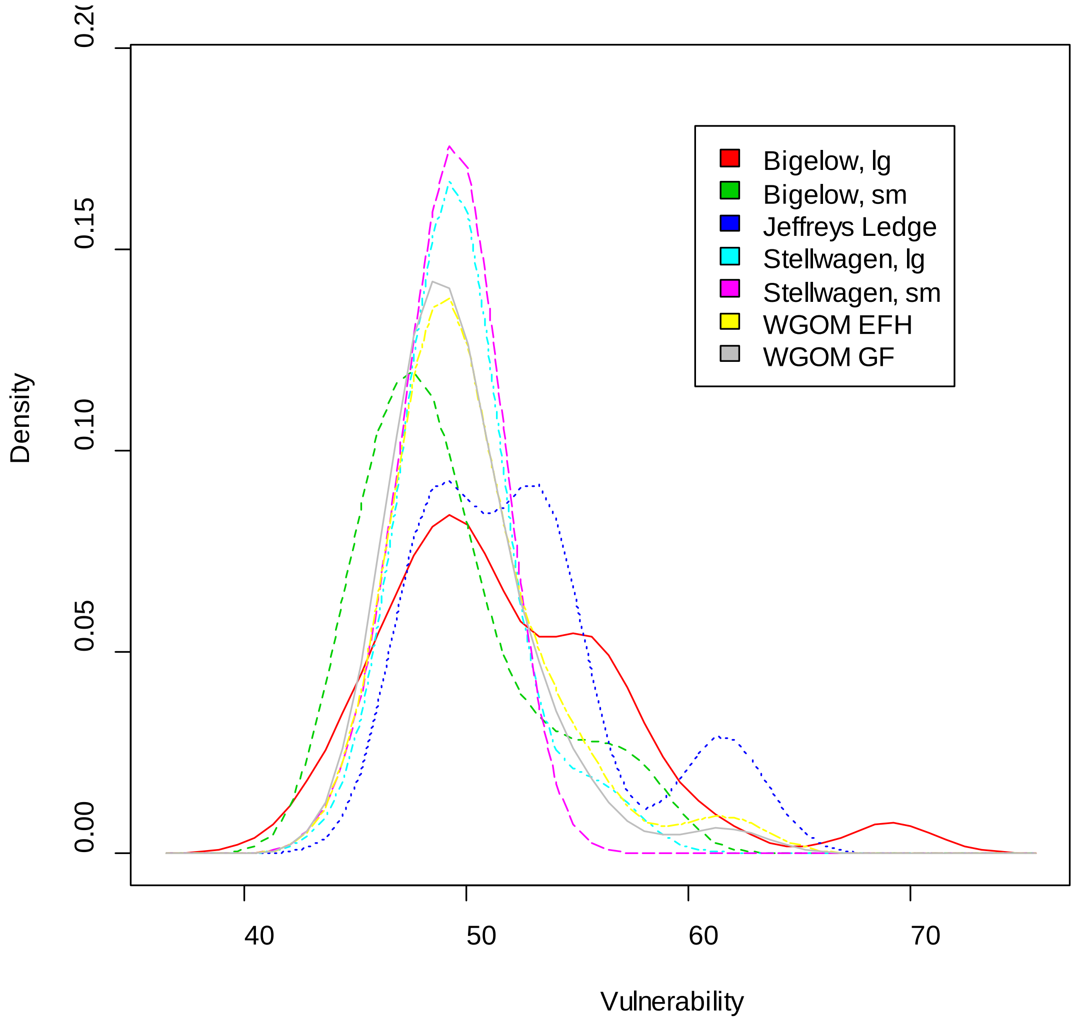
Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
Western Gulf of Maine EFH (848)		6%	50%	35%		6%	3%	2256
No action groundfish								
Western Gulf of Maine GF (876)		8%	49%	34%		6%	3%	2941
Habitat management areas								
Bigelow Bight, large (471)		3%	90%	7%				1696
Bigelow Bight, small (146)		5%	86%	8%				560
Jeffreys Ledge (158)		13%	36%	9%		29%	13%	714
Stellwagen, large (639)		2%	52%	44%		1%	1%	1185
Stellwagen, small (540)			47%	51%		1%	1%	650
Inshore Roller Gear Area (3480)		3%	43%	46%		3%	4%	8384
Alternate Roller Gear Area (2376)		2%	39%	50%		3%	6%	4107

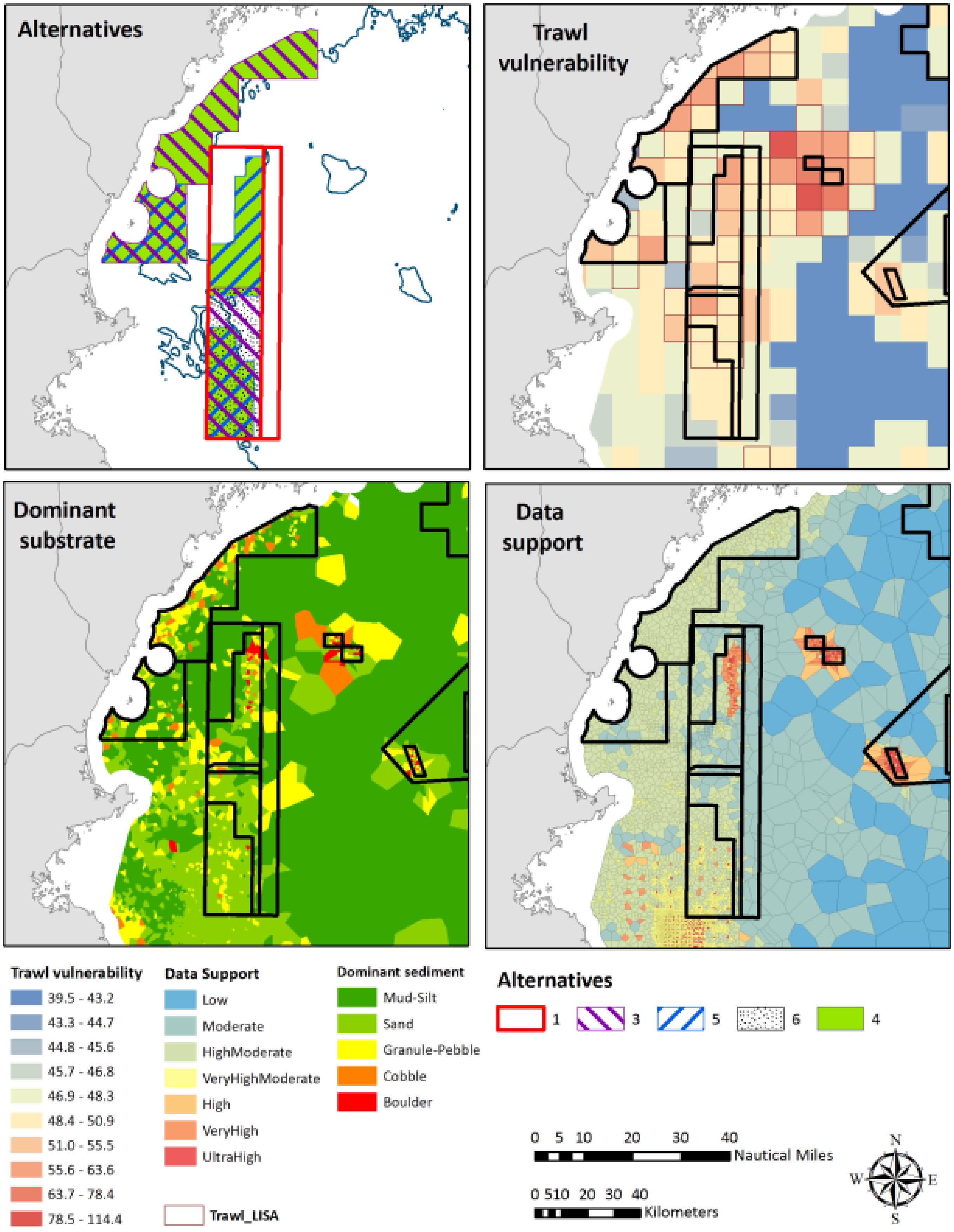
Table 33 – WGOM: minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	Max	*N*	Min	Max	*N*	Min	Max	*N*
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*

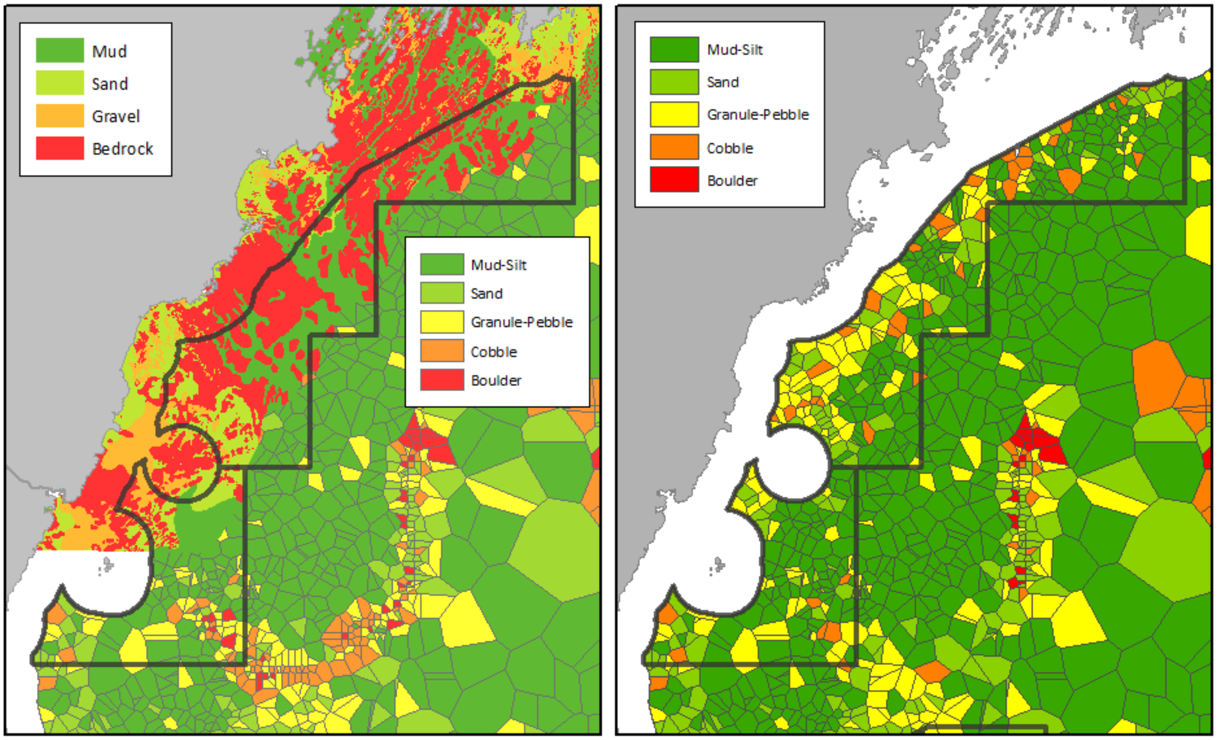
Figure 7 – WGOM: distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.



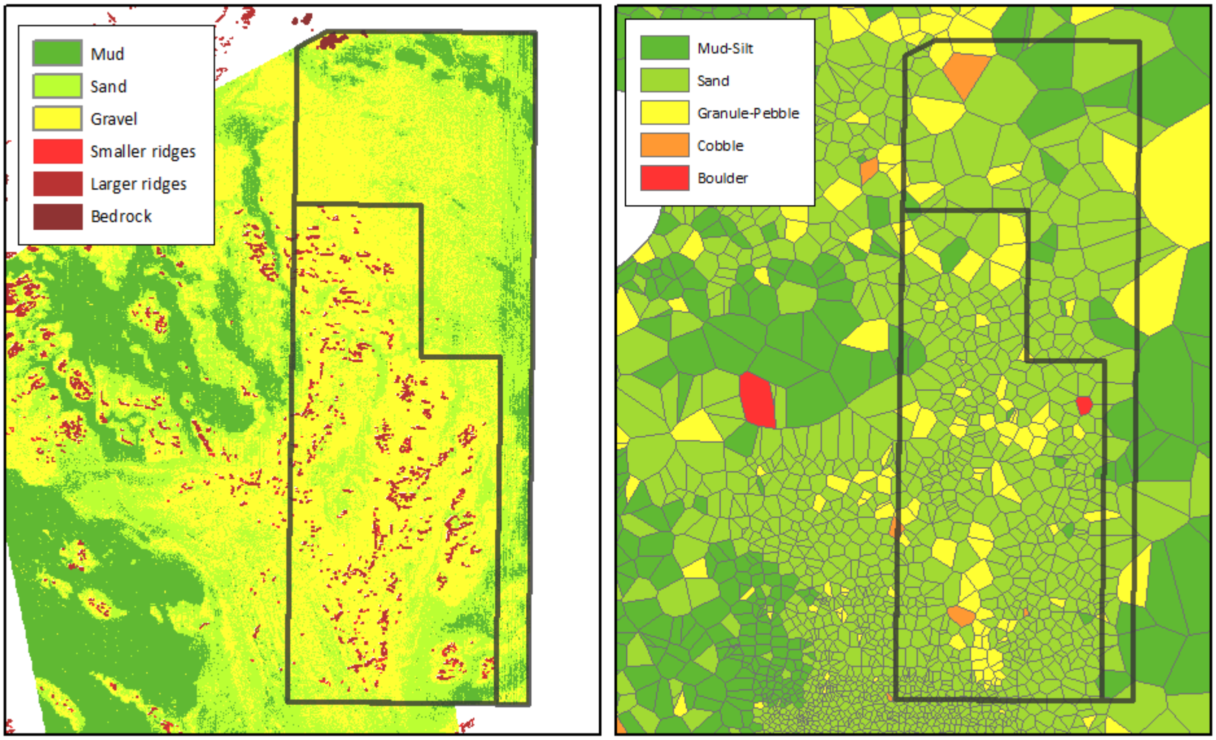
Map 35 – WGOM: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



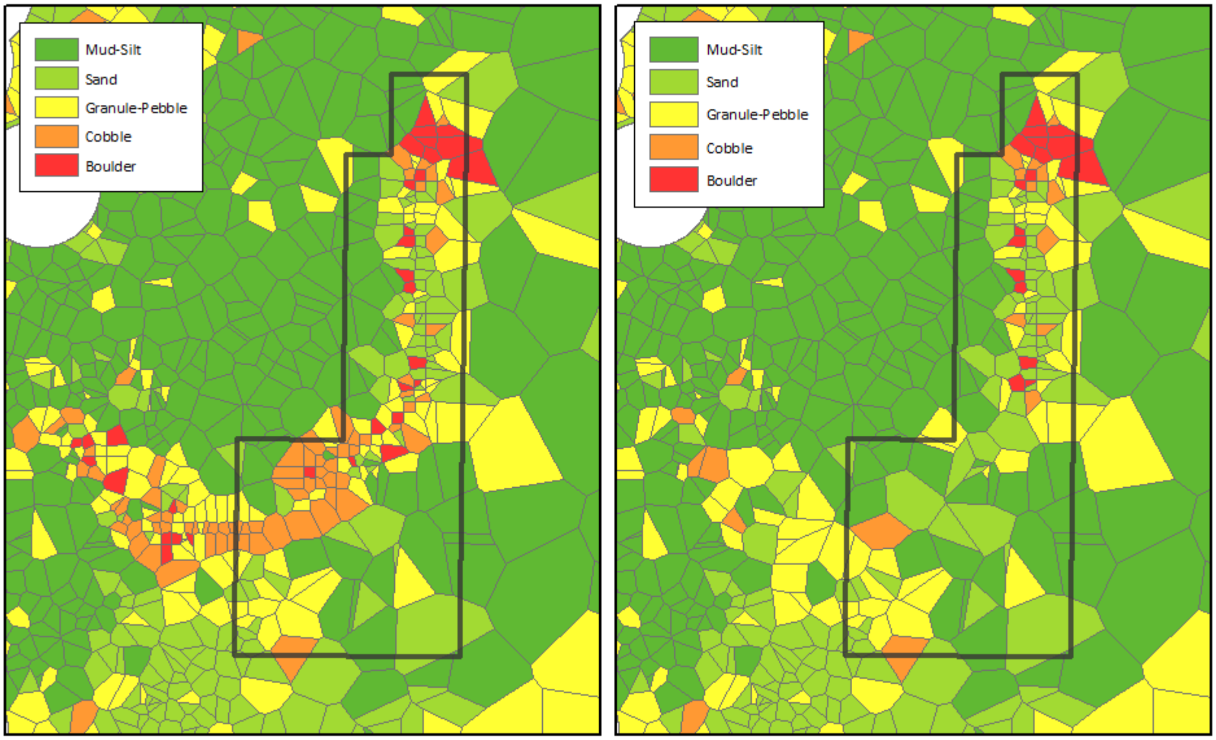
Map 36 – Bigelow Bight substrate distribution comparison. Left panel – Maine Bottom Type data along coast (legend in upper left) overlaid on updated SASI grid with additional Jeffreys Ledge data (legend at right). Right panel – SASI grid on which vulnerability model runs are based.



Map 37 – Stellwagen substrate distribution comparison. Left panel – multibeam backscatter (mud, sand, and gravel) overlaid with boulder ridges and bedrock outcrops in red. Right panel – SASI grid on which vulnerability model runs are based.



Map 38 – Jeffreys Ledge substrate distribution comparison. Left panel – updated SASI grid. Data were collected using video and analyzed to match SASI methods. Right panel – SASI grid on which vulnerability model runs are based.



4.1.1.3.1 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. These areas are generally low energy, except for the tops of Stellwagen Bank and Jeffreys Ledge, and include a mix of sediment types. The dominant substrate type is predominantly mud and sand, with about 15% of the area dominated by granule-pebble, and small fractions of cobble- and boulder-dominated areas according to the SASI substrate map (Map 35). 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. Cobble and boulder habitat types are under-represented in these data sets, and sampling on Jeffreys Ledge subsequent to the development of SASI identified additional cobble- and boulder-dominated areas (Map 38). Multibeam data that couldn't be readily integrated with the SASI grid better resolve the substrate distribution in the southern part of the areas overlapping Stellwagen Bank (Map 37) and in the Bigelow Bight Area (Map 36).

Vulnerability estimates are moderate to high for these and other management areas in this region relative to other locations not proposed for habitat management (Table 33). 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, it is difficult to distinguish between the various management areas on the basis of vulnerability scores. As compared to the Alternative 1/No Action areas, scores are somewhat higher (i.e., density plot shifted to the right) within the Jeffreys Ledge HMA (Figure 7). This is expected based on the outcomes of the SASI vulnerability assessment, as parts of the No Action EFH and groundfish closures in the WGOM sub-region include deeper mud habitats expected to be less vulnerable to fishing. The Small and Large Stellwagen areas, however, cannot be readily distinguished from the No Action areas of which they are subsets. It is likely that vulnerability is underestimated in these Stellwagen areas, given the discrepancy between the multibeam-based map and the SASI map. The Small Stellwagen HMA in particular should have a higher average vulnerability to fishing based on the mix of habitat types as compared to the No Action areas.

Although the No Action areas are less efficient at encompassing vulnerable habitats as compared to the alternative areas within them, they do include these vulnerable seabed types, and the fishing restriction measures associated with WGOM EFH and groundfish closures are sufficient for protecting these habitats from the impacts of the most damaging gear types, i.e. mobile bottom-tending gears. In addition, under No Action, 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. Note that two mobile bottom-tending gears, clam dredges and shrimp trawls, are exempted from the No Action groundfish closure, such that they could be used in the eastern sliver that doesn't overlap the habitat area. However, it is unlikely that these gears have been used much if at all in this area since shrimping tends to occur further west, and most of the area overlaps with a food safety shellfish closure.

<u>Overall, Alternative 1/No Action in the Western Gulf of Maine sub-region has positive impacts on seabed habitats.</u>

4.1.1.3.2 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. Habitats within the WGOM closure that are vulnerable to adverse effects would be fished by mobile bottom-tending gears for the first time since 1998 when the closure was enacted. Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

4.1.1.3.3 Alternative 3

Alternative 3 includes the Large Bigelow Bight and Large Stellwagen HMAs. Both of these areas include seabed types that are vulnerable to fishing relative to the region as a whole (Table 33). The distribution of rocky substrates including bedrock, boulder ridges, and cobble-dominated areas is more clearly identified in extra-SASI data sources (Map 36 and Map 37). In general, the SASI substrate grid under-represents gravel substrates in the coastal Gulf of Maine. Higher vulnerability scores relative to the regional average may have resulted if these additional data sets had been incorporated into the model.

The Large Stellwagen area is currently closed to mobile bottom-tending gear as part of the WGOM habitat closure area. Options 1 and 2 are equivalent in terms of their impacts because there is no hydraulic clam dredging in this part of the Gulf of Maine, so these options would maintain No Action habitat conservation measures in this HMA. The Large Bigelow Bight area is currently open to mobile-bottom tending gear fishing, such that application of Option 1 or 2 in that area would be expected to have positive impacts of seabed habitats in that area. However, this alternative would allow mobile bottom-tending gear fishing on Jeffreys Ledge, which is currently closed.

It is difficult to estimate the net benefits of shifting habitat closures in this manner. One consideration is that Jeffreys Ledge has been closed to many types of fishing since 1998, such that recovery of benthic habitats has been allowed to occur since that time, while Bigelow Bight has been continuously fished, excepting seasonal rolling closures. Another is how mobile bottom-tending gear effort would redistribute if Jeffreys Ledge was opened to it and Bigelow Bight was closed. If all the mobile bottom-tending gear fishing (mainly trawling, in this region) shifted from the Bigelow Bight to Jeffreys Ledge, net benefits would likely be neutral to negative, given habitat recovery that has already occurred on Jeffreys Ledge. Given that Option 1 or 2 measures maintain current protections in the Large Stellwagen HMA, this means that Alternative 3 would likely have neutral to negative impacts on seabed habitats relative to No Action, assuming Option 1 or 2 is selected for each of the areas.

If Option 3 or 4 is selected for the Large Stellwagen HMA, negative impacts on seabed habitats are expected because this decreases protection from what is currently in place. If these options are selected for the Large Bigelow Bight area, they would probably have a neutral impact within that HMA. Overall, if Option 3 or 4 is selected for both areas, negative impacts are expected relative to No Action.

4.1.1.3.4 Alternative 4

Alternative 4 includes the Large Bigelow Bight, Small Stellwagen, and Jeffreys Ledge HMAs. The Large Bigelow Bight area is discussed above. The Small Stellwagen and Jeffreys Ledge HMAs were each selected to efficiently encompass vulnerable seabed while allowing access to deeper water mud habitats. Similar to the Bigelow Bight and Stellwagen HMAs, vulnerability of the Jeffreys Ledge HMA is probably underestimated, based on the discrepancy between the updated SASI grid and the grid used in modeling (Map 38). Because these two areas cover the majority of vulnerable seabed areas in the existing WGOM habitat closure area, redefining these areas into the Small Stellwagen and Jeffreys Bank HMAs probably has neutral impacts to the seabed, assuming they remain closed to mobile bottom-tending gears (Option 1 or 2). The addition of habitat management measures in the Large Bigelow Bight Area would result in positive habitat impacts of this alternative overall relative to No Action, especially if Option 1 or 2 is selected. If Options 3 or 4 are selected for all three areas, negative impacts are expected overall, because less protection would be afforded to currently closed areas.

4.1.1.3.5 Alternative 5

Alternative 5 includes the Small Bigelow Bight, Small Stellwagen, and Jeffreys Ledge HMAs. The Small Bigelow Bight HMA is not as well mapped as the larger area because the Maine Bottom Type coverage does not overlap the area very well, and SASI data support is moderate.

However, the area definitely contains complex and vulnerable substrate types closer to the coast/state waters boundary, and on Old Scantum, in the southeastern corner (Map 36). Overall, habitat impacts would likely be positive relative to No Action if all areas are managed as mobile bottom-tending gear closures (Option 1 or 2), and negative relative to No Action if Option 3 or 4 is selected.

4.1.1.3.6 Alternative 6

Alternative 6 includes the Large Stellwagen HMA only. Because this alternative removes habitat protections on Jeffreys Ledge, and does not add any protections in the Bigelow Bight region, there would be negative impacts on habitat relative to No Action if any management option is selected, but especially if Options 3 or 4 are selected.

4.1.1.3.7 Alternative 7 (Options A and B)

These alternatives would designate the existing inshore roller gear restriction as a habitat management measure (7A), or implement this restriction in an alternate area as a habitat management measure (7B). In theory, limiting roller size to 12 inches is expected to limit the seabed types in which bottom trawl vessels can fish to areas dominated by smaller substrates and less complex attached biota, and thus this type of restriction can be viewed as a habitat conservation measure.

Unfortunately given the spatial resolution of seabed data and fishing effort data, it is challenging to evaluate whether or not limiting roller size to 12 inches affects the distribution of fishing effort with respect to habitat type. The multi-beam backscatter and boulder ridge data in the vicinity of Stellwagen Bank is of sufficient resolution for comparison with observed hauls, but there is not a comparable substrate distribution data set outside the Inshore Roller Gear Restricted Area. Nonetheless, patterns of trawl effort can be examined relative to these data [insert figure of observed hauls relative to these data]. Based on straight line tow paths (an oversimplification of how fishing effort is actually distributed), it appears that trawls avoid boulder ridge areas, but given the lack of ability to compare outside the roller gear area, it isn't clear that the roller size limit itself is responsible for or at least contributes to this avoidance. It could be that these same spatial patterns would be observed even in areas where roller size is not restricted.

Assuming that the roller gear size limit does contribute to habitat conservation, Alternative 7 Option A (current roller gear area footprint) would improve habitat protection relative to No Action because the requirement would apply to all bottom trawl vessels. Currently, the inshore roller gear restriction only applies to Northeast Multispecies vessels, and not to vessels fishing under other permits (for example, shrimp trawl vessels). The increase in habitat conservation would likely be small in magnitude, because many shrimp trawl vessels already use roller gear sizes of 12 inches or less [insert figure or table showing this – I think Andy has one]. Alternative 7 Option B would probably have neutral impacts to positive impacts when combined with the No Action roller gear area as it is currently implemented. The Alternative 7 Option B area covers additional areas of complex seabed in the Bigelow Bight region [insert figure showing additional area covered], and might be expected to improve habitat conservation in this location. Alternative 7 Option B would apply to all trawl vessels, including shrimp vessels, and the additional area covered by Option B as compared to Option A is a relatively important fishing area for the shrimp trawl fishery. Other types of bottom trawls would also need to use 12 inch rollers in this location. Simply trading off this area for other locations not covered by the Option B areas might have neutral impacts, but given that the current roller gear restriction would continue, Option B should have slightly positive impacts for habitat protection.

4.1.1.4 *Georges Bank*

There are six 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, (5) Georges Shoal HMA as a mobile bottom-tending closure area and large Georges Shoal Gear Modification Area, (6a) modified CAII HMA, and (6b) a smaller version of the modified CAII HMA, with an open buffer along the EEZ boundary. The Northern Edge and modified CAII HMAs could have any one of the four options; the larger and smaller gear modification areas could have options 3 or 4 only.

Table 34 – GB: dominant substrate coverage within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km²
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Closed Area I EFH N (607)		4%				2%	82%	12%			2028
Closed Area I EFH S (263)							92%	7%	1%		617
Closed Area II EFH (1175)	1%	1%					32%	53%	12%		650
No action groundfish											
Closed Area I GF (2628)		2%				1%	81%	14%	2%		4063
Closed Area II GF (2904)		5%	1%			1%	84%	8%	2%		6832
Habitat management areas											
Georges Shoal Gear Mod Area, large (3876)	1%	3%				1%	65%	19%	9%		6930
Georges Shoal Gear Mod Area, small (538)							49%	26%	24%		1050
Georges Shoal MBTG closure (212)						1%	78%	16%	5%		946
Northern Edge (949)	2%	8%					26%	51%	12%		436
CAII EFH modified, large	1%	7%					31%	47%	15%		1138
CAII EFH modified, small		8%					32%	44%	15%		794

Table 35 – GB: data support within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km²
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Closed Area I EFH N (607)		4%	6%	1%	3%	34%	51%	2028
Closed Area I EFH S (263)			3%	2%		60%	35%	617
Closed Area II EFH (1175)				3%		11%	86%	650
No action groundfish								
Closed Area I GF (2628)		1%	2%	1%	1%	28%	67%	4063
Closed Area II GF (2904)			3%	2%	1%	49%	45%	6832

Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
Habitat management areas								
Georges Shoal Gear Mod Area, large (3876)			3%	5%	2%	39%	50%	6930
Georges Shoal Gear Mod Area, small (538)			5%	20%	1%	62%	12%	1050
Georges Shoal MBTG closure (212)			28%	19%	12%	35%	6%	946
Northern Edge (949)				1%		2%	96%	436
CAII EFH modified, large			2%	2%	1%	44%	51%	1138
CAII EFH modified, small			2%	2%	2%	56%	38%	794

Table 36 – GB: 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*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	Max	*N*	Min	Max	*N*	Min	Max	*N*
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*
CAII EFH modified, large	47.3	57.2	11	50.1	59.4	11	115.7	126.4	11
CAII EFH modified, small	47.3	54.5	7	50.1	56.8	7	115.7	122.9	7

Figure 8 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, No Action areas. 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.

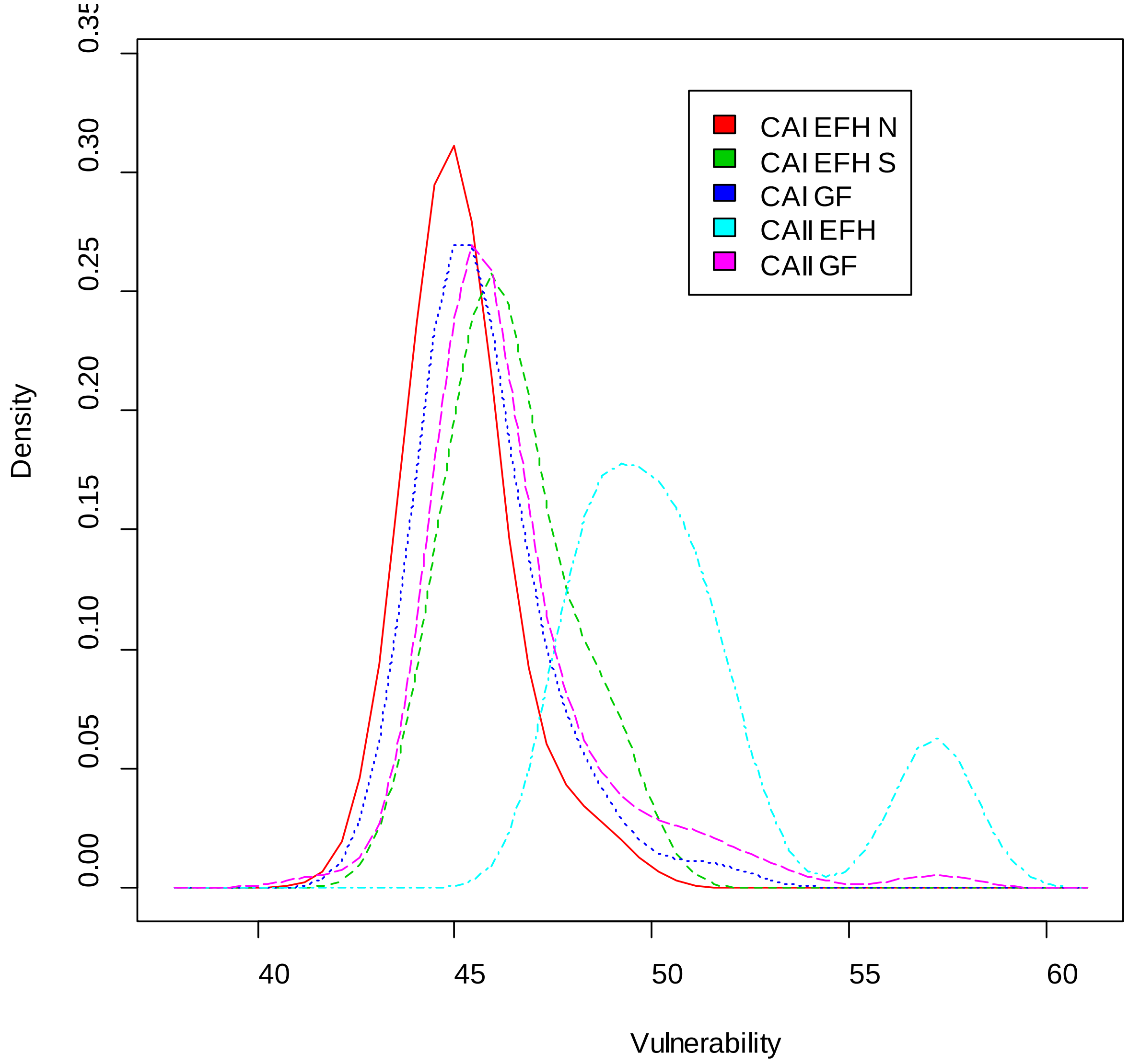
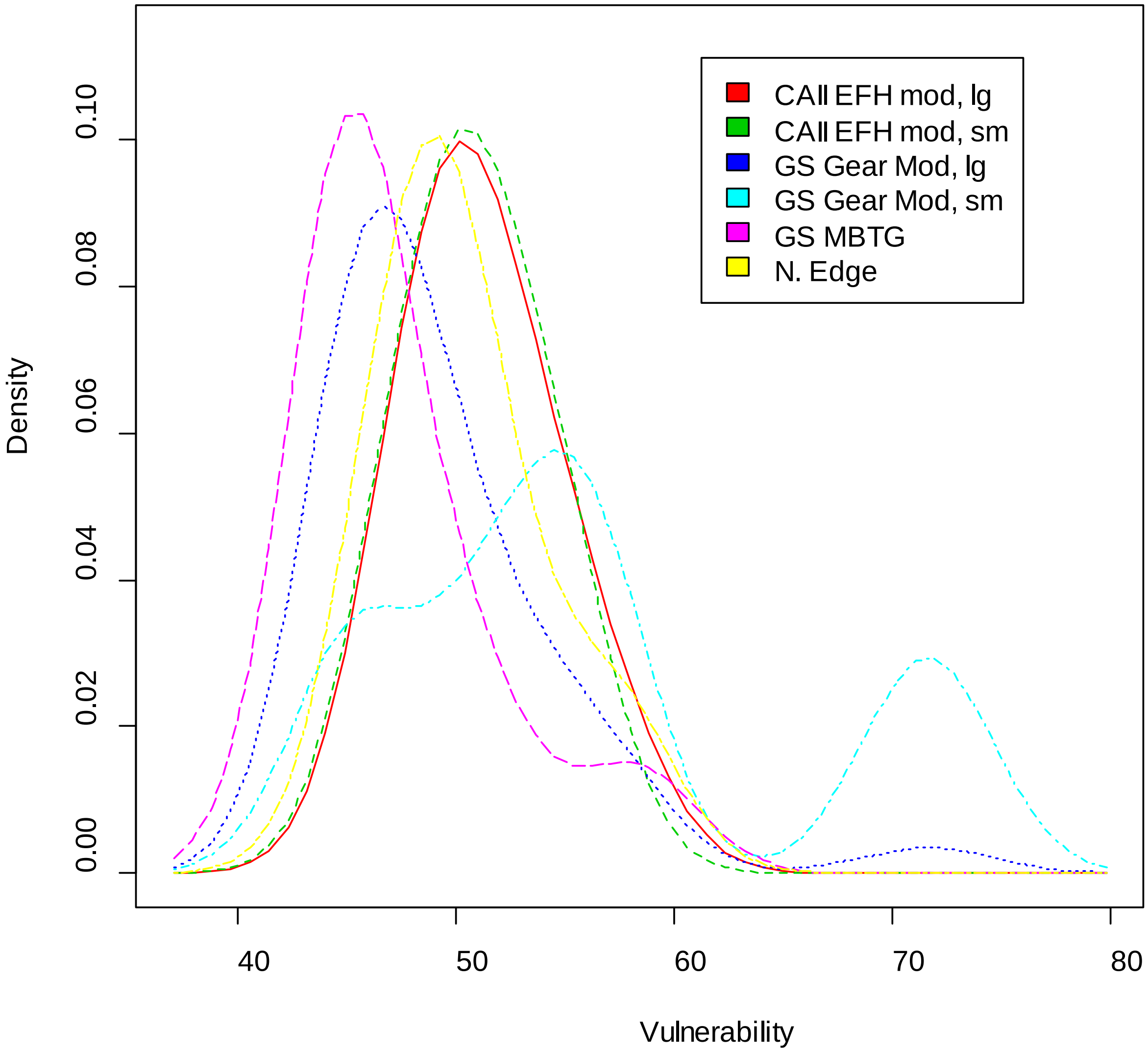
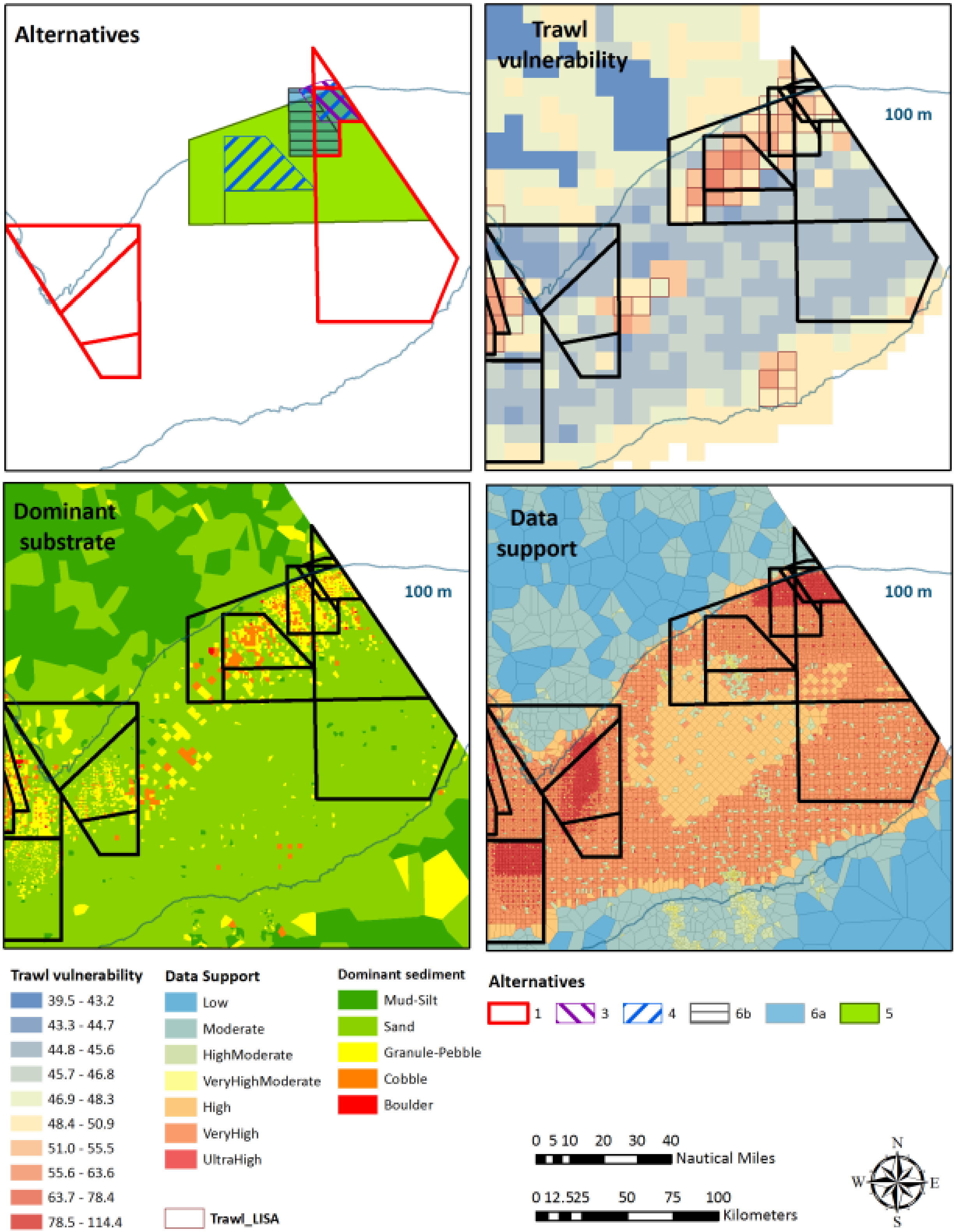


Figure 9 – GB: distribution of vulnerability scores for trawl gear displayed as density plots, new or modified areas. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater number (density) of grids with similar scores.



Map 39 – GB: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



4.1.1.4.1 Alternative 1 (No action)

The No Action habitat closure areas in this sub-region are managed as closures to mobile bottom-tending gears. The southern part of CAI and the CAII habitat closure are also closed to other gears that catch groundfish including demersal longlines and sink gillnets.

The No Action alternative also includes year round groundfish closed areas. Portions of these areas not overlapping the habitat closures are fished by mobile bottom-tending gears. The portion of Closed Area II south of 41° 30' and the central part of CAI between the two habitat closures are fished with scallop dredges as scallop access areas. The southern part of CAII is also fished with bottom trawls as part of a groundfish Special Access Program. The portion of CAII north of 42° 10' is also accessible to otter trawl gear as part of a SAP. Current fishing activities in these areas are important to consider. Because these areas are already fished with mobile bottom-tending gears, these portions of the closed area provide limited habitat benefits. Note that the northern portion of CAI is fished with demersal longline gear but this gear type does not cause significant adverse effects on seabed habitats.

Seabed vulnerability within these areas is highly variable. The distribution of vulnerability scores is similar within the three CAI areas and the CAII groundfish closure (Figure 8, Table 36), and the overall distribution of values is shifted to the right for the CAII habitat closure (Figure 8). The CAII groundfish closure includes these high values (Table 36) as it overlaps the habitat closure, but on average the habitats in the groundfish closure are lower vulnerability.

Dominant substrate composition (Table 34) and the structural features associated with these substrates drive the vulnerability scores. High vs. low energy habitat type is not driving the differences in vulnerability, as all of the no action management areas are predominantly high energy (94-100%, depending on the area). All of the areas are dominated by sand substrates (83-92% sand), with the exception of the CAII habitat closure (only 32% sand). The fraction of gravel-pebble substrates ranges from 7-14% for areas other than the CAII habitat closure, while this area has 53% granule-pebble coverage and is the only area with substantial cobble-dominated habitat (12%, vs. 0-2% for the other areas).

While the resolution of the unstructured grid does influence vulnerability scores in this sub-region (this is further discussed below), all of the areas in this region are relatively well sampled in terms of their substrate type, especially relative to some areas in the Gulf of Maine. At most, in CAI N habitat closure, only 11% of the areas were sampled with gears not capable of detecting cobble and boulder substrates. In other areas 95-97% of each area was sampled with video gear capable of detecting cobble and boulder substrates. Thus there is high certainty that the habitat types described for each area do occur there, and that the substrate maps are identifying geologic features with relative accuracy. Sampling resolution is somewhat lower in the center of the bank (Map 40), but there is not a great deal of overlap between the center of GB and the no action areas.

<u>Overall, the Alternative 1 areas in combination are relatively low vulnerability, and are generally inefficient in terms of encompassing vulnerable habitat types that warrant protection from mobile</u>

bottom-tending gears. The exception to this is the CAII habitat closure, which has much coarser substrates on average as compared to the other areas and as a result much higher estimated vulnerability. This area specifically has a positive impact on seabed habitats. In general, the coarse substrates and higher vulnerability areas on Georges Bank occur within this habitat closure and extend west/southwest along the margin of the bank (Map 40). To the extent that the other lower vulnerability areas (CAI areas, CAII groundfish) result in redistribution of effort onto vulnerable habitat types outside the CAII habitat closure, these areas could be having a negative impact on seabed habitats. It is difficult to weigh protection of vulnerable habitats in the CAII habitat closure with potential for effort redistribution to assess the performance of the No Action alternative in this sub-region overall. Given that there are various access programs occurring within these areas, this alternative probably has positive impacts overall, despite being inefficient in terms of encompassing vulnerable habitat types. The action alternatives certainly afford an opportunity to increase the relative vulnerability of habitats within habitat management areas.

4.1.1.4.2 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. The groundfish closures could remain in place seasonally as spawning areas, or year round under the No Action spawning alternative. In the absence of specific habitat management areas where mobile bottom-tending gear use is managed directly, minimization of adverse effects would rely on fishing as efficiently as possible, with the greatest catches for the least swept area. As noted above, the habitat closure portions of the no action areas prohibit mobile bottom-tending gear fishing in habitat types that are not especially vulnerable, specifically in the CAI habitat closure areas. This alternative, as well as the other action alternatives in this sub-region, afford an opportunity to increase flexibility in terms of fishing location on Georges Bank. This would hopefully increase efficiency somewhat, and could relieve pressure on more vulnerable habitat types. However, habitat types that are more vulnerable to accumulating fishing impacts, i.e. those along the northeastern flank of the bank, would not receive any specific protections under this alternative. Given this, it is estimated that Alternative 2 would have a negative impact overall, and relative to no action, on seabed habitats.

It should be noted that even if there are no year-round habitat closure areas on Georges Bank that the overall amount of fishing effort would still be capped using catch limits and other management tools. For example, going forward under any of the action alternatives, rotational scallop fishing in the existing CAI and CAII access areas would not be expected to change much. The access area designations are part of the scallop FMP and are not being removed or adjusted by this alternative. While access area boundaries in CAI could shift if an action alternative is selected for this sub-region or a new access area in northern CAII could be added, the overall levels of fishing would be limited to optimize yield and fishing will continue to occur on a periodic basis within the access areas. Other locations that are no longer part of a habitat closure, groundfish closure, or scallop access area could be fished under open area days at sea.

4.1.1.4.3 Alternative 3

This alternative would designate the Northern Edge HMA with one of the four mobile bottom-tending gear restrictions, and remove the existing habitat closure areas and groundfish closure areas. The groundfish closures could remain in place seasonally as spawning areas, or year round under the No Action spawning alternative. The 476 km^2 Northern Edge HMA overlaps with the existing CAII habitat closure, and has similar characteristics in terms of substrate composition (Table 34) and vulnerability (Table 36). The Northern Edge area eliminates the southern part of the habitat closure, but extends further west and north. The existing habitat closure is somewhat larger at 641 km^2.

Relative to No Action for this sub-region, Alternative 3 offers a similar level of habitat conservation benefits, while increasing flexibility in terms of choice of fishing location. The assumption here is that the bulk of the No Action areas afford limited habitat conservation because they are already fished by mobile bottom-tending gears, or are not well located as they contain lower vulnerability habitat types. Because the Northern Edge HMA is somewhat smaller than the CAII habitat closure, this alternative likely has a lower magnitude of positive impacts relative to No Action.

Option 1, complete closure to mobile bottom-tending gears, offers the highest level of habitat conservation benefit. Option 2 for this area is going to have similar benefits as there are relatively fewer clams within the Northern Edge HMA, and hydraulic clam dredges cannot operate in very coarse substrates, so little hydraulic dredging would be expected within the HMA, even if that gear type is exempted. Options 3 and 4 would likely have limited habitat conservation benefits and would have a negative impact relative to No Action. Scallop dredges would be allowed to fish unrestricted in the area under Option 3 or 4, and there would likely be substantial levels of scallop fishing (probably via a rotational access program) within the HMA given the high abundance of scallops in the area. Trawl gears would have restricted length and elevated ground cables (Option 3) or no ground cables (Option 4), but the catchability tradeoff and therefore net change in area swept are not well understood and cannot be estimated.

4.1.1.4.4 Alternative 4

Alternative 4 is similar to Alternative 3, except that it includes an additional gear modification area west of CAII. The direction of impacts associated with the gear modification area as compared to the area's current status as an open fishing area are not known, but are probably relatively small in magnitude. Impacts could be slightly positive if reductions in gear width lead to reduced area swept by trawl vessels, or impacts could be slightly negative if there is reduced catchability with the modified gear that outweighs reduced gear width. Given the substrate composition of the gear modification area, it is well-sited to encompass more vulnerable seabed types, but it is not clear that the gear modification measures will provide much conservation benefit. Overall, impacts of Alternative 4 should be similar to those for Alternative 3, given the likely small magnitude of impacts associated with the gear modification area.

4.1.1.4.5 Alternative 5

Alternative 5 includes a much larger gear modification area that covers most of the northeastern portion of the bank. This 6,838km^2 area is well located to encompass much of the vulnerable seabed on Georges Bank, but the impacts associated with gear modification areas are uncertain (see above). The alternative also includes a smaller mobile bottom-tending gear closure towards the center of the bank. Of the various action alternative areas, the mobile bottom-tending gear closure has the lowest vulnerability (Figure 9). This is because the area is generally sandier than other action alternative habitat management areas in this sub-region (Table 34). Relative to No Action, this alternative would have negative impacts. It would largely eliminate conservation measures in the existing habitat closure, trading the existing area for a gear modification area with uncertain benefits and a mobile bottom-tending gear closure that is not very well located to encompass vulnerable seabed types.

4.1.1.4.6 Alternative 6

Alternative 6 includes two different modifications of the existing CAII habitat closure, and would remove other management areas. Alternative 6A would extend the existing closure to the west and increase its size by roughly 80%. Alternative 6B shifts the area to the west, extending the western boundary but removing the eastern 8nm along the EEZ. This adjustment increases the area's size by about 25%. Both modifications have similar percent coverage of granule-pebble and cobble substrate relative to sand as compared with the existing CAII habitat closure and the Northern Edge HMA, which is not unexpected as they all overlap.

If Alternative 6A is implemented with Option 1 or 2, there would be positive impacts relative to No Action, given that the 6A area encompasses a larger area containing vulnerable seabed habitats as compared to the existing CAII habitat closure. As discussed under Alternative 3, the remaining portions of the existing areas are not particularly vulnerable to fishing. If Alternative 6A is implemented with Options 3 or 4, there would be negative impacts relative to No Action, as discussed above.

If Alternative 6B is implemented with Option 1 or 2, there would be neutral to slightly negative impacts relative to No Action. While there would be a slight increase in overall area protected, the 6B area eliminates continued protection of an area that has been closed to mobile bottom-tending gear fishing for nearly 20 years in exchange for areas further west that are currently open to fishing. Given that habitat recovery of some features in cobble-dominated environments may take 10 years or longer, continued protection of recovered biological epifauna in an existing area is probably of greater benefit versus new conservation measures in a currently open area containing similar geological structures. If Alternative 6A is implemented with Options 3 or 4, there would be negative impacts relative to No Action, as discussed above.

4.1.1.5 *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.

Table 37 – GSC-SNE: Dominant substrate coverage within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	

Area name, type, and region (number of overlapping unstructured grids)	Substrate										Area, km^2
	Low energy					High energy					
	M	S	G	C	B	M	S	G	C	B	
No action EFH											
Nantucket Lightship EFH (603)	3%	32%				1%	62%	2%	1%		3354
No action groundfish											
Nantucket Lightship GF (3509)	12%	28%				2%	54%	3%			6066
Habitat management areas											
Cox Ledge (37)						6%	73%	6%	6%	8%	199
Great South Channel (1518)							60%	22%	16%	2%	2545
Great South Channel Gear Mod Area (1656)							52%	31%	14%	2%	2328
Great South Channel, east (2186)							54%	27%	17%	2%	3334
Nantucket Shoals (1134)							68%	19%	12%	1%	2319
Nantucket Shoals, west (1244)							74%	15%	9%	1%	2936

Table 38 – GSC-SNE: Data support within each management area. Area indicates the total areal coverage of the unstructured grids that have their center point within the HMA, and is not the same as the exact size of the HMA.

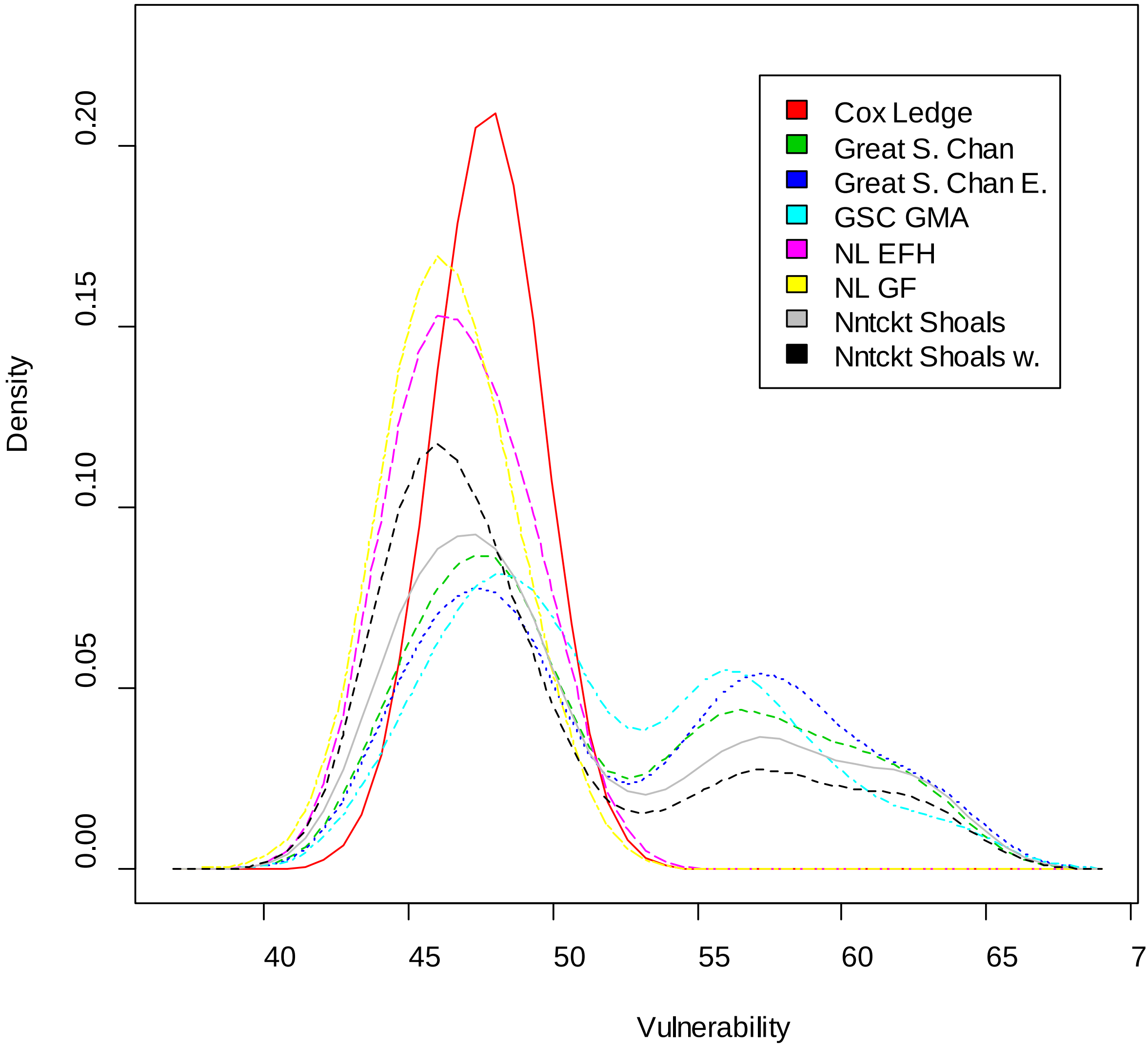
Area name, type, and region (number of overlapping unstructured grids)	Data support							Area, km^2
	Low	Moderate			High			
	1	2	3	4	5	6	7	
No action EFH								
Nantucket Lightship EFH (603)		5%	23%	3%	3%	54%	11%	3354
No action groundfish								
Nantucket Lightship GF (3509)		1%	2%	1%	1%	22%	73%	6066
Habitat management areas								
Cox Ledge (37)		24%	22%		6%	48%	1%	199
Great South Channel (1518)			16%	12%		52%	20%	2545
Great South Channel Gear Mod Area (1656)			4%	6%		62%	29%	2328
Great South Channel, east (2186)			12%	11%		53%	24%	3334
Nantucket Shoals (1134)		1%	26%	15%		42%	15%	2319
Nantucket Shoals, west (1244)		2%	29%	15%		39%	14%	2936

Table 39 – Minimum and maximum mobile bottom-tending gear vulnerability scores for each habitat management area in the Great South Channel/Southern New England sub-region, and the number of structured (10km x 10km) grids overlapping each area (*N*). Blanks indicate that the scallop dredge model domain did not cover the area, because it was beyond the maximum depth fished by that gear.

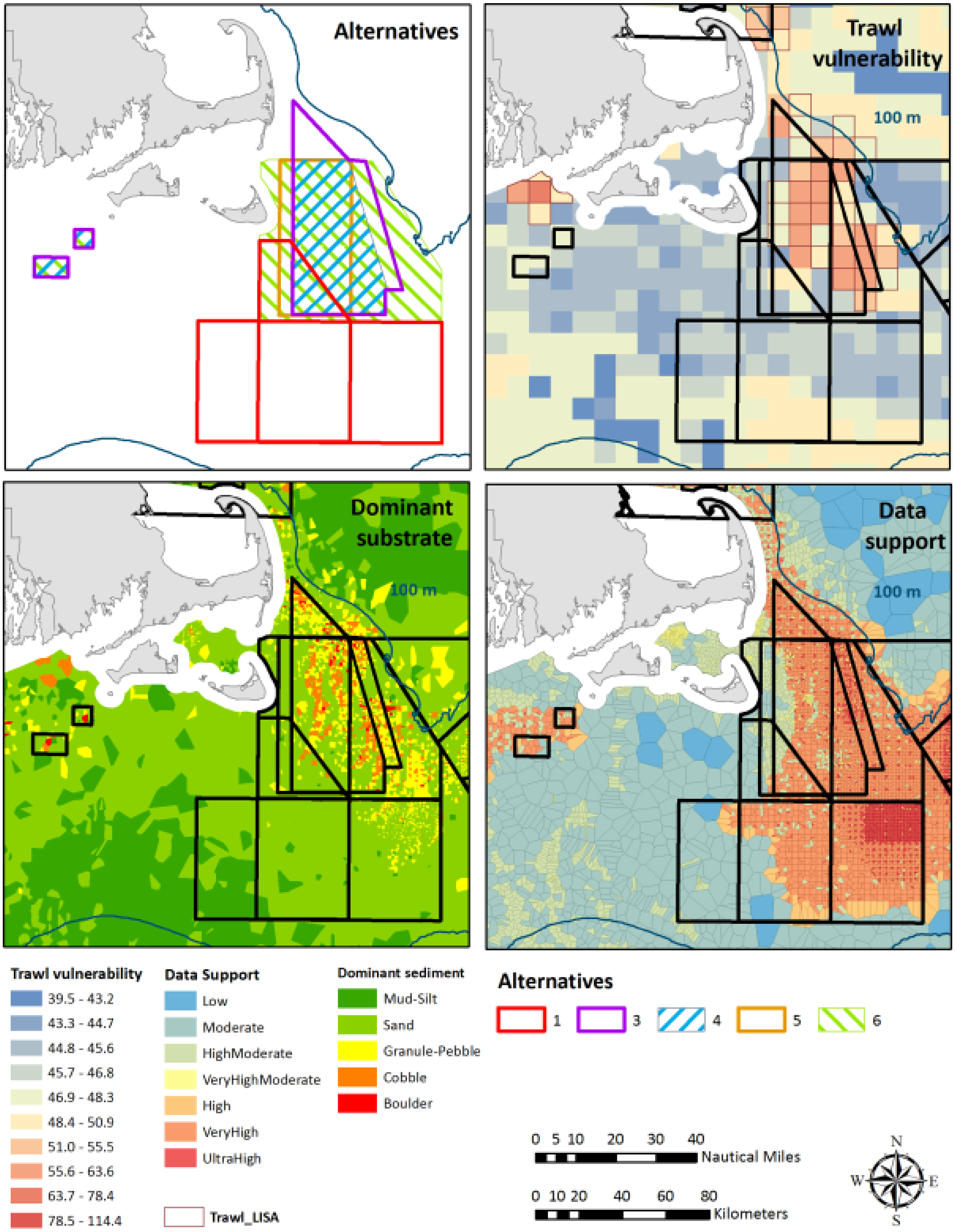
	Otter trawl			Scallop dredge			Hydraulic dredge		
	Min	Max	*N*	Min	Max	*N*	Min	Max	*N*
EFH closure									
Nantucket Lightship EFH	44.4	50.0	*31*	47.1	52.4	*31*	107.2	133.6	*31*
Groundfish closure									
Nantucket Lightship GF	42.2	49.2	*66*	46.3	51.8	*62*	107.2	136.0	*65*
Habitat Management Area									
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*

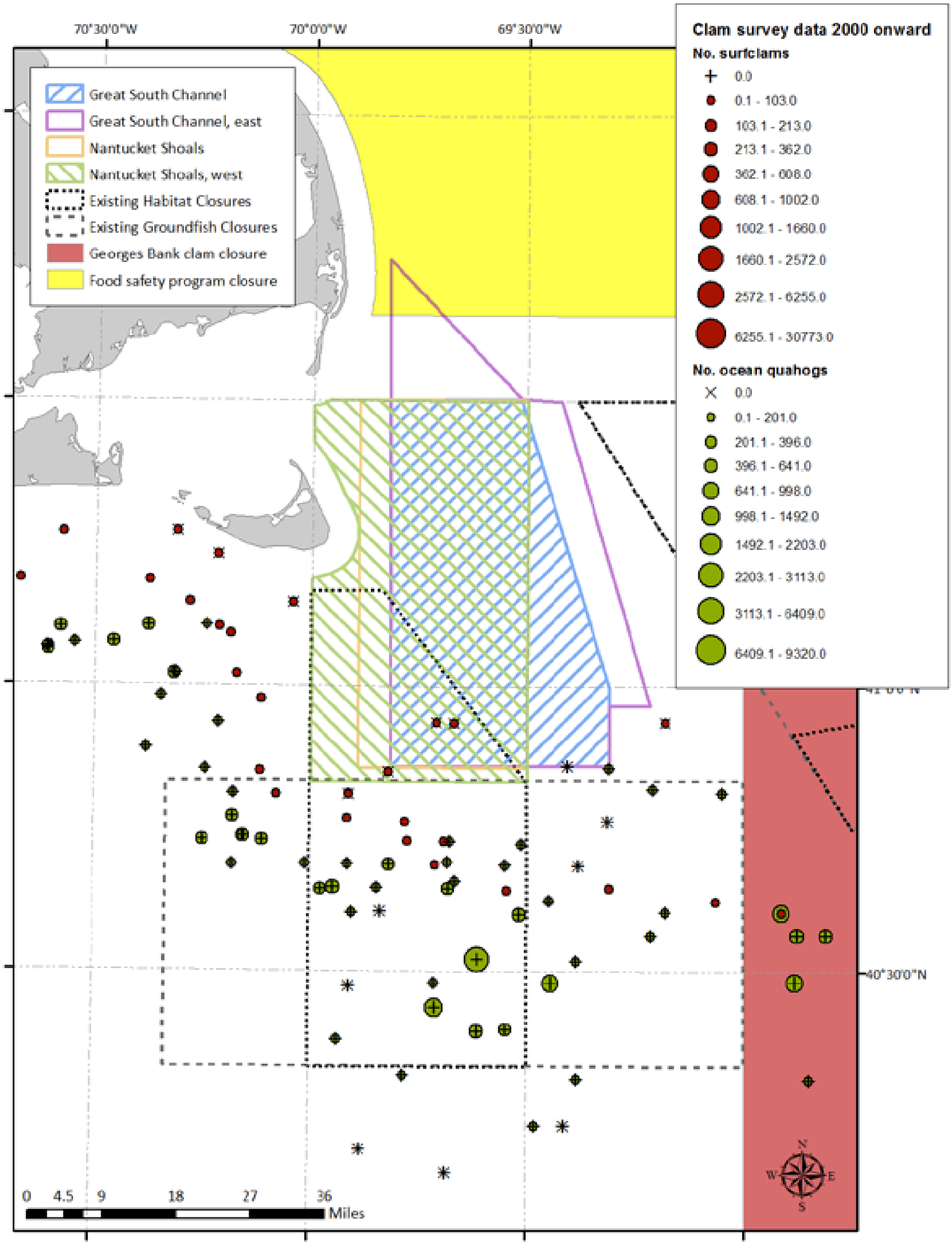
Figure 10 – GSC: Distribution of vulnerability scores for trawl gear displayed as density plots. A density distribution shifted to the left indicates relatively lower vulnerability, while a density distribution shifted to the right indicates relatively higher vulnerability. Taller curves indicate a greater 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.



Map 40 – GSC-SNE: SASI dominant substrate, data support, and vulnerability outputs (trawl gear). Management areas not shown in the upper left panel are from other sub-regions.



Map 41 – Distribution of surfclams and ocean quahogs in clam dredge surveys since 2000 relative to the boundaries of existing and proposed habitat areas in the Great South Channel region.



4.1.1.5.1 Alternative 1 (No action)

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, so these areas offer limited habitat conservation benefits. Relative to the various action alternative areas, the Nantucket Lightship habitat closure is not as vulnerable to fishing gear impacts (vulnerability distribution shifted to the left in Figure 10), and consists mainly of high and low energy sand-dominated habitats (Table 37). Overall, the No Action alternative has neutral to slightly negative impacts on seabed habitats, if closure of the existing areas to various types of fishing effort results in a displacement of effort onto more vulnerable habitat types. If displacement is not occurring due to differences in species composition in the existing vs. alternative areas, then the current areas and measures are likely more neutral in terms of their impacts on habitat.

4.1.1.5.2 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. Because the No Action areas in this sub-region are not very effective in terms of encompassing vulnerable habitats, Alternative 2 would have a neutral to slightly positive impact on seabed habitats in this sub-region relative to no action, to the extent that it removes existing areas and allows greater flexibility in choice of fishing location and could shift fishing effort from more vulnerable habitat types to less vulnerable habitats that are currently closed. Alternative 2 has negative impacts relative to Alternatives 3, 4, and 5 if Options 1 or 2 are selected and also relative to Alternative 6, because unlike those alternatives, Alternative 2 offers no specific protection for vulnerable habitat types north of the currently closed areas.

4.1.1.5.3 Alternative 3

Alternative 3 includes the Great South Channel East HMA and Cox Ledge HMA (2 sub-areas). The Great South Channel East is the largest of the alternative areas in the sub-region at 3,356 km^2, and roughly comparable in size to the existing Nantucket Lightship EFH closure (3,387 km^2). This area also has the largest fraction by area of cobble- and boulder-dominated habitat, with 17% cobble and 2% boulder coverage (Table 37). Data support is high for 77% of the area, meaning that these larger grain sizes are detectable in the substrate data overlapping most of the management area (Table 38). Greater uncertainty in substrate classification due to lower data support occurs in the western portion of the area (Map 40). Habitat vulnerability in this area, and the other action alternative areas, is much higher than for the existing Nantucket Lightship EFH closure. Therefore, implementation of the GSC East HMA with Option 1 is expected to have a positive impact on seabed habitats relative to No Action.

In general, clam dredges are used frequently in this sub-region as compared to other sub-regions, so their exemption from the HMA restrictions (Options 2, 3, or 4) or not (Option 1) has an influence on the habitat conservation benefits of any particular area. This is different from other regions where the habitat impacts of Options 1 and 2 are probably equivalent to one another due to little overlap with the clam resource or clam fisheries. As shown in the economic impacts sections, clam dredging represents an increasing fraction of overall revenues across all gear types from the Great South Channel East HMA (Alternative 3) to the Nantucket Shoals West HMA (Alternative 6). Clam dredges have an adverse effect on the seabed and therefore Alternative 3 Option 2 has lesser positive impacts as compared to Alternative 3 Option 1. However, the areas in which clams occur are probably the lower vulnerability portions of the GSC East HMA and other alternative HMAs in Alternatives 4, 5, and 6. Specifically, the clam survey is conducted and shows the presence of clams in the southwestern portion of these areas (Map 41), and these locations tend to be relatively sand dominated and less vulnerable to adverse effects as compared to the northern and eastern parts of these HMAs (Map 40).

Selecting Option 3 or 4 for the GSC East HMA will have neutral impacts relative to No Action, but negative impacts relative to Option 1 or 2. While the existing No Action areas are not particularly vulnerable to fishing, removing these areas and implementing a gear modification area that has uncertain impacts (probably slightly negative to slightly positive) should have roughly neutral impacts overall.

The Cox Ledge HMA is the same for Alternatives 3-6. The two sub-areas in combination are much smaller in scale as compared to the Great South Channel/Nantucket Shoals HMAs at 213 km^2. The southern of the two areas overlaps Cox Ledge itself, while the northern area overlaps a feature known as 19 Fathom Bank. The areas overlap the edge of the video survey sampling region as it existed when the SASI base grid was developed, so while the presence of cobble- and boulder-dominated habitats is well known, the actual substrate map is not very well resolved spatially, especially along the northern edge of the 19 Fathom Bank area and the southern edge of the Cox Ledge area. Therefore, while it can be stated confidently that the full range of grain sizes are present in the areas, it is difficult to compare the percent coverage of various substrates between the Cox Ledge HMA and the GSC/NS HMAs. Various types of fishing effort and realized adverse effects overlap these HMAs, but lower impact gillnet and trap gears are prevalent in recent years. Bottom trawl effort also overlaps the areas, and designation of the Cox Ledge HMA would primarily serve to mitigate trawl gear impacts. Other mobile bottom-tending gear effort including scallop dredging, clam dredging, and squid trawling appear to overlap to a lesser extent. Designation of the Cox Ledge HMA is expected to have positive habitat impacts if implemented with Option 1 or 2, and these options are probably similar in terms of impacts as hydraulic clam dredging appears to be limited in the area. Designation of the HMA if implemented with Option 3 or 4 is expected to have neutral impacts on habitats, for reasons previously discussed.

4.1.1.5.4 Alternative 4

Alternative 4 includes the Great South Channel HMA and Cox Ledge HMA (2 sub-areas). The Great South Channel HMA is a subset of the GSC East HMA and overall has a similar distribution of habitat types (i.e. similar percent coverage of cobble and boulder areas). Given that the habitat types in these two areas are similar, the smaller Alternative 4 area affords less protection for vulnerable seabed in the sub-region and therefore has a lesser positive impact relative to Alternative 3, but still a positive impact relative to No Action, if implemented with Option 1 or 2. If implemented with Option 3 or 4, impacts are expected to be neutral relative to No Action. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well.

4.1.1.5.5 Alternative 5

Alternative 5 includes the Nantucket Shoals HMA and Cox Ledge HMA (2 sub-areas). The Nantucket Shoals HMA overlaps with the GSC and GSC East HMAs and overall is somewhat sandier than these two areas (Table 37, Map 40). Given that the area is similar in size to the GSC HMA (Alternative 4) but has a lower percent coverage of cobble and boulder habitats, Alternative 5 affords less protection for vulnerable seabed in the sub-region and therefore has a lesser positive impact relative to Alternative 4 (and 3), but still a positive impact relative to No Action, if implemented with Option 1 or 2. If implemented with Option 3 or 4, impacts are expected to be neutral relative to No Action. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well.

4.1.1.5.6 Alternative 6

Alternative 6 includes the Nantucket Shoals West HMA as a mobile bottom-tending gear closure, and the Great South Channel Gear Modification Area. The Nantucket Shoals West HMA overlaps with the GSC, GSC East, and Nantucket Shoals HMAs and overall is somewhat sandier (Table 37, Map 40). Given that the area is essentially a larger version of the Nantucket Shoals HMA, but the extension is into sandy, lower vulnerability habitat types, impacts are probably similar to those for Alternative 5, Option 1 or 2. The gear modification component of this alternative is expected to result in neutral impacts relative to No Action. The Alternative 3 discussions about clam distributions/clam fishing and the Cox Ledge HMA generally apply to this alternative as well; the Nantucket Shoals West HMA appears to have the greatest overlap with clams and the clam fishery of any of the Alternatives 3-6.

4.1.1.6 *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 40 - Table 44. 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 7A areas, indicating the most potential positive effects for each species group in the Western GOM. Diversity in Alternative 7B 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 7A and Alternative 7B areas than No Action. All species diversity in Alternative 7B 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 7A areas are less than No Action, yet all species diversity is greater and the highest in the season. Alternative 7A 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 7B 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 7A areas but is still slightly higher than in No Action areas. Diversity is lowest in Alternative 7B 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 3 affect no areas so no diversity values are included. 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. Diversity for each species group is also higher in Alternative 5 areas than in No Action. Each species group is less diverse in Alternative 6A areas and Alternative 6B areas than in No Action, indicating the least positive effects.

Groundfish diversity appears to be highest during summer in Georges Bank. Diversity of groundfish is lower in Alternative 4 areas than No Action, but regulated and all species diversity are the highest of the season. 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 diversity is highest in Alternative 6A areas, yet diversity for regulated and all species is lower than No Action. Diversity for each species group is lower in Alternative 6B areas than No Action.

Fall diversity of each species group is higher in Alternative 4 areas than No Action. Alternative 4 areas could also have the most positive effects for all species in the fall in Georges Bank. Groundfish diversity in Alternative 5 areas is also higher than No Action, but regulated and all species diversity is lower. Diversity of each species group in Alternative 6A areas are lower than No Action. Groundfish and regulated species diversity are higher in Alternative 6.2 areas than No Action, yet all species diversity is lower.

In the winter, none of the areas affected by Alternative 4 or 5 were sampled. Diversity of each species group is higher in areas affected by Alternative 6A and 6B than No Action and also equal, indicating that these alternatives have the potential for greater positive effects for each species group in Georges Bank.

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 40 – 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 41 – 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 42 – 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 43 – 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	94	0.954	0.583	1.165	128	0.994	0.519	0.943	33	0.908	0.684	1.534	4	0.949	0.662	1.601
Groundfish Closure	248	0.903	0.643	1.239	399	0.992	0.602	1.084	96	0.894	0.619	1.443	7	0.830	0.543	1.173
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	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 4	33	0.983	0.781	1.362	23	0.986	0.857	1.466	11	0.962	0.773	1.838				
Alternative 5	86	0.980	0.657	1.216	104	0.991	0.724	1.268	39	0.960	0.656	1.373				
Alternative 6.1	72	0.924	0.439	0.832	106	0.995	0.344	0.606	19	0.863	0.678	1.501	3	0.974	0.717	1.662
Alternative 6.2	41	0.910	0.482	0.879	52	0.992	0.464	0.762	12	0.932	0.698	1.470	3	0.974	0.717	1.662

Table 44 – 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 Large mesh groundfish stocks and their habitats

4.1.2.1 *Analytical approach and assumptions*

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.

4.1.2.1.1 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 45 – 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.

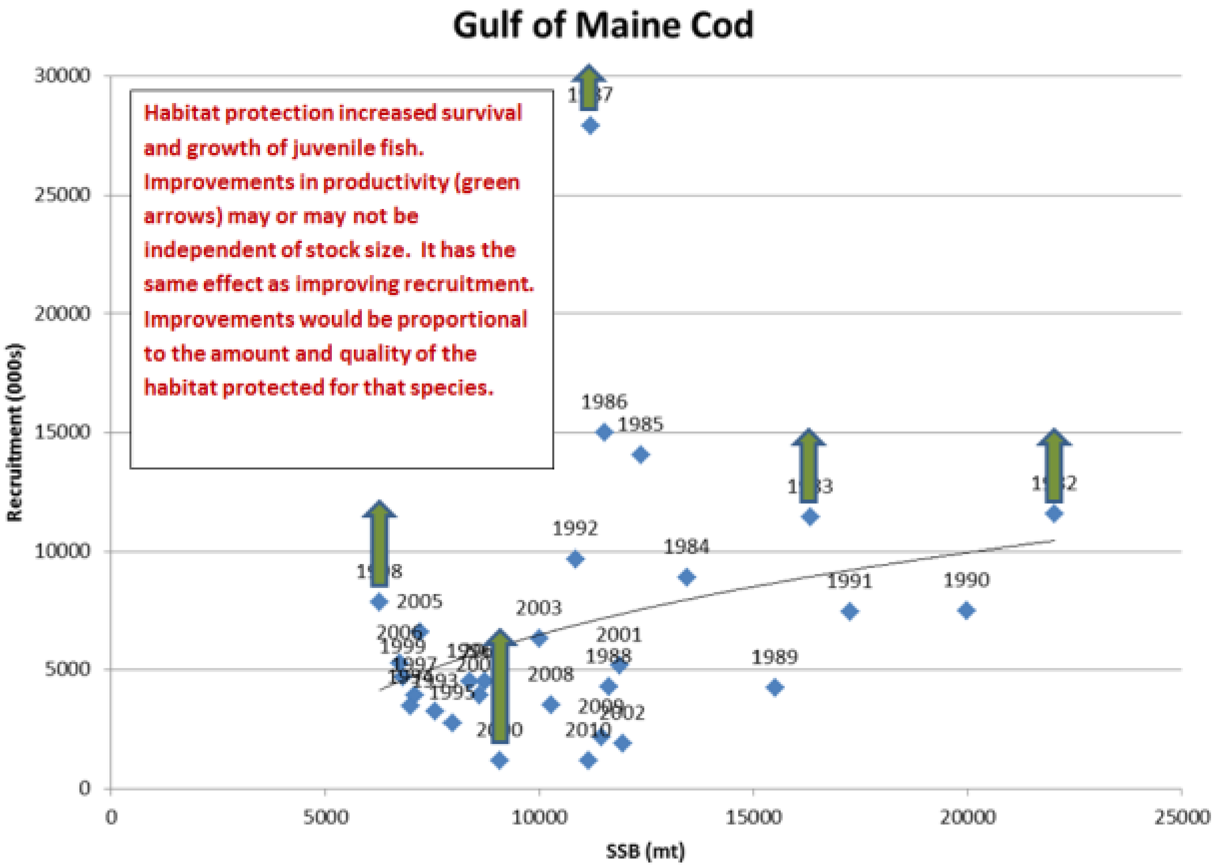
At a stock level, there are many ways to improve productivity of a stock and increase sustainable yield including improving survival and growth of young ages through better habitat, increasing the population of primary prey species, reducing population levels of predators, and reducing fishing mortality 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 11 – Illustration of potential impacts of habitat improvement on recruitment using actual spawning stock biomass and recruitment estimates for Gulf of Maine cod. Data are from NEFSC 2013; http://nefsc.noaa.gov/publications/crd/crd1311/.



Habitat protection increased survival and growth of juvenile fish. Improvements in productivity (green arrows) may or may not be independent of stock size. It has the same effect as improving recruitment. Improvements would be proportional to the amount and quality of the habitat protected for that species.

4.1.2.1.2 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.

4.1.2.1.2.1 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.

4.1.2.1.2.2 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.

4.1.2.1.2.3 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).

4.1.2.1.3 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. 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 12 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 42 – Current gillnet effort distribution (left, 2010-2013) compared to historic gillnet effort distribution (right, 1994-1998) before the Western Gulf of Maine closure.

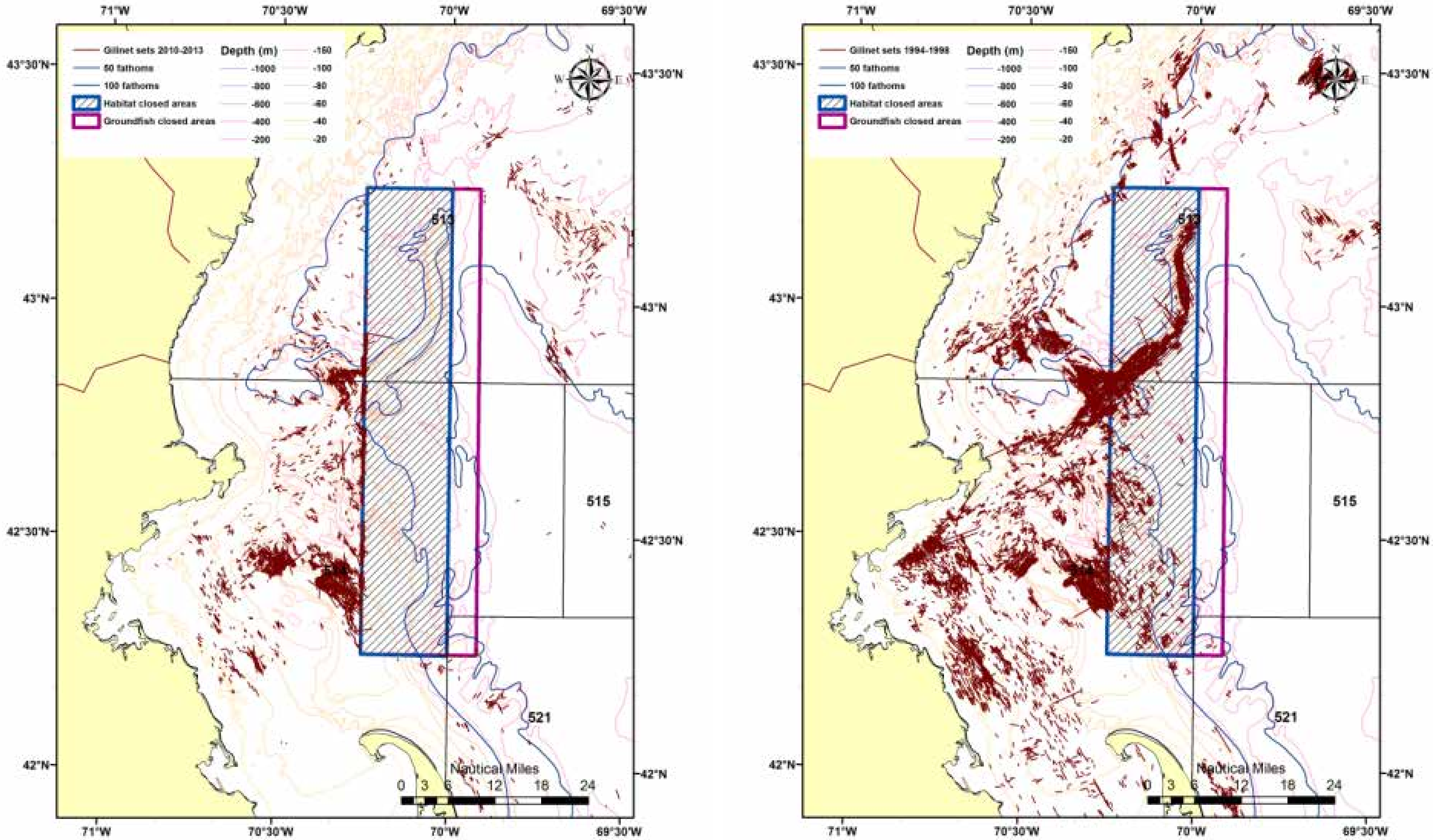
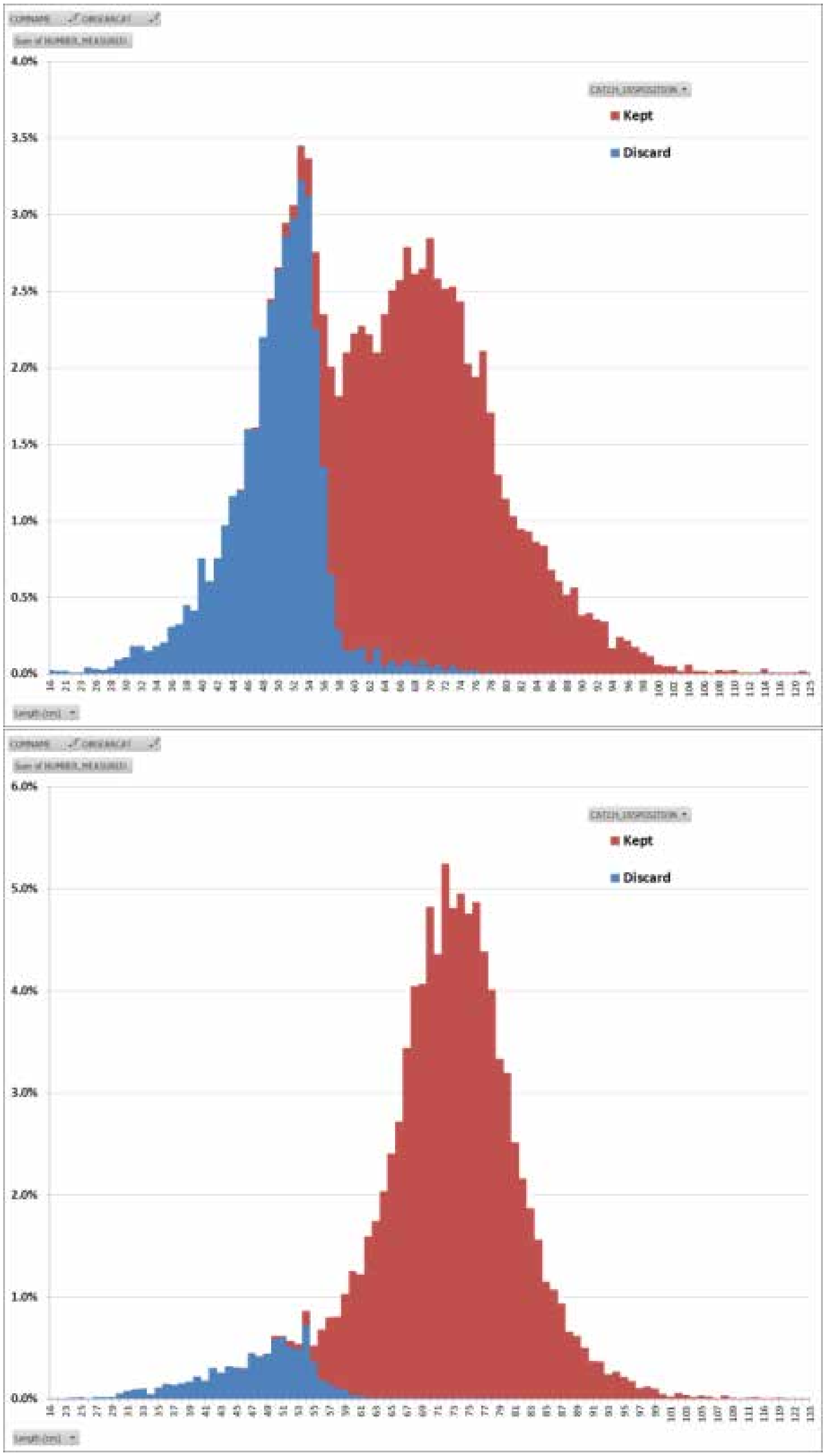


Figure 12 – Length frequency of observed cod catches in the Gulf of Maine (Statistical Areas 511-515) by trawls (top) and gillnets (bottom) during 2010-2013.



4.1.2.1.4 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 43). 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 43). 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 43. In the spring (Figure 13), 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 43). In the spring (Figure 13), there appear to be significantly more 0-25 cm cod only at 7ºC, but not at any other temperature[7]. At temperatures above 9ºC, only sub-legal cod below 25 cm were caught.

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

In the fall (Figure 14), 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-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 13 – 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.

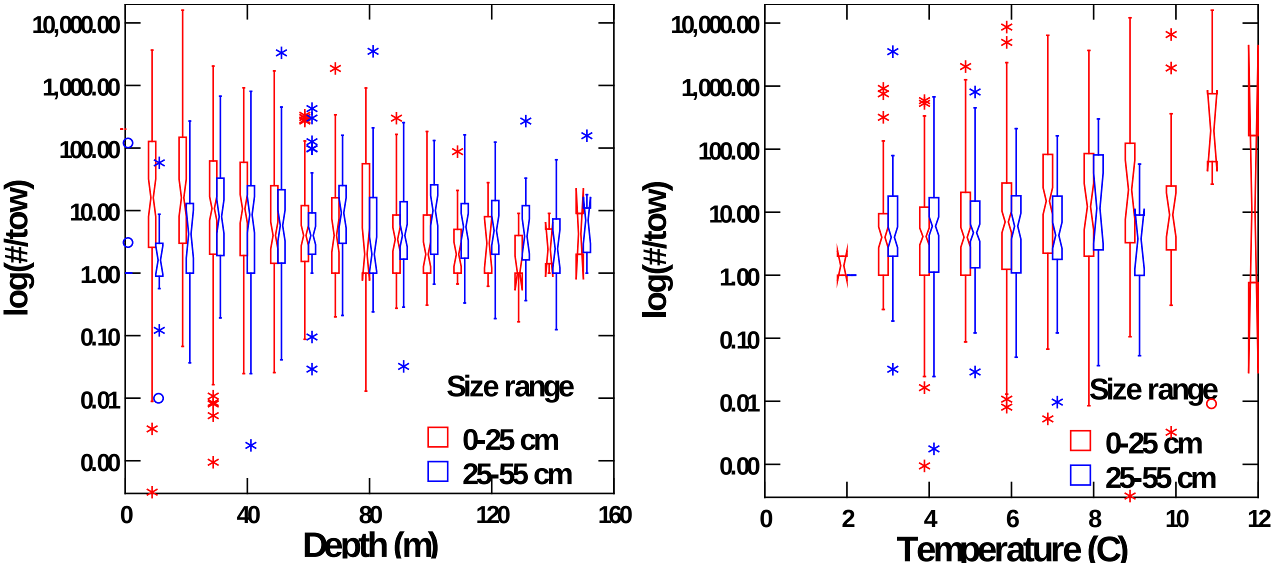
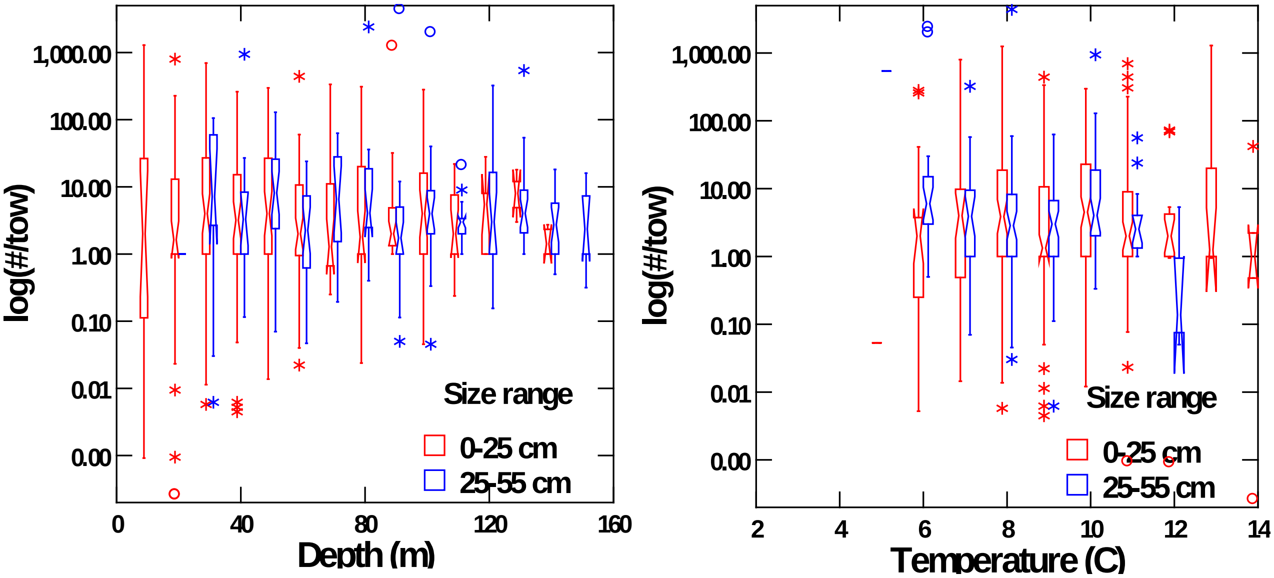
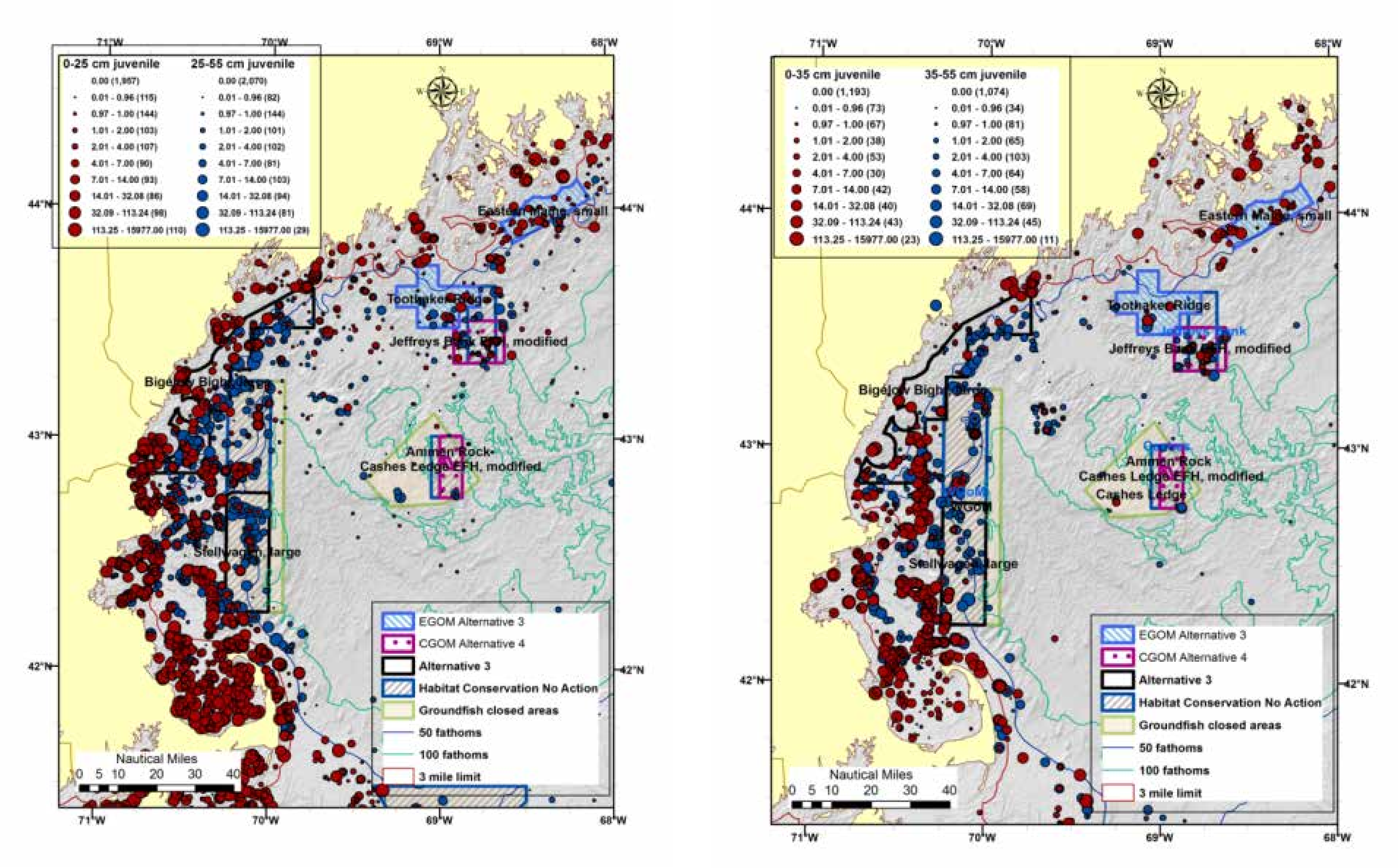


Figure 14 – Juvenile cod per tow by size category and depth (left) and bottom temperature (right) in Gulf of Maine strata, 2002-2011 fall surveys (NMFS, MADMF, ME-NH, IBS cod). Notches in bars represent the 95th percent confidence interval for the mean.



Map 43 – 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

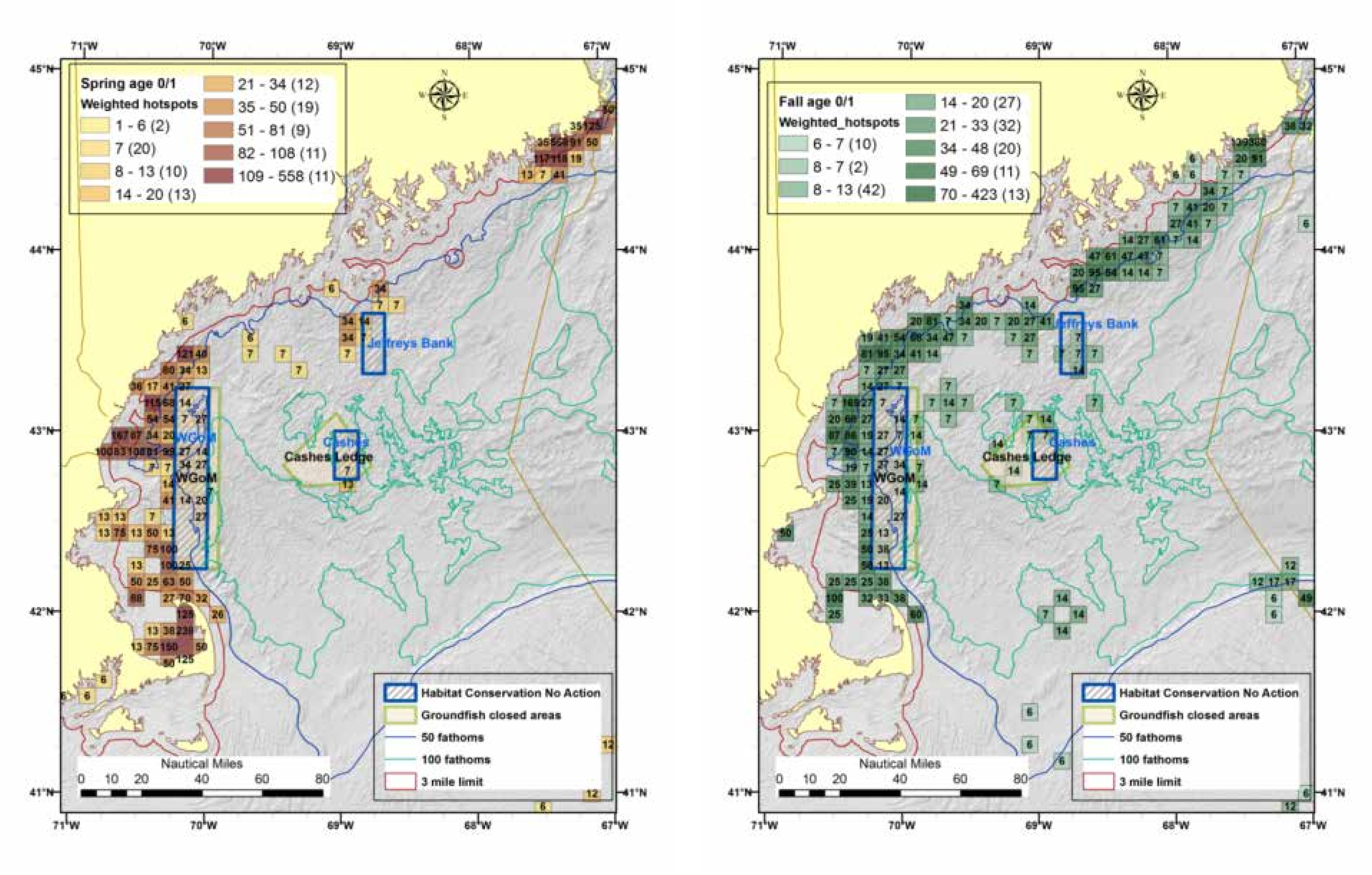
Fall and winter

4.1.2.2 *Eastern Gulf of Maine and the Scotian Shelf*

4.1.2.2.1 Alternative 1 (No action)

There are currently no habitat management areas in this sub-region, which would continue under no action. The distribution of unweighted and weighted hotspots in each survey season is shown on Map 44. Only the spring and fall figures are shown in this section as the summer and winter surveys do not cover the EGOM sub-region. Given the positive presence of weighted juvenile groundfish hotspots in this sub-region, continuing No Action is unlikely to substantially improve habitat quality associated with age 0/1 large mesh groundfish species because no special protection would be afforded for these juvenile groundfish populations.

Map 44 – Overlap of No Action EFH closures and year round groundfish closed areas with spring (left) and fall (right) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



4.1.2.2.2 Alternative 2

Total unweighted and weighted hotspots in the areas proposed for habitat management in EGOM Alternatives 2 and 3 are summarized in Table 46. Only spring and fall surveys are conducted in this sub-region, a NMFS trawl survey and a coastal ME-NH trawl survey. The areas combined have a weighted hotspot total of 235 in the spring and 591.7 in the fall. The spatial distribution of the hotspots change with seasons: in the spring, more groundfish hotspots overlap the proposed Machias Habitat Management Area and in the fall more hotspots overlap the proposed Eastern Maine, Large Habitat Management Area (Map 45). There were no age 0/1 cod hotspots in the proposed Eastern Maine, Large Habitat Management Area, but age 0/1 cod and herring hotspots were identified inshore within ME state waters. Habitat protection in the Eastern Maine, Large Habitat Management Area could be important to cod and other species when coupled with restoration activities in the area.

The Penobscot River Restoration 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). 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 Eastern Maine, Large Habitat Management Area could provide more protection to cod habitats in this region than the smaller area proposed in Alternative 3.

Because Alternative 1, the No Action/No HMA alternative has no identified areas, the hotspot score is zero. Therefore, Alternative 2 is expected to improve habitat benefits for age 0/1 groundfish. The amount of weighted hotspots are about the same as those for Alternative 3. The total number of hotspots for species given non-zero weights was somewhat higher in Alternative 2 than Alternative 3 (Table 47). The number of hotspots was 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, which is consistent with the conclusions in the physical and biological impacts section.

Table 46 – 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 45 – EGOM Alternative 2 overlap with spring (left), and fall (right) weighted age 0/1 groundfish hotspots from 2002-2012 NMFS and ME-NH survey data.

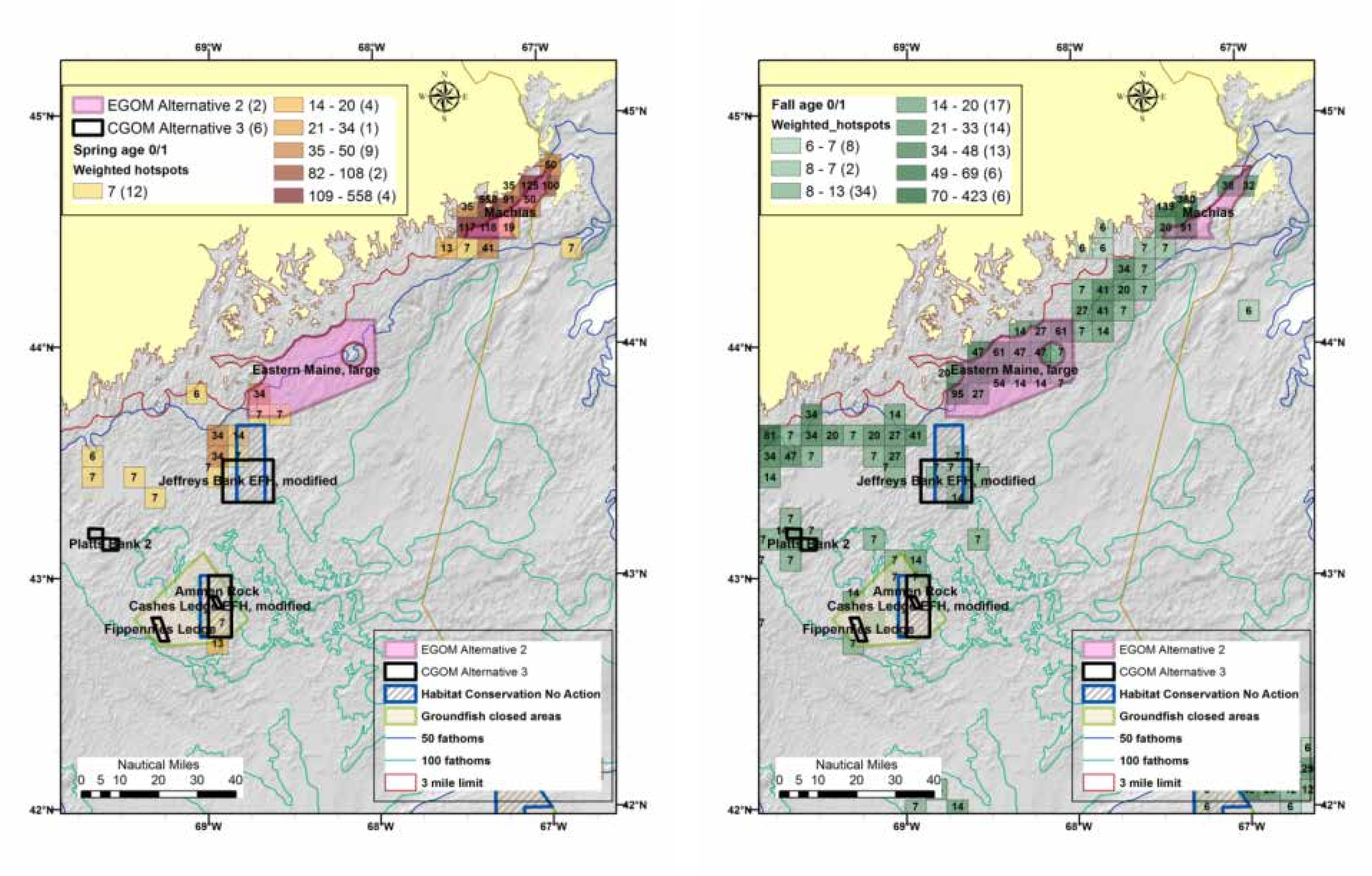


Table 47 – Total hotspots by species for EGOM habitat management area alternatives, compared to No Action.

	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

4.1.2.2.3 Alternative 3

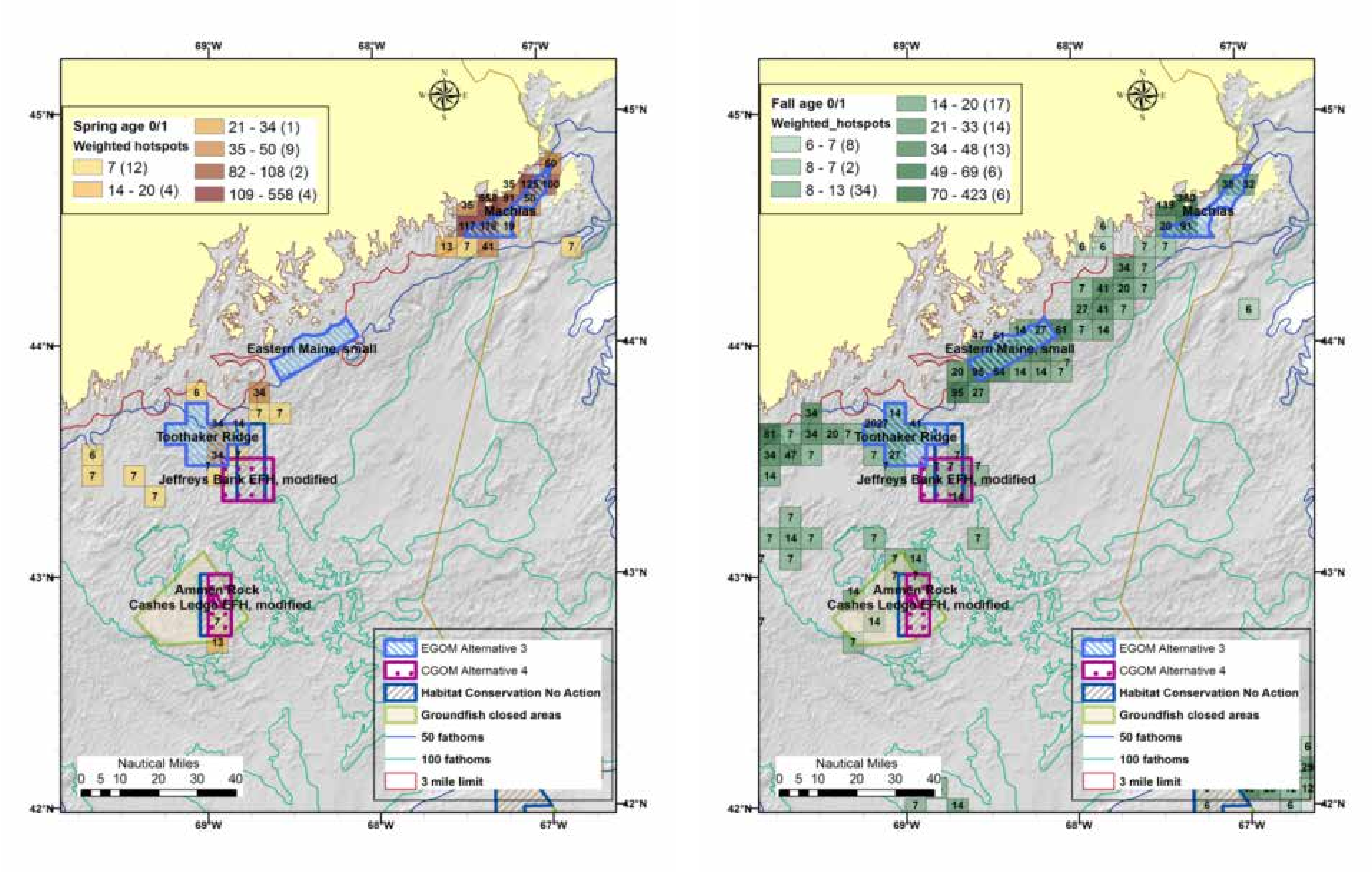
Alternative 3 includes the Small Eastern Maine, Machias, and Toothaker Ridge HMAs. All of the Eastern Maine areas cover areas of complex benthic habitat with rocky substrates (see substrate panel in Map 33). In this alternative, the Large Eastern Maine Area is reduced in size to the Small Eastern Maine area and the Toothaker Ridge Area is added to offset the size reduction of the proposed area in Eastern Maine.

Only spring and fall surveys are conducted in this sub-region, a NMFS trawl survey and a coastal ME-NH trawl survey. The areas combined have a weighted hotspot total of 268.8 in the spring and 449.8 in the fall (Table 46). The spatial distribution of the hotspots change with seasons: in the spring, more groundfish hotspots overlap the proposed Machias HMA and in the fall more hotspots overlap the proposed Eastern Maine, Small HMA and Toothaker Ridge HMA (Map 45). The total number of weighted hotspots in habitat management areas proposed by this alternative is 342, compared to 428 for Alternative 2 (Large Eastern Maine and Machias). Compared to Alternative 2, for species associated with hard and coarse substrates, the total number of hotspots was lower for redfish and witch flounder but the same for cod (Table 47).

There were no age 0/1 cod hotspots in the proposed Small Eastern Maine HMA, but age 0/1 cod and herring hotspots were identified inshore within ME state waters. Habitat protection in the Small Eastern Maine HMA could be important to cod and other species when coupled with the synergistic effects of the Penobscot River Restoration Project, summarized under Alternative 2. 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 similar magnitude because the hotspots are concentrated inshore and are well captured by the smaller Eastern Maine area.

Alternative 2 has higher hotspot scores for hard-bottom associated species and a higher hotspot score overall compared to Alternative 3. However, part of the score is driven by a higher prevalence of hakes which are associated with softer bottoms which are less vulnerable to the adverse effects of fishing. Therefore, existing groundfish data do not provide a level of precision to clearly distinguish which Alternative, 2 or 3, is expected to have more habitat protection value for juvenile groundfish. Based on the available date, the number of weighted hotspots are about the same for Alternative 2 and Alternative 3, so they would be expected to have similar conservation benefits for juvenile groundfish.

Map 46 – EGOM 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-NH, and IBS survey data.



4.1.2.3 *Central Gulf of Maine*

4.1.2.3.1 Alternative 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 47. Summer and winter hotspots in the Gulf of Maine are few, 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). 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. These totals include No Action areas in both the central and the western GOM. The low number of hotspots on Cashes Ledge is probably due to low sampling intensity in this specific area, but not to low sampling intensity elsewhere.

Continuing 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) is unlikely to substantially improve habitat quality associated with age 0/1 large mesh groundfish species. Continuation of No Action is likely to have positive impacts on the groundfish resource, but population level impacts have been so far difficult to detect.

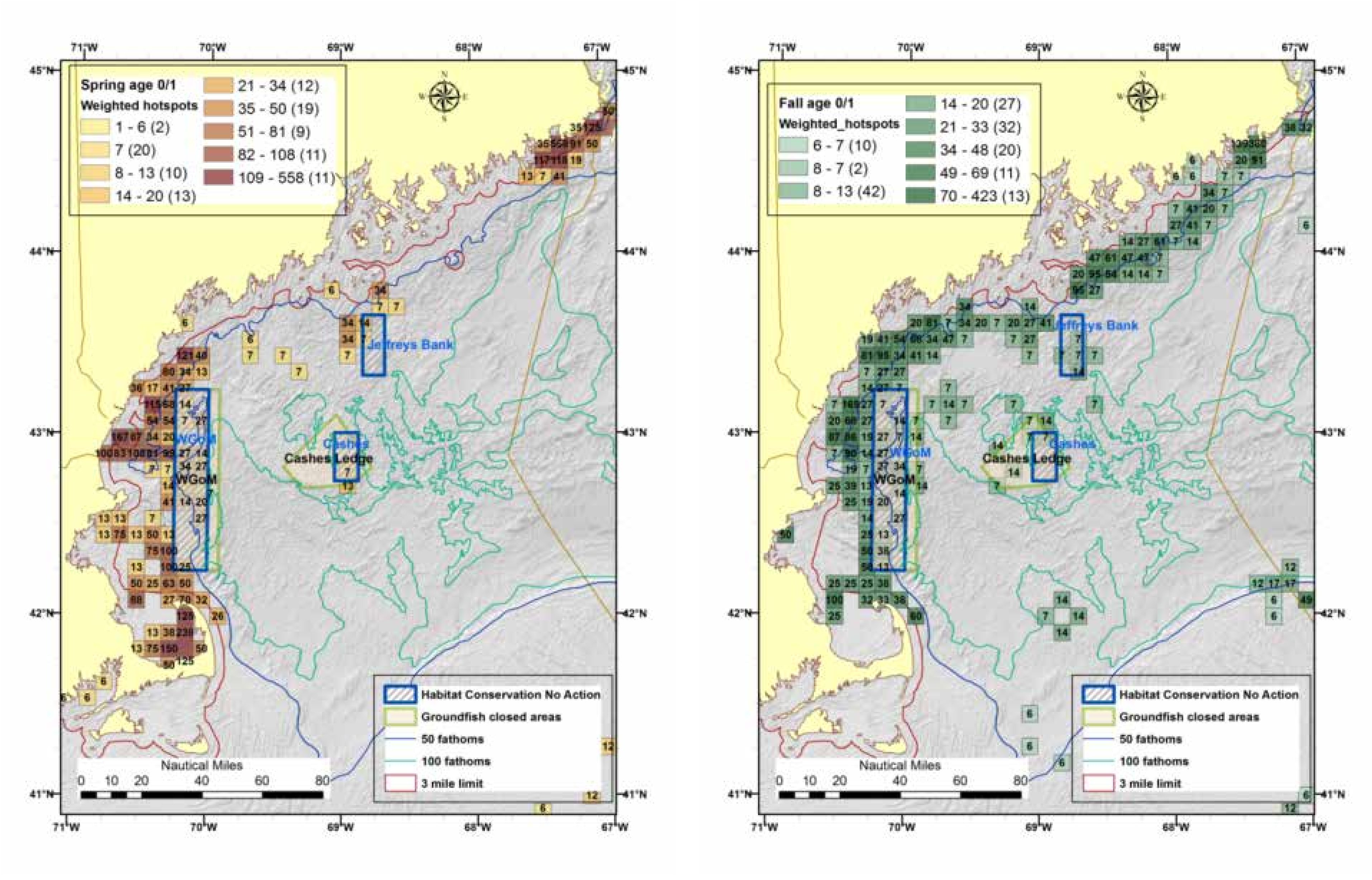
Despite these hotspot analysis results, it is still however possible that the existing groundfish and EFH closed areas have a positive impact on the groundfish resource. The effects on groundfish survival and growth while in the closed areas may be realized by the fishery operating outside the boundary of the closed areas, instead of causing a biomass buildup in the closed area or a measureable increase of productivity for the stock as a whole.

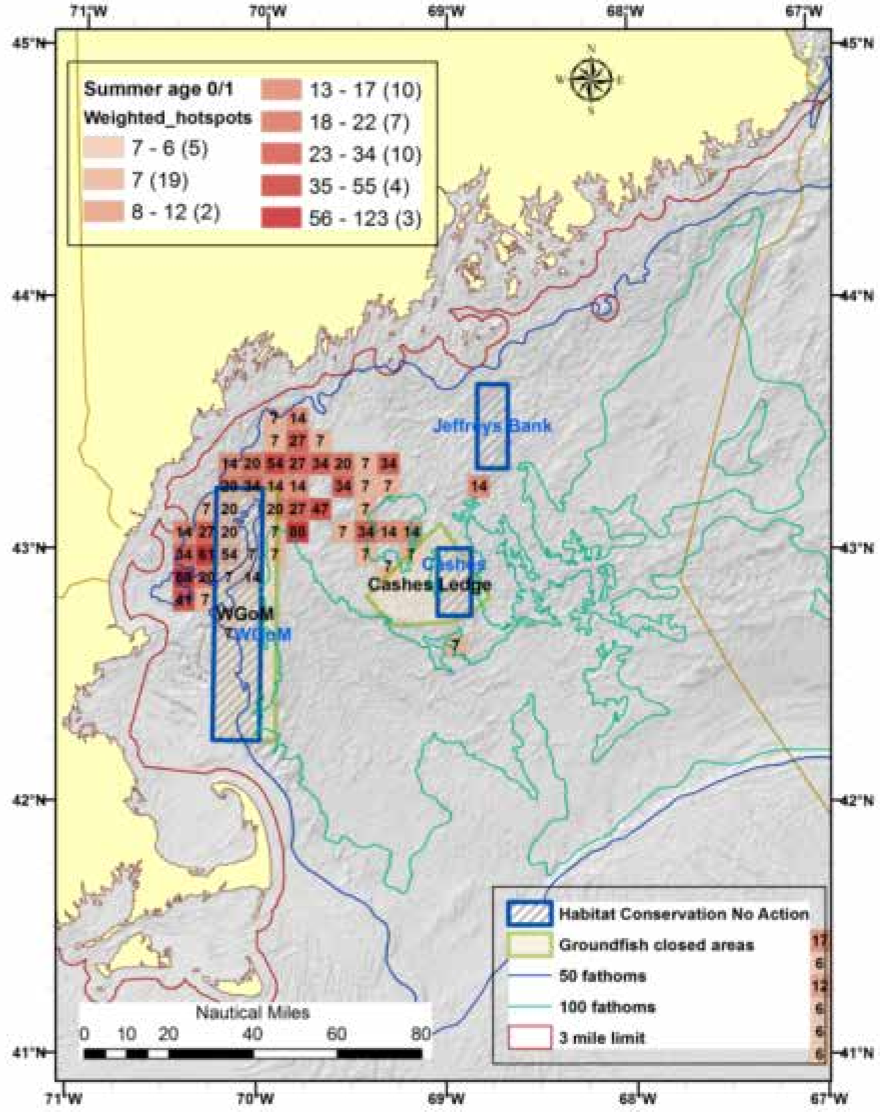
Therefore, based on this reasoning and the evidence at hand, the impacts of the No Action alternative in the Gulf of Maine is slightly positive.

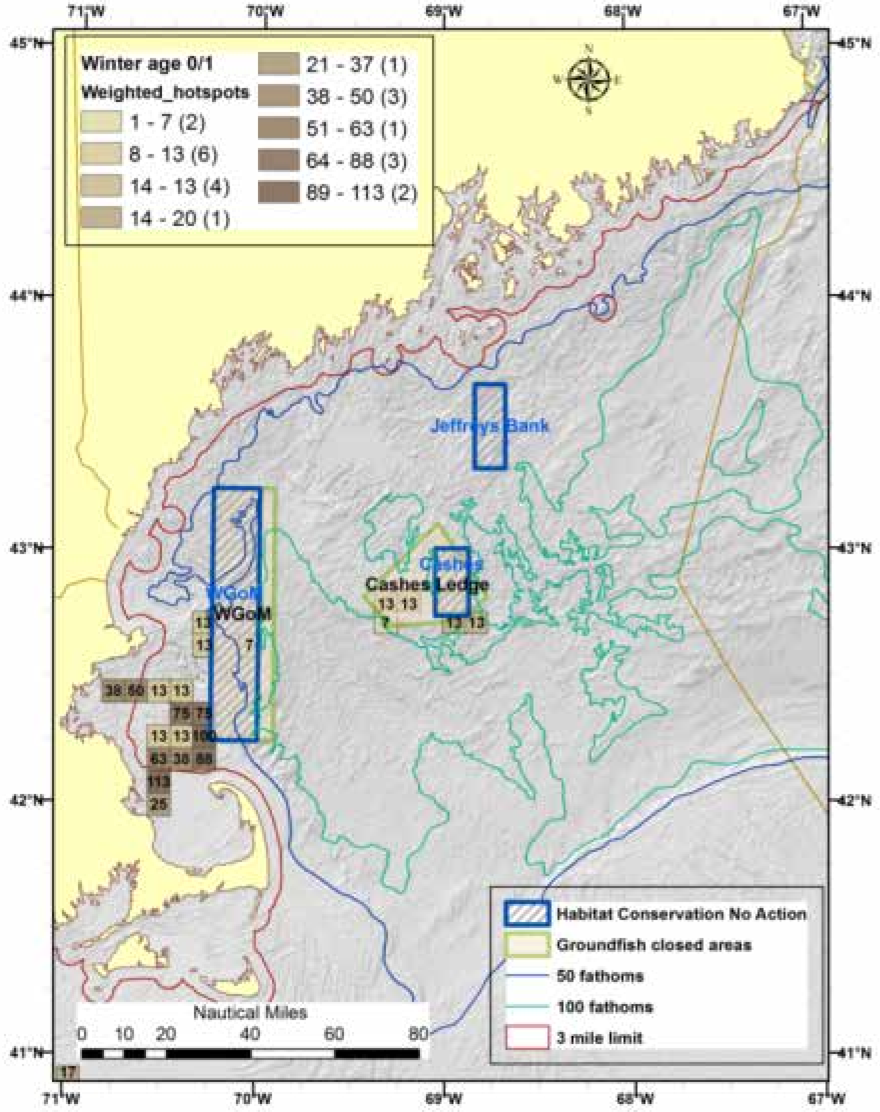
Table 48 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Gulf of Maine.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine	92	288.05	104	175.76	101	386.83	5	33.55
EFH closure								
Cashes Ledge EFH	1	6.7	2	0.0	2	6.8	0	0.0
Jeffreys Bank EFH	7	20.3	39	0.0	22	33.8	0	0.0
Western Gulf of Maine EFH	70	261.1	32	128.4	56	265.2	1	6.7
Groundfish closure								
Cashes Ledge GF	1	6.7	16	13.5	12	47.3	4	26.8
Western Gulf of Maine GF	84	261.1	49	162.2	67	305.7	1	6.7

Map 47 - 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-NH, and IBS survey data.




Summer 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
71°W
70°W
69°W
68°W
67°W
45°N
44°N
43°N
42°N
41°N


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
71°W
70°W
69°W
68°W
67°W
45°N
44°N
43°N
42°N
41°N

4.1.2.3.2 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 less conservation of groundfish habitat and lower benefits for groundfish stocks than either Alternative 1 (No Action), or Alternatives 3 and 4.

4.1.2.3.3 Alternative 3

Alternative 3 proposes a revised Jeffreys Bank and Cashes Ledge Area for habitat management, as well as an Ammen Rock management area which would be closed to all fishing gears except lobster traps. 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 49) than Alternative 1 (No Action).

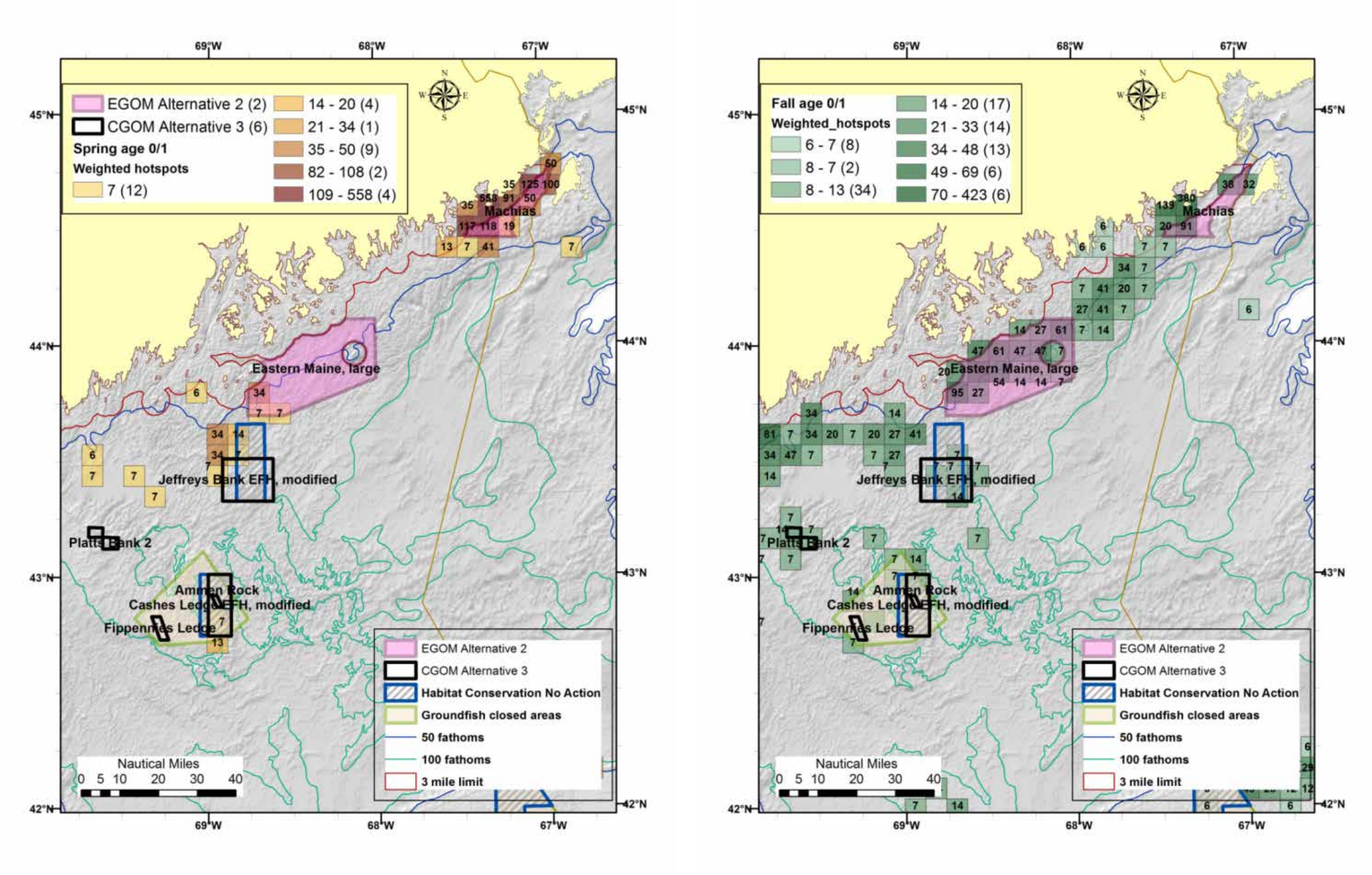
Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable (Table 50), but both are generally lower than those for Alternative 1 (No Action). There are no age 0/1 cod hotspots for any alternative, but this is probably due to the undersampling of the areas noted above. This 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.

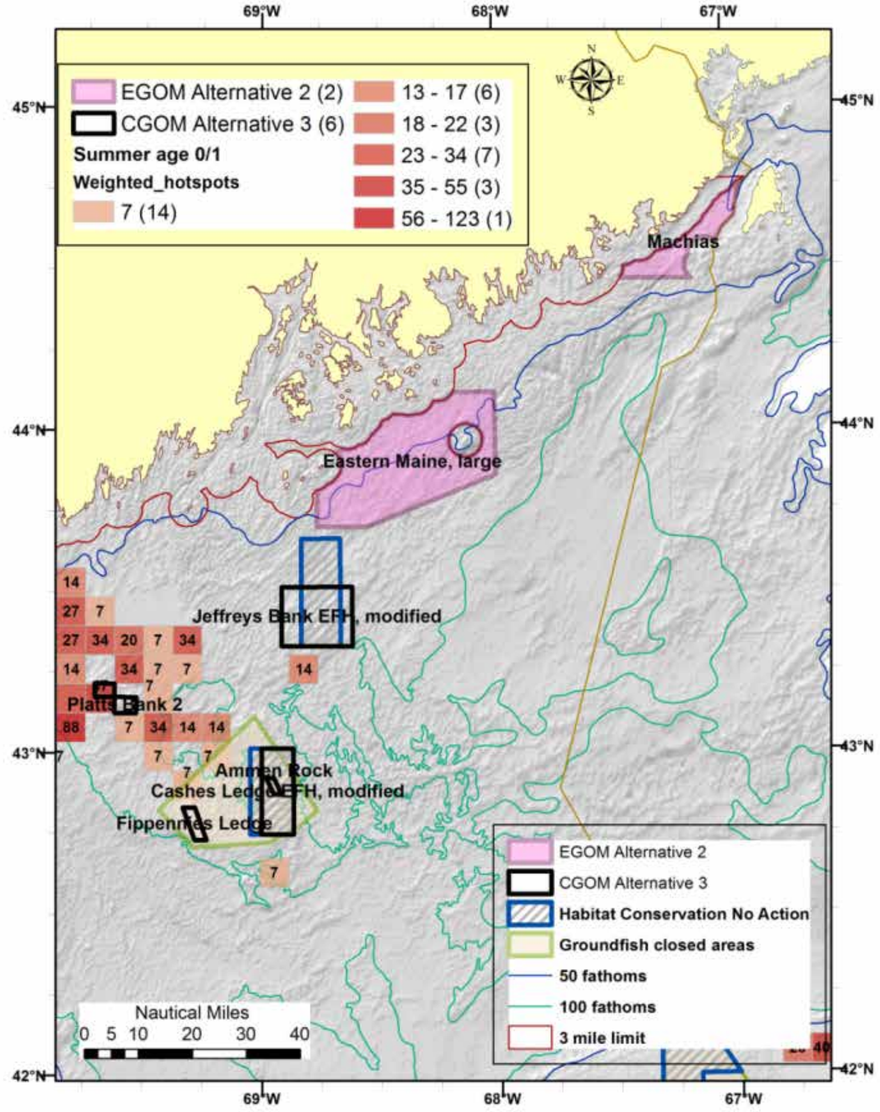
Based on the number and distribution of hotspots, Alternative 3 has less conservation benefits than Alternative 1 (No Action). Alternative 1 (No Action) does not include any EFH Closures around Platts Bank and Fippennies Ledge however, two areas with some survey catches of age 0/1 cod and other groundfish,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

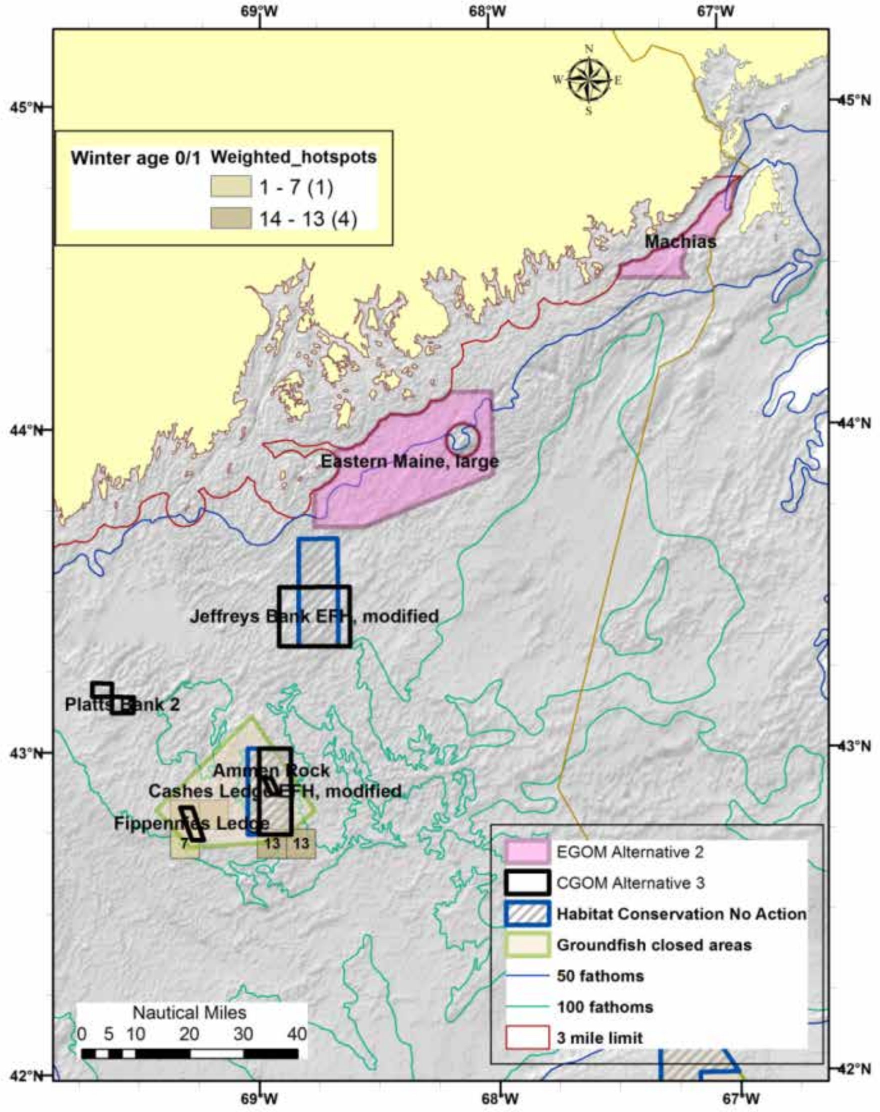
Table 49 – Total unweighted and weighted hotspots in CGOM habitat management area alternatives compared to No Action.

	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
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

Map 48 – CGOM Alternative 3 overlap with spring (left), fall (right), summer (left on next page), and winter (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, 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

4.1.2.3.4 Alternative 4

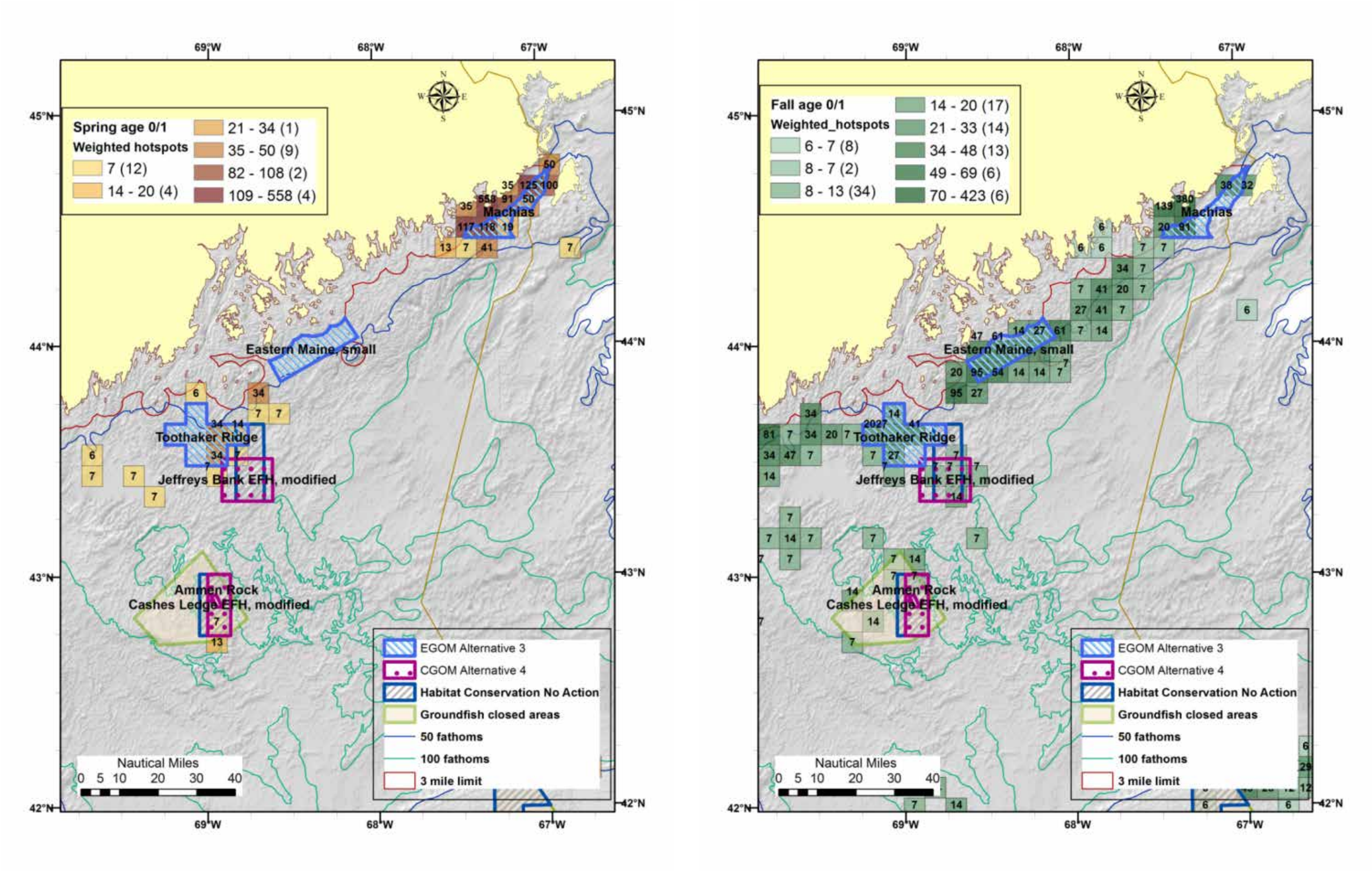
Alternative 4 proposes a revised Jeffreys Bank and Cashes Ledge Area for habitat management, as well as an Ammen Rock management area which would be closed to mobile bottom tending gears and gillnets. Unlike Alternative 3, habitat management areas around Platts Bank and Fippennies Ledge are not included.

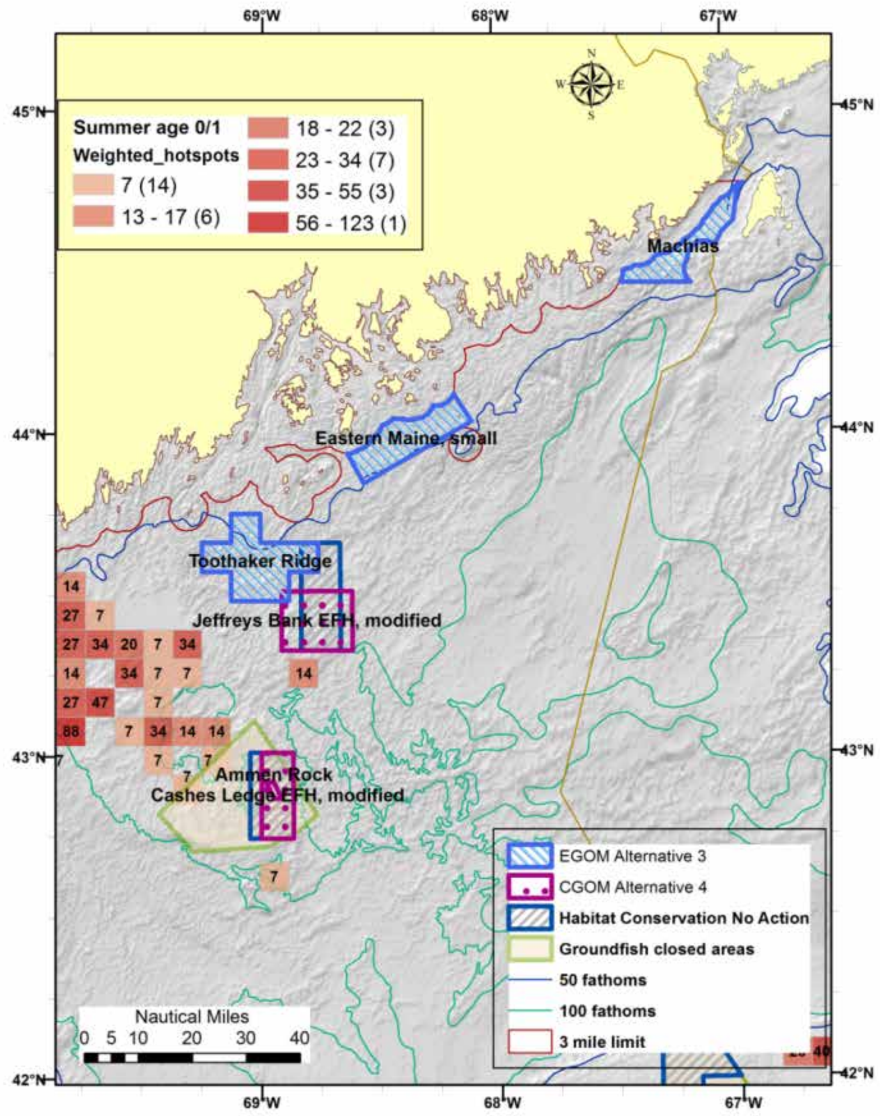
Differences between total hotspots for Alternative 3 and Alternative 4 are unremarkable (Table 50), but both are generally lower than those for Alternative 1 (No Action). Based on the number and distribution of hotspots, Alternative 4 has less conservation benefits than Alternative 1 (No Action). Alternative 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.

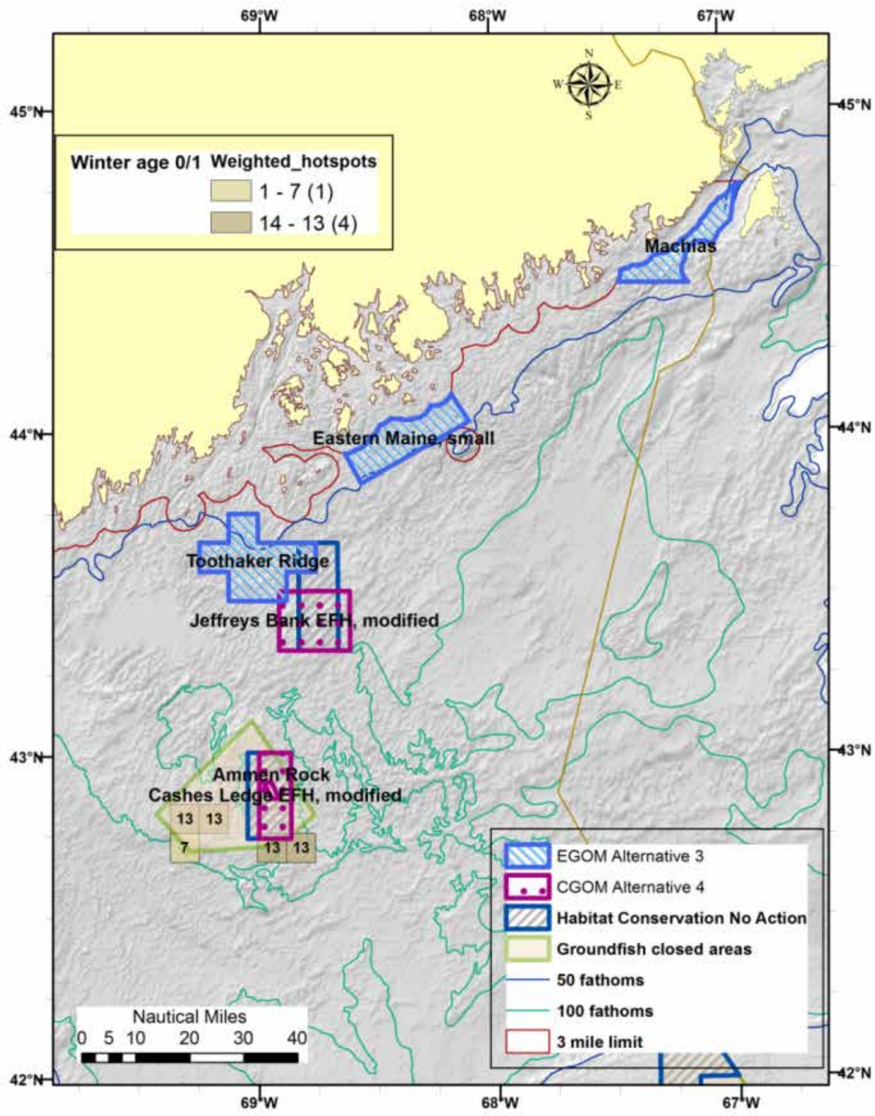
Table 50 – Total hotspots by species for CGOM habitat management area alternatives, compared to No Action.

	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

Map 49 – CGOM Alternative 4 overlap with spring (left), fall (right), summer (left on next page), and winter (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.




Summer age 0/1
Weighted_hotspots
7 (14)
13 - 17 (6)
18 - 22 (3)
23 - 34 (7)
35 - 55 (3)
56 - 123 (1)
69°W
68°W
67°W
45°N
44°N
43°N
42°N
N
S
E
W
Machias
Eastern Maine, small
Toothaker Ridge
Jeffreys Bank EFH, modified
Ammen Rock
Cashes Ledge EFH, modified
14
27
7
27
34
20
7
34
14
34
7
7
27
47
7
88
7
34
14
14
14
7
7
7
7
40
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


Winter age 0/1
Weighted_hotspots
1 - 7 (1)
14 - 13 (4)
69°W
68°W
67°W
45°N
44°N
43°N
42°N
N
S
E
W
Machias
Eastern Maine, small
Toothaker Ridge
Jeffreys Bank EFH, modified
Ammen Rock
Cashes Ledge EFH, modified
13
13
7
13
13
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

4.1.2.4 *Western Gulf of Maine*

4.1.2.4.1 Alternative 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 50. Summer and winter hotspots in the Gulf of Maine are few, 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 in the hotspot analysis section of Volume 1)].

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.

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 the fishery sections in Volume 1). 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.

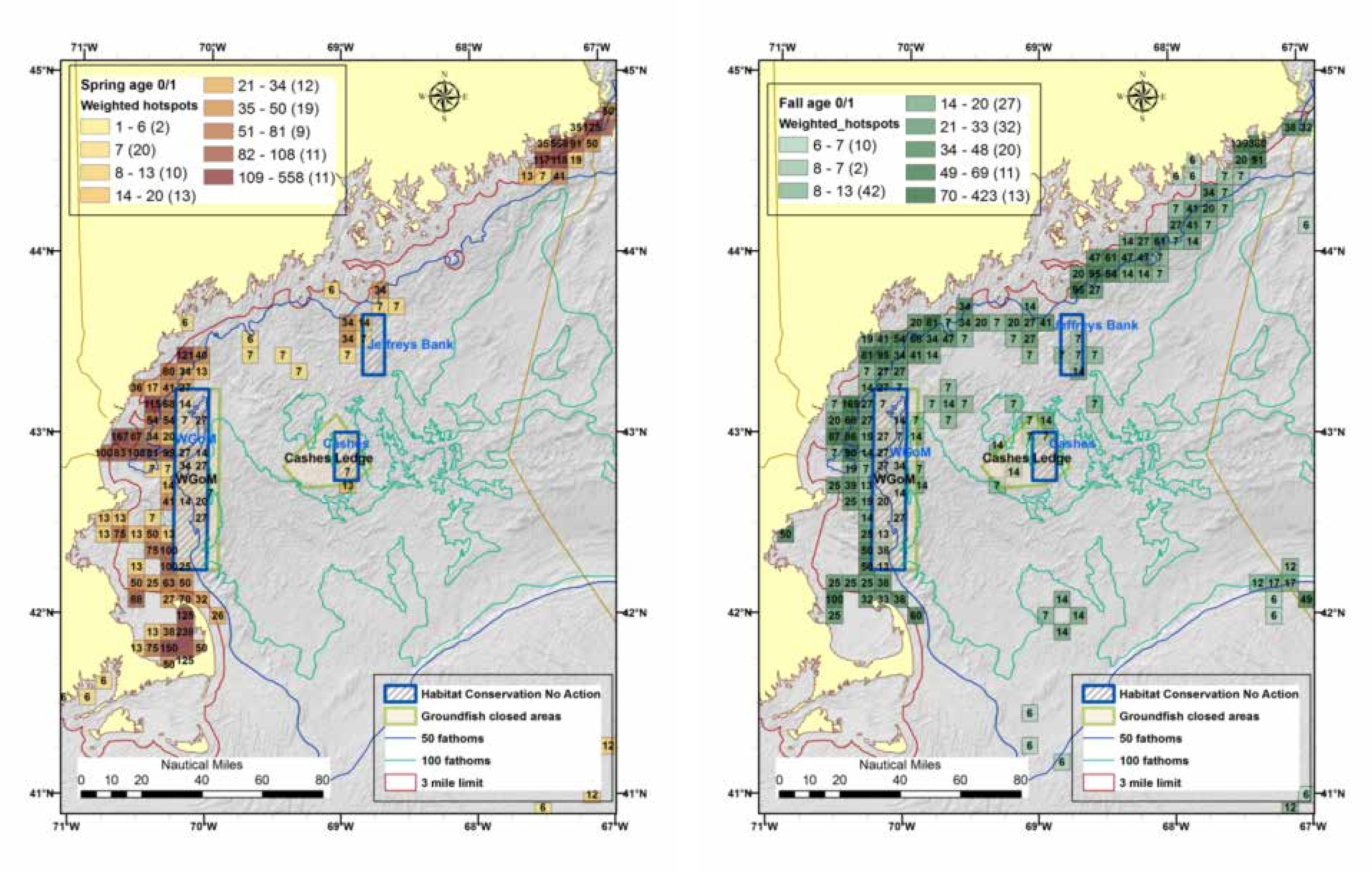
Despite these hotspot analysis results, it is still however possible that the existing groundfish and EFH closed areas have a positive impact on the groundfish resource. The effects on groundfish survival and growth while in the closed areas may be realized by the fishery operating outside the boundary of the closed areas, instead of causing a biomass buildup in the closed area or a measureable increase of productivity for the stock as a whole.

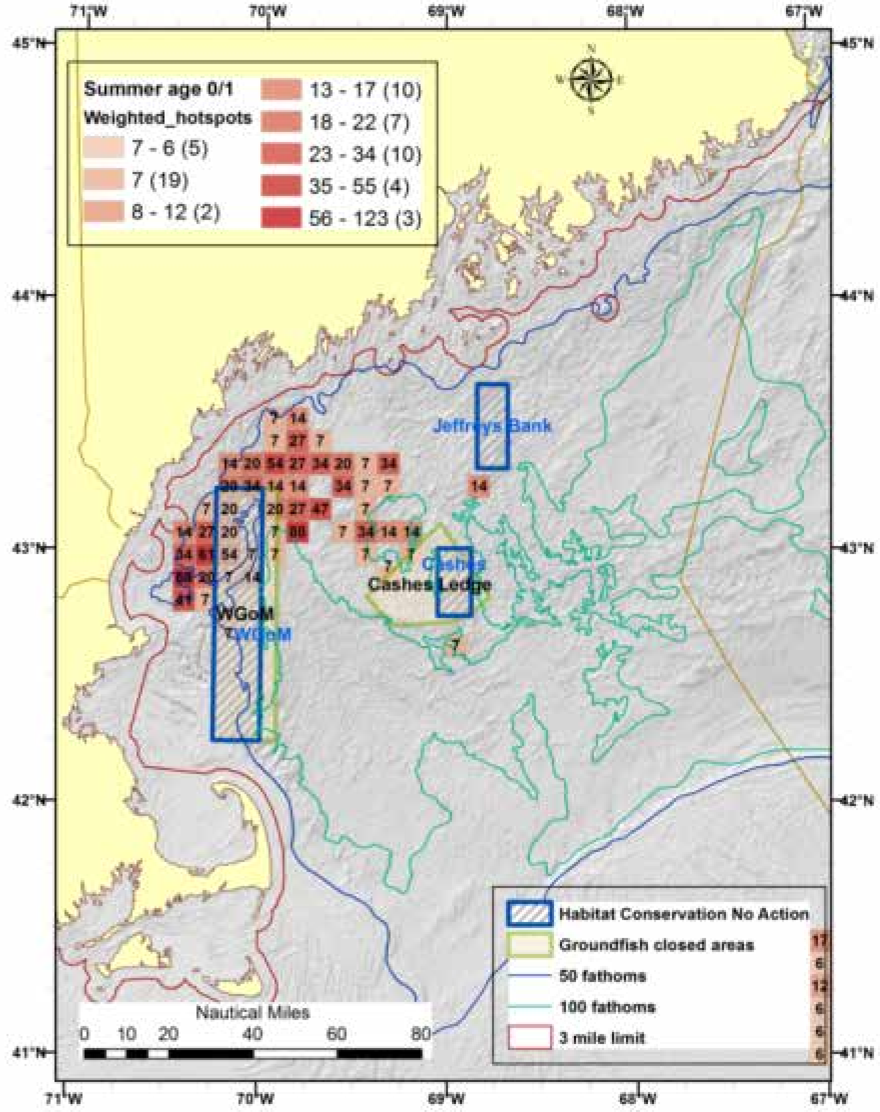
Therefore, based on this reasoning and the evidence at hand, the impacts of the No Action alternative in the Gulf of Maine is slightly positive.

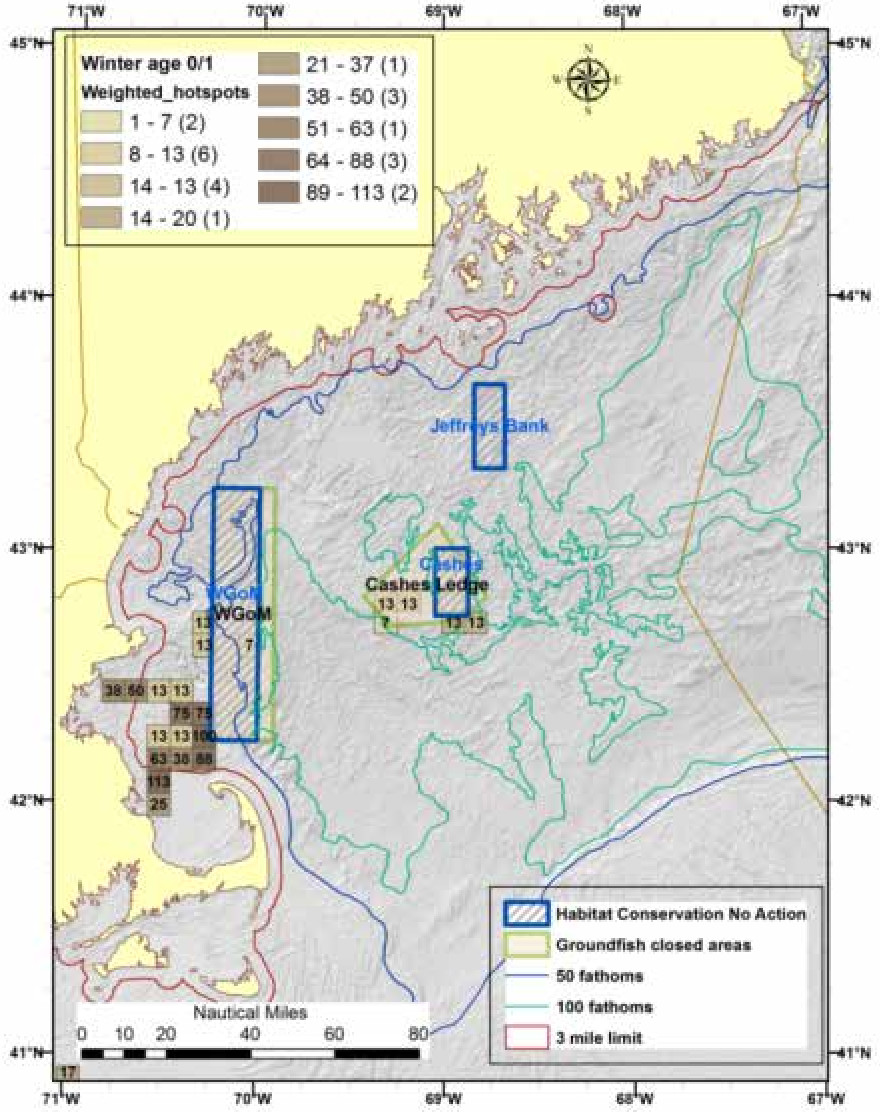
Table 51 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Gulf of Maine.

	Spring		Summer		Fall		Winter	
	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots	Total hotspots	Total weighted hotspots
Gulf of Maine	92	288.05	104	175.76	101	386.83	5	33.55
EFH closure								
Cashes Ledge EFH	1	6.7	2	0.0	2	6.8	0	0.0
Jeffreys Bank EFH	7	20.3	39	0.0	22	33.8	0	0.0
Western Gulf of Maine EFH	70	261.1	32	128.4	56	265.2	1	6.7
Groundfish closure								
Cashes Ledge GF	1	6.7	16	13.5	12	47.3	4	26.8
Western Gulf of Maine GF	84	261.1	49	162.2	67	305.7	1	6.7

Map 50 - 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-NH, and IBS survey data.




Summer 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 Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
71°W
70°W
69°W
68°W
67°W
45°N
44°N
43°N
42°N
41°N


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 Ledge
WGoM
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 10 20 40 60 80
71°W
70°W
69°W
68°W
67°W
45°N
44°N
43°N
42°N
41°N

4.1.2.4.2 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 7A would continue, although it might not be explicitly recognized as a habitat protection measure. In this case, Alternative 2 and Alternative 7A would otherwise be synonymous and provide equal habitat conservation benefits, but less than Alternative 1 (No Action), Alternatives 3-6, and Alternative 7B. Therefore, the overall impact of this alternative on managed large mesh groundfish is expected to be negative.

4.1.2.4.3 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 51).

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 52) 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 53). 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 7A) or modified (Alternative 7B) 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.

4.1.2.4.4 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 51).

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 52) 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.

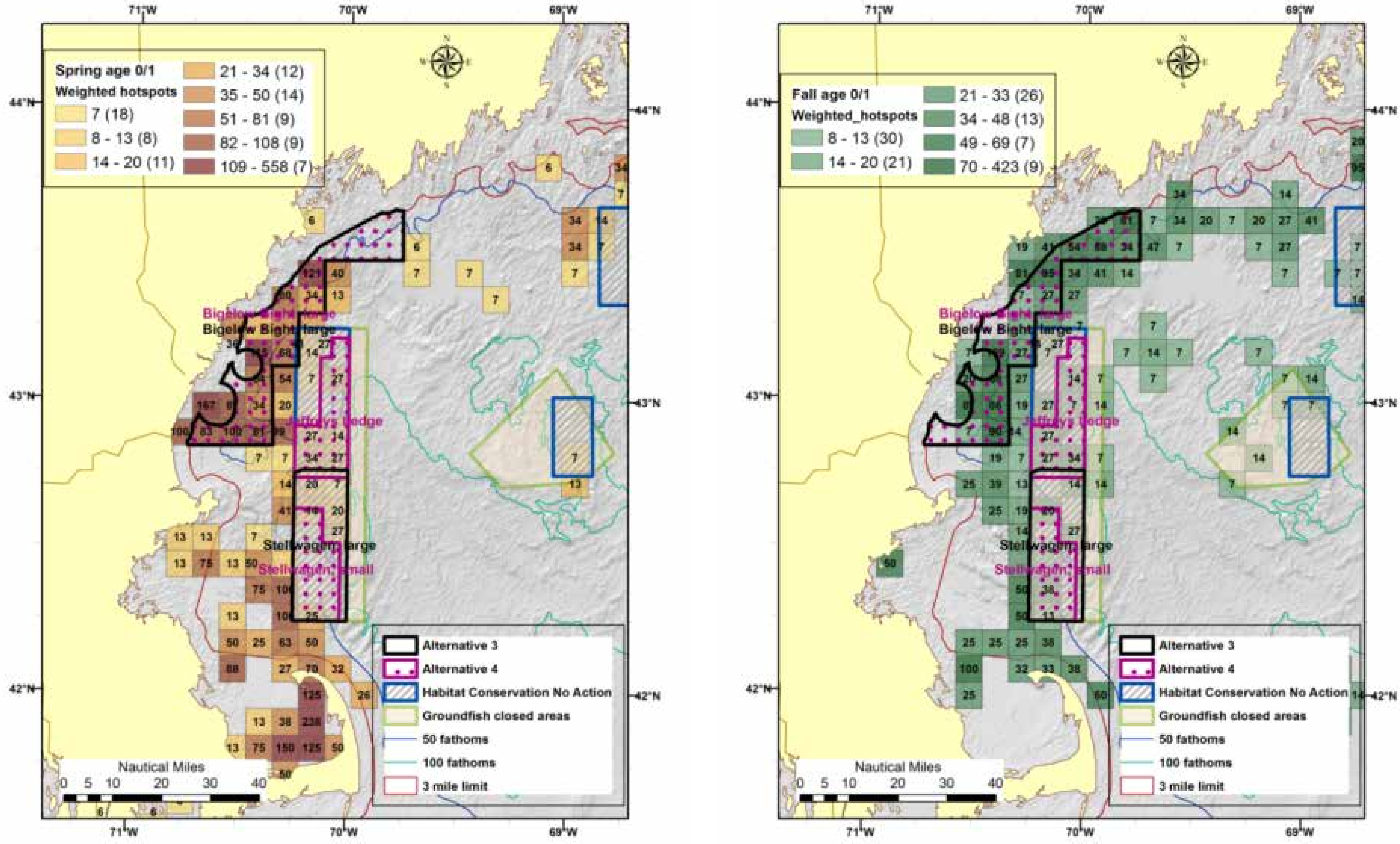
Likewise, the hotspot species composition for Alternative 4 is similar to that for Alternative 3, with most of the hotspots include redfish, plaice, red hake, and silver hake (Table 53). The number of age 0/1 cod hotspots (16) is identical to that for Alternative 3, and nearly the same as that for Alternative 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 7A) or modified (Alternative 7B) 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.

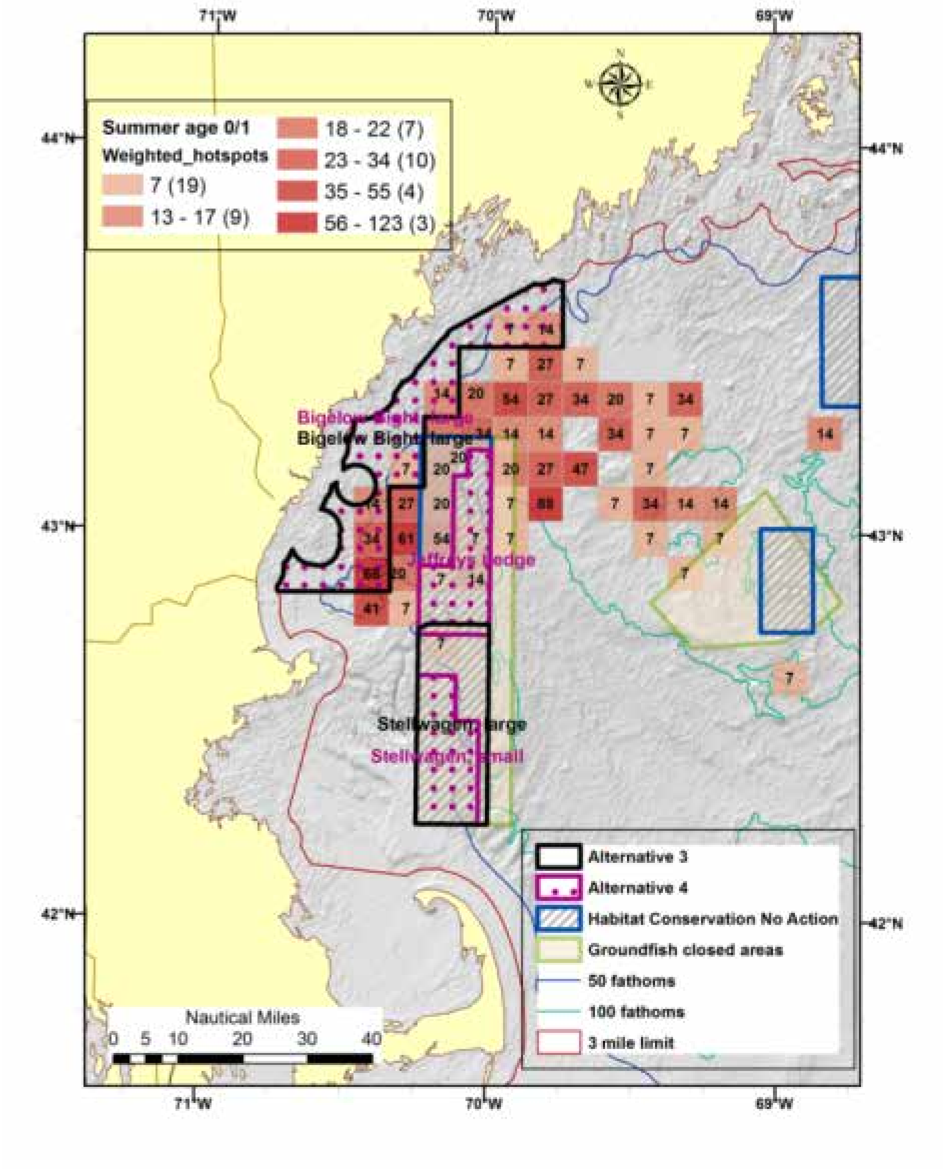
Based on the number and prevalence of weighted hotspots being nearly 2 to 3 times those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have greater conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse and hard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

Table 52 – 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 51 – 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-NH, 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

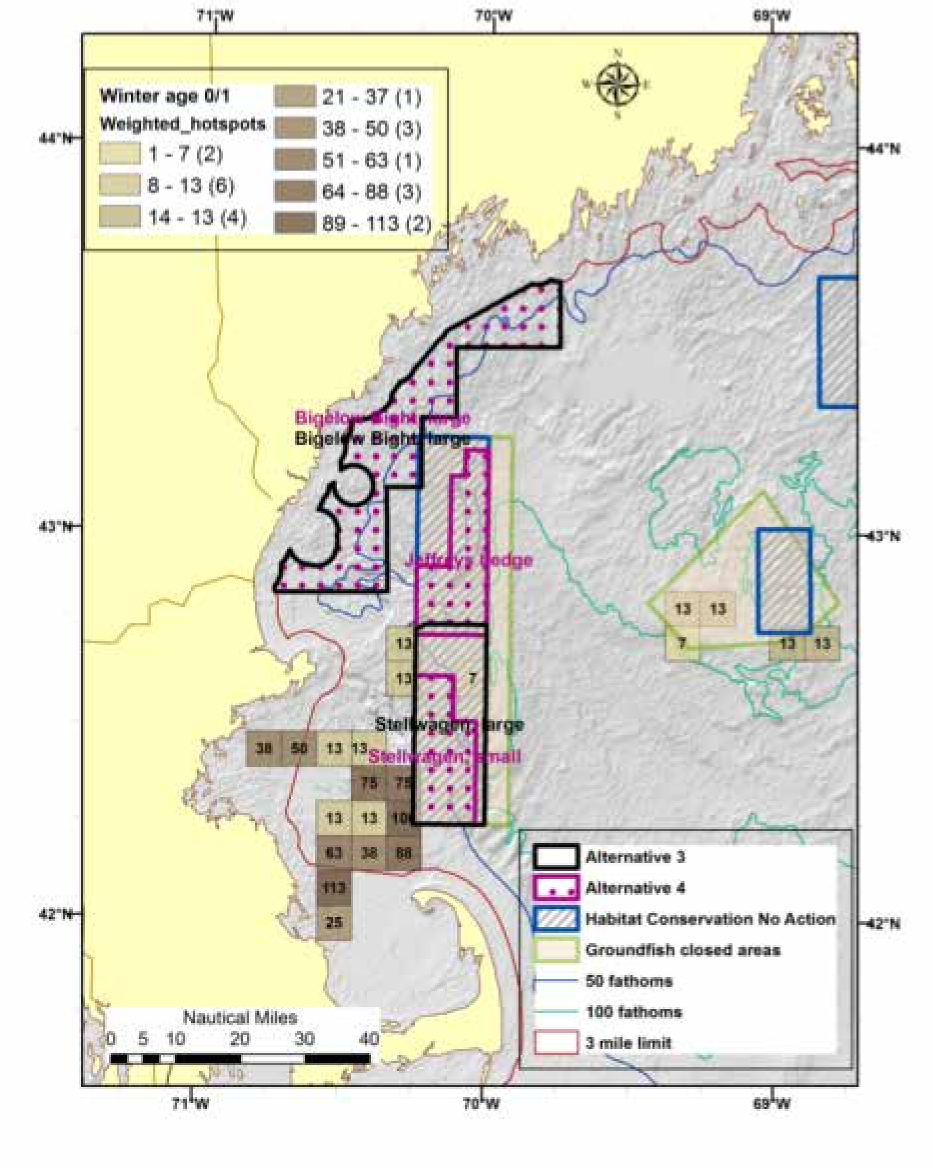

Winter age 0/1
Weighted_hotspots
1 - 7 (2)
8 - 13 (6)
14 - 13 (4)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Bigelow Bight, large
Jeffreys Ledge
Stellwagen, large
Stellwagen, small
Alternative 3
Alternative 4
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms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

Table 53 – 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

4.1.2.4.5 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 52), 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 52). 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 53). 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.

4.1.2.4.6 Alternative 6

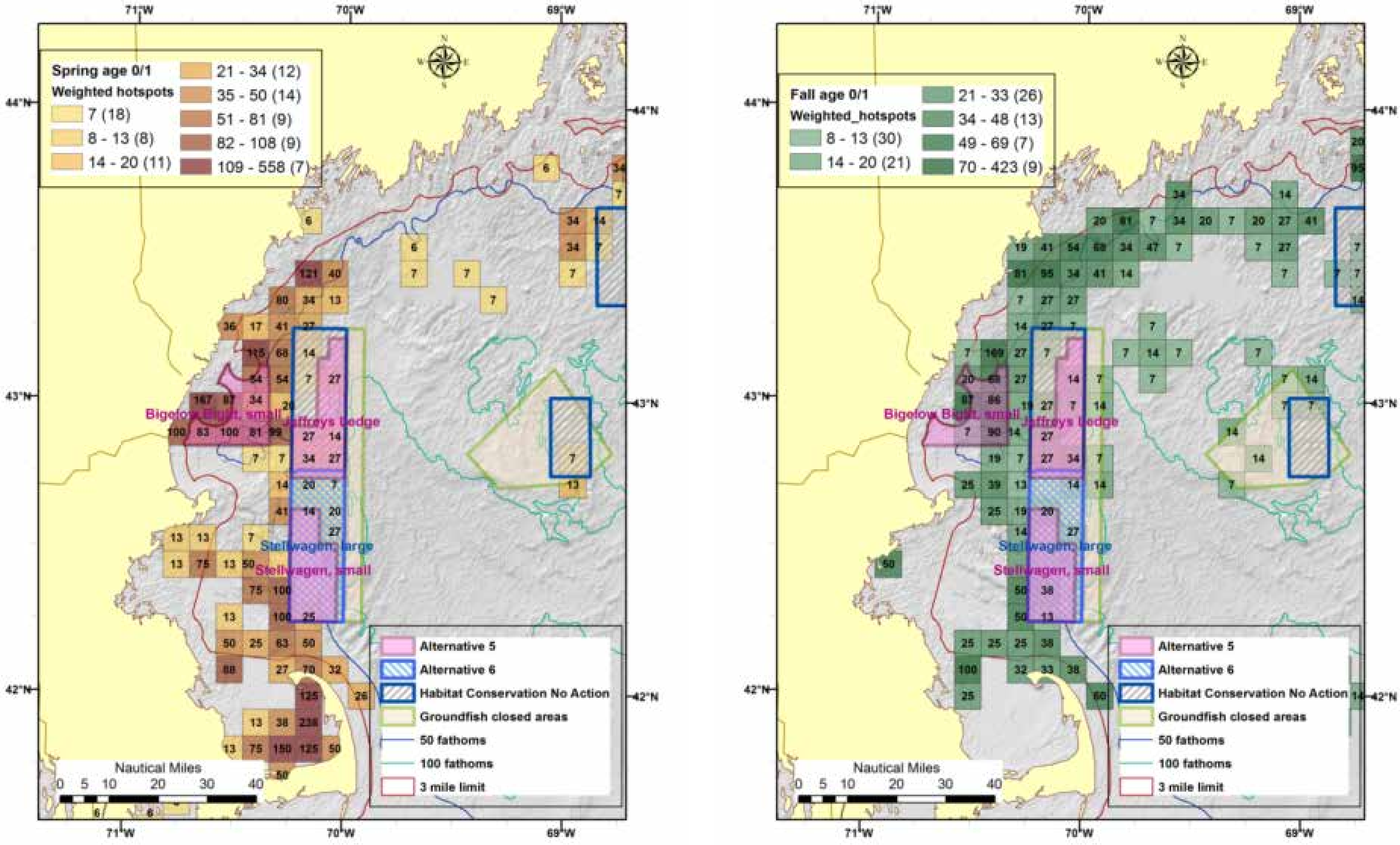
This alternative proposes only one area, the Stellwagen Large area, as a habitat management area in the Western Gulf of Maine (Map 52). It is similar to Alternative 3, but does not include either the Small or Large Bigelow Bight Area, which contains a considerable amount of weighted hotspots. This alternative has the lowest amount of total weighted hotspots as any alternative (Table 52), including Alternative 1 (No Action).

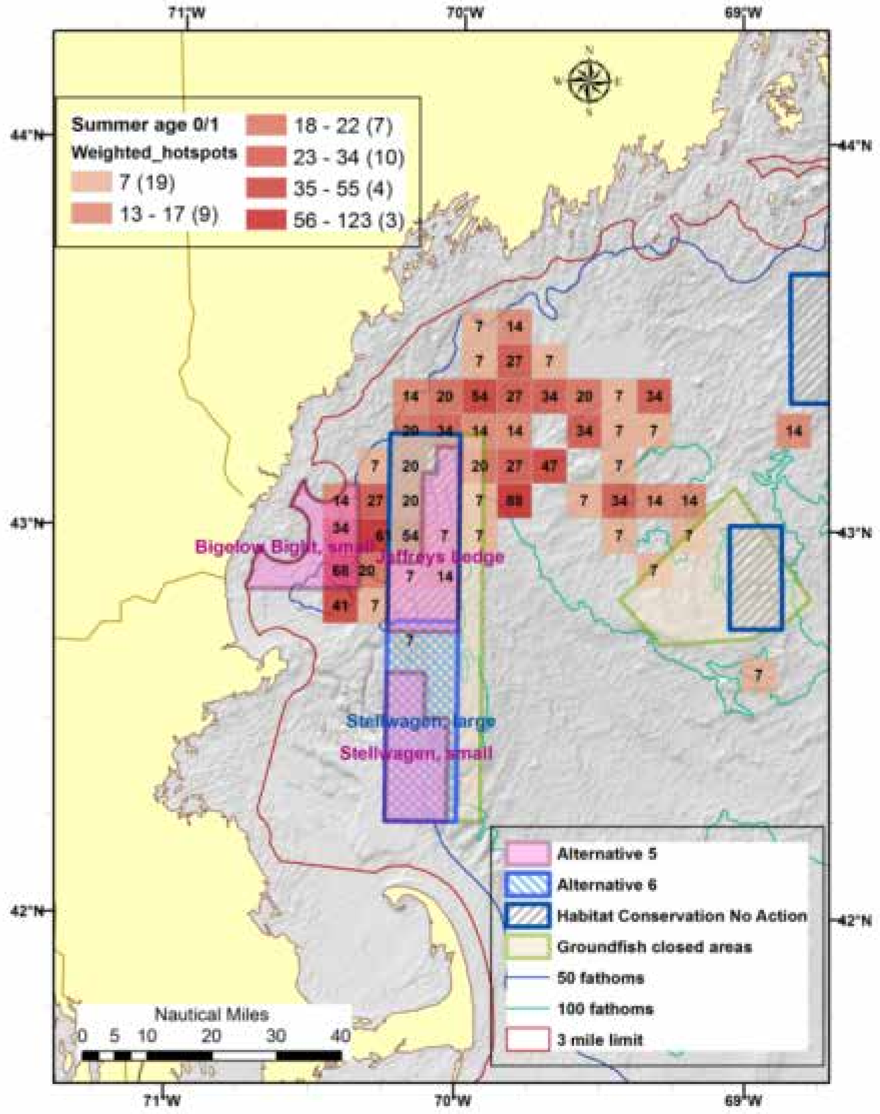
By species, this alternative has fewer age 0/1 hotspots than any other alternative including Alternative 1 (No Action) for redfish, plaice, cod, haddock, red hake, silver hake, white hake, and winter flounder (Table 53).

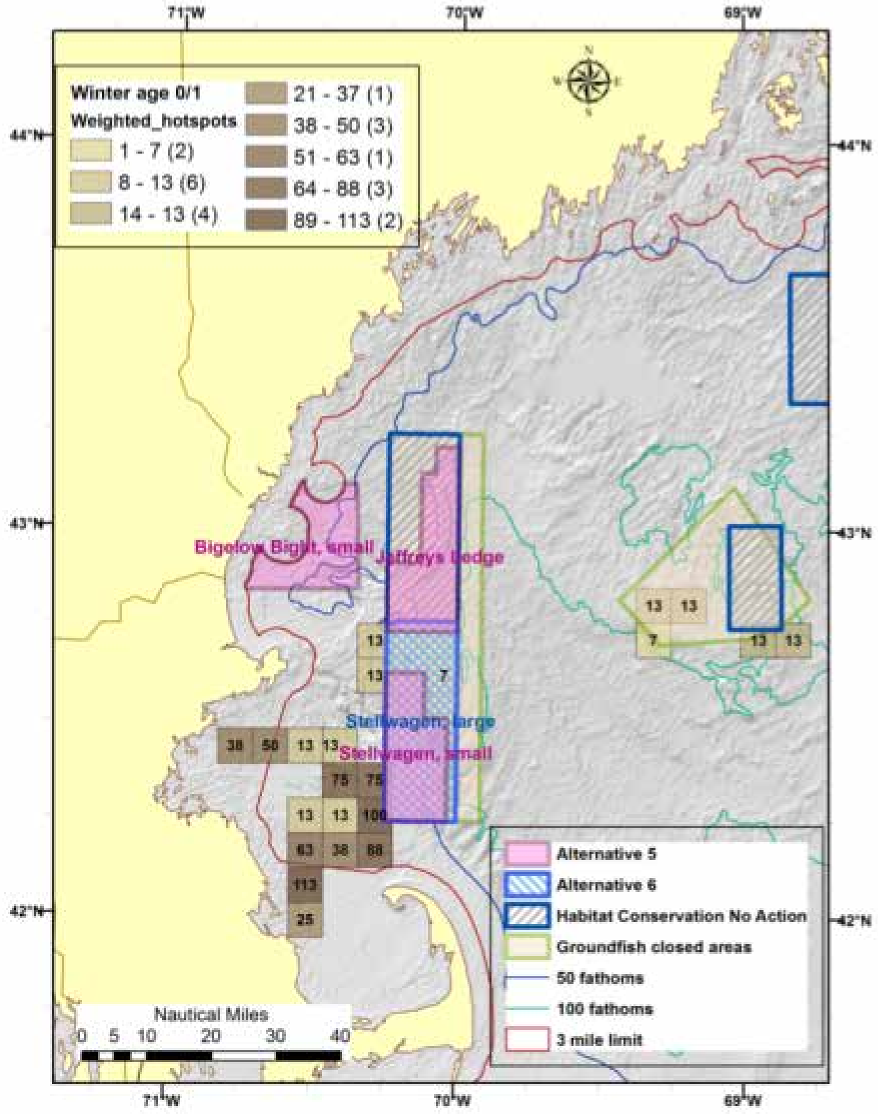
Based on the number and prevalence of weighted hotspots being a third to a half of those for Alternative 1 (No Action) in the spring and fall surveys, this alternative is expected to have considerably less conservation benefits for groundfish stocks that are at low biomass and/or associated with coarse 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 52 – 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-NH, 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

4.1.2.4.7 Alternative 7A

This alternative adapts the existing roller gear area (shown hatched in the maps below) to recognize its potential habitat conservation benefits. 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 53). 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 7B is outlined with a black border. 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 km^2 cells that are outlined). Under either alternative 7A or 7B, 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. This type of effort 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 beginning and ending haul locations, which could miss the fine scale changes in tow direction to avoid these harder substrates. Also, the local spatial accuracy of the substrate distribution grids/map is relatively uncertain in the WGOM region, given the underlying data used to classify substrate type. Thus, combining fishing effort and substrate maps that are not finely resolved spatially makes inference of effort according to habitat type challenging.

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. Vessels 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 some of this fishing occurs within the restricted roller gear area, many tows continue outside of the roller gear area and compliance with the roller gear restriction on these tows is questionable.

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 are the hard bottom off Scituate, MA, the NW corner of Stellwagen Bank, and the southern flank of Jeffreys Ledge. According to the sediment 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.

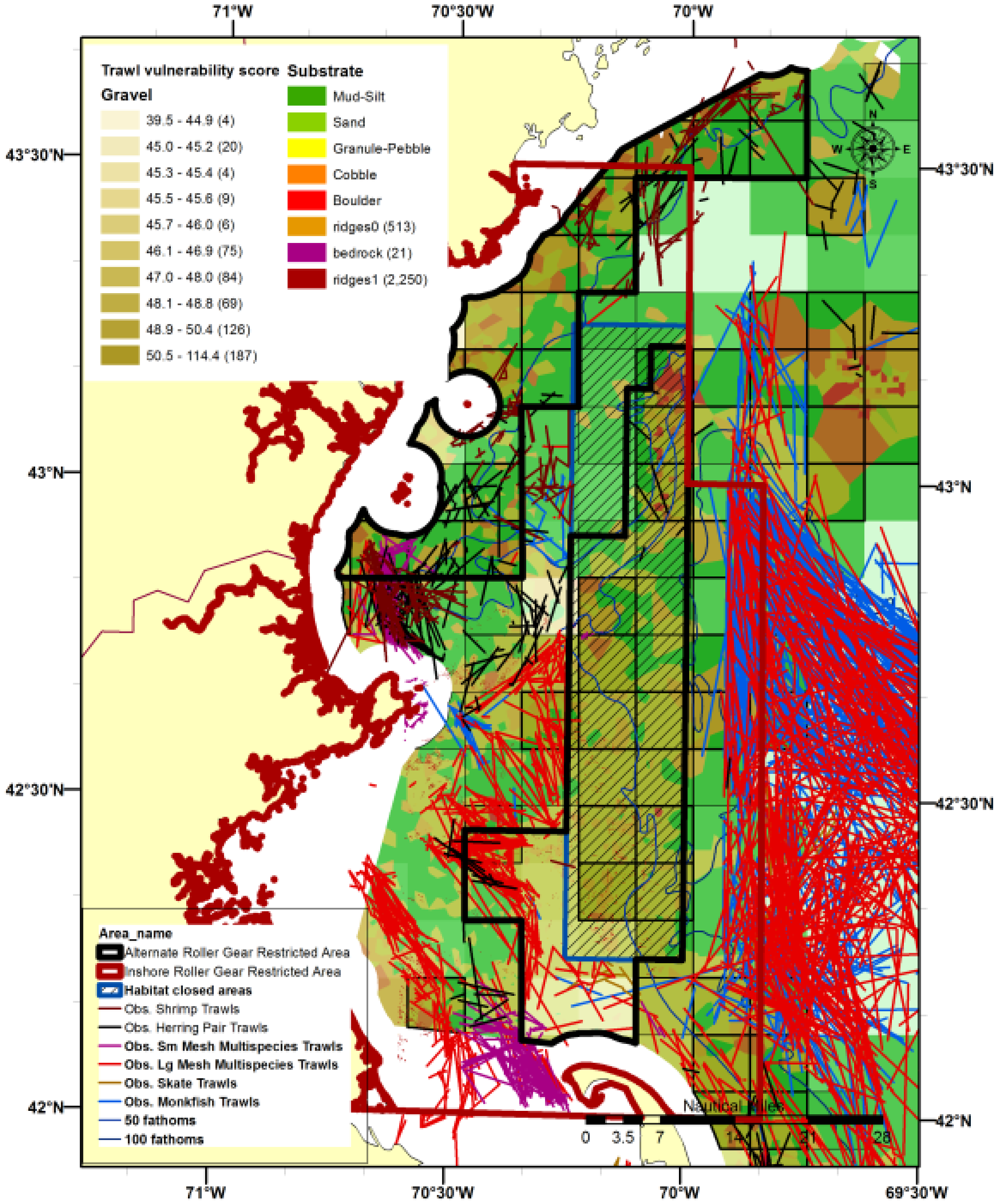
Because Alternative 7A encompasses a much bigger area, which overlaps Massachusetts and Cape Cod Bays where IBS cod and winter trawl surveys have taken place, the total number of age 0/1 weighted groundfish hotspots is considerably higher than any other alternative (Table 52), including five to ten times 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 53).

Compared with the weighted age 0/1 groundfish hotspots in the spring (Map 54, 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 54, 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.

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.

Because it covers a larger area containing more juvenile groundfish habitat, if this measure is as effective as a habitat management area is in reducing the use of MBTG 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. However, LM trawl fishing for groundfish and monkfish south and west of the WGOM Closed Area does seem to correspond with areas having harder substrates and with age 0/1 groundfish hotspots, even though these vessels are currently required to use small roller gear. Identifying this roller gear requirement as a habitat measure is unlikely to change their fishing behavior to avoid areas of harder substrates, and therefore will not improve groundfish habitat. Relying on an expanded roller gear restriction in the area 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 53 – Location of observed 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.



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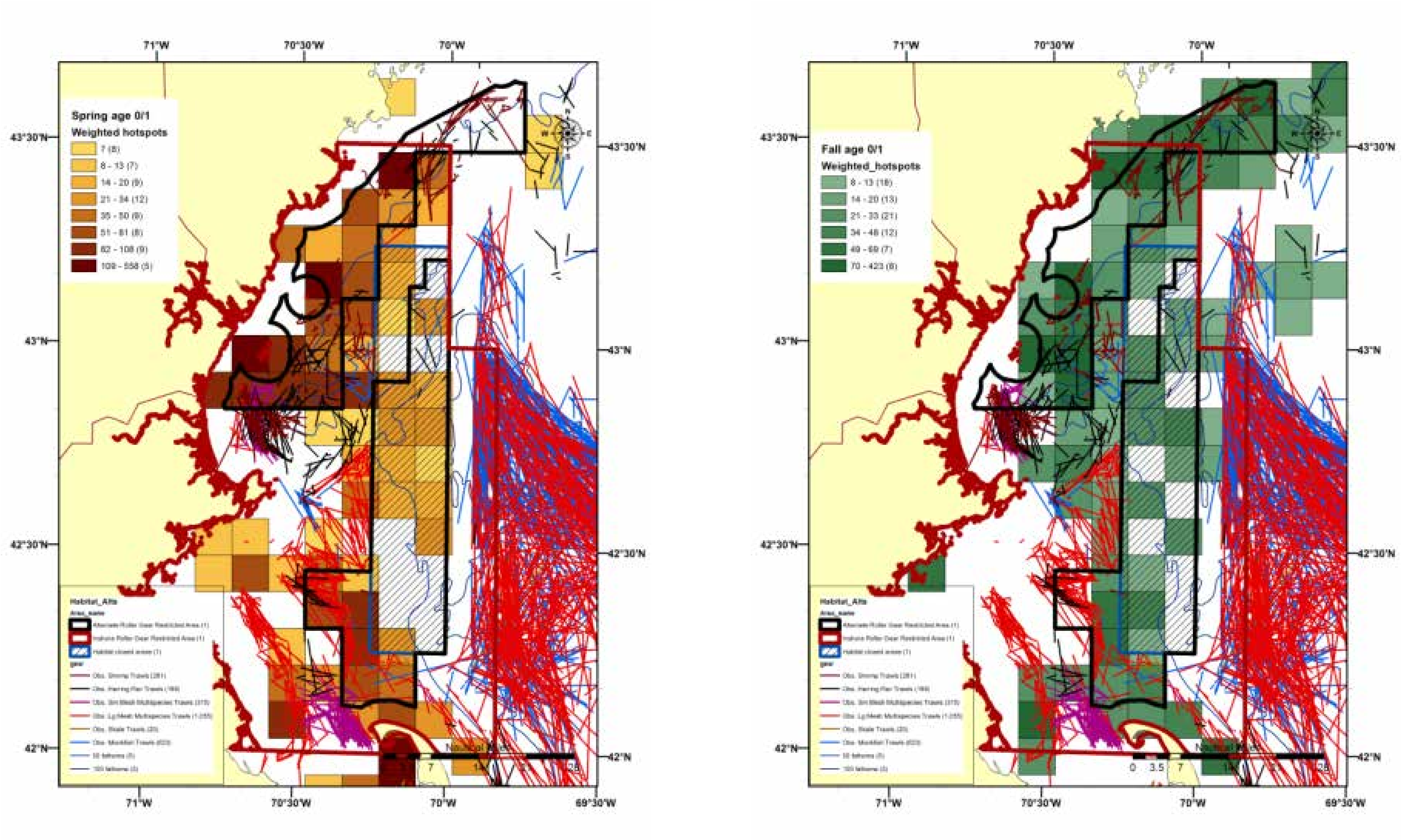
Map 54 – Location of observes hauls since 2008 by vessels targeting shrimp, herring, whiting, large-mesh multispecies, skates, and monkfish compared spring (left) and fall (right) age 0/1 groundfish hotspots heavily weighted in favor of stocks that are at low biomass and/or associated with coarse and hard substrates.



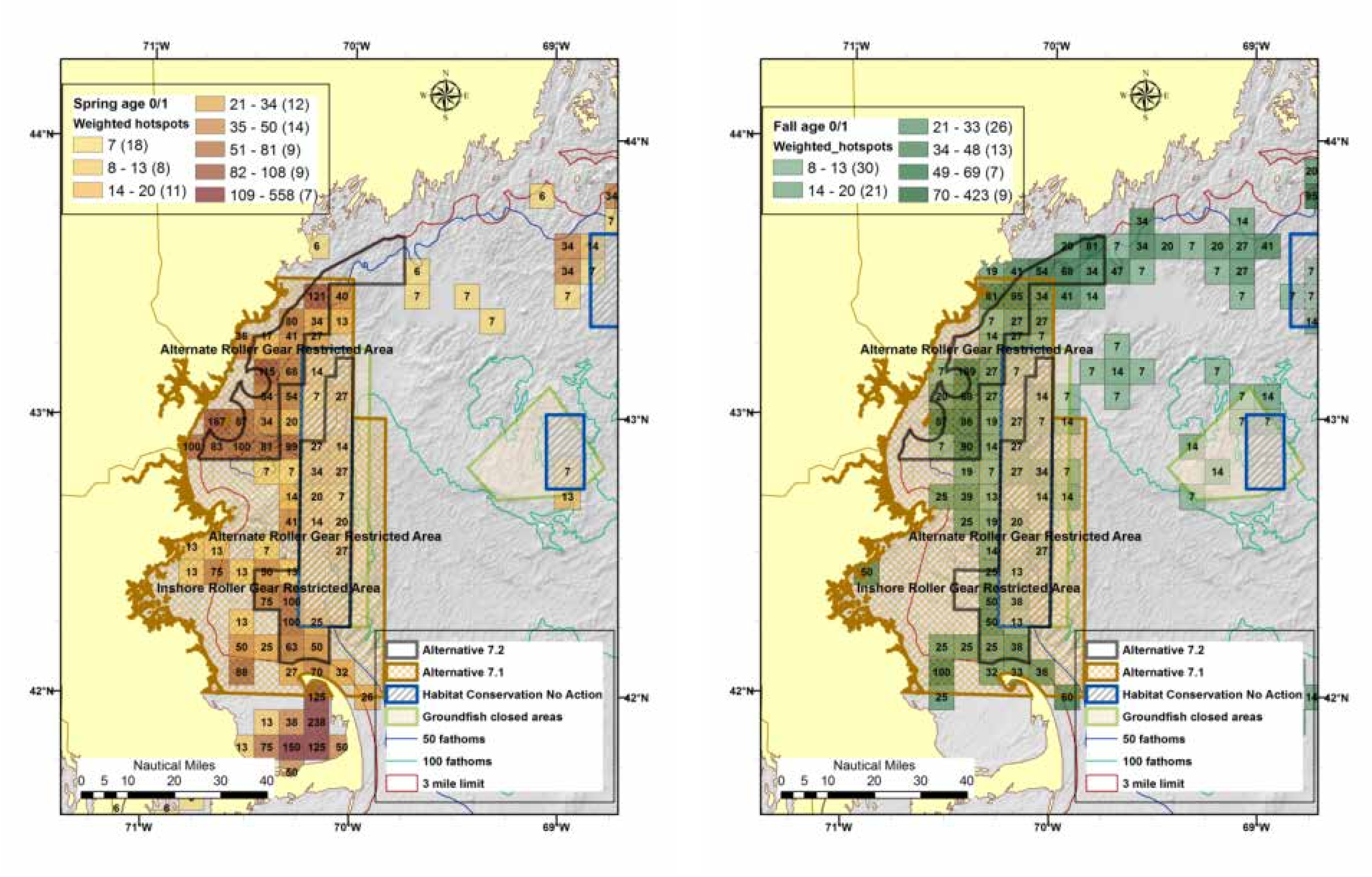
4.1.2.4.8 Alternative 7B

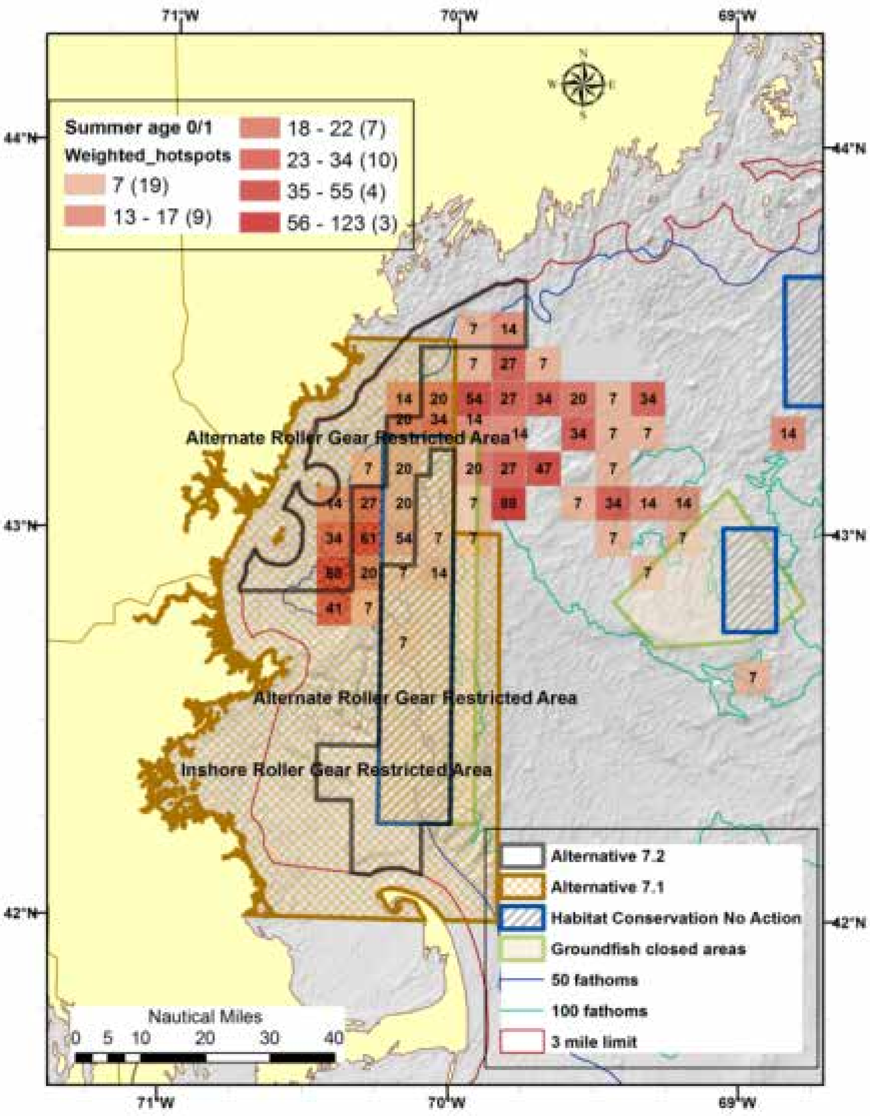
This alternative proposes a smaller area than Alternative 7A in the Western Gulf of Maine as a restricted gear area to protect vulnerable habitat. The existing roller gear area would remain in place, so the difference is that Alternative 7B would extend the roller gear restriction to the northeast off the central ME coastline in federal waters and apply the restriction to all trawl vessels. Implementing both areas simultaneously but applying them to different gears could be somewhat confusing.

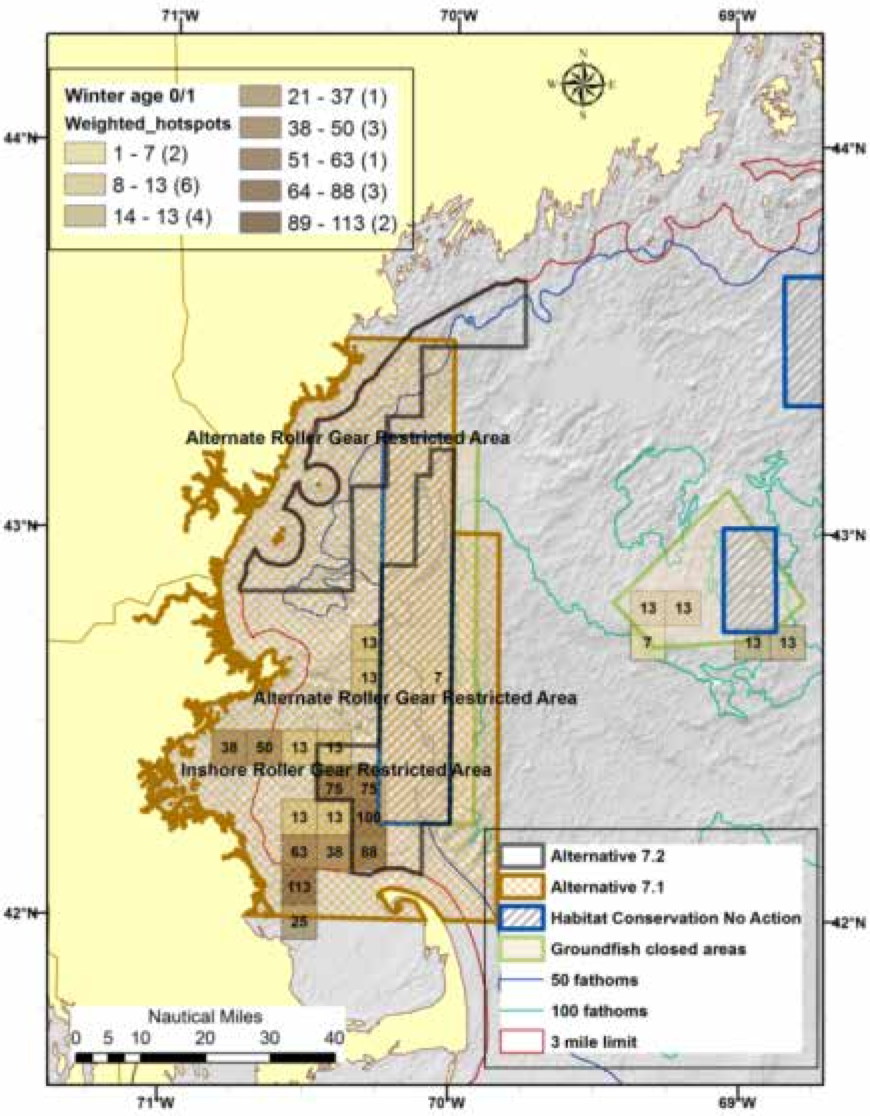
The area encompassed by this alternative contains fewer age 0/1 weighted groundfish hotspots (Table 52) than Alternative 7A, but more than Alternative 1 (No Action). This is true for redfish, plaice, cod, haddock, red hake, silver hake, winter flounder, and yellowtail flounder (Table 53). Compared to Alternative 7A, there are more hotspots for alewife and goosefish due to the proposed northeast extension of the existing restricted roller gear area (Map 55).

Similar to Alternative 7A, 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 55), 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 55 – WGOM Alternatives 7A and 7B 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-NH, 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)
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
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)
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
0 5 10 20 30 40
71°W
70°W
69°W
44°N
43°N
42°N

4.1.2.5 ***Georges Bank***

4.1.2.5.1 Alternative 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 56. Data used to identify these hotspots, or clusters of significantly high abundance of small juvenile groundfish, include the spring, fall, and winter NMFS trawl surveys and the summer dredge survey. 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[8]).

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 (Table 54). 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 56), 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 58). 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 apparent, however, that Closed Area II is protecting critical cod habitat, except possibly for the

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[8] 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.

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 59, 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 59, 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.

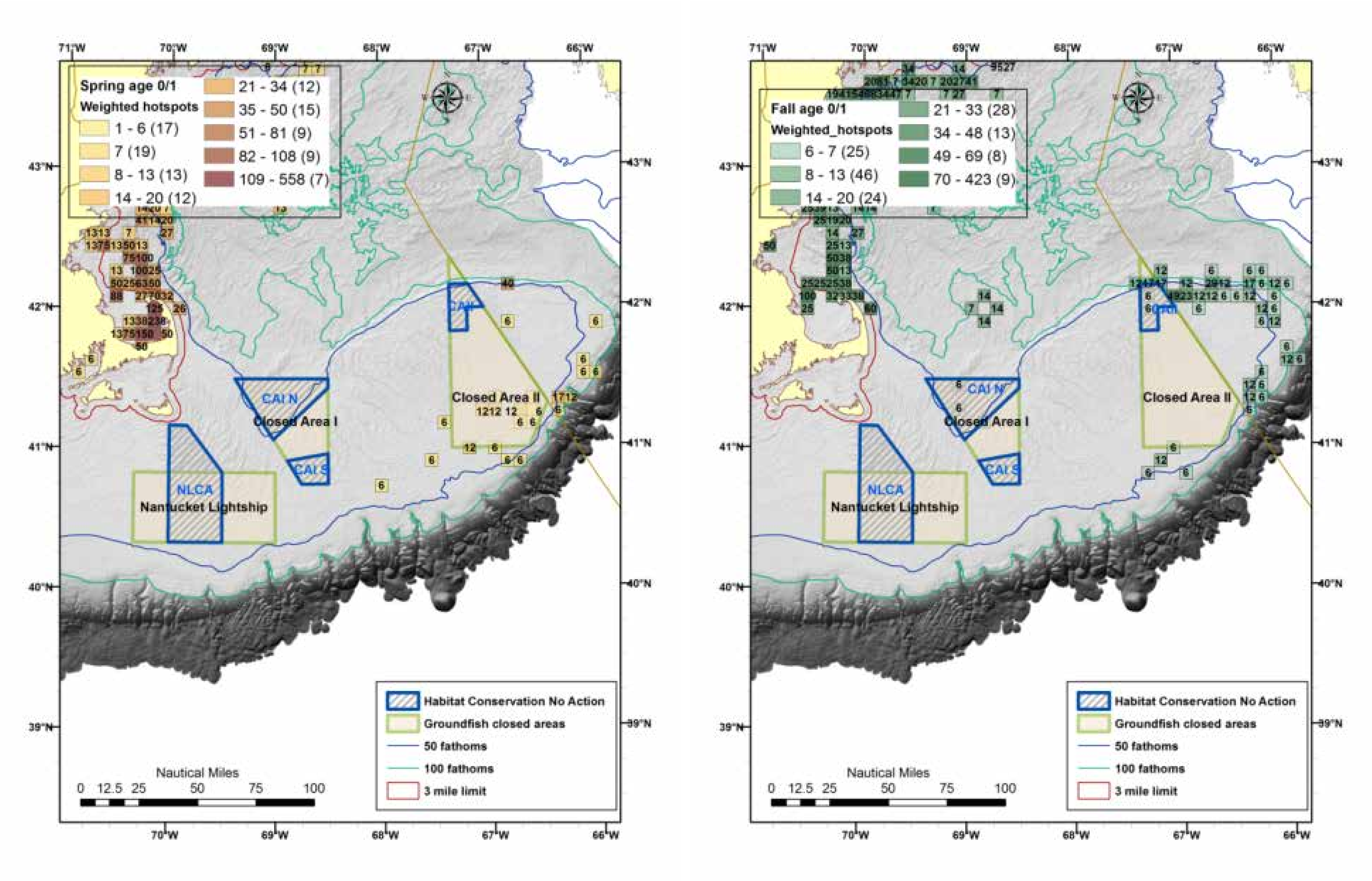
Although the hotspots were sparser on Georges Bank than in the Gulf of Maine, the totals within existing and proposed habitat management areas for Georges Bank are comparable to each other. Even though there were few age 0/1 hotspots identified in US waters of Georges Bank, there were a substantial number of unweighted and weighted hotspots on the Northern Edge, mostly in Canadian waters and partially in US waters (Map 56).

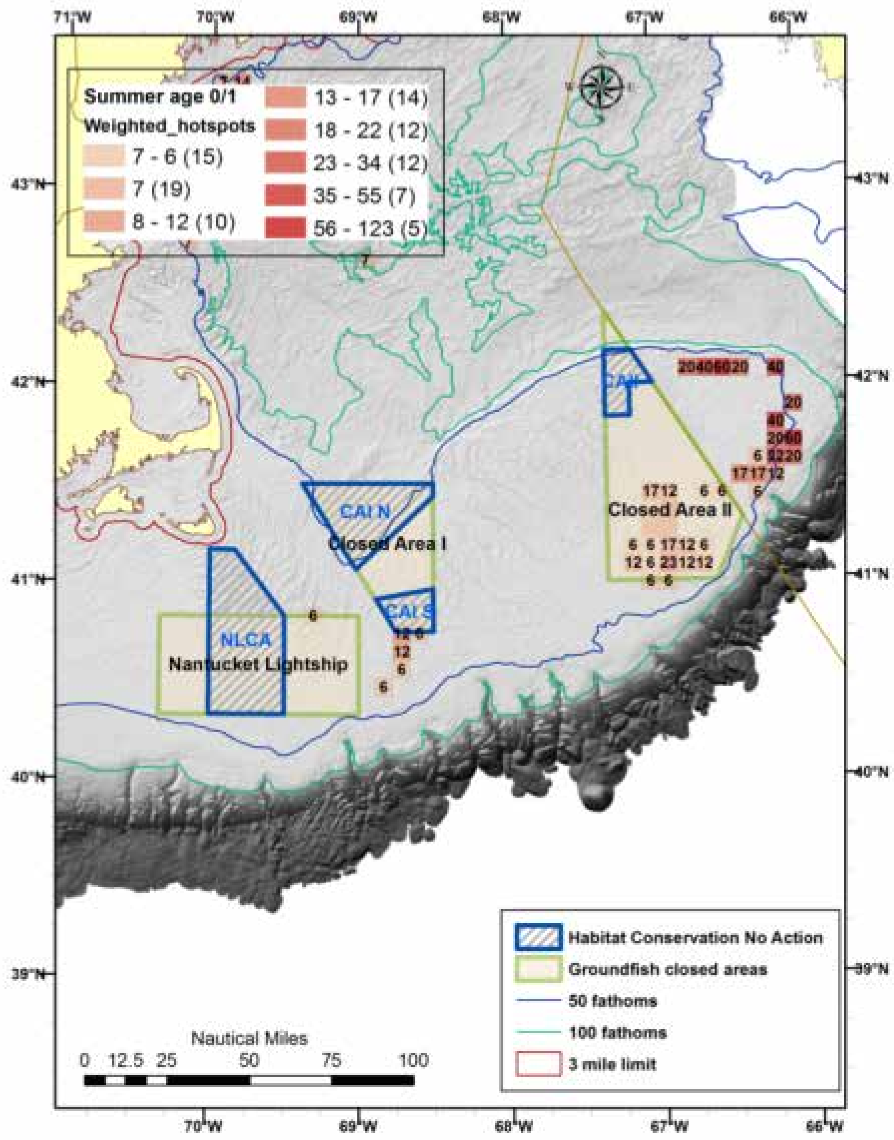
Impacts on groundfish habitat and groundfish populations from Alternative 1 (No Action) are likely to be beneficial to species inhabiting coarse and hard substrates in the EFH closures, but not the other portions of the year round groundfish closed areas due to the effect of access program fishing. Based 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.

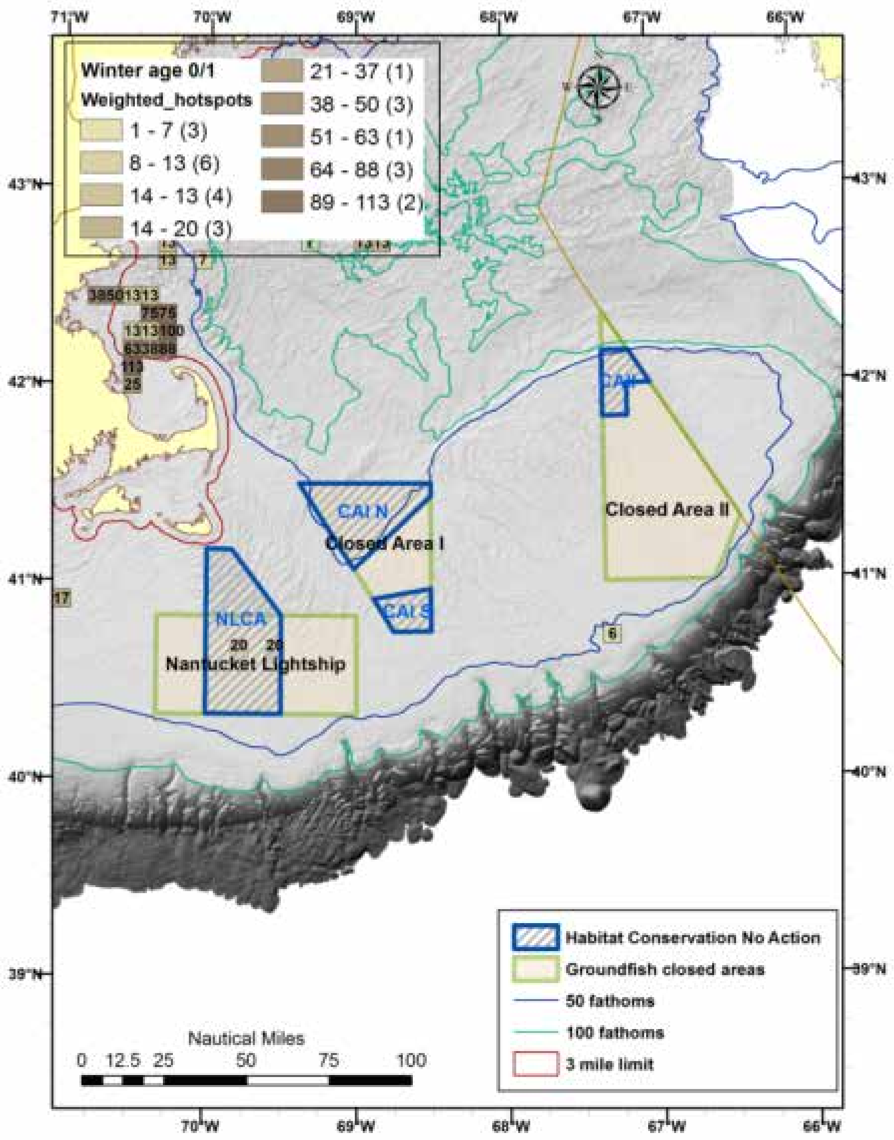
Table 54 – Total unweighted and weighted hotspots in EFH closures and year round groundfish closures in the Georges Bank region.

	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 56 – 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 trawl and summer dredge 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
NLCA
Nantucket Lightship
CAII
Closed Area II
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100
71°W
70°W
69°W
68°W
67°W
66°W
43°N
42°N
41°N
40°N
39°N


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
NLCA
Nantucket Lightship
CAII
Closed Area II
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 12.5 25 50 75 100
71°W
70°W
69°W
68°W
67°W
66°W
43°N
42°N
41°N
40°N
39°N

4.1.2.5.2 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.

4.1.2.5.3 Alternative 3

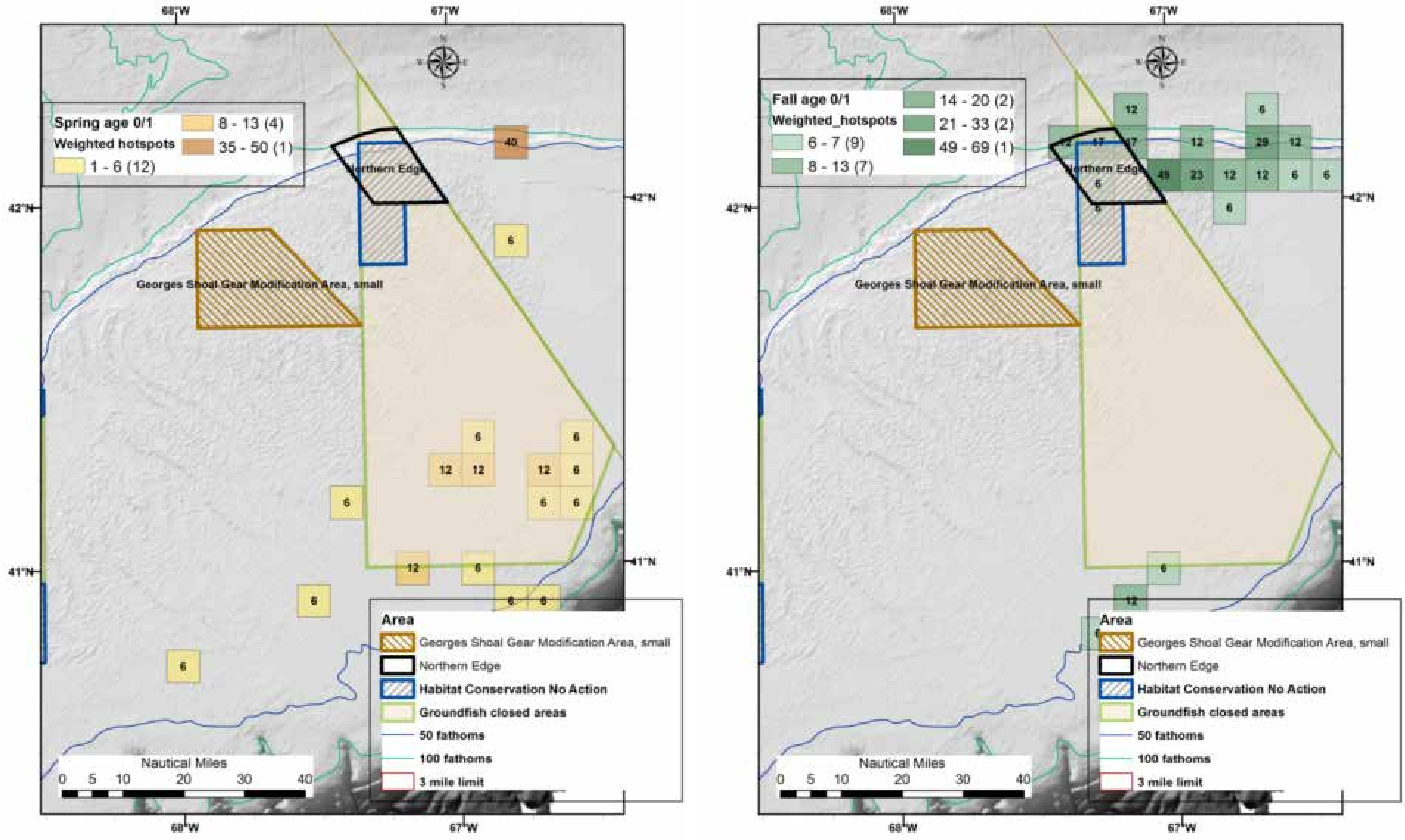
Alternative 3 includes a new Northern Edge habitat management area that largely overlaps the existing Cod HAPC, but extends slightly into the deeper water slope on the Northern Edge. The total number of age 0/1 groundfish hotspots, heavily weighted in favor of stocks at low biomass and/or having a high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

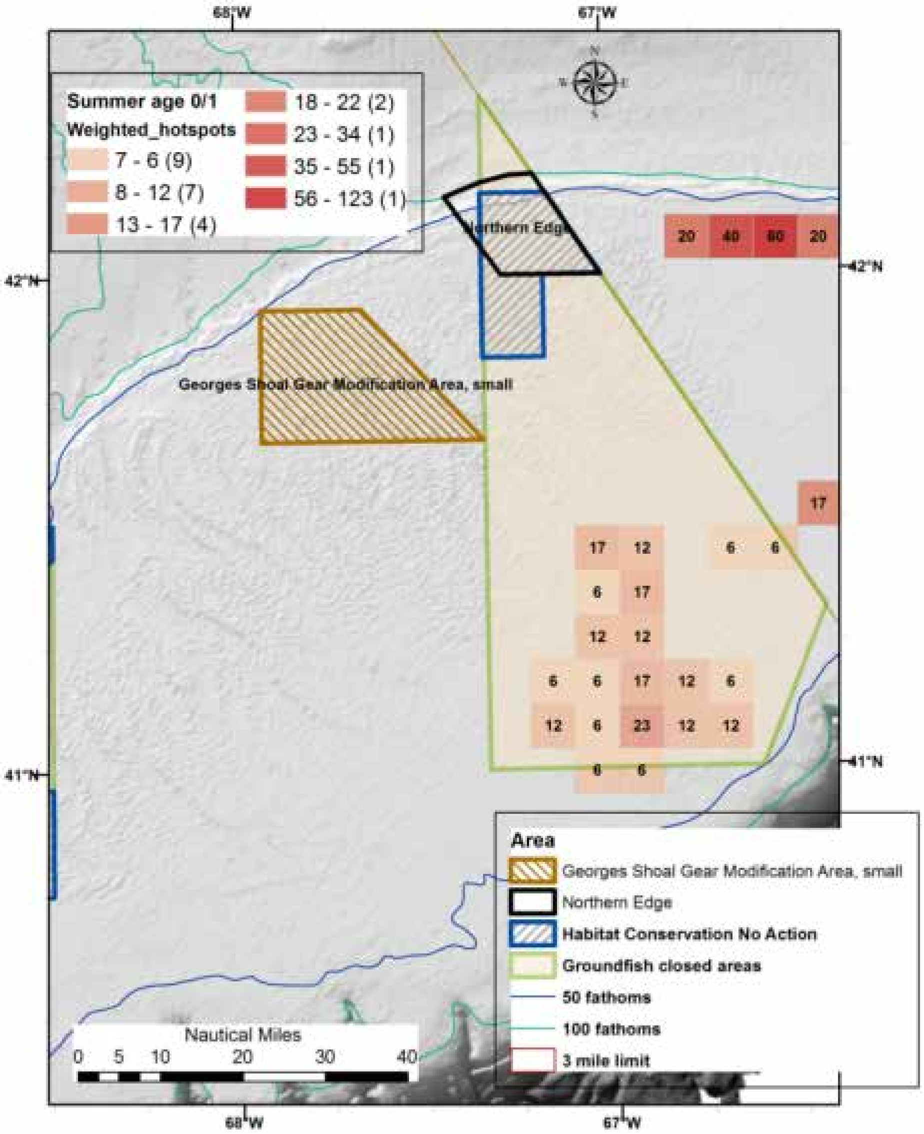
Based on the amount and presence of weighted hotspots, this alternative would have negative effects on groundfish habitat relative to that for Alternative 1 (No Action). The amount of protection of habitat for age 0/1 and larger sub-legal cod is about the same as No Action (Map 58), but the protection 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 59) and where hotspots occur (Table 56) are already fished by both multispecies trawl and scallop dredge access programs. Haddock and red hake hotspots (Table 56) are present in the proposed Northern Edge habitat management area.

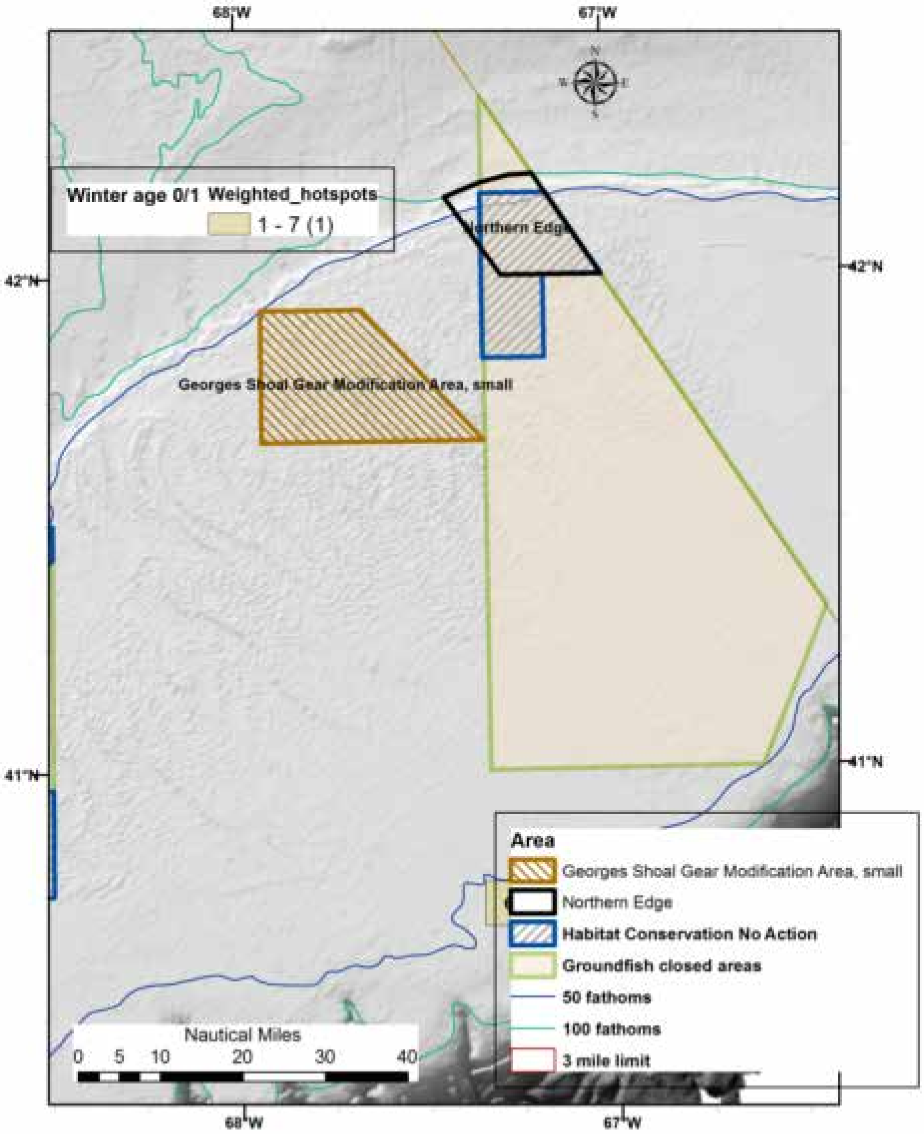
Table 55 – Total unweighted and weighted hotspots in GB habitat management area alternatives compared to No Action.

	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
Alternative 6.1	0	0.0	13	0.0	12	11.5	0	0.0
Alternative 6.2	0	0.0	13	0.0	10	5.8	0	0.0

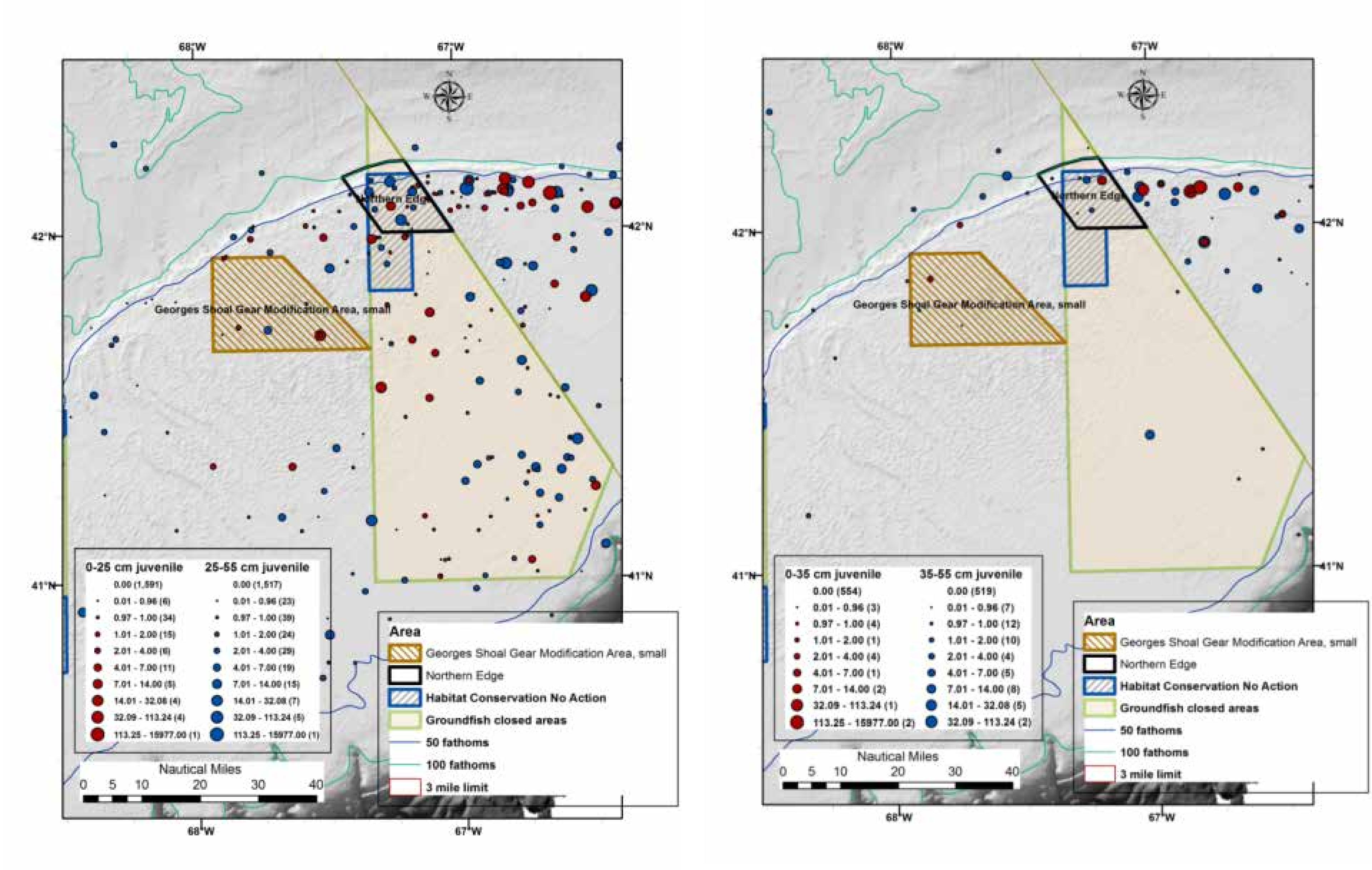
Map 57 – GB Alternatives 3 and 4 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data. Alternative 3 includes the Northern Edge only, while Alternative 4 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
20
40
80
20
17
17
12
6
6
6
17
12
12
6
6
17
12
6
12
6
23
12
12
6
6
Area
Georges Shoal Gear Modification Area, small
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40


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
Area
Georges Shoal Gear Modification Area, small
Northern Edge
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

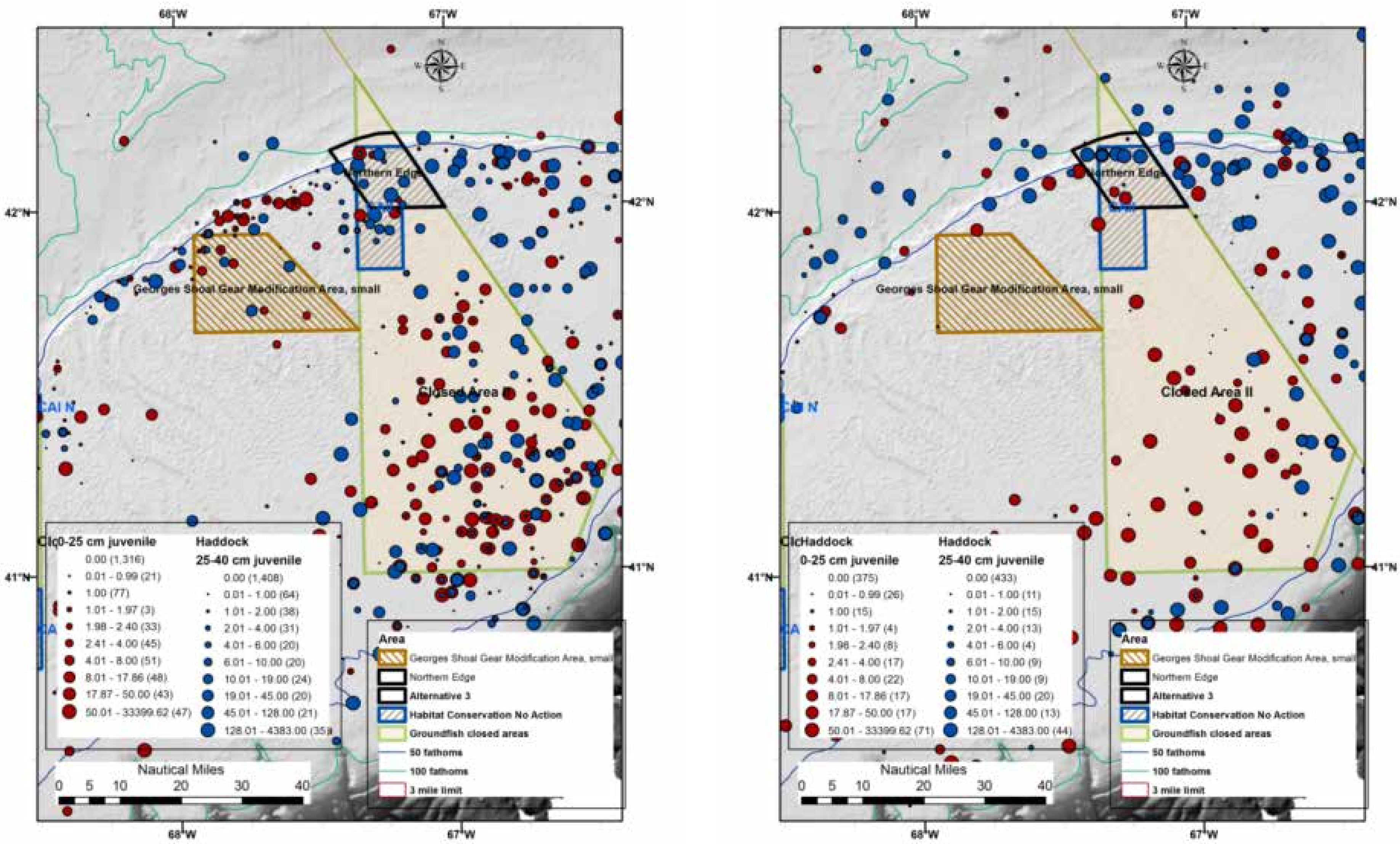
Map 58 – Overlap of GB Alternatives 3 and 4 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.



Spring and summer

Fall and winter

Map 59 – 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 56 – 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
Alternative 6.1	0	0	0	0	0	0	0	2	0	0	9	0	0	1	13	0	0	25
Alternative 6.2	0	0	0	0	0	0	0	1	0	0	8	0	0	1	13	0	0	23

4.1.2.5.4 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 55), with slightly more red hake hotspots (Table 56). 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 4.1.2.1.2???).

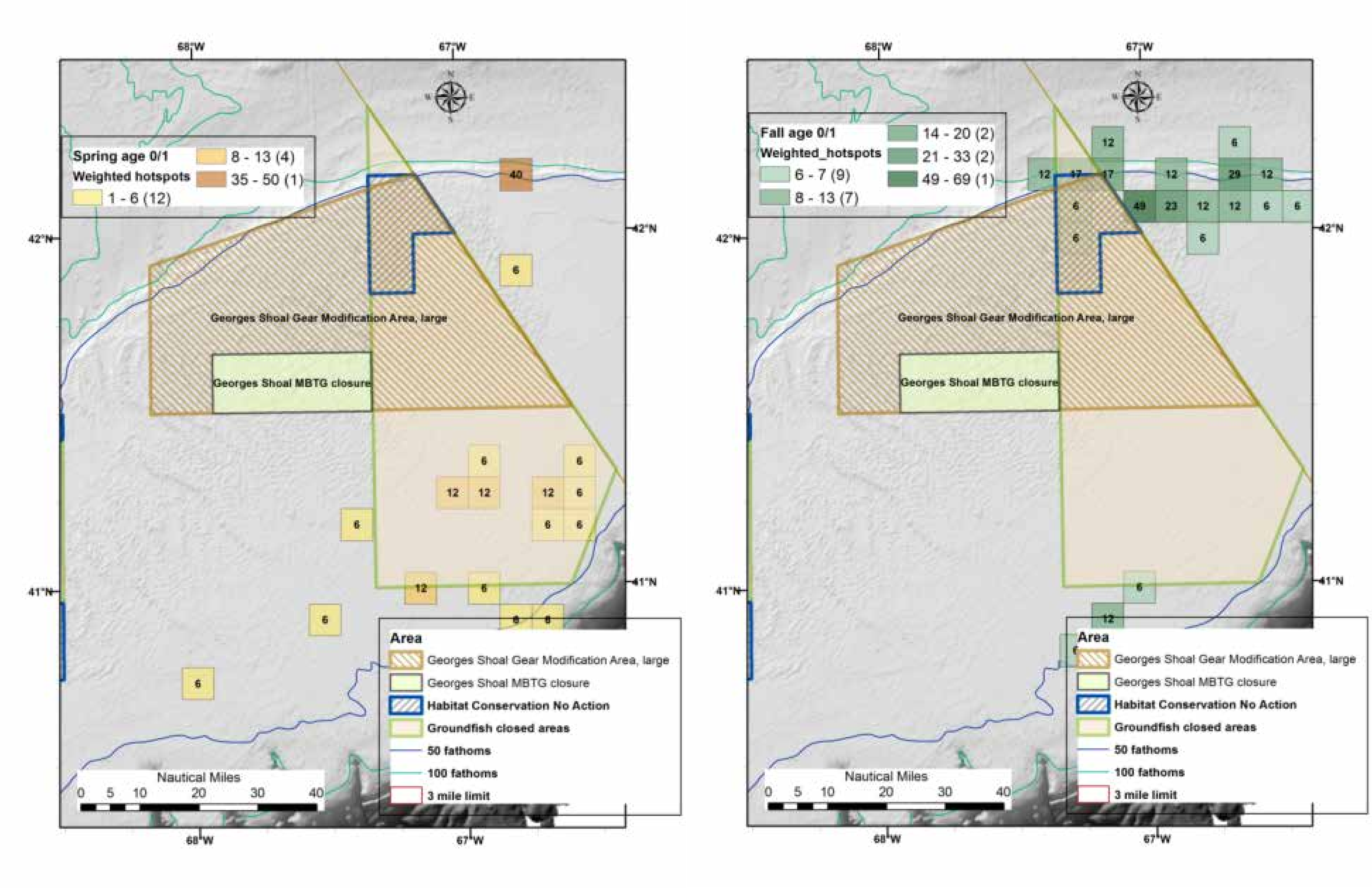
4.1.2.5.5 Alternative 5

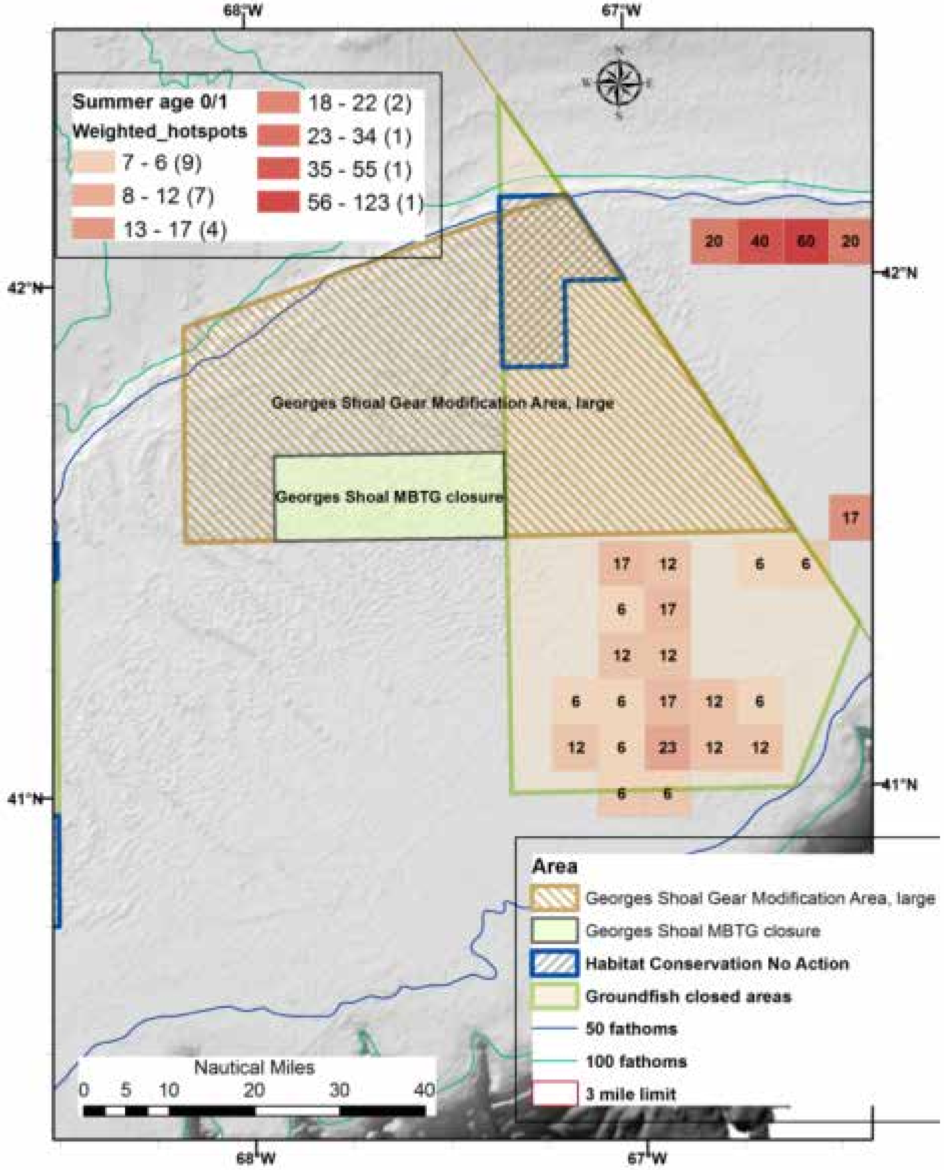
Alternative 5 includes a much larger Georges Shoal gear modification area, overlapping the Cod HAPC and proposed Northern Edge habitat management area in Alternatives 3 and 4. An additional Georges Shoal MBTG closure area would apply, west of the Closed Area II boundary (Map 60). These areas together contain less weighted age 0/1 groundfish hotspots than any other alternative (except Alternative 2 which includes no habitat management areas).

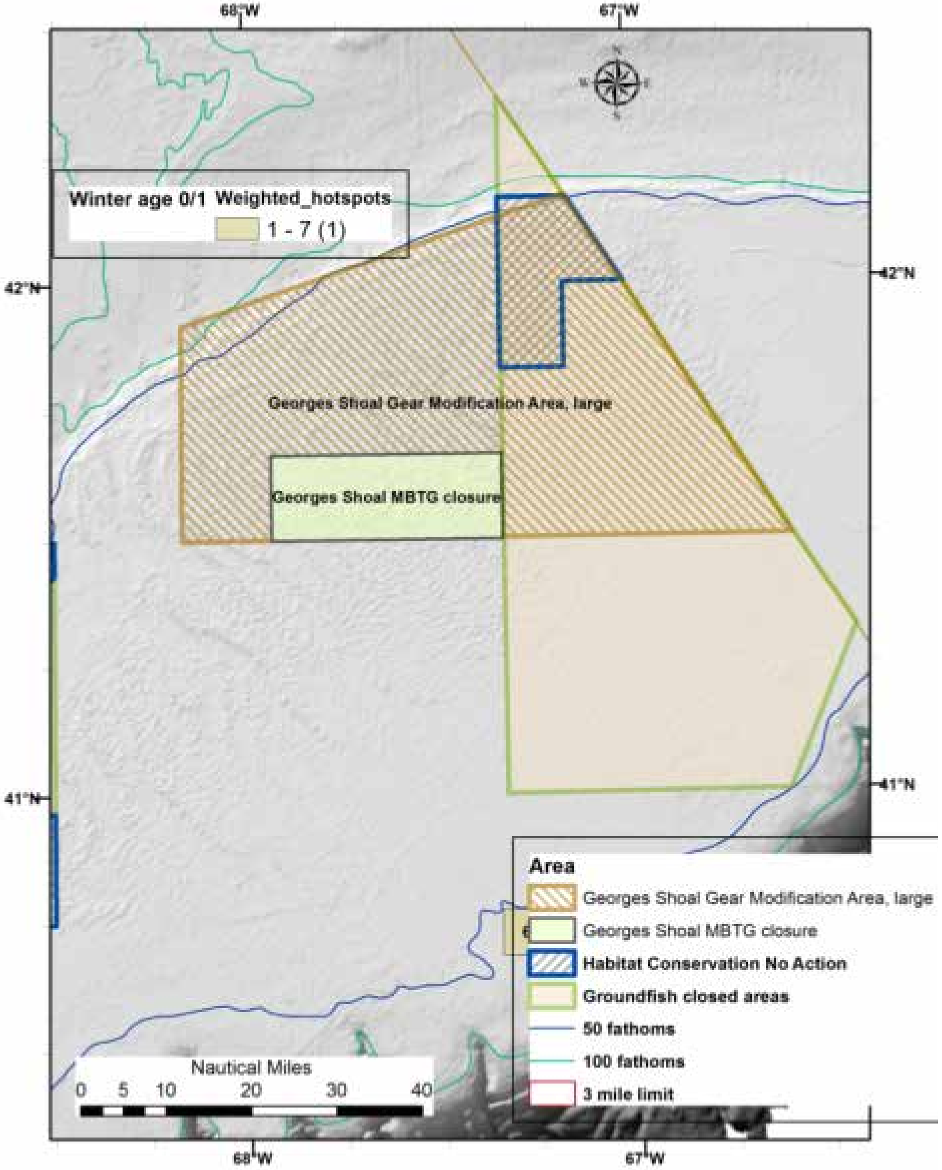
It has fewer hotspots for haddock and red hake, but slightly more winter flounder hotspots (Table 56). There does not appear to be more abundance of age 0/1 and older sublegal cod in the gear modification area and no cod or haddock juvenile catches in the proposed Georges Shoal MBTG closure area. Extending 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 59), depending on the effect of gear modifications (Section 4.1.2.1.2).

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 60 – 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 trawl and summer dredge survey data.




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)
20
40
60
20
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
17
17
12
6
6
6
17
12
12
6
6
17
12
6
12
6
23
12
12
6
6
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


68°W
67°W
42°N
41°N
Winter age 0/1 Weighted_hotspots
1 - 7 (1)
Georges Shoal Gear Modification Area, large
Georges Shoal MBTG closure
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

4.1.2.5.6 Alternative 6A

This alternative expands the existing habitat management area now known as the ‘Cod HAPC’ west to 67º30’ W longitude, encompassing more areas of vulnerable substrate and juvenile groundfish habitat than exist in the Cod HAPC (Map 61). This larger area is shaded red with a brown border in Map 61, shown with the total number of weighted age 0/1 groundfish hotspots by season. The amount of age 0/1 groundfish unweighted and weighted hotspots (Table 55) is similar to the amount for Alternative 5, less than that for Alternatives 3 and 4.

Although there are few cod and haddock hotspots identified on the US side of the Northern Edge, protection of cod and haddock can be evaluated a little more broadly by examining the distribution of all survey catches of age 0/1 and age 2+ juvenile cod and haddock. One caveat that should be considered to interpret these results however is the effect that fishing has on abundance and presence of juvenile groundfish.

During the spring and fall (Map 62) most of the age 0/1 cod are on the Canadian side of the Hague line, but there are more catches of age 2+ juvenile cod west of the Hague line, particularly during the spring and summer. Most of the age 2+ cod on the Northern Edge in US waters were observed within the boundary of the existing cod HAPC. For cod, there does not appear to be additional protection for juvenile cod by expanding the Cod HAPC, and there may be less protection for juvenile cod than that given by Alternative 1 (No Action). The GAMs based habitat suitability analysis (Appendix ???) however indicates that age 0/1 cod habitat is important in the Cod HAPC and in the areas to the immediate west, along the edge of the bank, which is partially encompassed by this alternative.

Catches of age 0/1 and age 2+ juvenile haddock (Map 63) are however more pravelent to the west of the Cod HAPC, an area partially encompassed by CAII EFH modified, large in this alternative. The area misses a notable concentration of survey catches of age 0/1 and age 2+ juvenile haddock extending to the SW along the northern edge of Georges Bank. Although the Alternative 6.1 Habitat Management Area includes some areas having age 0/1 and age 2+ haddock, particularly in the spring and summery surveys, it is doubtful that this additional protection completely compensates for the high abundance of haddock (see hotspots shown in Map ???) in the southern part of Closed Area II, even though the latter has less vulnerable substrate.

Based on the amount of weighted hotspots and the distribution of age 0/1 and older juvenile cod and haddock, the expected impacts on groundfish habitat and groundfish stocks is expected to be slightly negative compared to Alternative 1 (No Action), and slightly negative compared with Alternatives 3 and 4. The assessment of impacts relative to Alternative 1 (No Action) is made considering the fact that most of Closed Area II is open to mobile bottom-tending gear fishing through haddock and yellowtail flounder special access programs using modified trawls and to periodic scallop fishing in the southern portion of Closed Area II. This also assumes that the ‘CAII EFH modified, large’ area is closed to fishing with MBTG. If another option is chosen that only requires modified gear, this alternative has much large negative impacts, compared to Alternative 1 (No Action).

4.1.2.5.7 Alternative 6B

Like alternative 6A, this alternative would extend the existing ‘Cod HAPC’ west to 67º30’ W longitude. An eight mile ‘buffer’ between the proposed Habitat Management Area and the Hague Line would be open to all fishing gears, however. The proposed ‘CAII EFH modified, small’ area is outlined with a red border in Map 61, shown with the total number of weighted age 0/1 groundfish hotspots by season.

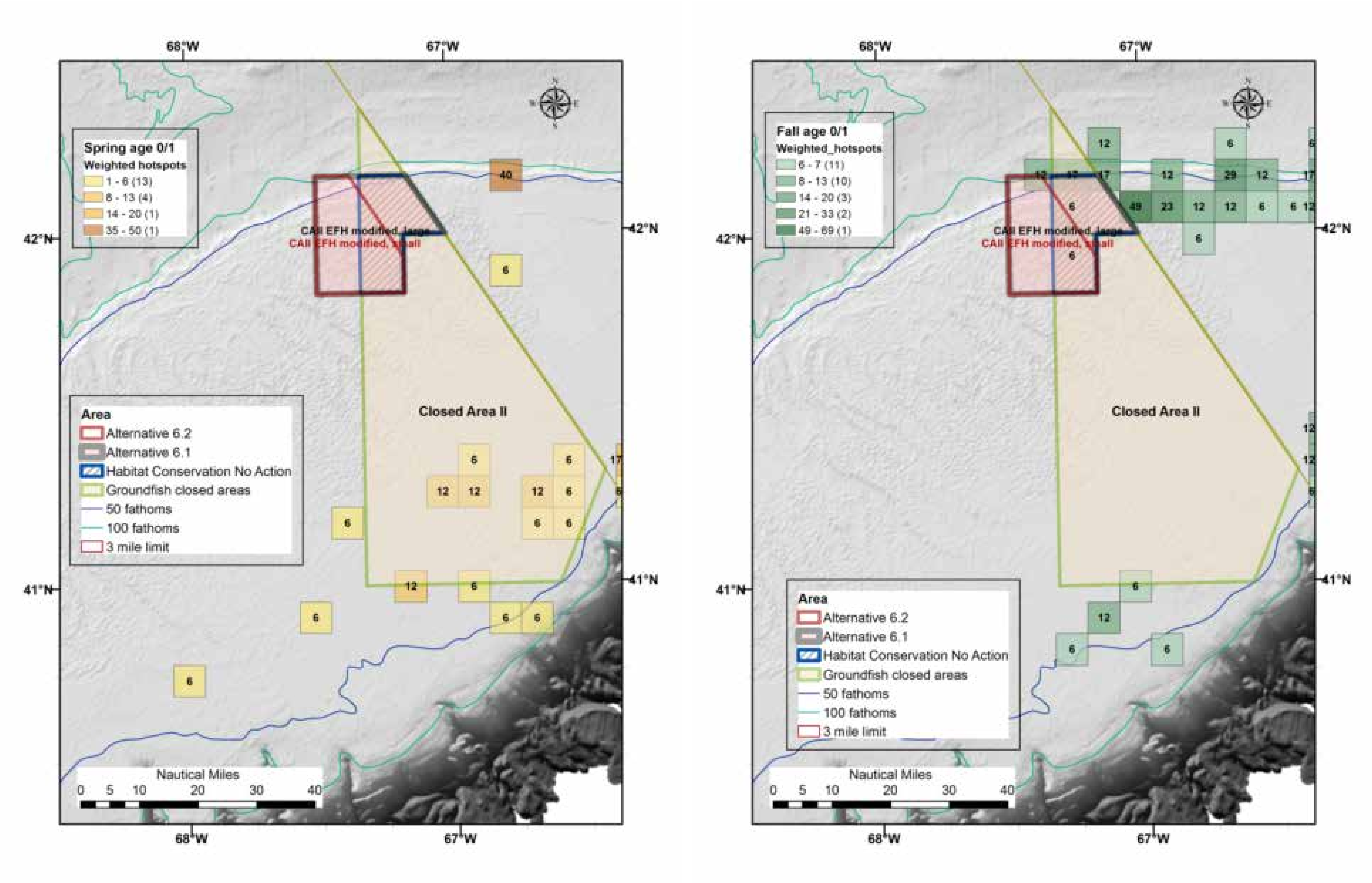
This modification would re-open all but about a third of the Cod HAPC to fishing, including the more vulnerable substrates found on the northern edge of Georges Bank. This would also allow scallop fishing where the concentrations of scallop biomass are currently found.

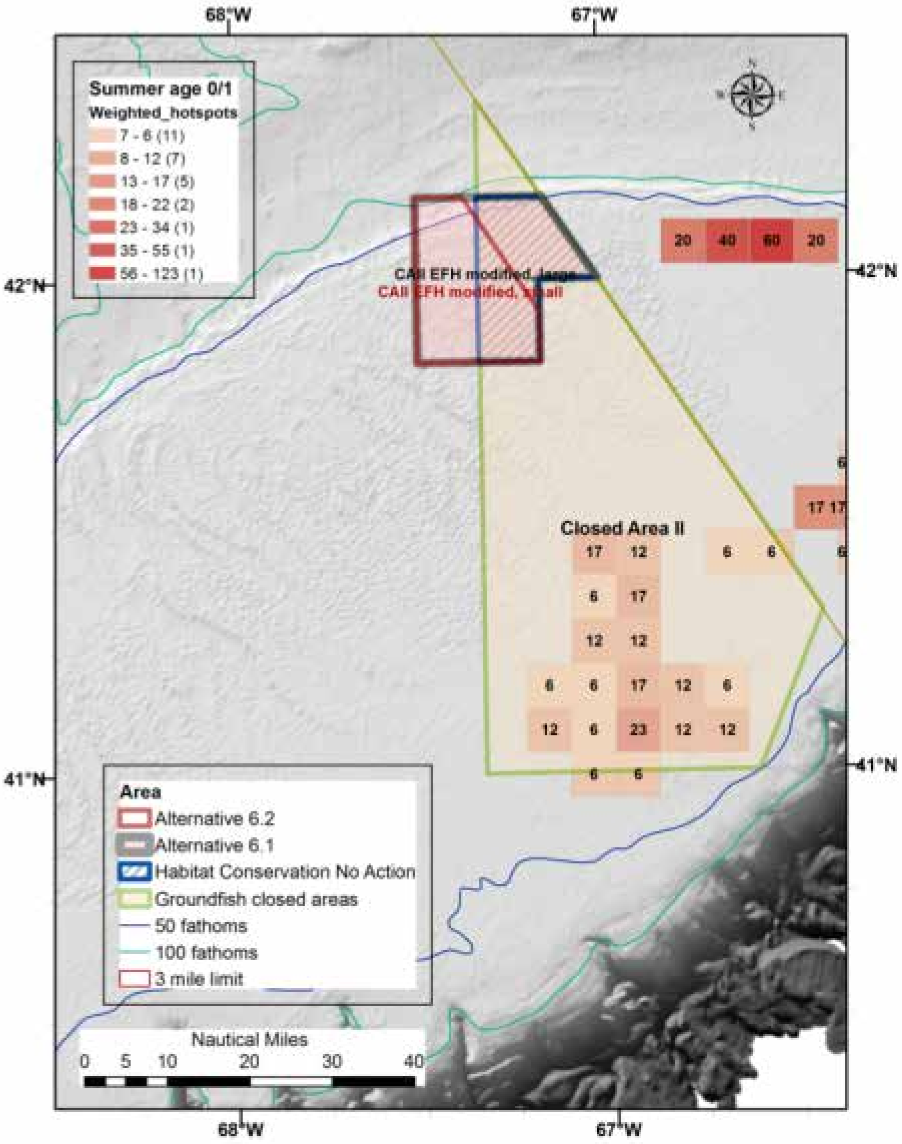
The number of unweighted and weighted age 0/1 groundfish hotspots in this proposed Habitat Management Area is fewer than any alternative other than Alternative 2 (Table 55), which has no proposed Habitat Management Areas. It has fewer than the existing EFH closure area, the Cod HAPC.

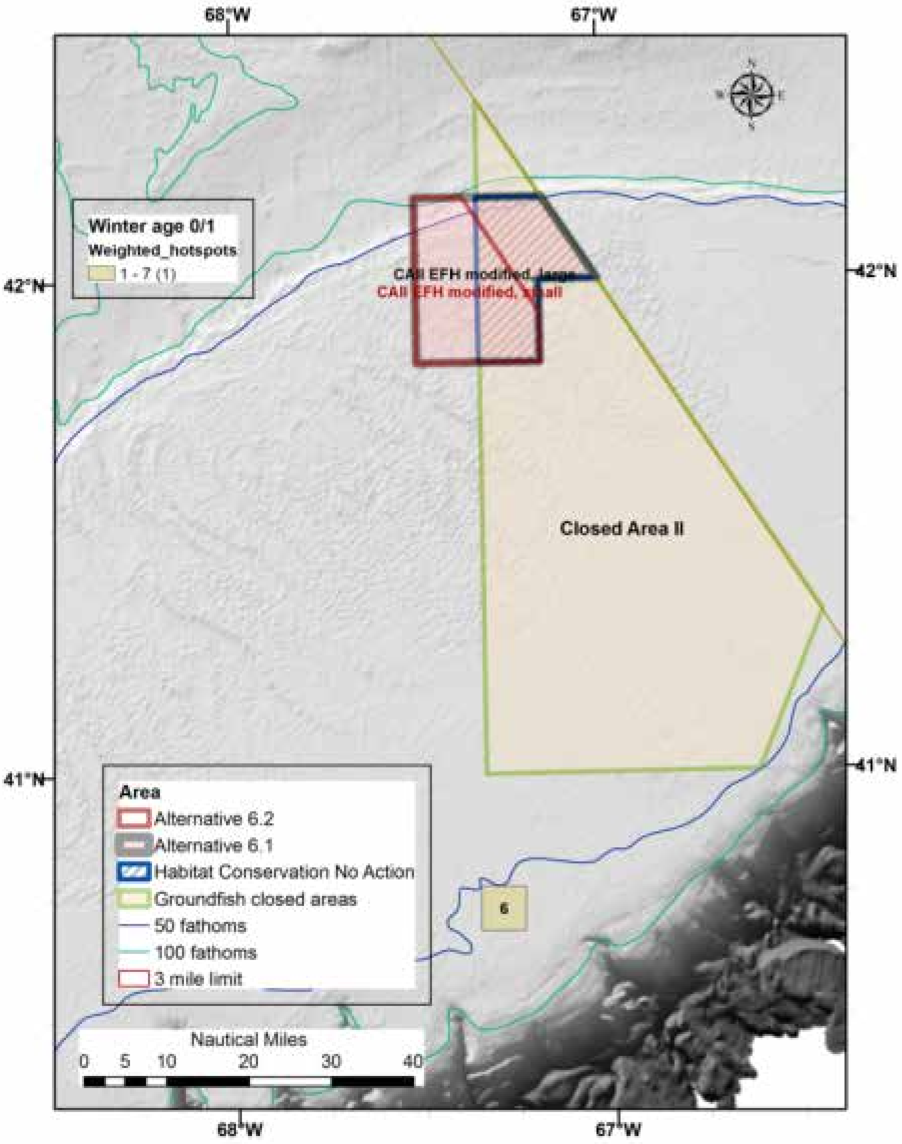
Examining the distribution of age 0/1 and age 2+ juvenile cod and haddock catches in survey tows, a substantial fraction of high-catch tows (Map 62 and Map 63) are in the 8-mile buffer that would be excluded and open to fishing by vessels using MBTGs.

While it may be true that the existing fishing activity immediately west of the Cod HAPC removes small cod and haddock and other groundfish that rely on vulnerable substrates (and there has been a detrimental effect of fishing on that habitat), the existing data indicate that this alternative would have a large negative impact on juvenile groundfish habitat relative to Alternative 1 (No Action) and also relative to all but Alternative 2.

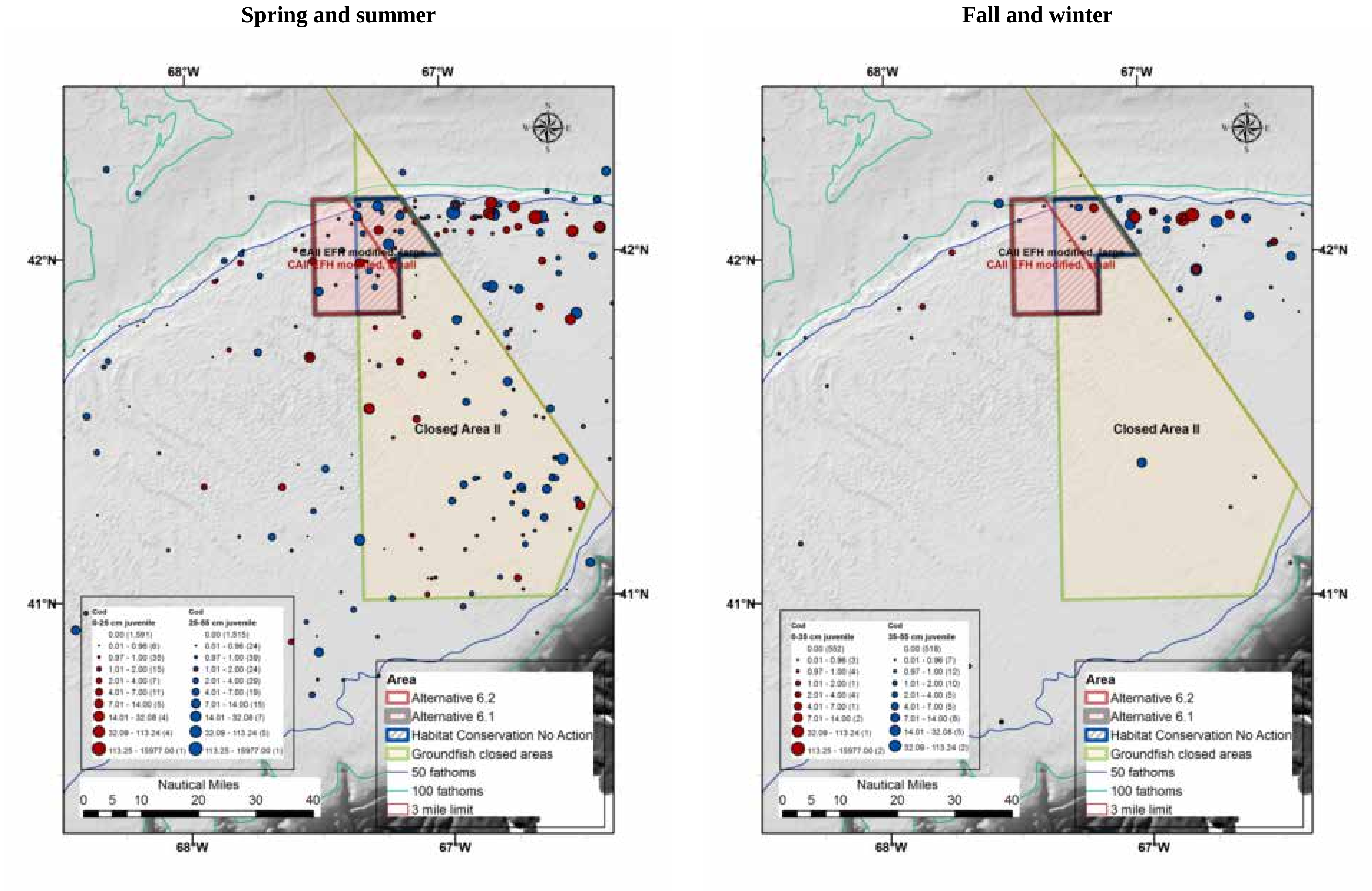
Map 61 – GB Alternative 6.1 (CAII EFH modified, large) and 6.2 (CAII EFH modified, small) overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS trawl and summer dredge survey data.




68°W
67°W
42°N
41°N
Summer age 0/1
Weighted_hotspots
7 - 6 (11)
8 - 12 (7)
13 - 17 (5)
18 - 22 (2)
23 - 34 (1)
35 - 55 (1)
56 - 123 (1)
CAII EFH modified, large
CAII EFH modified, small
Closed Area II
20 40 60 20
17 17
17 12 6 6
6 17
12 12
6 6 17 12 6
12 6 23 12 12
6 6
Area
Alternative 6.2
Alternative 6.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40


68°W
67°W
42°N
41°N
Winter age 0/1
Weighted_hotspots
1 - 7 (1)
CAII EFH modified, large
CAII EFH modified, small
Closed Area II
6
Area
Alternative 6.2
Alternative 6.1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 5 10 20 30 40

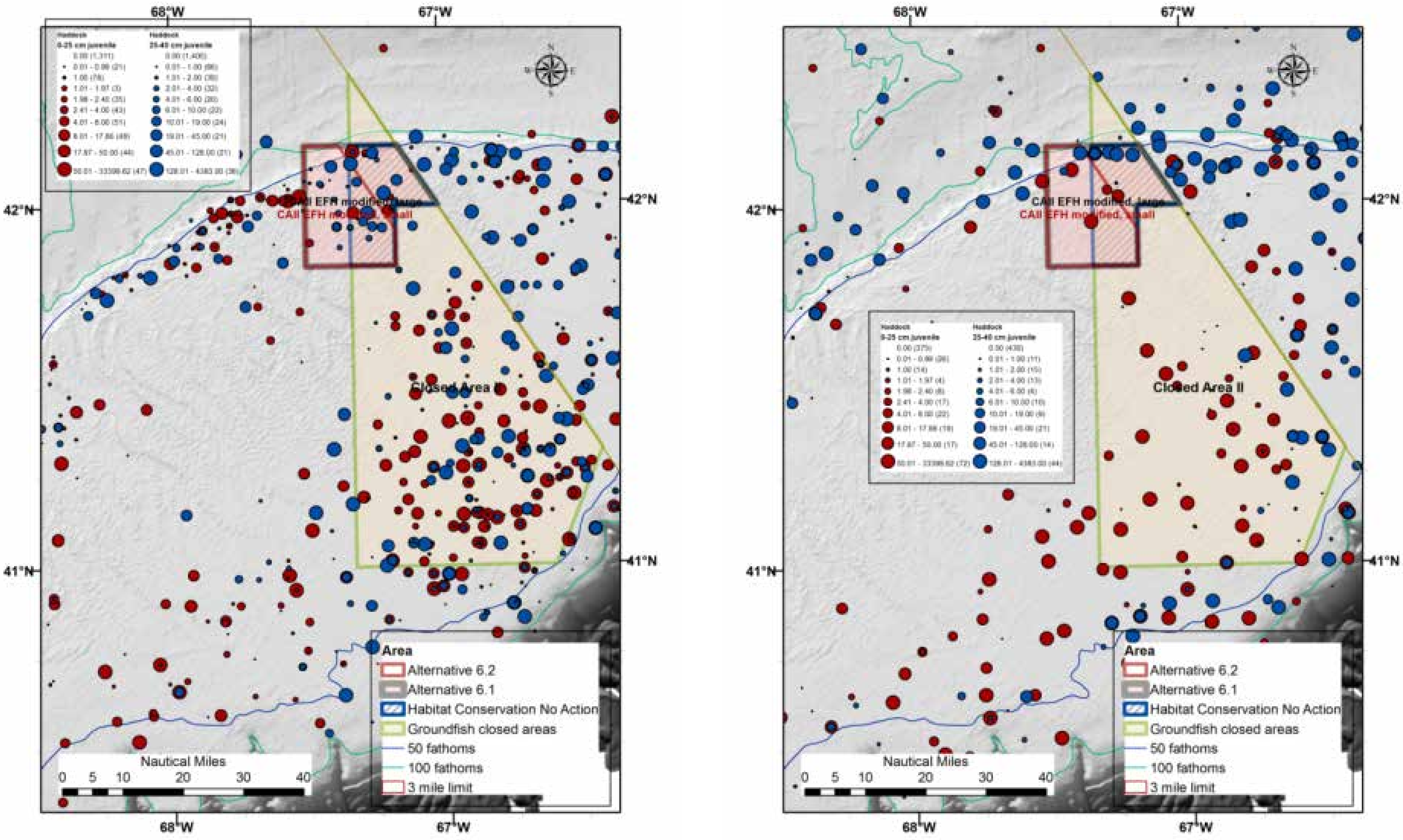
Map 62 – Overlap of GB Alternatives 6.1 and 6.2 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS surveys.



Spring and summer

Fall and winter

Map 63 – Overlap of GB Alternatives 6.1 and 6.2 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

4.1.2.6 *Great South Channel and Southern New England*

4.1.2.6.1 Alternative 1 (No action)

See tables and maps under GB Alternative 1 section.

4.1.2.6.2 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.

4.1.2.6.3 Alternative 3

Alternative 3 includes proposed two small habitat management areas around Cox Ledge and a large Great South Channel area extended a little east into the deeper portion of the channel. Like the other action alternative for the Great South Channel sub-region, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 57; Map 64). It is difficult to assess groundfish habitat in the proposed habitat management areas because a large portion that overlaps the Nantucket Shoals is not surveyed.

Map 65 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.

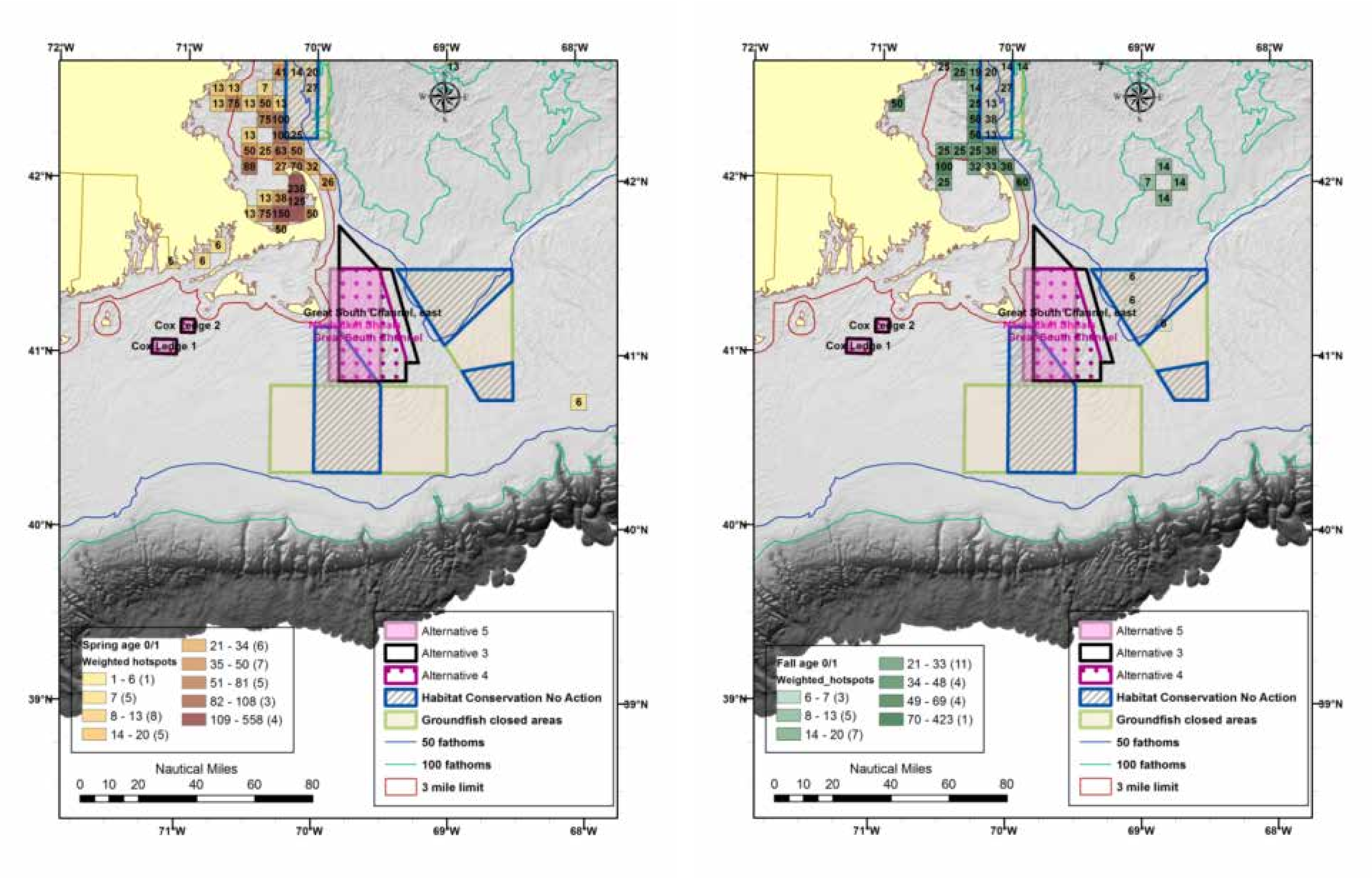
Map 66 shows the relationship between the proposed habitat management alternatives and survey catches of age 0/1 and larger sub-legal haddock. Except for the central portion of Closed Area I and the northeastern part of the Nantucket Lightship Area (which are also scallop dredge access areas), there 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 hosts older sub-legal juvenile haddock, although it is unclear whether it also includes areas with vulnerable substrate that older haddock rely on.

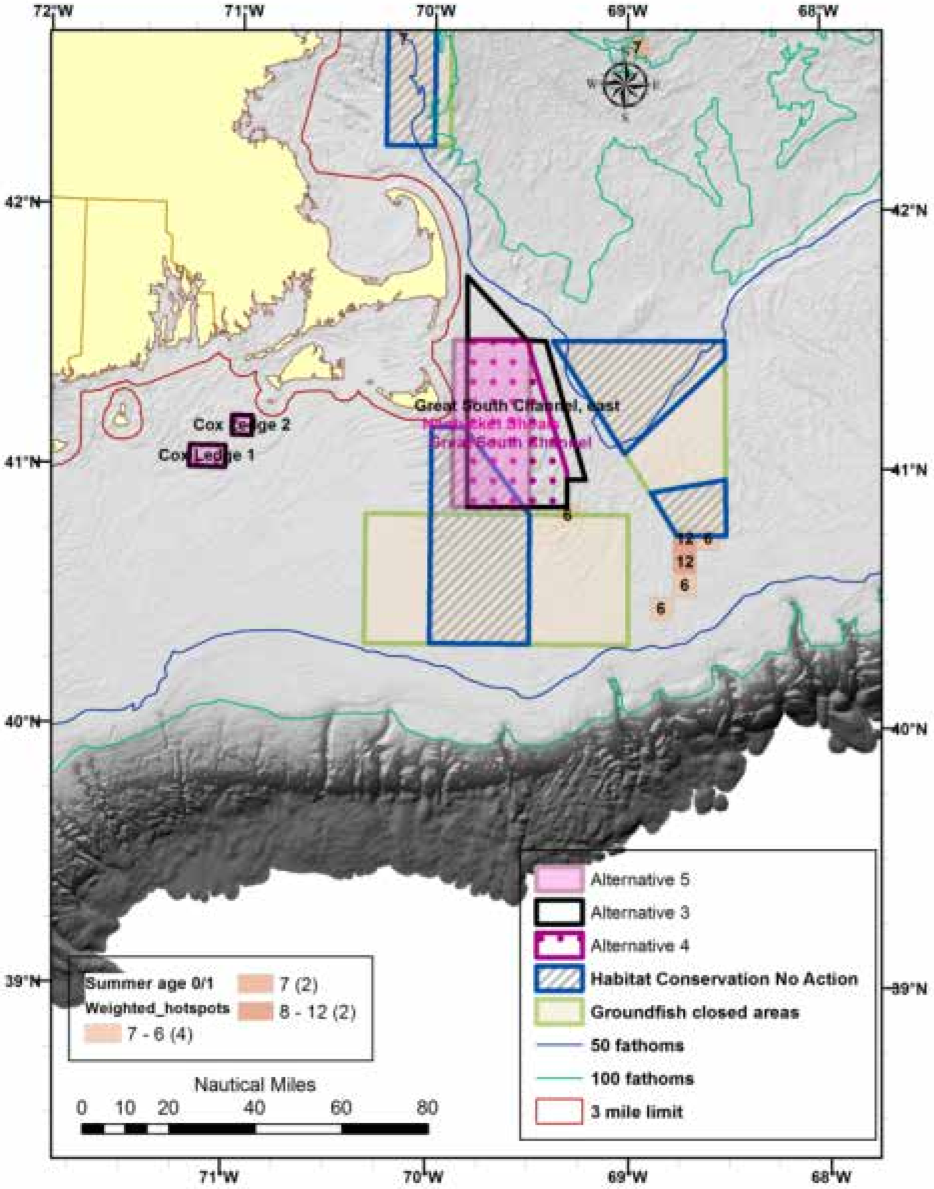
The effect of this alternative on groundfish habitat and on groundfish stocks is therefore highly uncertain.

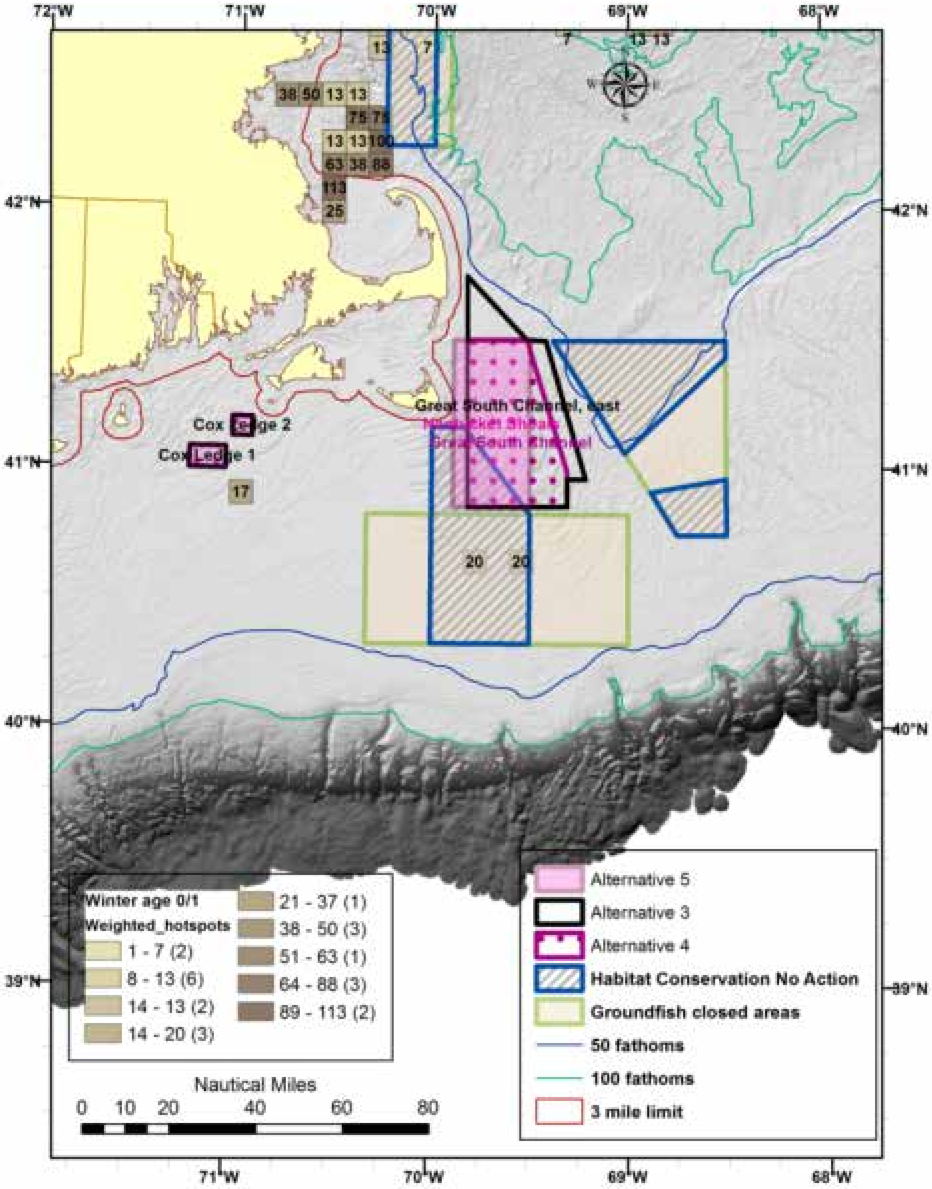
Table 57 – Total unweighted and weighted hotspots in GSC habitat management area alternatives compared to No Action.

	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

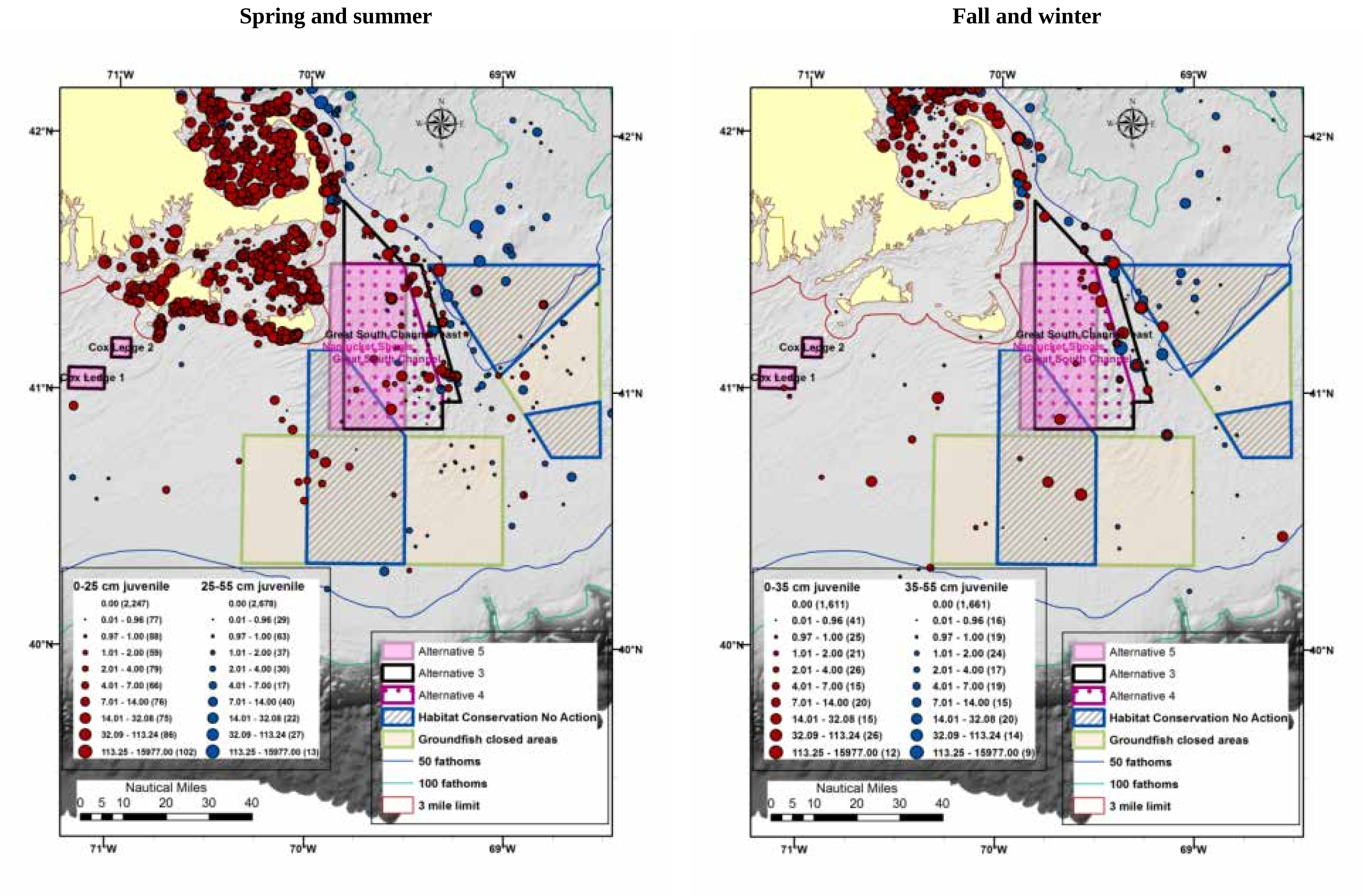
Map 64 – GSC Alternatives 3, 4, and 5 overlap with spring (left), fall (right), summer (left on next page), and summer (right on next page) total weighted age 0/1 groundfish hotspots from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.




72°W
71°W
70°W
69°W
68°W
42°N
41°N
40°N
39°N
Great South Channel, east
Nantucket Shoals
Great South Channel
Cox Ledge 2
Cox Ledge 1
7
7
6
12
6
12
6
6
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


72°W
71°W
70°W
69°W
68°W
42°N
41°N
40°N
39°N
Great South Channel, east
Nantucket Shoals
Great South Channel
Cox Ledge 2
Cox Ledge 1
13
7
7
13
13
38
50
13
13
75
75
13
13
100
63
38
88
113
25
17
20
20
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

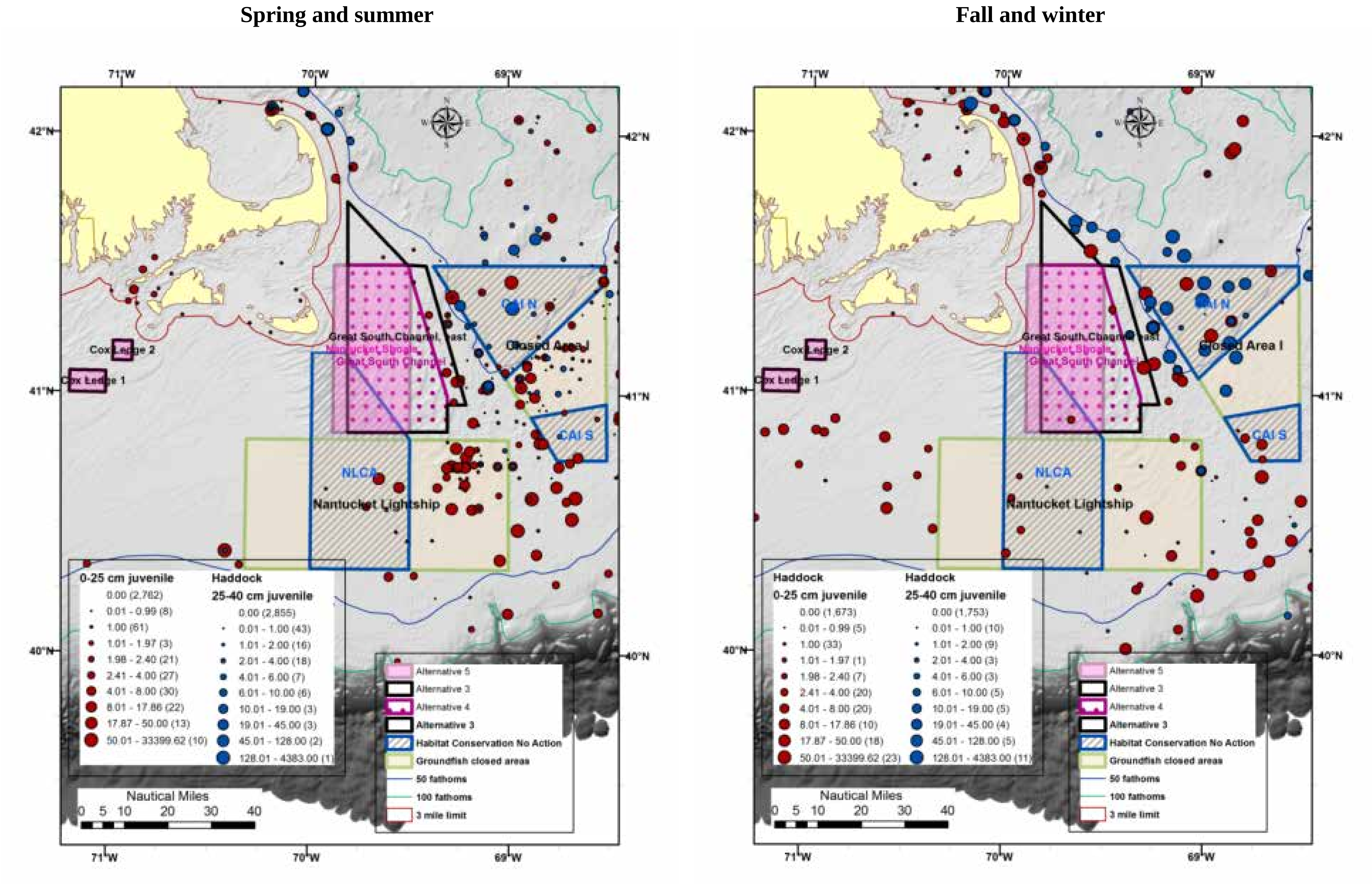
Map 65 – Overlap of GSC Alternatives 3, 4, and 5 with distributions of sub-legal cod number per tow for age 0/1 and age 2+ size classes in 2002-2012 NMFS, MADMF, and IBS surveys.



Spring and summer

Fall and winter

Map 66 – 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

4.1.2.6.4 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 sub-region, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 57; Map 65). It is difficult to assess groundfish habitat in the proposed habitat management areas however, because a large portion that overlaps the Nantucket Shoals is not surveyed. The effect of this alternative 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.

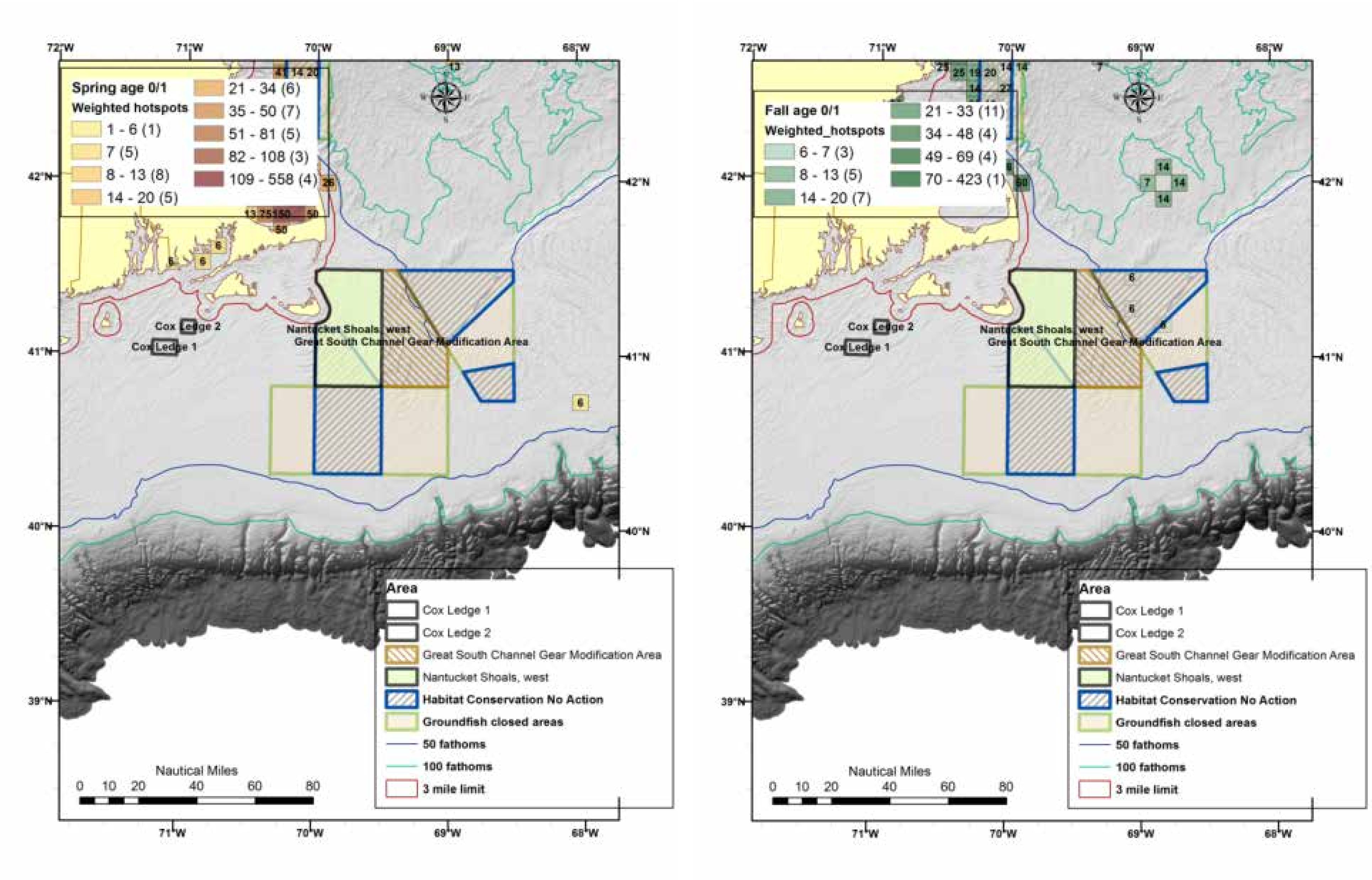
4.1.2.6.5 Alternative 5

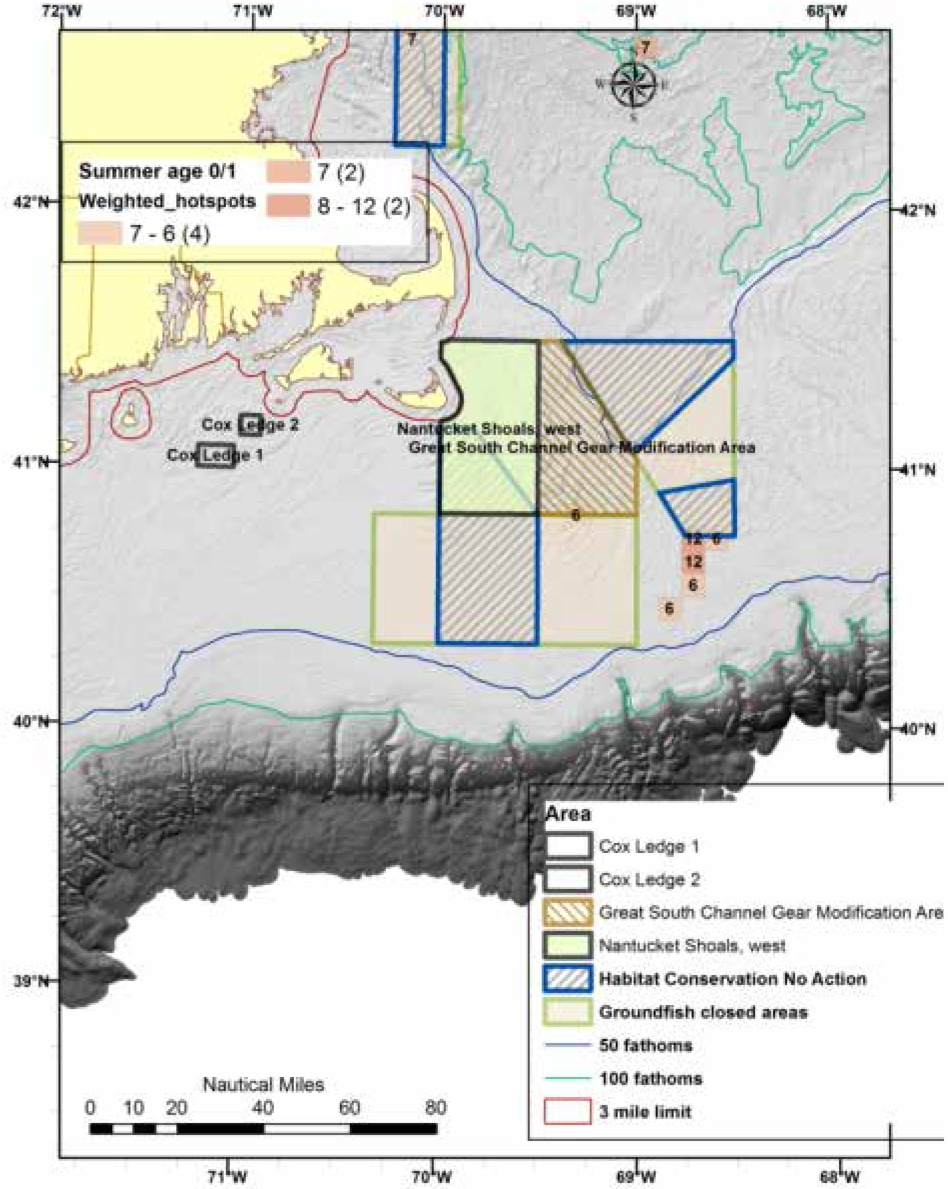
Alternative 5 also includes two habitat management areas around Cox Ledge, but proposes a Nantucket Shoals west habitat management area that includes the northern portion of the Nantucket Lightship EFH closure and overlaps Nantucket Shoals, where there are few to no survey observations. Like any other action alternative for the Great South Channel sub-region, there were no weighted groundfish hotspots found in the proposed habitat areas (Table 57; Map 67). It is difficult to assess groundfish habitat in the proposed habitat management areas, 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 alternative 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.

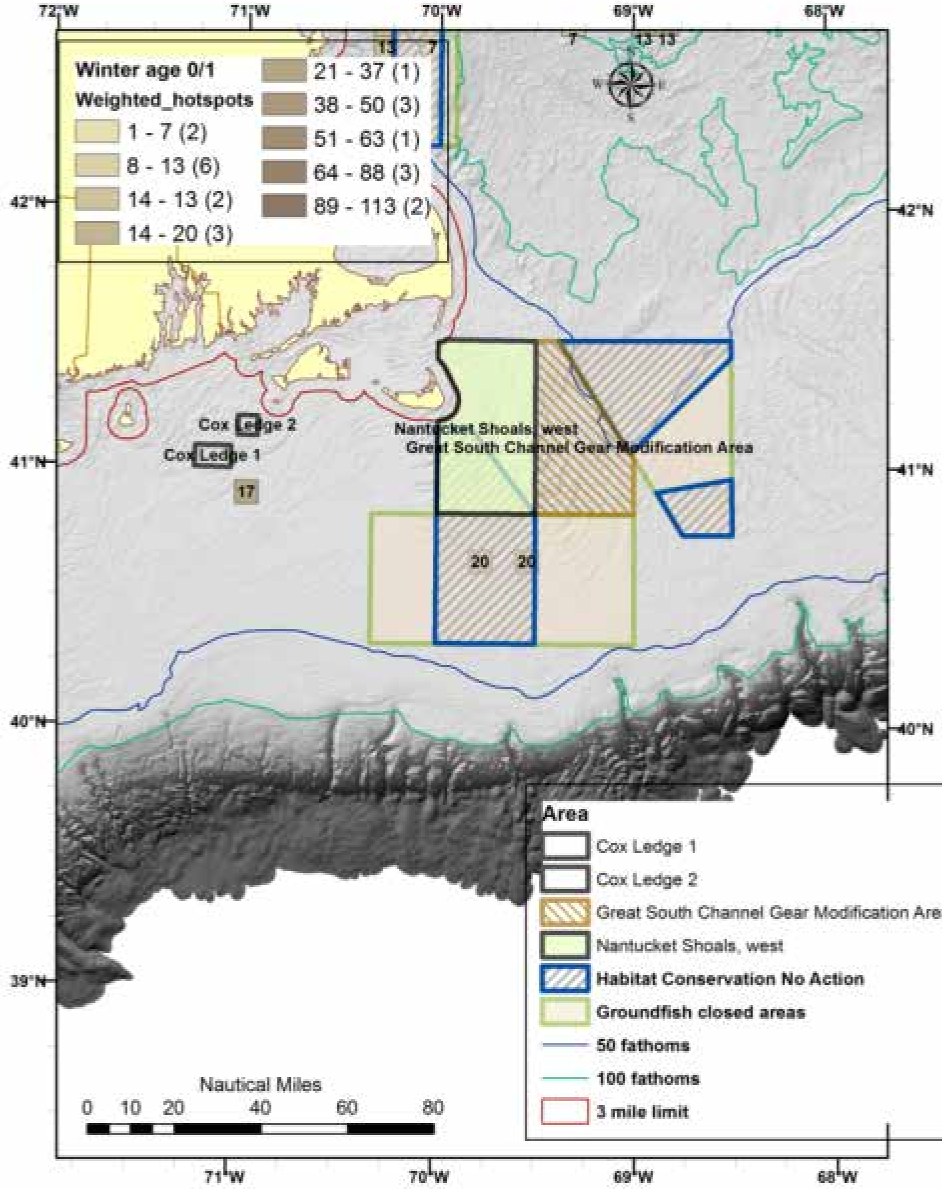
4.1.2.6.6 Alternative 6

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 67). 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 alternative on groundfish habitat and on groundfish stocks highly uncertain, due to uncertainties about the effectiveness of proposed trawl gear modifications coupled with exemptions for fishing with scallop and clam dredges (discussed in Section 4.1.2.1.2).

Map 67 – GSC Alternatives 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-NH, 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 *Analytical approach and assumptions*

The general methods for the economic and social analyses are described at the beginning of section 4.

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.

4.1.3.1.1 No Action Alternative (maintain status quo)

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.

4.1.3.1.2 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. Additionally, opening areas for fishing allows fishermen more flexibility in their harvesting behavior. This can have positive impacts on the *Non-Economic Social Aspects* of the fishing industry as it allows harvesters more freedom regarding when and where they fish, which may allow them to take fewer risks, fish more safely, and create schedules that are less constrained.

There are many positive social impacts associated with opening closed areas. Opposite of the way that vessels would be displaced from fishing in a newly closed area, a re-opened area would reduce negative impacts on vessels that normally fish in proximity to an existing closed area.

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 borders 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). Re-opened closed areas would conversely reduce congestion next to these areas and remove the incentive to fish around the area's boundaries since the vessels would no longer capitalize on the biological "spillover". Relieving this congestion and conflict would have a positive social impact on *Social Structures and Organizations*. This impact on *Social Structures and Organizations* would be exacerbated if the existing closed areas are seen as benefiting a particular segment of the fishery at the expense of another.

There are however 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.

4.1.3.1.3 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 habitat 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 sections 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 of VTR data described in the introduction to section 4. 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 is 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 tables 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.

The communities listed in these tables are not the only communities that will be impacted by the addition of new closed areas. 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 borders 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 ocean and 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.

4.1.3.1.4 Gear modifications (options 3-4)

In comparison to the no action alternatives, several gear modifications are being proposed in the alternatives under consideration. In terms of the social impact assessment, 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 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 *Eastern GOM and the Scotian Shelf*

Tables and figures related to analysis of the economic and social 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 15 – Machias HMA 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

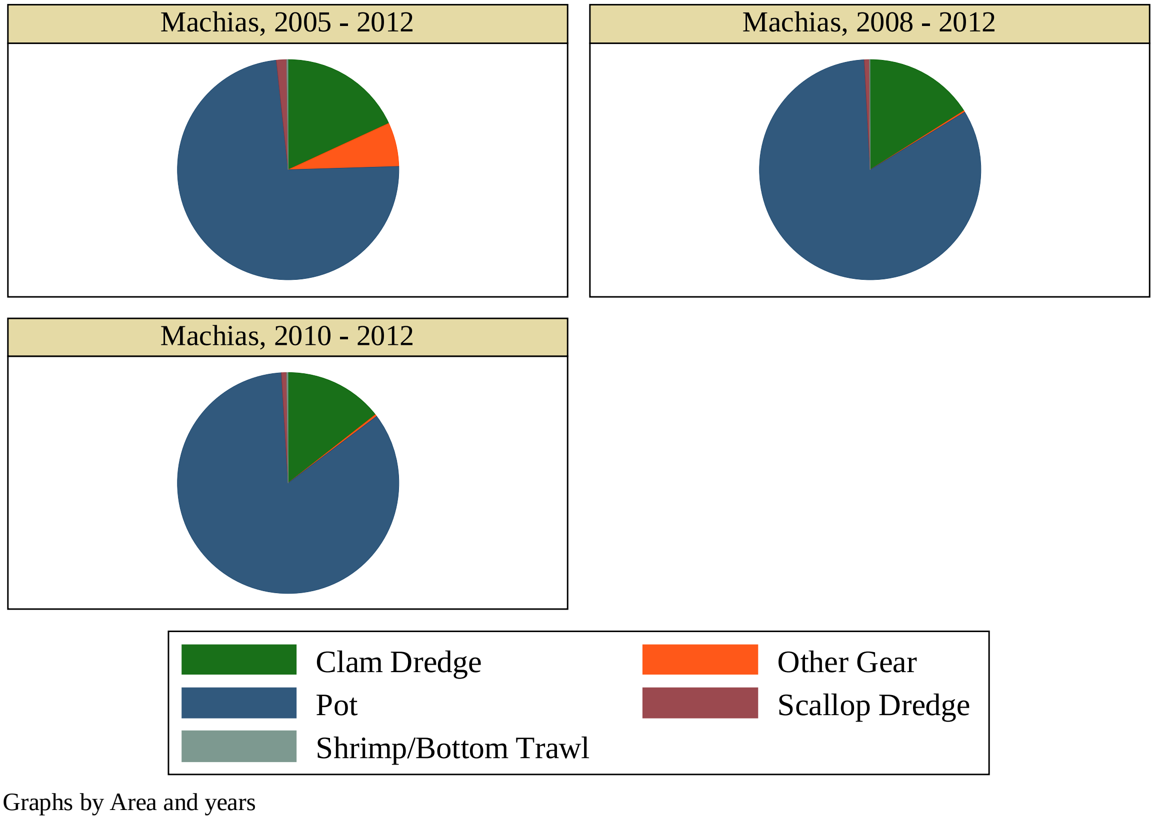
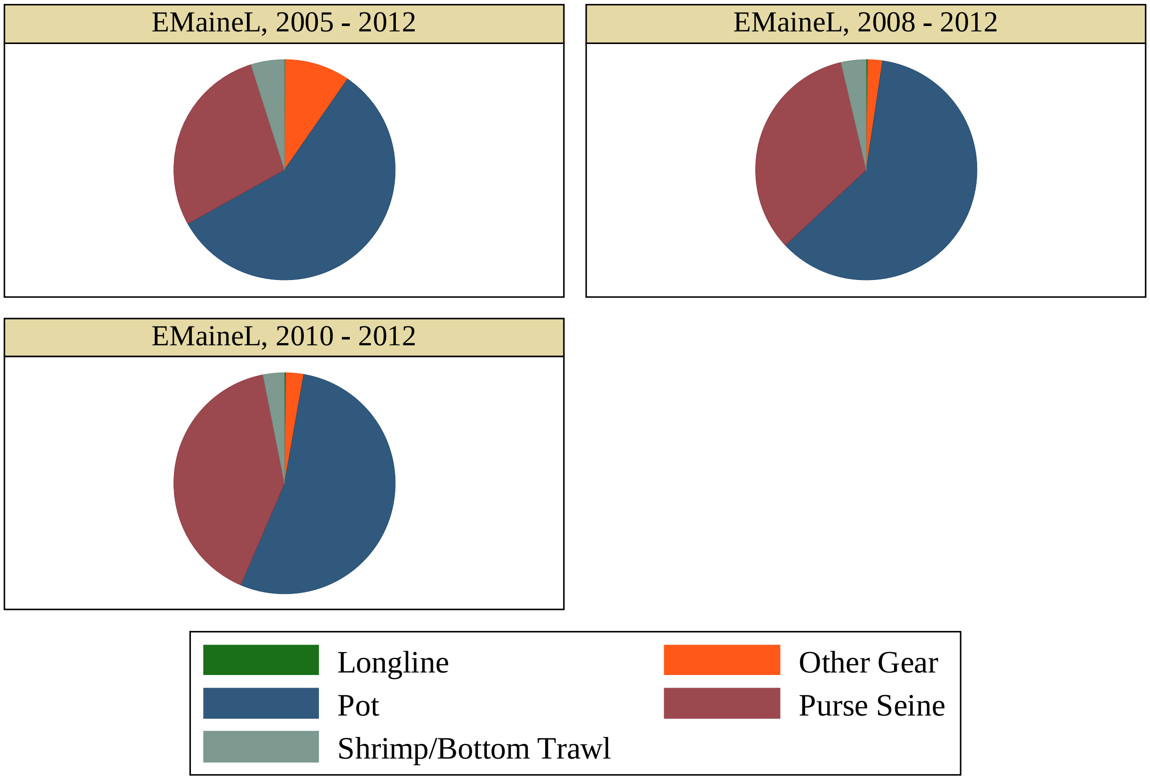
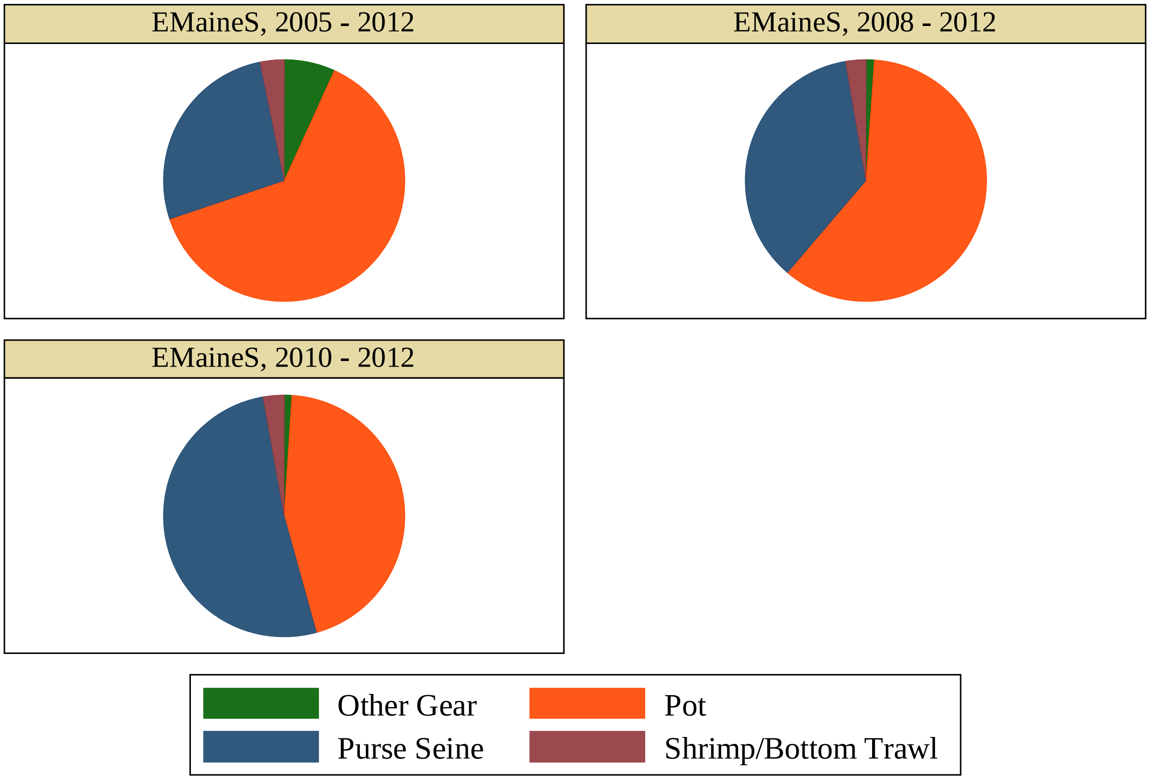


Figure 16 – Large E. Maine HMA revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 2,076,300; 2008 - 2012 =$ 2,059,535; 2010 - 2012 = $ 2,719,470



Graphs by Area and years

Figure 17 – Small E. Maine HMA 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



Graphs by Area and years

Figure 18 – Toothaker Ridge HMA 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

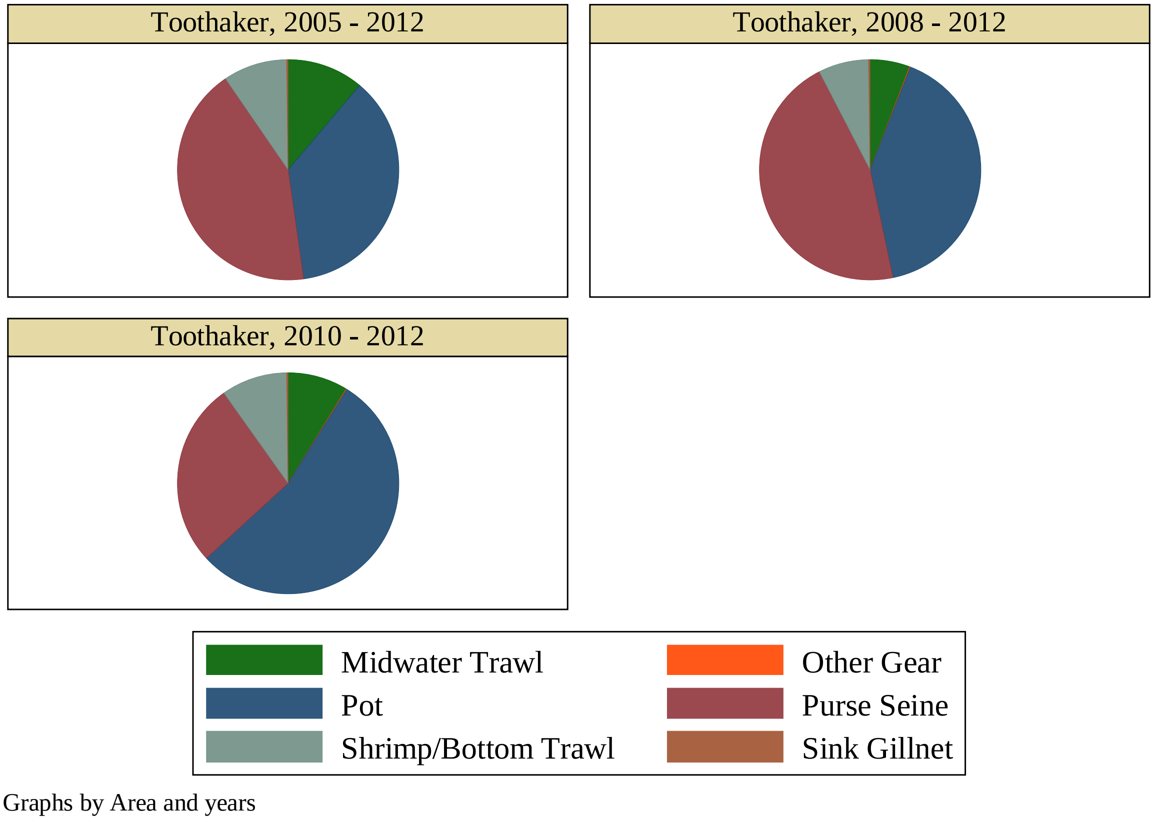


Table 58 – Mobile bottom-tending gear potentially impacted Eastern Maine Habitat Alternative 2. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U= unknown vessel characteristics.

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 59 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the Eastern GOM Alternative 2 areas, 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 60 – 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 61 – Mobile bottom-tending gear potentially impacted by Eastern Maine Habitat Alternative 3. 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 62 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the Eastern GOM Alternative 3 areas, 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

Table 63 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Eastern Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

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

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

There are currently no year-round closed areas in this sub-region.

Section 4.1.2.2.1 indicates that there is some expectation that recent restoration projects in Eastern Maine will help rejuvenate groundfish populations in this sub-region. However, there is high uncertainty regarding the overall cause of the groundfish population collapse, and thus whether the restoration projects will ultimately prove successful. Therefore, the current no action alternative is expected to have a neutral economic impact, with a possibility of negative impacts if synergies between restoration and conservation actions are not capitalized upon.

Alternative 1 would result in mainly neutral non-economic social impacts as it would maintain the status quo.

4.1.3.2.2 Alternative 2

Alternative 2 would designate two new habitat management areas, the Large Eastern Maine Habitat Management Area and the Machias Habitat Management Area.

Figure 15 and Figure 16 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. Note 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 58 provides a more detailed view of mobile bottom-tending gear use. 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, appears to occur outside of the Machias management area. 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 EGOM 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 larger than 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 seems to represent fishing on the edges of more productive fishing grounds as opposed to the area being a center of fishing.

Table 59 presents the VMS analysis of fishing effort in Machias and Large Eastern Maine, which seem to bear out the VTR analysis of Table 58. Historically, some small amount of GC scalloping has occurred within the boundaries of Machias, while Large Eastern Maine shows insubstantial amounts of bottom trawl and scallop fishing.

Table 60 summarizes the recreational fishing reported within EGOM Alternative 2. 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 6% - 8% (between $185,694 and $253,682 annually) of the total revenue generated 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.

The short term impacts of EGOM Alternative 2 are thus expected to be slightly negative, with neither Machias nor Eastern Maine Large reported to be centers of mobile bottom tending gear activity. In the long run, positive net benefits are expected through expected increases in groundfish productivity (see section 4.1.2.2.1), though as noted these benefits are less certain and smaller than those expected from management areas in other sub-regions. The magnitude of these benefits are expected to be smaller than Alternative 3, given the relative habitat protection afforded (see section 4.1.2.2.3).

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. What information exists indicates that option 3 would be expected to decrease catch rates for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats identified in section 4.1.1.1.2, indicates that both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

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 62). With the exception of Portland, ME, most of these communities are smaller coastal communities that have high levels of engagement and reliance on commercial fishing and have limited economic opportunities outside of fishing and relatively high social vulnerability indices (see tables in Volume 1 Fishing Communities section). 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 and less reliance on commercial fishing, 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 (Stevenson 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.

The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be slightly negative although slightly less negative than the impacts associated with 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 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.

Figure 15, Figure 17, and Figure 18 present the major gear types fishing in the vicinity of the EGOM Alternative 3 management areas. Although the overall pattern of gear usage is similar, the Small E. Maine area encompasses roughly 25-30% of the revenue associated with the Large E. Maine area in Alternative 2. Again, purse seine and lobster pots are the dominant gear types in the Small E. Maine area. 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. Machias is discussed under Alternative 2. Toothaker Ridge 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 61 provides a more detailed view of the mobile bottom-tending gears used in these three areas. Machias is discussed under Alternative 2. In the Small 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 $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 Small Eastern Maine 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, where 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 62 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. 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). This impact mainly affects bottom trawl fishermen in the vicinity of Toothaker Ridge, and clam dredge fishermen around Machias. As noted above, clam dredging in this area is prosecuted with the dry clam dredge and thus would not qualify for the Option 2 exemption.

Options 3 and 4 would primarily exempt fishermen dredging in Machias, and thus a substantial portion of the revenue potentially displaced by area management. However, as discussed under Alternative 2, both the costs and the benefits of gear restrictions are highly uncertain. Option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish, and fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats identified in section 4.1.1.1.3, indicates that both options 3 and 4 would be expected to induce a net negative benefit as compared to no action.

The short-term social impacts of Alternative 3 in comparison to the no action alternative are expected to be slightly negative and slightly more negative in comparison to Alternative 2. See the alternative 2 discussion for further details. 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.

4.1.3.3 *Central GOM*

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

Figure 19 – Jeffreys Bank HMA 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

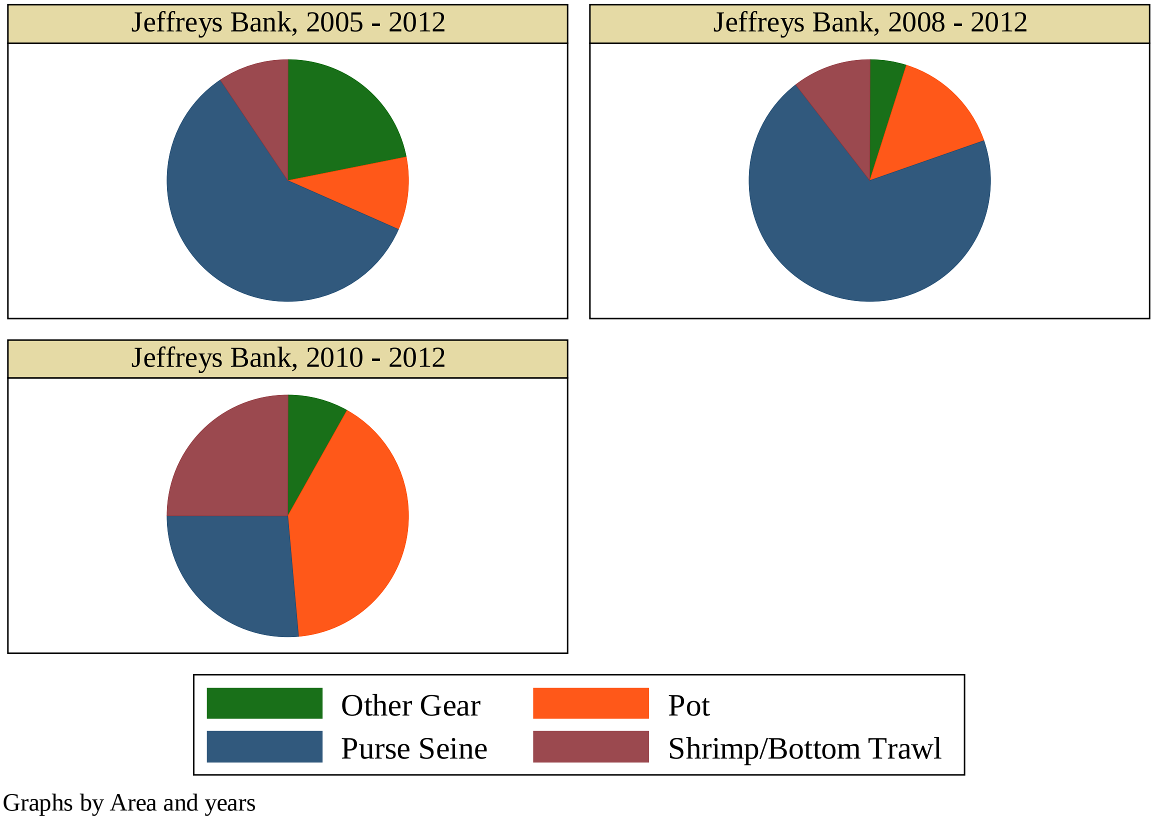


Figure 20 – Platts Bank HMA revenue in the currently open portion of the area by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 206,164; 2008 - 2012 = $ 185,991; 2010 - 2012 = $ 209,074

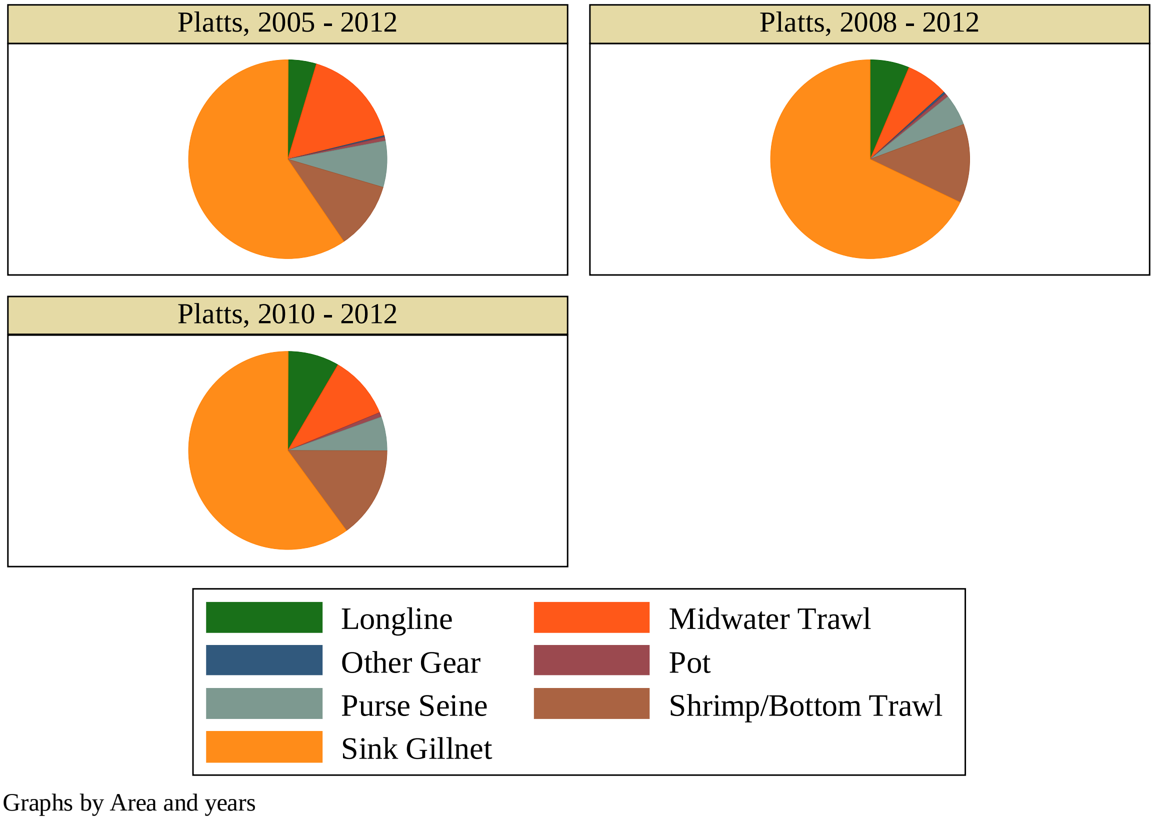


Table 64 – Mobile bottom-tending gear in currently open portions of the Central GOM Habitat Alternatives potentially displaced by the management options. All variables represent annual estimates. Blanks indicate no data for the time period. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = 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 65 – 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
Jeffreys Bank	Bottom Trawl	2010 - 2012	88.97	14.67	6.07	0.33	14.09

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
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 66 – 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 the 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 67 – 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%
	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%

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

Table 68 – 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 69 – 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

Table 70 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Central Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

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

4.1.3.3.1 Alternative 1 (No action)

The no action habitat management alternative in the CGOM region includes the Jeffreys Bank and Cashes Ledge habitat closure areas and the Cashes Ledge groundfish closure area. Given the length of time over which the Cashes Ledge and Jeffreys Bank areas have been closed, the expectation is that benefits afforded by these areas are already flowing, but additional benefits of these conservation measures are expected to accrue in the future. Despite current, direct costs to the fleet in terms of fishing displacement, no action is expected to induce positive net economic benefits due to the protection of habitats supporting juvenile groundfish that are susceptible to fishing disturbance.

Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.3.2 Alternative 2 (No Habitat Management Areas)

This alternative would remove the current Cashes Ledge and Jeffreys Bank habitat closure areas, and the Cashes Ledge groundfish closure area (removal of the groundfish closure would be subject to selection of GOM Spawning Alternative 2), and would not designate any additional habitat management areas in the region.

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 removing management areas 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 67 and Table 68 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 groundfish and 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 fishing for species in a reopened 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 Fishing Communities (4.6) sections of 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, particularly compared to areas on Georges Bank, 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 expected to displace current effort, as opposed to generating additional effort in the groundfish fishery.

Table 69 presents the recreational fishing revenue estimates for 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 reopening the area with 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.

In the short run Alternative 2 is expected to generate slightly positive net benefits when compared to the no action alternative, as groundfish and mobile bottom tending gear fishermen gain additional flexibility in when and how they are allowed to fish. However, the long run net benefits are expected to be negative when compared to the status quo, due to the lack of protection for habitat supporting juvenile groundfish and susceptible to fishing disturbance. Given the length of time over which Cashes Ledge and Jeffreys Bank areas have been closed, and thus the expectation that any benefits afforded by these areas are already flowing, the overall impact of Alternative 2 is expected to be negative.

The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be slightly 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.

4.1.3.3.3 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.

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank and Platts Bank management areas are presented in Figure 19 and Figure 20. The currently open area of the Modified Jeffreys Bank has supported a substantial amount of revenue derived from gears that would not be displaced by this alternative, although the proportion derived from Bottom/Shrimp Trawls has increased in the most recent 3 year period. However during 2010-2012 the open portions of Jeffreys Bank generated only about half of the longer run average revenue (Figure 19). Platts Bank revenue has similarly been dominated by gear that would not be displaced by this alternative. Table 64 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 65 presents VMS effort estimates for the currently open areas of Modified Jeffreys Bank and for 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 64. 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 66 details the recreational fishing revenue reported to fall within the boundaries 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. The total area currently closed to a combination of gear capable of catching groundfish, and mobile bottom-tending gear is substantially larger than the total area under consideration in Alternative 3 (Volume 1, Table 21). Thus, Alternative 3 opens more water to fishing than the no action Alternative 1, particularly to gillnet and longline fishermen. Relative to no action, groundfish are likely to face a negative impact (see section 4.1.2.3.3). Thus, the short-term economic impact of Alternative 3, option 1 is likely to be positive when compared to no action, but the long-term benefit is expected to be negative when compared to the same. Conversely, the short-term economic benefit of Alternative 3, option 1 is likely to be smaller than Alternative 2, but the positive long term economic impact is likely to be larger than Alternative 2. Both the short and long-term benefits of Alternative 3, option 1 are expected to be negligibly different than Alternative 4, option 1. Given the lack of clam dredge effort in this portion of the Gulf of Maine, Alternative 3, option 2 is expected to have the same benefits as Alternative 3, option 1.

As discussed previously, 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. Available data indicate that option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be needed to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats identified in section 4.1.1.2.3, indicates that both option 3 and 4 would be expected to induce a negative net benefit as compared to no action.

The social impacts of the Alternatives 3 and 4 would most heavily impact landing ports in Maine as well as Boston, Gloucester and New Bedford, MA. New Bedford and Boston have high social vulnerability index scores and New Bedford and Gloucester have high levels of dependence on commercial fishing (see table in Volume 1, Affected Environment section 4.6). Impacts to communities where permit owners reside are concentrated in mid-coast and southern Maine (Table 70). With the exception of Portland and Westbrook, these communities all have the highest level of dependence on commercial fishing. None of the identified communities included vessels using hydraulic clam dredges or scallop dredges and therefore they would not benefit from the clam dredge exemption (option 2) or the gear modification options (option 3, 4).

While Alternative 3 may open up more total area to fishing than the no action alternative, it will have a negligible impact on the size and demographic characteristics of the fishery given that it is likely to only impact local fishing effort. The impacts associated with modifying current closed areas and adding additional closures will likely have a negative impact on the size and demographic characteristics of the fishery as well as potential negative impacts on the attitudes, beliefs and values of fishermen, therefore the short-term non-economic social impacts of Alternative 3 in comparison to the no action alternative are expected to be slightly negative and slightly more negative than Alternative 4. In particular, the modification of Jeffreys 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 into open areas.

4.1.3.3.4 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.

Historical average annual revenue associated with currently open areas of the Modified Jeffreys Bank and Platts Bank management areas are presented in Figure 19, Figure 20, Table 64 (VTR), and Table 65 (VMS), and Table 66 (recreational fishing).

As noted above, 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). As with Alternative 3, the total area currently closed to a combination of gear capable of catching groundfish, and mobile bottom-tending gear is substantially larger than that under consideration in Alternative 4 (Volume 1, Table 21). Thus, Alternative 4 opens more water to fishing than the no action alternative, particularly to gillnet and longline fishermen. As compared to Alternative 1, groundfish themselves are likely to face a negative impact (see section 4.1.2.3.4). Thus, the short-term economic impact of Alternative 4, Option 1 is likely to be positive when compared to Alternative 1, but the long-term benefit is expected to be negative when compared to the same. Conversely, the short-term economic benefit of Alternative 4, Option 1 is likely to be smaller than Alternative 2, but the long term economic benefit is likely to be larger than Alternative 2. Both the short and long-term benefits of Alternative 4, Option 1 are expected to be negligibly different than Alternative 3, Option 1. Given the lack of clam dredge effort in this portion of the Gulf of Maine, Alternative 4, Option 2 is expected to have the same benefits as Alternative 4, Option 1.

As discussed previously, 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.

Alternative 4, Options 3 and 4 would be expected to induce a negative net benefit as compared to no action.

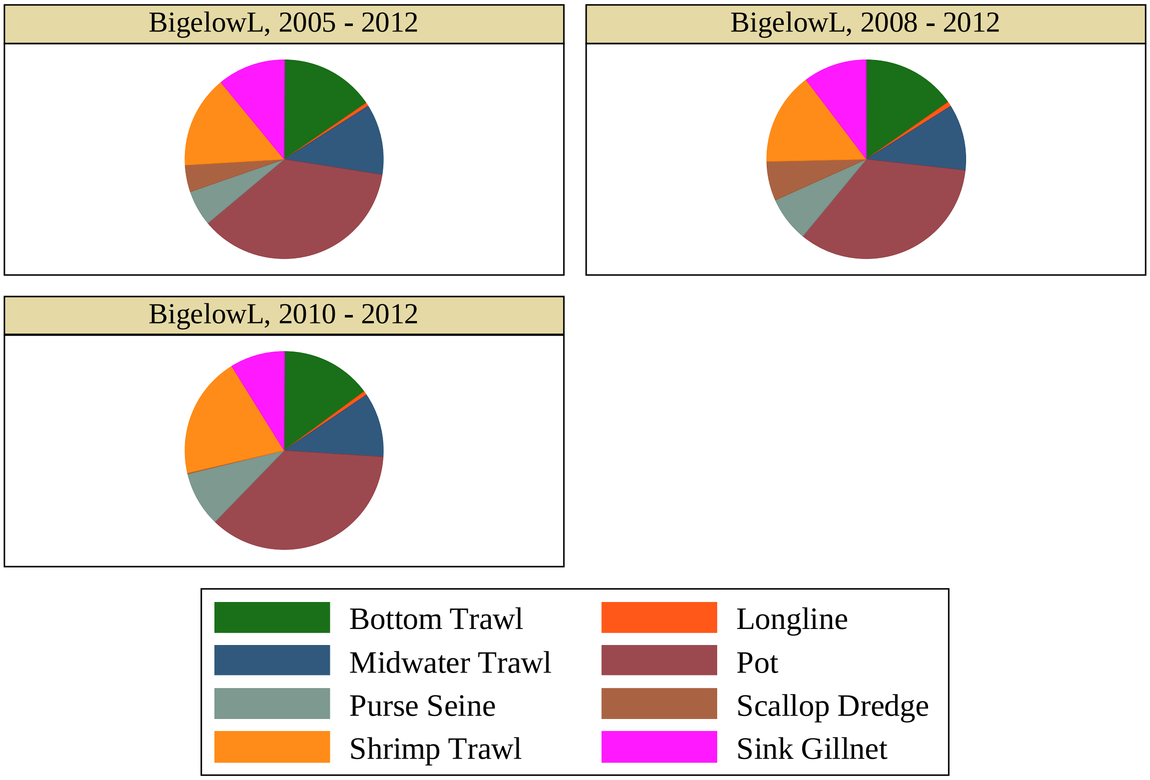
As with Alternative 3, while Alternative 4 may open up more total area to fishing than the no action alternative, it will have a negligible impact on the size and demographic characteristics of the fishery given that it is likely to only impact local fishing effort. The impacts associated with modifying current closed areas and adding additional closures will likely have a negative impact on the size and demographic characteristics of the fishery as well as potential negative impacts on the attitudes, beliefs and values of fishermen, therefore the short-term non-economic social impacts of Alternative 4 in comparison to the no action alternative are expected to be slightly negative and slightly less negative than Alternative 3. In particular, the modification of Jeffreys Bank will have a large impact on fishing vessels from the midcoast Maine area. These vessels are highly dependent on groundfish in this area. Positive social impacts are possible in the long-term, if adjustments to closed areas effectively increase fish populations and there are spillover benefits in open areas.

4.1.3.4 *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.

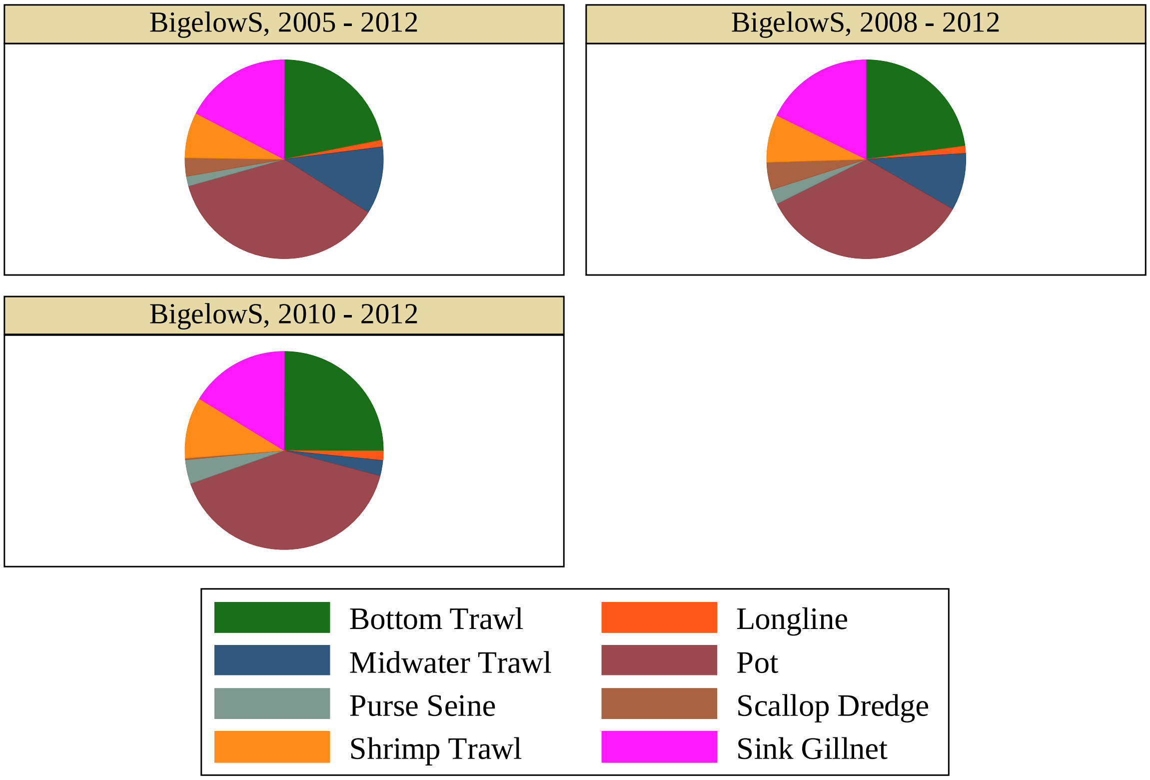
Note that the expected economic impact to the scallop trawl fishery is based on historical data, when in actuality the impact to this fishery in the next year, and potentially further into the future, is expected to be neutral in all alternatives given that the fishery is currently under a moratorium (see http://www.asmfc.org/species/northern-shrimp).

Figure 21 – Large Bigelow Bight HMA 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



Graphs by Area and years

Figure 22 – Small Bigelow Bight HMA 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



Graphs by Area and years

Table 71 – Mobile bottom-tending gear in currently open portions of the Western GOM Habitat Alternatives 3 and 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 72 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within the Western GOM Alternatives 3 and 4, estimated from VMS polls using the approach of Records and Demarest (2013). Total effort and individuals are the yearly means, while the other 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 73 – Recreational fishing revenue associated with the areas included in WGOM Alternatives 3, 4, and 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 the 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
StellwagenL	2006 - 2012	1,937,635.30	70.14	11,176.00	2,446.51	1,117.74	2,685.22
StellwagenL	2008 - 2012	1,556,208.63	66.80	9,099.40	2,196.17	1,117.74	2,360.07
StellwagenL	2010 - 2012	1,386,290.43	65.33	7,964.67	2,104.69	1,117.74	2,318.12
JeffreysLedge	2006 - 2012	2,349,754.80	50.57	21,758.14	2,236.95	1,960.75	1,630.08
JeffreysLedge	2008 - 2012	2,169,797.99	48.40	20,269.40	2,205.98	2,046.00	1,547.31
JeffreysLedge	2010 - 2012	2,130,533.06	48.33	20,245.00	2,121.34	1,875.50	1,509.67
StellwagenS	2006 - 2012	1,646,086.23	58.00	8,965.71	2,440.71	1,117.74	2,778.78
StellwagenS	2008 - 2012	1,303,553.52	54.20	7,111.80	2,146.83	1,117.74	2,424.74
StellwagenS	2010 - 2012	1,162,954.24	52.00	6,319.33	2,041.46	1,117.74	2,362.64

Table 74 – Mobile bottom-tending gear in currently open portions of WGOM Alternative 5. 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
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 75 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within WGOM 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 other 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

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
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
BigelowS	Shrimp Trawl	2010 - 2012	1,656.72	27.33	60.61	27.09	76.30

Table 76 – Recreational fishing revenue associated with the WGOM Alternative 5 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 the 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 77 – 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

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		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
		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

		Month											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
		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%			
	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 78 – Recreational fishing revenue associated with the current WGOM habitat closure. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Rrevenue 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

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 WGOM potentially impacted by the management alternatives.

Western Gulf of Maine	Alternative 3 and 4 (Bigelow Large)	Alternative 5 (Bigelow Small)

Western Gulf of Maine		**Alternative 3 and 4 (Bigelow Large)**		**Alternative 5 (Bigelow Small)**	
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

Table 79 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Western Gulf of Maine alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Western Gulf of Maine		**Alternative 2 (current WGOM)**		**Alternative 3**		**Alternative 4 and 7**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**62**	**62**	**59**	**57**	**61**	**60**	**61**	**60**	**55**	**54**

Western Gulf of Maine		**Alternative 2 (current WGOM)**		**Alternative 3**		**Alternative 4 and 7**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
	Boston			3		3		3			
	Gloucester	13	6	13	6	13	6	13	6	13	6
	Marshfield	23	10	23	10	23	10	23	10	23	10
	Newburyport	5	4	5	4	7	5	7	5		3
	Plymouth	3	3	4	3	3	3	3	3	4	3
	Salisbury	4				4		4			
	Scituate	6		4		4		4		4	
ME		**17**	**15**	**8**	**8**	**17**	**16**	**15**	**14**		
	Ogunquit		3				3		3		
	Portland	3				4					
	Saco	4				3		3			
	Wells	5				5		5			
NH		**24**	**24**	**23**	**24**	**27**	**28**	**27**	**28**	**9**	**9**
	Hampton	7	5	7	5	7	5	7	5		
	Hampton Falls		3		3		3		3		3
	Portsmouth					3		3			
	Rye	8	5	7	4	10	6	10	6		
	Seabrook	7		7		7		7		5	

4.1.3.4.1 Alternative 1 (No action)

Alternative 1 is expected to induce positive net economic benefits, mainly accrued to the groundfish fishery, through the protection of both groundfish habitat and spawning grounds. Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo. A detailed discussion of no action vs. no habitat management areas (Alternative 2) is provided below.

4.1.3.4.2 Alternative 2 (No Habitat Management Areas)

This alternative would remove the current WGOM habitat closure area and the WGOM groundfish closure area (removal of the groundfish closure is subject to selection of GOM Spawning Alternative 2) and would not designate any additional habitat management areas in the region.

Table 77 presents the haul-level revenue generated by species caught on observed trips in the area within a 10 nautical mile buffer of the WGOM groundfish 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 GOM cod stock is overfished, and overfishing is occurring, and thus in the short term no significant increases in revenue are expected to develop from this species under WGOM Alternative 2. Pollock is not overfished, and overfishing is not occurring. In addition, the analyses conducted for Framework 48 to the Northeast Multispecies FMP and this amendment suggest the WGOM 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 access to biomass 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 WGOM 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 WGOM Alternative 2.

At a combined 883 square nautical miles, 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 in the groundfish impacts section of this volume indicate that a substantial amount of effort currently occurs very near to the area boundaries. Statistical area 514 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 WGOM Alternative 2 is chosen. Furthermore, the sheer size and position of the WGOM 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 78 presents the revenue from recreational charter and party vessels whose VTR points fall within the boundaries of the WGOM closures. A large number of permit holders, and a substantially larger number of anglers, currently ply these waters. Table 79 lists communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts. These recreational charter and party permits are mainly associated with communities in Massachusetts although there are some from southern Maine and New Hampshire (Table 79).

Increased fishing gear interactions and potential displacement of existing recreational fishing effort within the WGOM 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 negative, given the substantial recreational fishing currently reported within the WGOM closure.

When compared to the no action alternative, Alternative 2 is expected to induce positive net economic benefits in the short run, and negative net economic benefits in the long run, the latter due to its negative impact on groundfish species (see section 4.1.2.4.1). The magnitude of the short run positive benefits are expected to be substantially larger than Alternatives 1, 3, 4, 5, or 6, equal to Alternative to 7.1, if the roller gear restrictions would continue, and smaller than 7.2. Conversely, the long run negative benefits would be substantially larger in magnitude than Alternatives 1, 3, 4, 5, or 6, but again equal to Alternative to 7.1, if the roller gear restrictions would continue, and smaller than 7.2.

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 relatively large and accessible fishing area. There are potential long-term negative social impacts if benefits to fish populations from the WGOM habitat closure area are lost.

4.1.3.4.3 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 WGOM groundfish closure would be removed, assuming GOM Spawning Alternative 2 is selected.

Figure 21 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 and 2012 is the substantial decrease in scallop dredge revenue in the most recent three year period. Table 71 indicates that 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 mean 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 mean 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 72 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 would be necessary in order to ascertain whether the difference between VMS and VTR results are significant. 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 73 details the recreational fishing revenue generated from the Large Bigelow Bight and Large Stellwagen areas. There is significant charter and party boat fishing in both areas, with a substantial number of angler trips and permitted vessels reported in the areas. To the extent that mobile bottom-tending gear crowds out recreational effort, an exclusion of these gear types would benefit the recreational fishery in the Large Bigelow Bight area. However, longline and gillnet effort is expected to flow into the areas currently closed to fishing by these gear types in the WGOM closures. To the extent that recreational and commercial gear interactions would increase due to this effort displacement, the recreational fishery is expected to experience negative benefits. Given the relative amount of recreational fishing reported within the Western GOM closure (Table 78), the net impact to the recreational fishery is likely to be negative for all options, when compared to Alternative 1. The negative impact to the recreational fishery is expected to be smaller than Alternative 2 and 6, but larger than Alternatives 4,5, and 7. These impacts are associated with trips that land in or have permits registered in towns in Massachusetts, southern Maine, and New Hampshire (Table 79).

A complete exclusion of mobile bottom tending gear, as per Option 1, would affect $2,716,628 in gross revenue (35% of the total) generated from Large Bigelow Bight in the most recent three year period (2010-2012). The Alternative 2 discussion above indicates that the economic benefits arisising from the removal of the Western Gulf of Maine closures was likely to derive from the decreased cost of commercial fishing, as opposed to increases in gross revenue. Statistical area 514, overlapping the Stellwagen Large portion of the Western GOM closure, generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears, though separator trawls are more active in other statistical areas. This, in turn, suggests that more effort is concentrated around the Stellwagen Large, versus the more northerly portion of the WGOM closures. Bigelow Bight Large is closer inshore, and larger than, the area around Jeffreys Ledge that would open under Alternative 3. Coupled with the importance of Bigelow Bight Large to bottom trawl and shrimp trawl fishermen, this indicates that Alternative 3, Option 1 is, in the short run, likely to generate negative economic benefits to bottom trawl and shrimp trawl fishermen, when compared to no action. Conversely, Alternative 3, Option 1 is likely to generate positive economic benefits for gillnet and longline fishermen, who will gain more flexibility in where and when they can fish, likely translating into a decreased cost of fishing. The net benefit across all commercial gear and recreational fleet, is expected to be negative in the short run given the relative size of each of the fleets. Net positive economic benefits are expected in the long run for all large mesh groundfish fishermen, when compared to Alternative 1, due to the expected highly positive impact of Alternative 3 on large mesh groundfish stocks (see section 4.1.2.4.3). The magnitude of the negative short-run impacts are expected to be larger than commesurate options in Alternatives 2, 7,1, and 6 (the first two of which are expected to have positive short run benefits), and smaller than Alternatives 4 and 5. Conversely, the positive long-run benefits are expected to be larger than Alternatives 1 , 2, 5, 6, and 7, and negligibly different from Alternative 4. Option 2 is expected to have the same economic outcome as Option 1, given the fact that the majority of the areas defined by Alternative 4 fall within the NOAA food safety program closure which prohibits clam fishing (Map 128).

As discussed previously, 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. Both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

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 (Table 79). 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 (Options 3 and 4). Analysis of the impacts of the modification of the current WGOM habitat closure is 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, slightly less negative than Alternative 4, and more negative than Alternative 5. 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 commented during informational interviews conducted by the NEFMC that this area 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.

4.1.3.4.4 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.

Fishing activity in the Large Bigelow Bight area is discussed under Alternative 3 above (Figure 21, Table 71 – VTR, Table 72 – VMS, Table 73 – recreational).

Given the relative amount of recreational fishing reported within the Western GOM closure (Table 78), the net impact to the recreational fishery is likely to be negative for all options, when compared to Alternative 1. The negative impact to the recreational fishery is expected to be smaller than Alternatives 2, 3, and 6, but larger than Alternatives 5 and 7. Table 79 lists communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts, particularly towns in Massachusetts, southern Maine, and New Hampshire are associated with trips that land in or have permits registered in these communities.

As discussed under Alternative 3, a complete exclusion of mobile bottom tending gear, as per option 1, would affect $2,716,628 in gross revenue (35% of the total) generated from Large Bigelow Bight in the most recent three year period (2010-2012). The combination of Large Bigelow Bight, Stellwagen Small, and Jeffreys Ledge are thus expected to induce negative economic impacts in the short run for shrimp and bottom trawl under Option 1, when compared to Alternatives 1 (no action) and 2. The magnitude is expected to be larger than Alternatives 3, 5, 6 and 7. Conversely, Alternative 4 is expected to induce positive economic benefits to gillnet and longline fishermen, by opening currently closed areas to fishing and decreasing interactions between static and commercial mobile gear, which is expeceted to decrease the costs of fishing compared to commesurate options in Alternatives 1, 2, 3, 5, and 6. As compared to no action, the net benefits are expected to be negative in the short term, due to the relative size of each of the fishing fleets affected, with the long run benefits expected to be positive. Option 2 is expected to have the same economic outcome as Option 1, given the fact that the majority of the areas defined by Alternative 4 fall within the NOAA food safety program closure , the logbook data do not indicate substantial clam effort in areas in the alternative currently open to clam dredges, and the statistical areas most important to surfclam and Ocean Quahog lay outside of the areas.

As discussed previously, 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. Both Option 3 and Option 4 would be expected to induce a net negative benefit as compared to no action.

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. 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 HMA. 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.

4.1.3.4.5 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.

Figure 22 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 74 details the revenue generated by gear potentially impacted by this alternative. 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 75, 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 75 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. Nevertheless, to the extent that recreational and commercial gear interactions would increase due to the displacement of gillnet and longline effort into areas currently closed to these gear types, the recreational fishery is expected to experience negative benefits. Table 73 presents the recreational effort reported within the boundaries of the Small Stellwagen and Jeffreys Ledge areas. Although these areas will continue to be exclusion zones for mobile bottom-tending gear, including the previously allowed shrimp trawl, given the relative amount of recreational fishing reported within the WGOM closure (Table 78), the net impact to the recreational fishery is likely to be negative for all options, when compared to Alternative 1. The magnitude of this negative impact is expected to be larger than that of Alternative 4, but smaller than Alternatives 2, 3, 6, or 7. Table 79 lists the communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts.

A complete exclusion of mobile bottom tending gear, as per option 1, would affect $1,093,667 in gross revenue (35% of the total) generated from Small Bigelow Bight in the most recent three year period (2010-2012). Alternative 5 Option 1 is likely to induce negative impacts to the shrimp trawl fishery as compared to Alternative 1. These impacts are expected to be lower than Alternative 3 and Alternative 4, in particular given that the Small Bigelow Bight area seems to exclude the most productive shrimp grounds, but substantially larger in magnitude than Alternatives 1, 2, 6, and 7. A substantial portion of the WGOM closure falling within statistical area 514 would continue to remain closed to bottom trawl fishing, meaning that Alternative 5 is expected to induce a neutral to slightly negative short-run impact for fishermen using bottom trawls when compared to Alternative 1. This short-run economic impact is expected to be substantially larger than Alternatives 2, 5, and 7, and smaller than Alternatives 3 and 4. Alternative 5 is expected to induce positive economic benefits to the gillnet and longline fishermen, by opening currently closed areas to fishing and decreasing interactions between static and commercial mobile gear, which is expeceted to decrease the costs of fishing compared to Alternatives 1- 4, 6, and 7. The short-run net benefits are expected to be negative, when compared to no action, due to the relative size of the fishing fleets under management. In the long run, a net positive benefit is expected from Alternative 5, Option 1 when compared to no action, due to increased protection for groundfish habitat (see section4.1.2.4.5). Option 2 is expected to have the same economic outcome as Option 1, for reasons noted above.

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. Both Options 3 and 4 would be expected to induce a net negative benefit as compared to no action.

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 Small Bigelow Bight Habitat Management Area. The implementation of the Small Bigelow Bight HMA will 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, particularly because many of the communities in Maine that would be impacted by the large Bigelow Bight HMA will not be impacted by this smaller area. 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.

4.1.3.4.6 Alternative 6

Alternative 6 would modify the boundaries of the current WGOM habitat closure to create the Large Stellwagen Habitat Management Area.

The Large Stellwagen area lays within statistical area 514, which generates the largest annual landings for multispecies bottom trawl, gillnet, and longline gears of any statistical area. A large portion of the current WGOM closure within statistical area 514 would remain closed to bottom trawl fishing under Alternative 6 Option 1. Nevertheless, Alternative 6 Option 1 is expected to generate positive economic benefits for fishermen using bottom trawls, when compared to Alternative 1, due to the fact that Alternative 6 is a subset of the area currently closed under Alternative 1. The short-run positive impact is expected to be substantially smaller than Alternatives 2 and 7, and substantially larger than Alternatives 3 (of which this is a subset), 4, and 5 given the relative size of the closures in each. The other fisheries/gears currently active within the Gulf of Maine have centers of effort outside of this statistical area. Shrimp trawl would likely see a positive impact from Alternative 6 when compared to Alternative 1. This impact is expected to be substantially smaller than Alternative 2 and 7, and substantially larger than Alternatives 3 - 5, which all include areas seemingly more productive for shrimp fishermen. Gillnet and longline fishermen are expected to experience positive economic impacts when compared to Alternative 1 due to the increase in area open to these gear types. The magnitude of this impact is negligibly smaller than what would be expected from Alternatives 3, 4, and 5, given that decreases in fishing costs might arise from decreased interactions between gear types. Conversely, the magnitude of the positive economic impacts to longline and gillnet fishermen is expected to be negligibly larger than Alternative 2.

Table 73 details the recreational fishing reported to occur within the Stellwagen Small area. Although this effort will continue to be shielded from gear interactions with bottom trawls, the influx of gillnet and longline effort in this area, in addition to the removal of exclusions against mobile bottom-tending gear and gear capable of catching groundfish in the northern portion of the current WGOM closure is expected to induce negative impacts to the recreational fishery when compared to Alternative 1. The magnitude of this impact is expected to be larger than Alternatives 3-5, but smaller than Alternative 2 and 7. Table 79 lists communities associated with recreational trips in these areas in 2012, which are likely to experience these impacts.

The short-term net benefit is expected to be positive when compared to the no action Alternative 1, given the relative size of the fleets under management. In the long term, negative net benefits are expected when compared to Alternative 1, given the decreased protection for groundfish habitat (see section 4.1.2.4.6). Option 2 is expected to have the same economic outcome as Option 1, for reasons noted above.

The short-term non-economic 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 due to its proximity in overall size and location of the current WGOM closure. There are potential long-term negative social impacts if benefits to fish populations from the WGOM habitat closure area are lost.

4.1.3.4.7 Alternative 7

Alternative 7 would implement roller gear size restrictions as a habitat management measure in the WGOM in the existing roller gear area (Alternative 7A) or a modified roller gear area (Alternative 7B). This alternative can be implemented in addition to any of the other six alternatives.

Taken as a standalone measure, when compared to the no action alternative, Alternative 7A is expected to induce positive net economic benefits in the short run, and negative net economic benefits in the long run, the latter due to its negative impact on groundfish species (see section 4.1.2.4.7). The magnitude of the short run positive benefits are expected to be substantially larger than Alternatives 1, 3-6, equal to Alternative 2, assuming the roller gear restrictions as currently implemented would continue in the latter, and smaller than 7B. Conversely, the long run negative benefits would be substantially larger in magnitude than Alternatives 1, 3-6, equal to Alternative 2, if the roller gear restrictions would continue in the latter, and smaller than 7B.

Given the smaller area encompassed by the roller gear restriction in Alternative 7B, which is for the most part a sub-set of the Alternative 7A area, the induced inefficiency by changing from what is ostensibly an optimal gear configuration is no larger, and likely smaller, than the inefficiency induced by the restrictions in the Alternative 7A area. Therefore the cost of Alternative 7B to bottom trawl fishermen is expected to be smaller than 7A. Conversely, what habitat conservation the gear restriction induces is also likely to be smaller than Option A, given that it protects a smaller amount of area susceptible to fishery impacts.

The social impacts of Alternative 7 will depend upon the other spatial alternatives selected. Taking Alternative 7 as a standalone option, generally, due to the positive short term impacts associated with opening the WGOM closed area, the short term impacts of Alternative 7 are expected to be positive in comparison to the no action alternative.

4.1.3.5 *Georges Bank*

Tables and figures related to analysis of the social and 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 23 – Northern Edge HMA 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 = $ 852,785; 2008 - 2012 = $ 1,087,408; 2010 - 2012 = $ 1,454,659

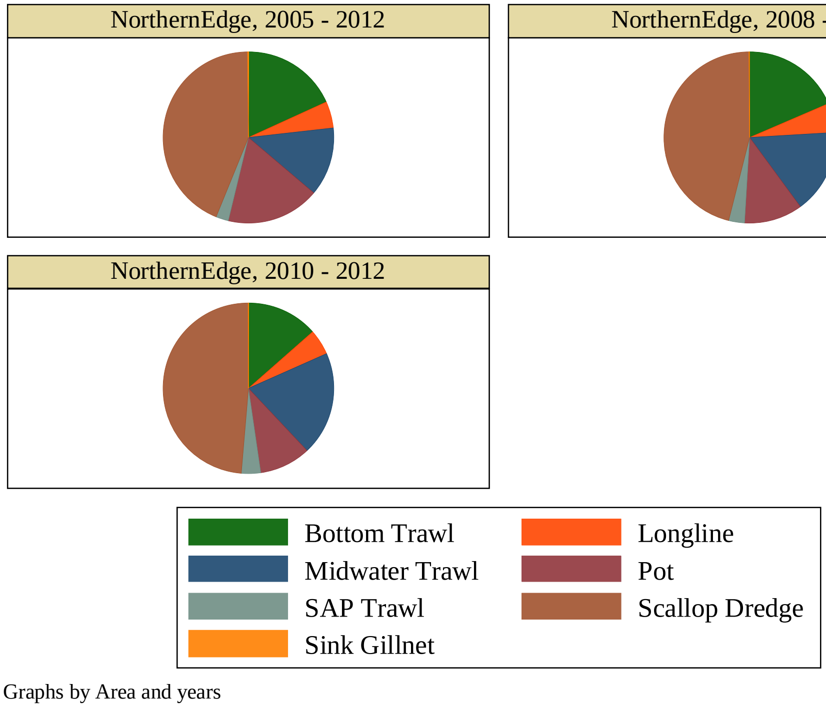


Figure 24 – Small Georges Shoal Gear Restricted Area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 3,448,932; 2008 - 2012 = $ 3,702,336; 2010 - 2012 = $ 5,053,355

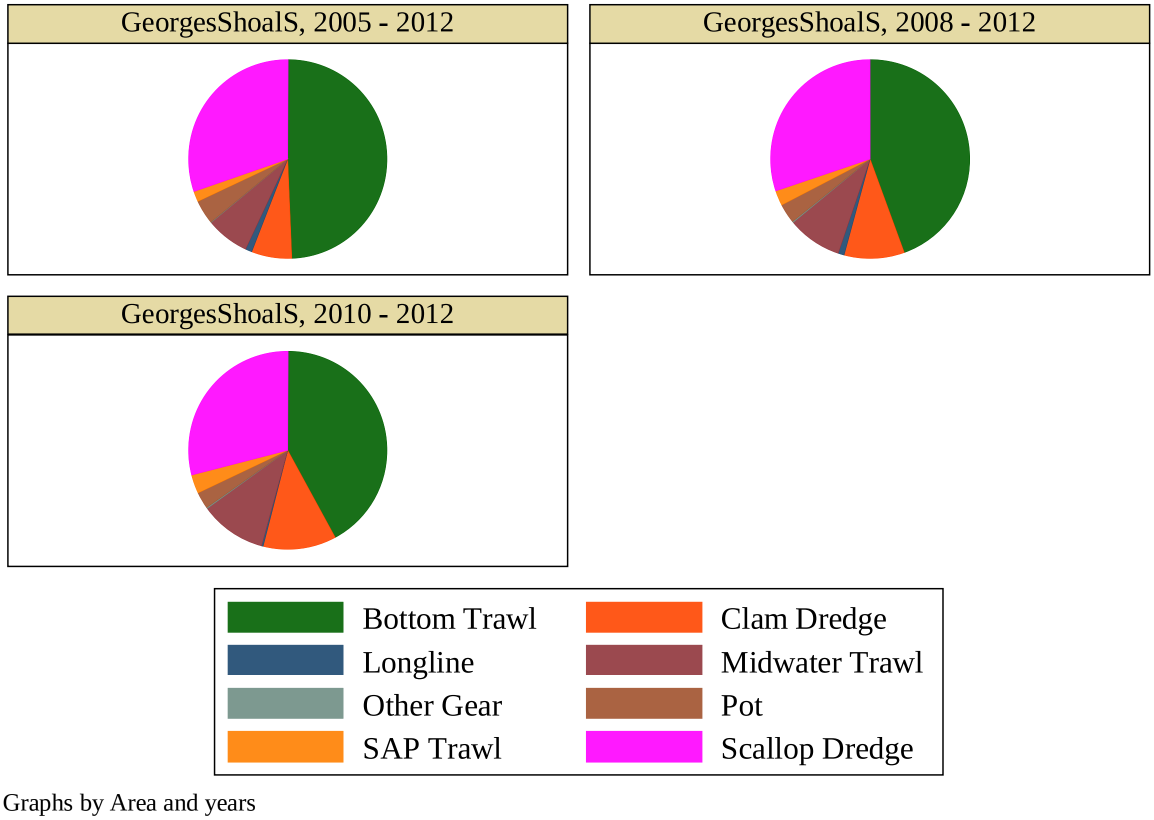
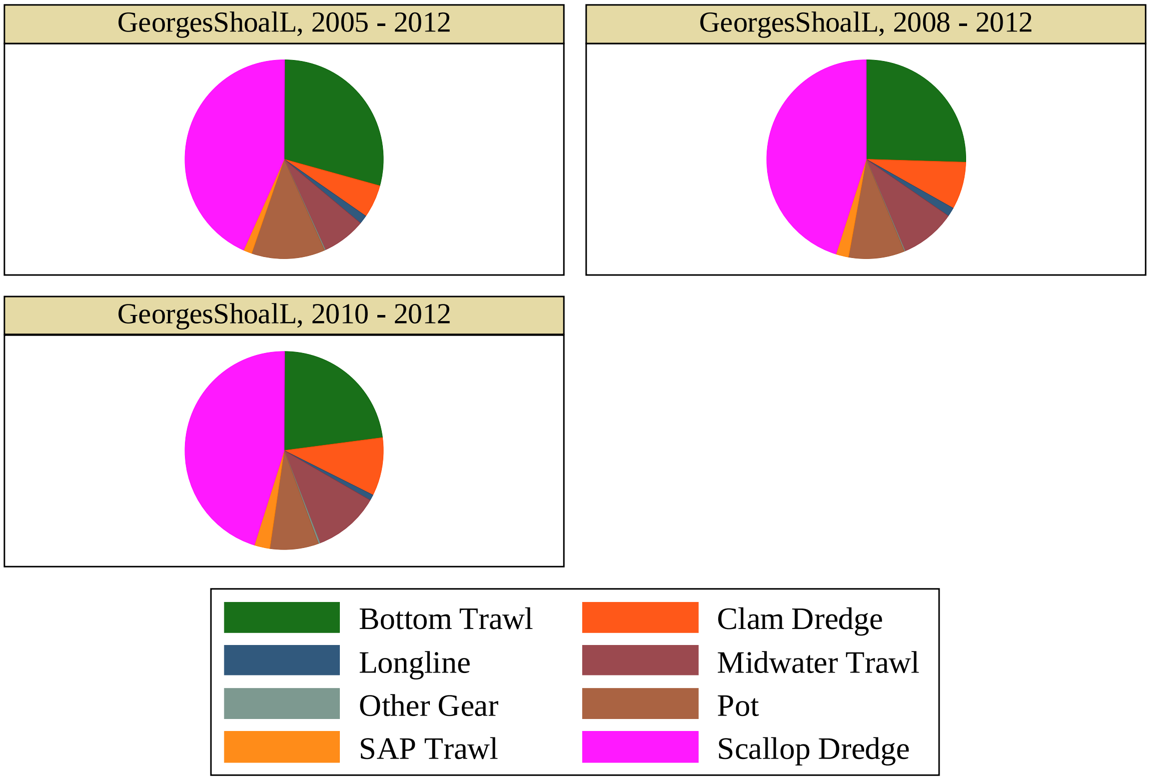
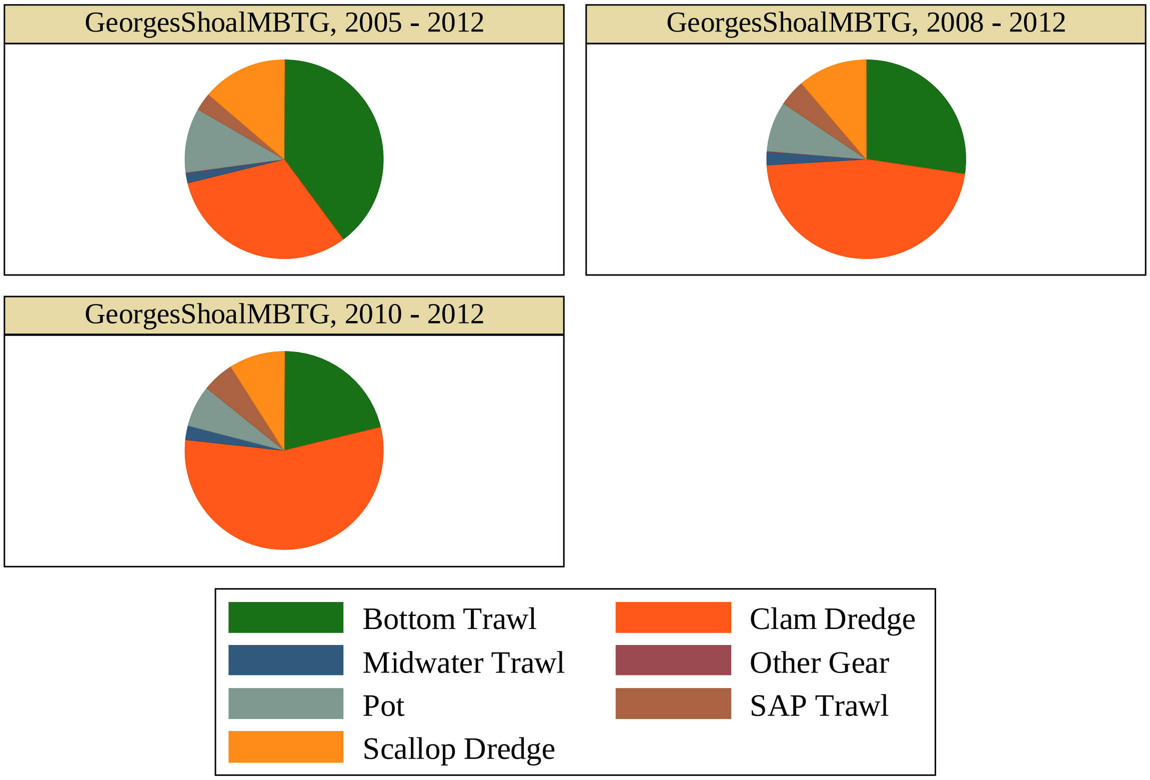


Figure 25 – Large Georges Shoal Gear Restricted Area revenue by gear, as a percentage of the total average revenue over the time period identified. Note that two gear types are not reported for privacy concerns. Average annual total revenue: 2005 - 2012 = $ 19,384,365; 2008 – 2012 = $ 21,334,179; 2010 – 2012 = $ 29,024,703



Graphs by Area and years

Figure 26 – Georges Shoal MBTG closure HMA 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



Graphs by Area and years

Figure 27 – Modified Closed Area II HMA (Alternative 6A) revenue by gear, as a percentage of the total average revenue over the time period identified. Average annual total revenue: 2005 - 2012 = $ 5,821,773; 2008 – 2012 = $ 6,731,022; 2010 – 2012 = $ 7,803,157

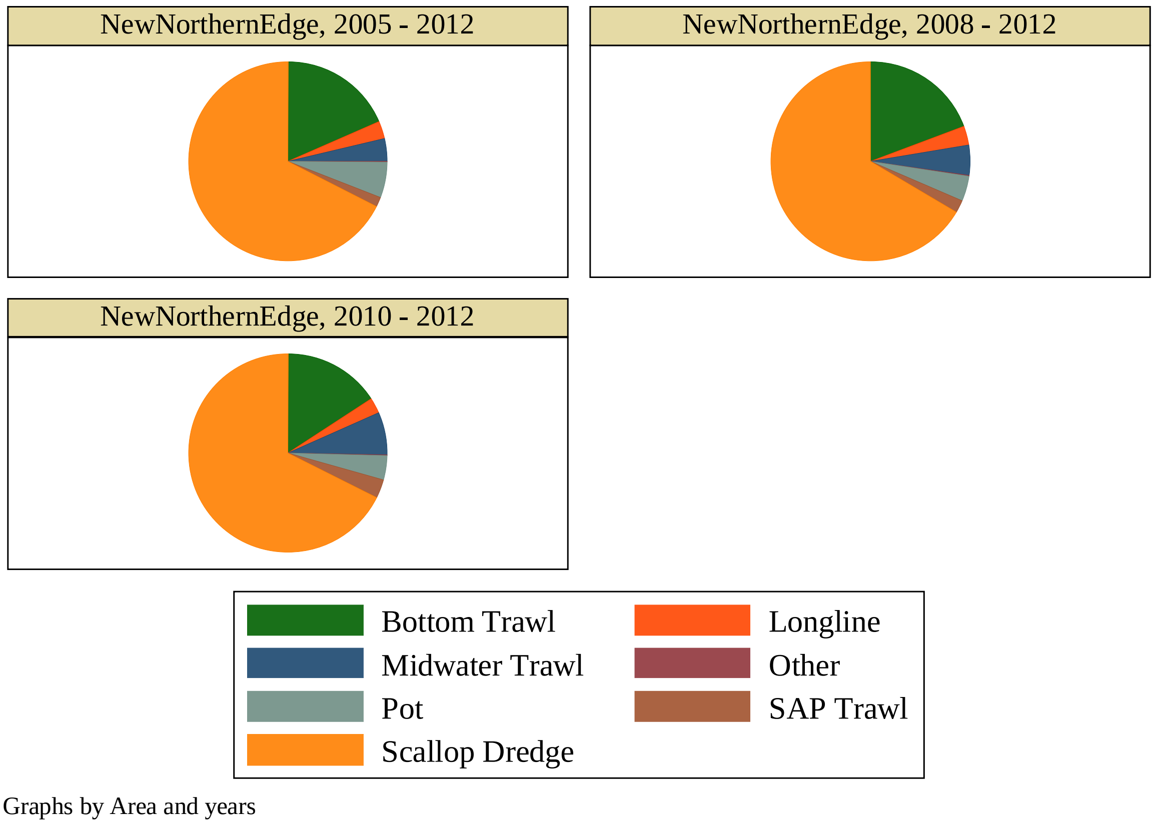


Table 80 – Mobile bottom-tending gear in currently open portions of the GB Alternative 3. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics.

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	NorthernEdge	L	130,708	147,035	64,237	199,617	41,662	86	536	2005 - 2012
Bottom Trawl	NorthernEdge	L	173,620	176,300	30,298	199,617	124,951	76	602	2008 - 2012
Bottom Trawl	NorthernEdge	L	181,177	176,300	15,098	198,111	169,120	67	612	2010 - 2012
Bottom Trawl	NorthernEdge	OTHER	24,221	18,060	17,542	63,660	10,492	19	70	2005 - 2012
Bottom Trawl	NorthernEdge	OTHER	27,492	18,485	21,990	63,660	10,492	16	68	2008 - 2012
Bottom Trawl	NorthernEdge	OTHER	13,760	12,302	4,191	18,485	10,492	13	67	2010 - 2012
SAP Trawl	NorthernEdge	ALL	19,844	0	29,802	77,560	0	21	38	2005 - 2012
SAP Trawl	NorthernEdge	ALL	31,751	35,324	32,890	77,560	0	21	61	2008 - 2012
SAP Trawl	NorthernEdge	ALL	52,919	45,872	21,982	77,560	35,324	21	102	2010 - 2012
Scallop Dredge	NorthernEdge	L	350,183	172,968	521,716	1,631,649	93,089	39	57	2005 - 2012
Scallop Dredge	NorthernEdge	L	470,187	250,421	653,543	1,631,649	93,089	40	59	2008 - 2012
Scallop Dredge	NorthernEdge	L	658,387	250,421	846,533	1,631,649	93,089	40	55	2010 - 2012
Scallop Dredge	NorthernEdge	OTHER	21,967	9,163	40,169	120,613	611	4	5	2005 - 2012
Scallop Dredge	NorthernEdge	OTHER	29,315	7,951	51,228	120,613	611	3	4	2008 - 2012
Scallop Dredge	NorthernEdge	OTHER	47,081	12,680	63,724	120,613	7,951	3	5	2010 - 2012

Table 81 – Mobile bottom-tending gear in additional areas included in GB Alternative 4. The Northern Edge HMA described in the table above is also included in this alternative. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics. Dat in this table were incorrect

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Bottom Trawl	GeorgesShoalS	L								2005 - 2012
Bottom Trawl	GeorgesShoalS	L								2008 - 2012
Bottom Trawl	GeorgesShoalS	L								2010 - 2012
Bottom Trawl	GeorgesShoalS	OTHER								2005 - 2012
Bottom Trawl	GeorgesShoalS	OTHER								2008 - 2012
Bottom Trawl	GeorgesShoalS	OTHER								2010 - 2012
SAP Trawl	GeorgesShoalS	L								2005 - 2012
SAP Trawl	GeorgesShoalS	L								2008 - 2012
SAP Trawl	GeorgesShoalS	L								2010 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
SAP Trawl	GeorgesShoalS	M								2005 - 2012
SAP Trawl	GeorgesShoalS	M								2008 - 2012
SAP Trawl	GeorgesShoalS	M								2010 - 2012

Table 82 – Fishing effort (in hours fished), and individuals fishing in areas currently open to fishing within GB 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
GeorgesShoalS	Bottom Trawl	2010 - 2012	4,997.69	76.33	65.47	9.57	114.94

Table 83 – Mobile bottom-tending gear in currently open portions of GB Alternative 5. 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

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
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
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 84 – 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

Area	Gear	Years	Total Effort	Individuals	Mean Effort	Median Effort	SD Effort
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 85 – 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. 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

		Month											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
		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%						
	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	$-	$-	$-

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							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%
	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 86 – 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. 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

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	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%
	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

		Month											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
		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
		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 87 – 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 the 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	-	-	-	-	-	-	-

Table 88 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Georges Bank alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

Georges Bank		**Alternative 3**		**Alternative 4**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**124**	**87**	**140**	**98**	**135**	**94**	**131**	**90**
	Boston	9		11				9	
	Fairhaven		13		16		15		14
	Gloucester	24	7	24	8	24	9	24	8
	New Bedford	96	60	107	64	103	61	101	60
	Peabody		3		3				3
ME		**3**	**19**	**4**	**20**	**5**	**20**	**3**	**19**
	Portland	3	10	4	9	5	10	3	9
	Westbrook		3		3		3		3
NC			**6**		**6**		**4**		**6**
NJ			**7**		**7**	**3**	**11**		**8**
	Cape May		5		5		5		5
NY					**3**		**3**		**3**
RI		**4**	**8**	**6**	**12**	**7**	**12**	**6**	**12**

	Point Judith	4		6		6	6	7	
	Wakefield		4		6				6

4.1.3.5.1 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. See Alternative 2 below for general discussions of the economic impact of no action. In summation, the economic impact of no action is expected to be highly negative. Although the groundfish fishery is gaining some benefits from no action management areas in Georges Bank, these benefits are not expected to surpass the substantial cost of current management to the scallop fishery.

Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo. Given the vulnerability in the groundfish fishery, benefits to groundfish may be felt more acutely than lost benefits to the scallop fishery, resulting in neutral social impacts overall.

4.1.3.5.2 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. The CAI and CAII groundfish closures would also be removed on a year round basis, subject to selection of GB Spawning Alternative 2 or 3.

Table 85 and Table 86 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 sink 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. GB cod and GB yellowtail flounder are overfished, and overfishing is occurring, and thus Alternative 2 is unlikely to generate any significant benefits from these two species. GB winter flounder and GB 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 the reopened closed until CPUE equates inside and outside the currently closed areas, and thus the benefits could be transitory.

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 changes 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 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. A more thorough economic analysis of access to CAI and CAII for the LA and GC scallop fishermen can be found in 4.5.4.1.2. Although successful exploratory fishing for surfclam 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 surfclam/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 87 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.

In the short term, the net benefits generated from Alternative 2 are expected to be positive when compared to the no action Alternative 1, as all fishermen gain additional flexibility in when and how they are able to fish. The long term net benefits are also expected to be positive, and are mainly driven by the scallop fishery. Although the groundfish fishery is expected to experience negative long term net benefits when compared to the status quo, these benefits are not expected to surpass the additional positive benefits accrued to the scallop fishery and detailed in 4.5.4.1.2.

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. Given the vulnerability in the groundfish fishery long-term negative impacts to groundfish may be felt more acutely than lost benefits to the scallop fishery.

4.1.3.5.3 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. The CAI and CAII groundfish closures would also be removed on a year round basis, subject to selection of GB Spawning Alternative 2 or 3.

Scallops and Bottom trawl generate the largest revenue from the portions of Northern Edge HMA currently open to fishing, as illustrated by Figure 23. 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 $296 for this largest vessel class in the Northern Edge. Scallop revenue per trip for vessels > 70 ft is substantially higher at $11,899. The small size of the Northern Edge area currently open to fishing makes interpretation of the VTR analysis somewhat uncertain, as the average annual number of trips that are estimated to spend at least of a portion of their time in the area is high, but the overall revenue estimated to fall in the area is low. This result could indicate either that the area is on the outskirts of more productive grounds, or that the area actually falls within an important center of fishing and the low revenue estimates are a result of the very small sliver of this area that is currently open to fishing. Given other information available (see, for instance Maps 50 – 53, 70 - 71), it is likely that this area is an important fishing ground, for both Bottom Trawl and Scallop Dredge fishermen. As Table 20 indicates, 65% of all revenues currently generated from Northern Edge would be affected by options being considered within Georges Bank HMA Alternative 3. This is equal to $953,323 annually in the years 2010 - 2012.

A complete exclusion of mobile bottom-tending gear, as per option 1, would be expected to displace $953,323, given the VTR analysis. The full impact of this alternative on the scallop fishery is identified in Section 4.5.4.1.2.2, and is expected to be on the order of two magnitudes larger than what is estimated through the VTR analysis. This disparity results from the fact that the majority of the Northern Edge area falls within the borders of the Habitat closure within CAII, as mentioned above. As compared to the status quo, the impact on bottom trawl fishermen is expected to be neutral in the short run, but negative in the long run. This is because Alternative 3 would provide additional access to areas not currently open to fishing within the current borders of CAII, but the portion of CAII currently open to fishing seems to be an important, but small, area of concentrated fishing effort.

Increased fishing gear interactions and potential displacement of existing fishing effort using non-groundfish/non-mobile bottom tending gear within the exemption areas 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 Closed Area II.

In the short term, Alternative 3, option 1 is expected to induce a net positive benefit, mainly accrued by the scallop fishery (see Section 4.5.4.1.2). The bottom trawl fishery is expected to experience negative benefits in the long run when compared to no action, but the impact will likely be outweighed by the substantial increase in economic surplus expected to be generated from the scallop fishery. Given the fact that the CAII HAPC and the Northern Edge area are relatively similar, the longer term benefit to the Scallop fishery is likely to be generated from access to the northern portion of CAI. The longer run net benefits are thus expected to be positive, but are more uncertain as they depend to some extent on the expected impact of Alternative 3, option 1on groundfish productivity (see section 4.1.2.7.2).

Option 2 is expected to have a neutral effect on the surfclam and ocean quahog fishery, when compared to no action, given that the Northern Edge falls within the current PSP closure. As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease CPUE for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats identified in 4.1.1.4.3, indicates that Options 3 and 4 would be expected to smaller positive benefit as compared to Options 1 and 2.

There are positive non-economic social impacts associated with Alternative 3 and the access gained to new fishing areas. Many of these benefits will impact the scallop fishery. Many of the identified communities (Table 88), particularly New Bedford and Fairhaven, MA and Cape May, NJ include vessels using scallop dredges which would benefit from gear modification options (options 3, 4). New Bedford, MA has relatively high indicators of social vulnerability and indicators demonstrate Cape May, NJ is vulnerable to gentrification. Both towns have high levels of dependence on commercial fishing (AE table). There may be negative long-term impacts if benefits to fish populations from the current closures are lost. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.1.3.5.4 Alternative 4

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. The small Georges Shoal Gear Restriction Area would also be designated. The CAI and CAII groundfish closures would also be removed on a year round basis, subject to selection of GB Spawning Alternative 2 or 3.

Figure 23 and Figure 24 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 80 and Table 81. 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. As Table 80 and Table 81 indicate, 50% ($3,231,195) 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 82 presents the VMS analysis for the Small Georges Shoal area, which again identifies the importance of this area for bottom trawl fishermen. This is apparent in terms of both hours and individuals fishing within the bounds of Small Georges Shoal.

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.

See the discussion of Alternative 3 for a full description of the net benefits expected from a Northern Edge HMA. The Small Georges Shoal area is expected to induce impacts very similar to those associated with Option 3 and 4 in Alternative 3. Therefore, the net benefits are expected to be positive when compared to the status quo both in the long and short run. These positive benefits mainly accrue to the scallop fishery, with the surfclam and ocean quahog fishery and, to a larger extent, the groundfish fishery, expected to experience both short and long term negative benefits. The positive net benefits are expected to be smaller than consistent options in Alternative 3, given the additional inefficiency induced by gear restrictions with no certain habitat benefits.

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.

4.1.3.5.5 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).

Figure 25 and Figure 26 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 83 details statistics for the gears being considered for management in options within the GB 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 surfclam 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 surfclam 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 surfclam and ocean quahog fishing (http://www.nero.noaa.gov/nr/2013/August/13clamsreopengbcaphl.pdf). The true value of this area to the Surfclam 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.

Given the above, and the lack of scallops falling within the MBTG area illustrated in Map 112, Alternative 5 is expected to generate positive net benefits in both the short and long run when compared to the status quo. These benefits accrue mainly to the scallop fishery, and are generated despite expected negative impacts in the groundfish and clam fisheries. The groundfish negative impact is due to expected long run negative impacts on groundfish habitat, while the surfclam and ocean quahog fisheries face both short run and long run displacement of effort from productive fishing grounds. The net benefits are expected to be smaller in magnitude than Alternative 2, mainly due to the inefficiency induced in the groundfish fishery with negative to neutral impacts on groundfish habitat (see Section 4.1.2.5.5). The magnitude of the positive benefits are expected to be larger than commensurate options in Alternatives 3 and 4, primarily due to the larger positive benefits expected for the scallop fishery.

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, particularly the scallop fishery. Given these uncertainties, it is likely that the social impacts of Alternative 5 will be somewhat negative. Given the vulnerability in the groundfish fishery negative impacts to groundfish may be felt more acutely than lost benefits to the scallop fishery.

4.1.3.5.6 Alternative 6

Alternative 6 would remove the current CAI habitat closure areas and would modify the CAII habitat closure to either designate all of CAII extended west to 67° 30' W longitude as a habitat management area, or all of CAII extended west to 67° 30' W longitude except that there would be an 8 nm open area buffer along the EEZ.

Figure 14 illustrate the gears currently employed within the currently open sections of the new Northern Edge areas being considered within the Georges Bank HMA Alternative 6. Scallop Dredge and Bottom Trawl are again the most prolific gear in these waters. Table 26 provides more detail for the mobile bottom tending gear currently fishing within the open area of Alternative 6. Given that the majority of this alternative falls within the current CAII HAPC closure, option A and B are equal in regards to current effort by mobile bottom tending gear. Between 2010 and 2012, Scallop Dredge trips are estimated to have generated an average of $78,564 per trip to this area, across all vessel categories. Per trip, Large Bottom Trawl vessels are estimated to have generated an average of $1,359, while all other Bottom Trawl vessel categories generated a similar $1,398 trip average. SAP trawl trips of all vessel categories combined estimated to have generated an average of $1,846. Although some clam dredge activity was estimated to have occurred within the bounds of Alternative 6, confidentiality issues keep this data from being presented at the gear level. Nevertheless, the majority of the exploratory fishing that has occurred on Georges Bank in the last three years seems to have fallen outside of the bounds of this new Northern Edge area.

The economic impact of the Northern Edge alternative is explored in Section 4.5.4. Map 108 of the same section presents the scallop numbers for all survey years of the NEFSC shellfish survey, which indicates that the area of Alternative 6 currently open to scallop fishing has historically been a concentration of substantial scallop biomass. The analyses undertaken thus suggest that Option A would generate substantial negative benefits to the scallop fishery when compared to the no action Alternative 1, and this impact is expected to greatly outweigh any short-term benefits to the groundfish fishery fro. Given the analysis of section 4.1.2.7.5, which finds a negative impact to groundfish habitat due to Alternative 6A, both the short run and long run net benefits are expected to be negative for Alternative 6A.

Alternative 6B is expected to generate positive net benefits for the scallop fishery in both the short run and long run when compared to no action Alternative 1, given the relative long-term yield estimates of the areas presented in section 4.5.4. The short term benefits to the groundfish fishery are expected to be positive, with the long-term benefit expected to be negative due to Alternative 6B's expected impact on groundfish habitat (see section 4.1.2.7.6). The overall net benefit from Alternative 6B, options 1 and 2 are thus expected to be positive in both the short run and long run, with the majority of the benefits accruing to the scallop fishery.

The exploratory fishing conducted by the surfclam and ocean quahog fishery is estimated to have been concentrated outside of the boundaries of Alternative 6, and the majority of the area encapsulated by Alternative 6 falls within an area that will continue to be closed under the GB PSP closure. Therefore option 1 and 2 are expected to generate impacts negligibly different from one another, for both Alternative 6A and Alternative 6B.

As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease cpue for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats, indicate that Options 3 and 4 would be expected to have a larger negative benefit as compared to Options 1 and 2 of 6A. Options 3 and 4 would also be expected to lead to somewhat smaller positive benefits than Options 1 and 2 of 6B.

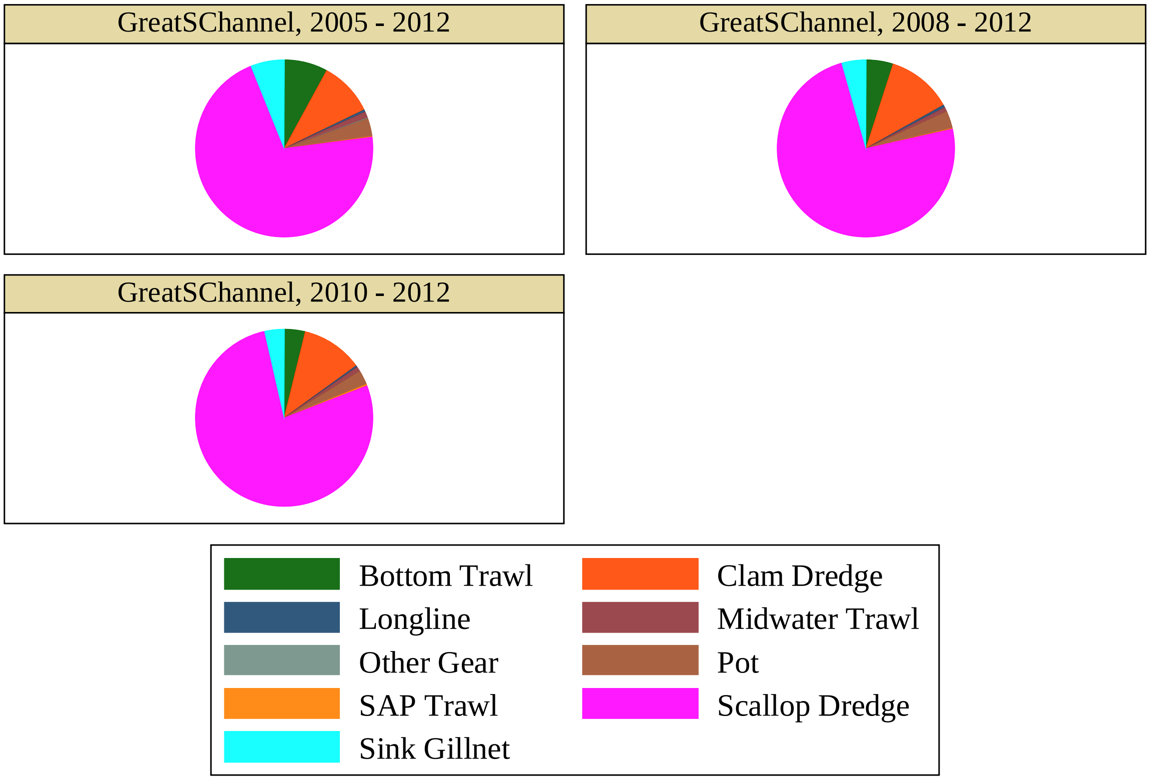
4.1.3.6 *Great South Channel/Southern New England*

Tables and figures related to analysis of the social and 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

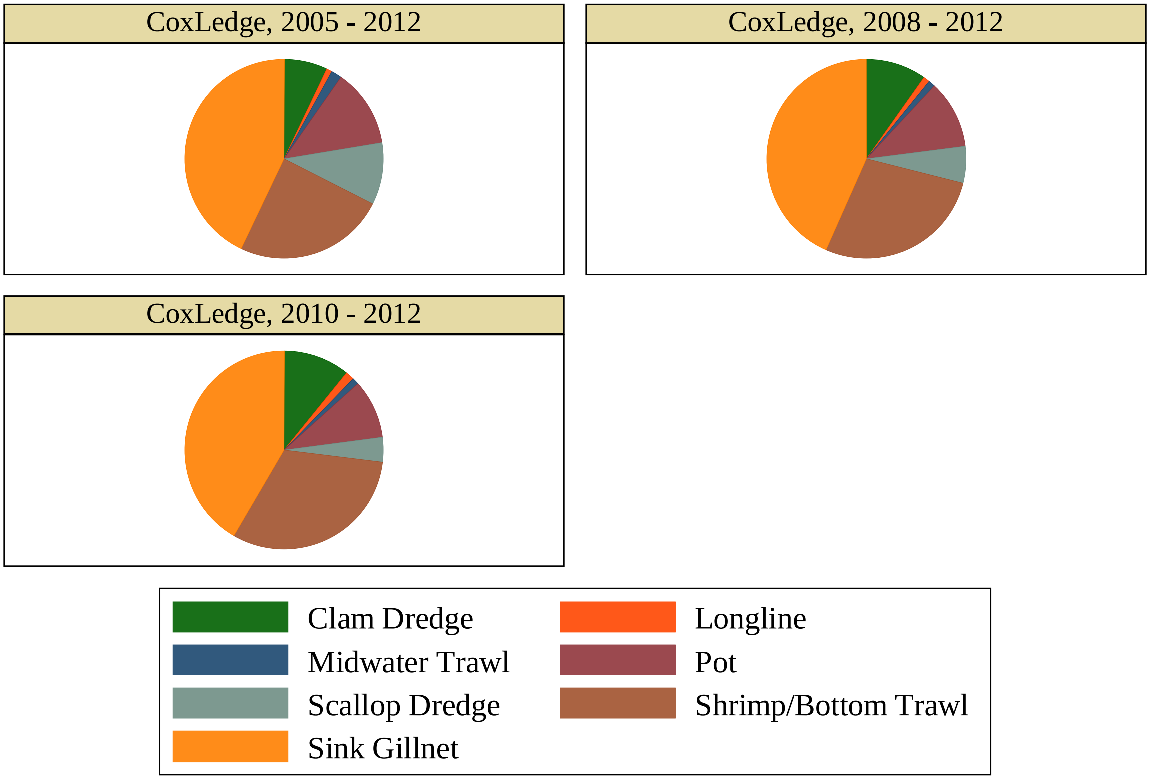
Great South Channel presenting the higher mean haul level revenue of the two areas, by $98. Additionally, a test of proportions was conducted in order to understand whether the proportion of hauls on which Winter Flounder was caught differed significantly between the two areas. Again, the test was significant 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 East 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 East HMA 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



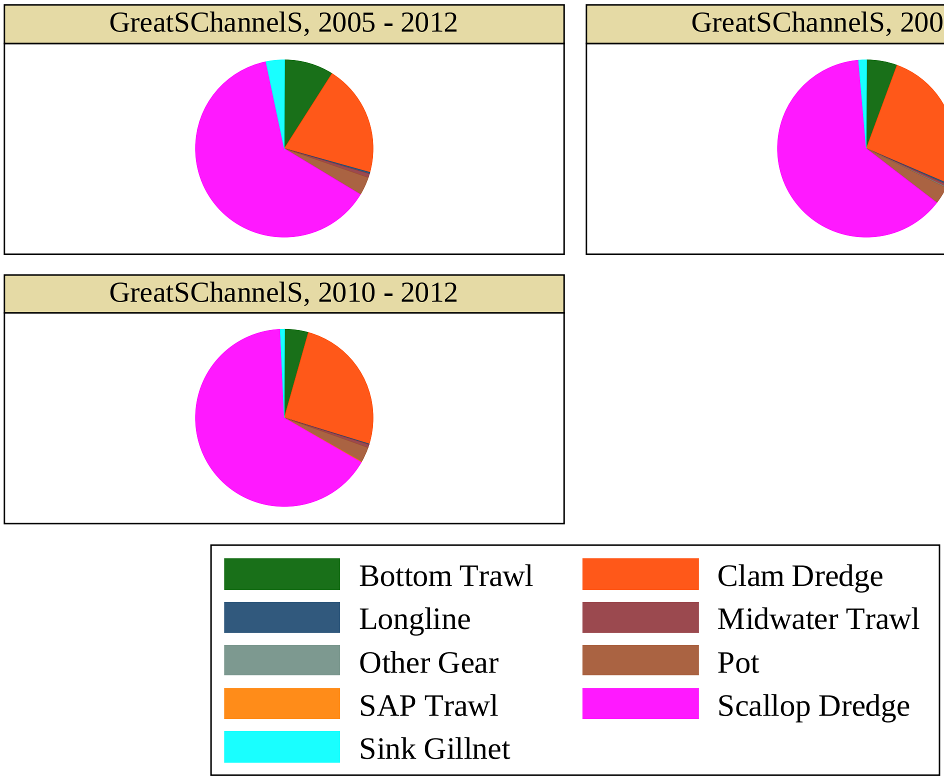
Graphs by Area and years

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



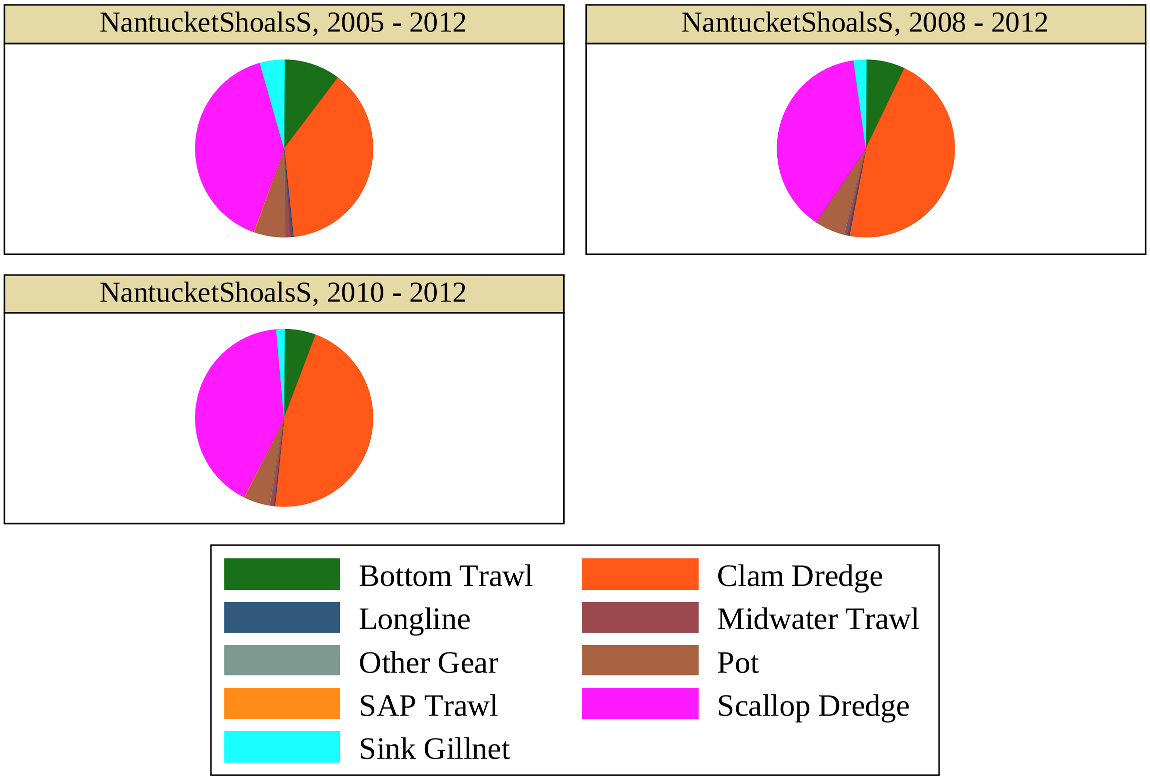
Graphs by Area and years

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



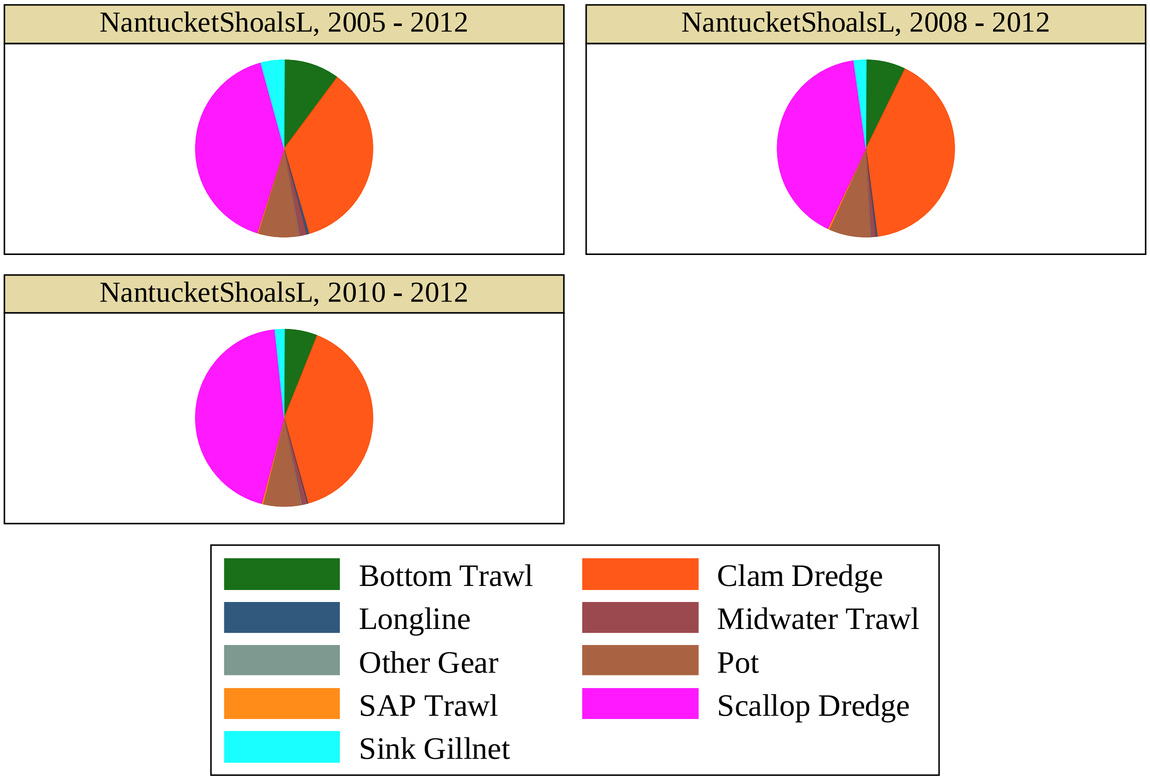
Graphs by Area and years

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



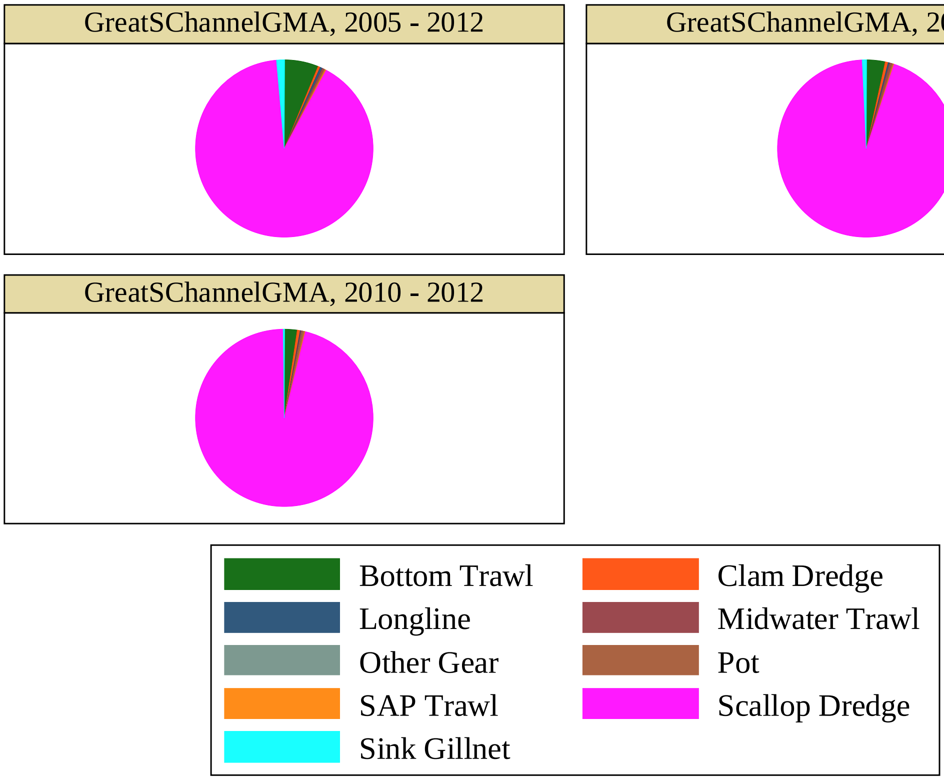
Graphs by Area and years

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



Graphs by Area and years

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



Graphs by Area and years

Table 89 - Nantucket Lightship: Average value per haul/set (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											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Bottom Trawl	Total Hauls	93	170	32	142	63	104	23	67	18	9	16	
	Cod	$7	$5	$4	$15	$5	$9	$40	$137	$168	$4	$175	
		1%	0%	0%	1%	1%	1%	9%	26%	24%	1%	52%	
	Haddock	$6	$7	$5	$9	$10	$504	$92	$4	$2	$0	$0	
		1%	1%	0%	1%	1%	49%	21%	1%	0%	0%	0%	
	Yellowtail	$182	$215	$7	$49	$134	$31	$23	$17	$2	$1	$1	
		19%	17%	1%	5%	17%	3%	5%	3%	0%	0%	0%	
	Monkfish	$128	$130	$83	$179	$313	$37	$76	$36	$6	$5	$5	
		14%	11%	8%	18%	40%	4%	17%	7%	1%	1%	2%	
	Winter Skate	$221	$562	$175	$442	$207	$8	$12	$14	$260	$300	$51	
		24%	46%	17%	45%	27%	1%	3%	3%	37%	75%	15%	
	Winter Flounder	$58	$7	$8	$2	$12	$331	$116	$256	$0	$62	$78	
		6%	1%	1%	0%	2%	32%	26%	49%	0%	15%	23%	
	Summer Flounder	$108	$110	$685	$197	$27	$28	$3	$10	$80	$24	$4	
		12%	9%	67%	20%	4%	3%	1%	2%	12%	6%	1%	
	Witch Flounder	$1	$9	$7	$37	$65	$5	$34	$0	$0	$0	$0	
		0%	1%	1%	4%	8%	1%	8%	0%	0%	0%	0%	
	Skate	$38	$101	$50	$45	$1	$0	$0	$0	$167	$0	$3	
		4%	8%	5%	5%	0%	0%	0%	0%	24%	0%	1%	
	Scallop	$186	$82	$3	$3	$0	$4	$0	$1	$0	$0	$0	
		20%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	Lobster	$1	$1	$0	$0	$2	$29	$44	$39	$2	$3	$18	
		0%	0%	0%	0%	0%	3%	10%	8%	0%	1%	5%	
Fixed Gillnet	Total Hauls	44	71	60	76	156	33						17
	Monkfish	$588	$536	$256	$598	$669	$657						$631
		77%	55%	32%	65%	85%	95%						67%

Winter Skate	$170	$332	$507	$318	$110	$23	$293
	22%	34%	64%	35%	14%	3%	31%
Skate	$0	$109	$16	$0	$2	$0	$9
	0%	11%	2%	0%	0%	0%	1%

Table 90 - Recreational fishing revenue currently associated with the Nantucket Lightship groundfish and EFH closures. 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
NantucketLightship	2006 - 2012	21,544.43	3.00	127.00	2,600.19	1,117.74	2,373.03
NantucketLightship	2008 - 2012	19,068.30	1.80	105.00	4,540.07	5,216.12	2,496.65
NantucketLightship	2010 - 2012	16,472.45	1.67	89.00	4,492.49	5,216.12	2,628.00

Table 91 – 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

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
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	GreatSChannelE	L	1,589,391	1,459,779	931,448	3,279,062	405,329	97	796	2005 - 2012
Bottom Trawl	GreatSChannelE	L	1,039,036	1,194,849	478,962	1,512,271	405,329	86	802	2008 - 2012
Bottom Trawl	GreatSChannelE	L	1,198,334	1,407,287	455,867	1,512,271	675,445	92	1,044	2010 - 2012
Bottom Trawl	GreatSChannelE	M	165,090	163,089	80,735	314,978	58,429	52	286	2005 - 2012
Bottom Trawl	GreatSChannelE	M	125,024	129,270	57,652	203,490	58,429	46	283	2008 - 2012
Bottom Trawl	GreatSChannelE	M	137,994	129,270	61,599	203,490	81,222	47	315	2010 - 2012
Bottom Trawl	GreatSChannelE	S/U	31,616	29,760	19,006	64,815	12,652	22	255	2005 - 2012
Bottom Trawl	GreatSChannelE	S/U	30,770	27,927	20,536	64,815	12,990	19	206	2008 - 2012
Bottom Trawl	GreatSChannelE	S/U	37,644	31,592	24,708	64,815	16,524	18	231	2010 - 2012
Clam Dredge	GreatSChannelE	ALL	2,231,270	1,672,132	1,768,077	5,704,136	534,663	8	272	2005 - 2012
Clam Dredge	GreatSChannelE	ALL	2,900,127	2,516,257	1,962,642	5,704,136	545,820	9	358	2008 - 2012
Clam Dredge	GreatSChannelE	ALL	4,016,726	3,829,786	1,602,140	5,704,136	2,516,257	12	507	2010 - 2012
SAP Trawl	GreatSChannelE	ALL	30,108	0	63,099	180,154	0	13	22	2005 - 2012
SAP Trawl	GreatSChannelE	ALL	48,173	10,059	76,680	180,154	0	13	35	2008 - 2012
SAP Trawl	GreatSChannelE	ALL	80,288	50,650	88,836	180,154	10,059	13	58	2010 - 2012
Scallop Dredge	GreatSChannelE	L	12,919,203	9,186,329	12,633,294	39,748,220	1,289,888	164	497	2005 - 2012
Scallop Dredge	GreatSChannelE	L	14,752,988	8,655,284	15,721,955	39,748,220	1,289,888	148	412	2008 - 2012
Scallop Dredge	GreatSChannelE	L	22,841,630	20,121,390	15,723,944	39,748,220	8,655,284	205	594	2010 - 2012
Scallop Dredge	GreatSChannelE	M	1,603,713	1,143,571	1,463,980	4,782,829	239,651	33	349	2005 - 2012
Scallop Dredge	GreatSChannelE	M	1,730,217	921,938	1,882,001	4,782,829	239,651	23	225	2008 - 2012
Scallop Dredge	GreatSChannelE	M	2,659,122	2,272,598	1,959,252	4,782,829	921,938	30	273	2010 - 2012
Scallop Dredge	GreatSChannelE	S/U	1,617,857	1,502,562	1,145,197	3,289,623	204,571	39	947	2005 - 2012
Scallop Dredge	GreatSChannelE	S/U	1,622,333	1,194,299	1,465,433	3,289,623	204,571	19	597	2008 - 2012

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
Scallop Dredge	GreatSChannelE	S/U	2,512,441	3,053,401	1,147,638	3,289,623	1,194,299	20	797	2010 - 2012

Table 92 – 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
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
GreatSChannelE	Bottom Trawl	2005 - 2012	3,802.93	111.63	34.07	0.90	91.14
GreatSChannelE	Bottom Trawl	2008 - 2012	1,730.40	93.60	18.49	0.88	66.78
GreatSChannelE	Bottom Trawl	2010 - 2012	1,176.55	80.33	14.65	1.15	45.54
GreatSChannelE	GC Scallop	2005 - 2012	1,706.94	63.63	26.83	4.07	52.16
GreatSChannelE	GC Scallop	2008 - 2012	1,470.81	51.80	28.39	1.91	60.91
GreatSChannelE	GC Scallop	2010 - 2012	1,776.07	46.00	38.61	2.04	75.55
GreatSChannelE	LA Scallop	2005 - 2012	13,559.23	283.75	47.79	1.96	101.20
GreatSChannelE	LA Scallop	2008 - 2012	10,703.60	238.60	44.86	1.19	92.49
GreatSChannelE	LA Scallop	2010 - 2012	13,548.11	258.33	52.44	1.93	101.09

Table 93 – 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
GreatSChannelE	2006 - 2012	80,829.54	9.14	459.14	2,595.44	1,117.74	2,598.89
GreatSChannelE	2008 - 2012	35,831.25	6.80	198.40	1,905.92	931.45	2,161.29
GreatSChannelE	2010 - 2012	9,438.69	4.67	50.67	884.88	838.31	428.48

Table 94 – 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

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
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
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 95 – 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
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 96 – 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 97 – 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
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

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
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 98 – 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
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 99 – 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 100 – 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
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

Gear	Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individuals	Trips	Years
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 101 - 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 102 – 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

Table 103 – 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	

Great South Channel/Southern New England		**Alternative 3**		**Alternative 4**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
	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**
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**

Great South Channel/Southern New England		**Alternative 3**		**Alternative 4**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
	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

Table 104 – Total number of vessels conducting mobile bottom tending gear trips in 2012 in currently open portions of the Great South Channel/Southern New England alternatives. Vessels are grouped by port of landing or city of registration, provided that location included at least three vessels. Cities/ports with less than three vessels each were included in the state totals only.

GSC SNE		**Alternative 1 (Nantucket Lightship)**		**Alternative 3**		**Alternative 4**		**Alternative 5**		**Alternative 6**	
State	**Community**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**	**Port**	**City**
MA		**7**	**6**	**5**	**3**	**3**		**7**	**6**	**10**	**8**

NY				**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
	Montauk			3		3		3		3	
RI				**5**	**6**	**5**	**6**	**5**	**6**	**5**	**6**
	Point Judith			4		4		4		4	

4.1.3.6.1 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.

See section 1.1.1.1.5.2 for the expected impacts resulting from no habitat management areas in the Great South Channel/Southern New England area. The expected neutral to slightly negative impact the no action alternative has on seabed habitat (see section 4.1.1.6.1), and the potential of shifting effort onto more susceptible habitats suggest that the net benefits of the current closure is negative both in the short and long run, although there is a high degree of uncertainty in this conclusion. In the long run, some negative benefits are expected for the groundfish fishery when compared to the status quo (see section 4.1.2.8.2). However, these negative benefits are potentially outweighed by the positive benefits that would be expected to be generated for the surfclam and ocean quahog fishery.

Alternative 1 would result in mainly neutral social impacts as it would maintain the status quo.

4.1.3.6.2 Alternative 2 (No Habitat Management Areas)

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.

Table 89 details the haul level revenue generated from the 10 nautical mile buffer surrounding the Groundfish and Habitat closures within Nantucket Lightship. Monkfish and Winter Skate represent the dominant species for both Bottom Trawl and Fixed Gillnet for the winter and spring months. Bottom Trawl also generates substantial revenue from a broad mix of additional species throughout the year. Overfishing is occurring for Winter Skate, though the stock is not overfished, while Cod and Witch Flounder are currently overfished, and overfishing is occurring. The benefits derived for these species are thus likely to be minimal. As currently written, Framework 50 will allow for retention of Winter Flounder in Great South Channel and Southern New England. Although the analysis of haul level data previously detailed suggests that Nantucket Lightship will generate less benefit from this species when compared to currently open portions of Great South Channel, additional access to this species through Alternative 2 will likely provide a slightly positive benefit to groundfish fishermen. Species within the skate complex vary with regard to overfished and overfishing status. The remainder of the species in Table 89 are, for the stock represented in Nantucket Lightship, not overfished, and overfishing is not occurring. The analysis of Framework 48 indicated that a small positive benefit would be expected from increased access to scallop biomass by bottom trawls, and the skate complex could generate additional benefits to the same individuals but the mechanism for the latter is unclear from the data available. Other species would be expected to provide negligible positive benefits to currently excluded fishermen within Nantucket Lightship. The Scallop PDT has conducted a more extensive analysis of the benefits and costs of area management alternatives for LA and GC scallop permitted vessels in Great South Channel/Southern New England, including Nantucket Lightship, which can be found in section 4.5.4.1.2. The current Nantucket

Lightship has relatively low levels of scallop biomass, when compared to the northern portions of CAI and CAII, and thus this fishery does not drive the benefit analysis within Alternative 2.

Surfclam and Ocean Quahog harvesting is currently allowed in the southern portion of the Temporary PSP Closure Area, which would include Nantucket Lightship under Alternative 2. Clam Dredges are currently allowed access to the groundfish closures within Nantucket Lightship, although they are excluded from the essential fish habitat area closure. The majority of trips within/surrounding Nantucket Lightship are reported on the northern edge of the EFH closure, along Nantucket Shoals, and abut areas currently closed to clam dredge fishing. It is likely that, under Alternative 2, some of this effort would displace into areas currently closed to the fishery. However, the extent of this displacement depends on relative catch rates inside versus outside of the closure, and is uncertain due to the lack of current effort in the area from which to gauge relative CPUE. Historical reporting (e.g. May 2013 MAFMC: Ocean Quahog Information Document, Atlantic Surfclam Information Document) suggests that the waters in and around Nantucket Lightship are relatively productive for both Surfclam and Ocean Quahog, and thus alternative 2 is likely to provide a positive benefit to the fishery.

Table 90 presents data on recreational fishing reported to have occurred within Nantucket Lightship. The data suggests that a small number of recreational businesses fish relatively intensively within the borders of Nantucket Lightship, with each individual generating on the order of $9,400/year in the current closures. This small number of individuals suggests that, although there is potential for increased gear interactions, the net benefit to the recreational industry is likely to be negative but negligible. Table 104 identifies the communities associated with these trips in 2012. These are all associated with Massachusetts however due to privacy concerns individual communities are not identified.

The short-term net benefits are thus expected to be positive when compared to no action, and accrue mainly to the surfclam and ocean quahog fishery. In the long run, the benefits are expected to be neutral to positive when compared to the status quo, particularly given the netural to slightly negative impact no action has on seabed habitats (see section 4.1.1.6.1) and the potential that the current closure could be shifting effort onto more succeptible seabed. Any positive benefits accrue mainly to the surfclam and ocean quahog fishery. In the long run, some negative benefits are expected for the groundfish fishery when compared to the status quo (see section 4.1.2.8.2). However, these negative benefits are potentially outweighed by the positive benefits that would be expected to be generated for the surfclam and ocean quahog fishery. The benefits generated from Alternative 2 are expected to be similar to Alternative 4, larger than Alternatives 3, 5 and 6, but highly uncertain.

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.

4.1.3.6.3 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.

Figure 28 and Figure 29 overview the gear active in the vicinity of Great South Channel East and Cox Ledge. The preponderance of revenue in Great South Channel East 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 91 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 East 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 92 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 East is consistently high, as would be expected given VTR analysis. The impact of Alternative 3 to the scallop industry is discussed in section 4.5.4.1.1, which further highlights the large biomass concentration, and high productivity, of scallops within the Great South Channel East area. 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 East.
Many vessels in the communities identified in table 103 use scallop dredges and would benefit from selection of the gear modification options (Option 3-4).

Table 93 overviews the recreational fishing reported in Cox Ledge and Great South Channel East. 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. Table 104 identifies the communities associated with these trips in 2012. These are associated with communities in MA, NY and RI. Due to privacy concerns many individual communities are not identified however Montauk, NY is identified as an impacted community which also has high levels of dependence on recreational fishing (Affected Environment Table).

Overall, a full exclusion of mobile bottom tending gear as in option 1 is expected to impact 91%, or $33,151,887 of the revenue generated from Great South Channel East and Cox Ledge. Scallop Dredge in the Great South Channel East area accounts for 82% of this revenue number. Given the discussion of section 4.5.4.1.1, it is unlikely that this revenue can be generated from a redistribution of effort to alternate sites, meaning that there will be a substantial negative benefit accrued to the scallop fishery by Alternative 3. Both the short run and long run net benefits due to Alternative 3 are thus expected to be negative, and concentrated within the scallop fishery. The magnitude of the loss to the scallop fishery is expected to dwarf the expected positive benefits of habitat conservation in this area.

Option 2 would exempt $4,131,900 worth of revenue that would otherwise be displaced from the surfclam and ocean quahog fishery. However, when compared to no action Alternative 1 both the short run and long run net benefits of option 2 are expected to be negative, given the impact on the scallop fishery. 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 option 2.

As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease cpue for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected negative to neutral impact on seabed habitats, indicates that both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

Alternative 3 is expected to produce outcomes more negative, and more certainly, than commensurate options for all other alternatives being considered for the Great South Channel/Southern New England.

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.

4.1.3.6.4 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.

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 East 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 East, 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 94 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 East area. Overall, the annual Scallop Dredge revenue for Great South Channel represents 37% of what is estimated to be derived from Great South Channel East. 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 East 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 East. 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 95 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 East 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's analyses within section 4.5.4 indicate that the majority of the scallop biomass in the vicinity does not fall within the bounds of the Great South Channel area being considered within Alternative 4. The Bottom Trawl effort estimates from VMS align more closely with the VTR estimate, with annual effort estimated to represent 30% of the effort within the encompassing Great South Channel East 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 96 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.
Table 104 identifies the communities associated with these trips in 2012. These are associated with communities in MA, NY and RI. Due to privacy concerns many individual communities are not identified however Montauk, NY is identified as an impacted community which also has high levels of dependence on recreational fishing (Affected Environment Table).

A complete exclusion of mobile bottom tending gear from the Great South Channel and Cox Ledge areas would be expected to impact 87%, or $4,645,461, in the most recent three year period, plus revenue generated from concentrations of winter flounder not in historical VTR data for this area as described in section 4.1.3.6. The majority of this impact falls upon the surfclam and ocean quahog fishery. Although the surfclam and ocean quahog fishery is managed under an ITQ system, there has been a shift of fishing effort out of the mid-Atlantic northward (see 56th SAW). This means that HMAs in the GSC/SNE area affect areas of the ocean on which the surf clam and ocean quahog fisheries are becoming more dependent. Assessing the expected impact to these fisheries means understanding not only the trade-off between opening the habitat closure in Nantucket Lightship and closing some other portion of GSC/SNE, but also how the recent opening of waters on Georges Bank is likely to affect future effort within the GSC/SNE area. The shift in effort into the GSC/SNE area suggests that it is more profitable than more southerly areas. Though extremely uncertain, the opening of productive grounds in GB is thus expected to draw additional effort northward, as opposed to shifting effort from GSC/SNE. This, coupled with the expected impacts documented in section 4.5.7.2.1 table 157, suggests that the short-term and long-term net benefits of Alternative 4 are likely to be negative for the clam fishery when compared to no action Alternative 1.

Likewise, given the differential seen in historical catches of winter flounder at the haul level presented in section 1.1.1.1.5, and the substantial revenue currently generated within the bounds of the Great South Channel area, the net benefits to the bottom trawl fishery are, in the short run, expected to be negative when compared to no action Alternative 1. As highlighted in section

4.1.2.8.3, the impact of this alternative as compared to no action are highly uncertain due to a general lack of survey data around Nantucket Shoals, although the habitat seems more susceptible to fishing impacts than the no action Alternative 1.

Overall, the net benefits in the short term are expected to be negative when compared to no action Alternative 1, and accrue mainly to the Bottom/SAP Trawl and Clam Dredge fisheries. The long run net benefits are highly uncertain, but expected to be neutral to positive, with a trade-off between the impact on the clam dredge fishery and potential increases in groundfish productivity. These benefits are expected to be on the same order of magnitude as Alternative 2, but larger than Alternatives 3, 5 and 6, with the trade-off being between the clam and groundfish fisheries.

Option 2 is expected to mitigate the impact on the Clam Dredge fishery, and thus the bulk of the impact on mobile bottom-tending gear. The overall short run net benefit is therefore expected to be positive when compared to the no action Alternative 1. However, option 2 is also expected to mitigate any long run benefits to the groundfish fishery that might otherwise accrue under option 1. Thus, the overall long run benefit is expected to be neutral to negative when compared to no action.

As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease cpue for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected neutral impact on seabed habitats, indicates that both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

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. . Many vessels in the communities identified in table 103 are associated with trips utilizing scallop dredges and would benefit from selection of the gear modification options (Option 3-4). 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 option 2. 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.

4.1.3.6.5 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.

Figures 14 and 16 overview the gear active in the vicinity of Cox Ledge and Nantucket Shoals. Scallop Dredge and Clam Dredge generate the majority of revenue from Nantucket Shoals, while Cox Ledge has a substantial amount of revenue from both Sink Gillnet and Shrimp/Bottom Trawl trips. Table 27 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 5. 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 is estimated to be $14,961 for vessels > 70 ft, $3,049 for vessels between 50 ft and 70 ft, and $260 for vessels < 50 ft. The total Scallop Dredge revenue estimated to fall within the Nantucket Shoals area is 13% of that of the adjoining Great South Channel Extended area, and 36% of Great South Channel. Clam Dredge is estimated to generate a mean per trip revenue of $8,177 within Nantucket Shoals, and total revenue is 4% higher than the Great South Channel Extended and 5% higher than the Great South Channel areas. Trip revenue from Bottom Trawls is estimated to be $640 for vessels > 70 ft, $429 for vessels between 50 ft and 70 ft, and $43 for vessels < 50 ft, while the revenue for SAP Trawls of all vessel sizes averages $305. Total combined Bottom Trawl and SAP Trawl revenues are estimated to be 36% of those associated with Great South Channel Extended, and 76% of that generated from Great South Channel.

Table 28 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 is relatively low for the surrounding and is estimated to be 3% of the effort falling within the Great South Channel Extended, and 28% of that associated with Great South Channel. GC Scallop effort is substantially lower, estimated to be 40 minutes per year for the average individual, a level 45% of that estimated for Great South Channel, and 1% of the Great South Channel Extended level. 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 again estimated to be lower than both Great South Channel Extended and Great South Channel, respectively representing 21% and 72% of the effort associated with the two adjoining areas.

Table 29 overviews the recreational fishing reported in Cox Ledge and Nantucket Shoals. Although the revenue reported within Cox Ledge is consistently high across all time periods, Nantucket Shoals has seen a decrease of 77% between the 2005 – 2012 and 2010 – 2012 annual revenue, and a decrease of 78% for the number of angler trips.

Given the analyses above, a complete exclusion of mobile bottom tending gear, as per option 1, would be expected to impact the clam fishery most heavily, as this area seems to fall further afield from the centers of groundfish and scallop fishing in the GSC/SNE area. Nevertheless, in the short run, the net benefits across all fisheries would be expected to be negative. The long-term benefits to the groundfish fishery is uncertain (see section 4.1.2.8.4), but likely negative when compared to the status quo, given the shift away from both the most vulnerable habitat in the GSC/SNE area and what seems to be higher concentrations of groundfish that would benefit from the conservation measure.

Option 2 is expected to mitigate the impact on the Clam Dredge fishery, but also decrease any potential benefits that would otherwise accrue to the groundfish fishery. The benefits to the Clam Dredge fishery would be equal to those associated with Alternative 2 (see section 1.1.1.1.5.2), and thus the long run net benefits are expected to slightly negative to positive, with negative benefits expected to accrue to the groundfish fishery. The benefits are likely to be smaller in magnitude than Alternative 2 and 4, but larger than 3 and 6.

As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease cpue for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected neutral impact on seabed habitats identified in section 4.1.1.6.5, indicates that both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

Table 104 identifies the communities associated with these trips in 2012. These are associated with communities in MA, NY and RI. Due to privacy concerns many individual communities are not identified however Montauk, NY is identified as an impacted community which also has high levels of dependence on recreational fishing (Affected Environment Table).

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. Many vessels in the communities identified in table 103 are associated with trips utilizing scallop dredges and would benefit from selection of the gear modification options (Option 3-4). 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 option 2. 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.

4.1.3.6.6 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.

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 100 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 East 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 East 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 East, 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 101 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 East, 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 East 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 East 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 102 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.

Option 1 would be expected to have the largest impact on the Clam Dredge and Bottom Trawl fisheries. Given the expected impacts on habitat most susceptible to fishing and groundfish stocks (see sections 4.1.1.6.6 and 4.1.2.8.5), Alternative 6 is expected to generate negative net benefits in both the short run and long run when compared to no action Alternative 1. These negative benefits accrue mainly to the Clam Dredge and Bottom Trawl fisheries. The negative benefits are expected to be larger than commensurate options in all other Alternatives under consideration for GSC/SNE, except for Alternative 3.

Option 2 is expected to mitigate the impact on the Clam Dredge fishery, although the long-run net benefits are still expected to be negative given the expected additional impacts on habitat and groundfish stocks.

As discussed previously in this Amendment, both the costs borne by trawl fishermen and the benefits of gear restrictions defined in options 3 and 4 in terms of habitat conservation are highly uncertain. What information exists indicates that option 3 would be expected to decrease cpue for some species, meaning more effort, and thus a higher cost, would be induced to catch the same quantity of fish. Additionally, fishermen would be faced with the cost of buying new/converting nets to meet the new requirements. This, coupled with the expected neutral impact on seabed habitats identified in section 4.1.1.6.6, indicates that both option 3 and 4 would be expected to induce a net negative benefit as compared to no action.

Table 104 identifies the communities associated with these trips in 2012. These are associated with communities in MA, NY and RI. Due to privacy concerns many individual communities are not identified however Montauk, NY is identified as an impacted community which also has high levels of dependence on recreational fishing (Affected Environment Table).

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.

4.1.4 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 104 – 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 72). 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 41° 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 71° 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 105). 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 105 – 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.

4.1.4.1 *Eastern Gulf of Maine*

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.

4.1.4.2 *Central Gulf of Maine*

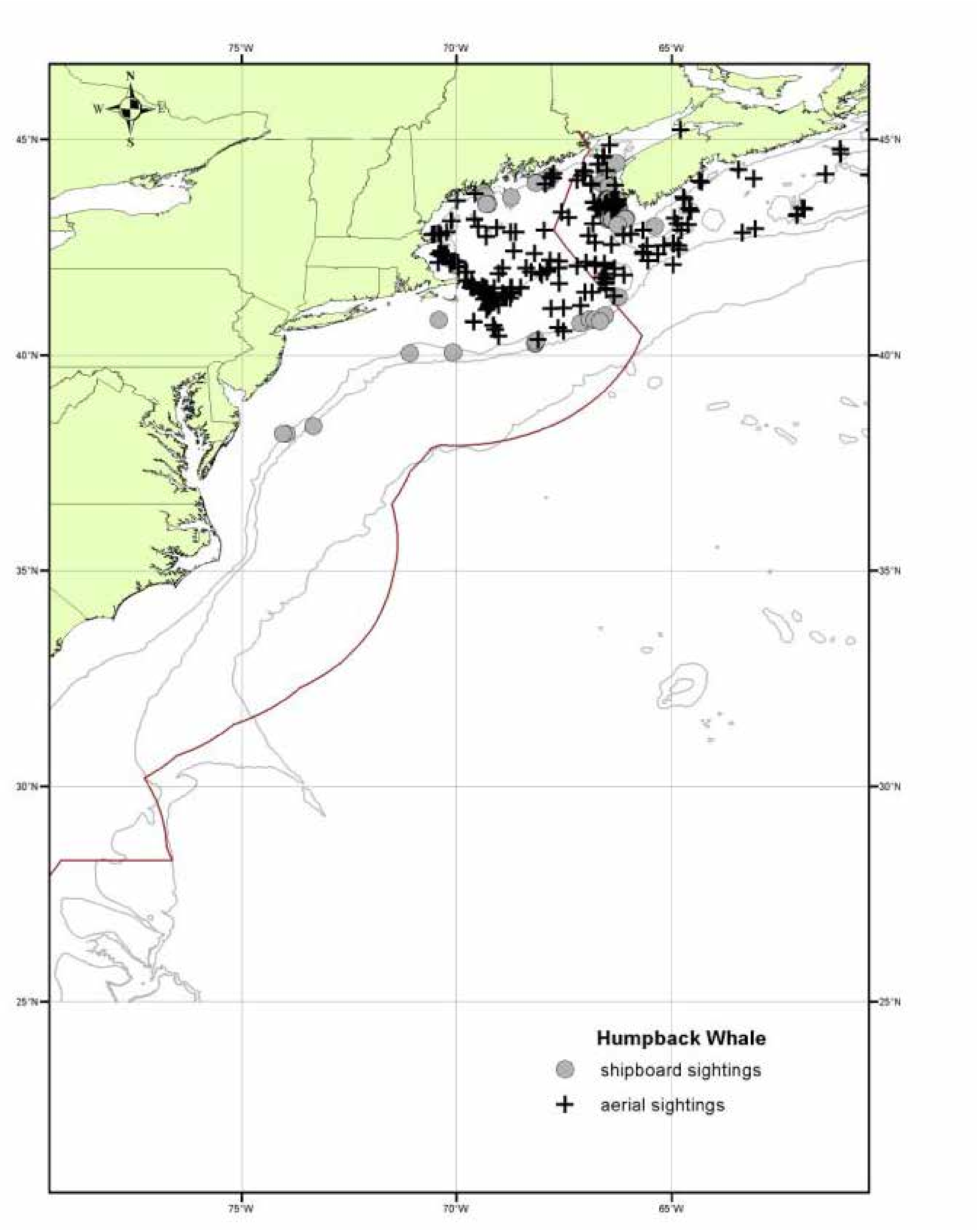
Sightings of large whales, particularly humpback, fin, and minke whales, are relatively common in the Central Gulf of Maine region (Map 68-Map 70). As a result, allowing gillnets into the Cashes Ledge Groundfish Closed Area, which would be the effect of implementing any of the action alternatives (Alternative 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.

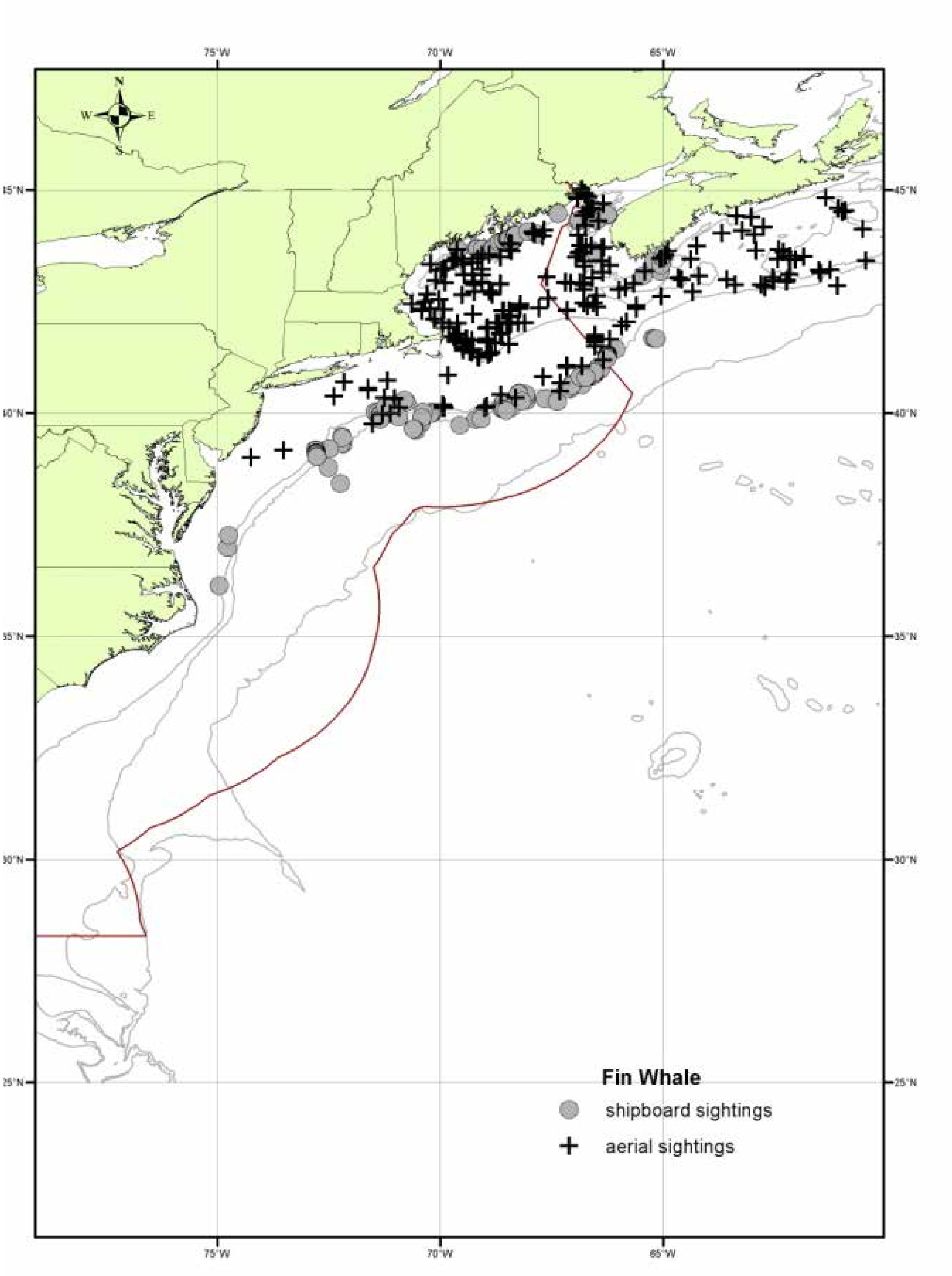
Unlike in the Eastern Maine sub-region which currently has no restrictions on mobile gear, the action alternatives in the Central Gulf of Maine would result in mobile gear being allowed into portions of the existing closed areas (Cashes Ledge and Jeffreys Bank). There have been a handful of interactions 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.

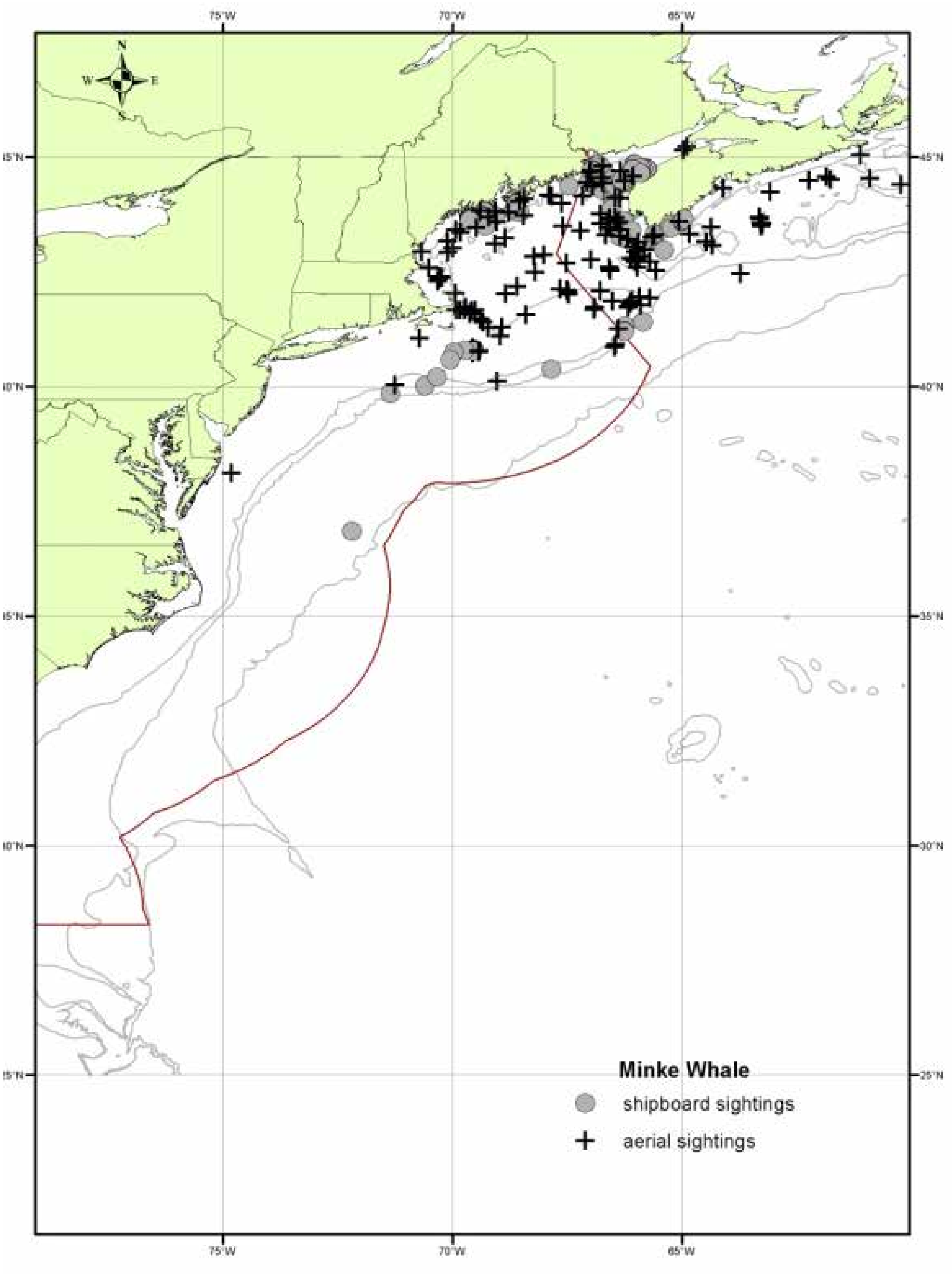
Map 68 – Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



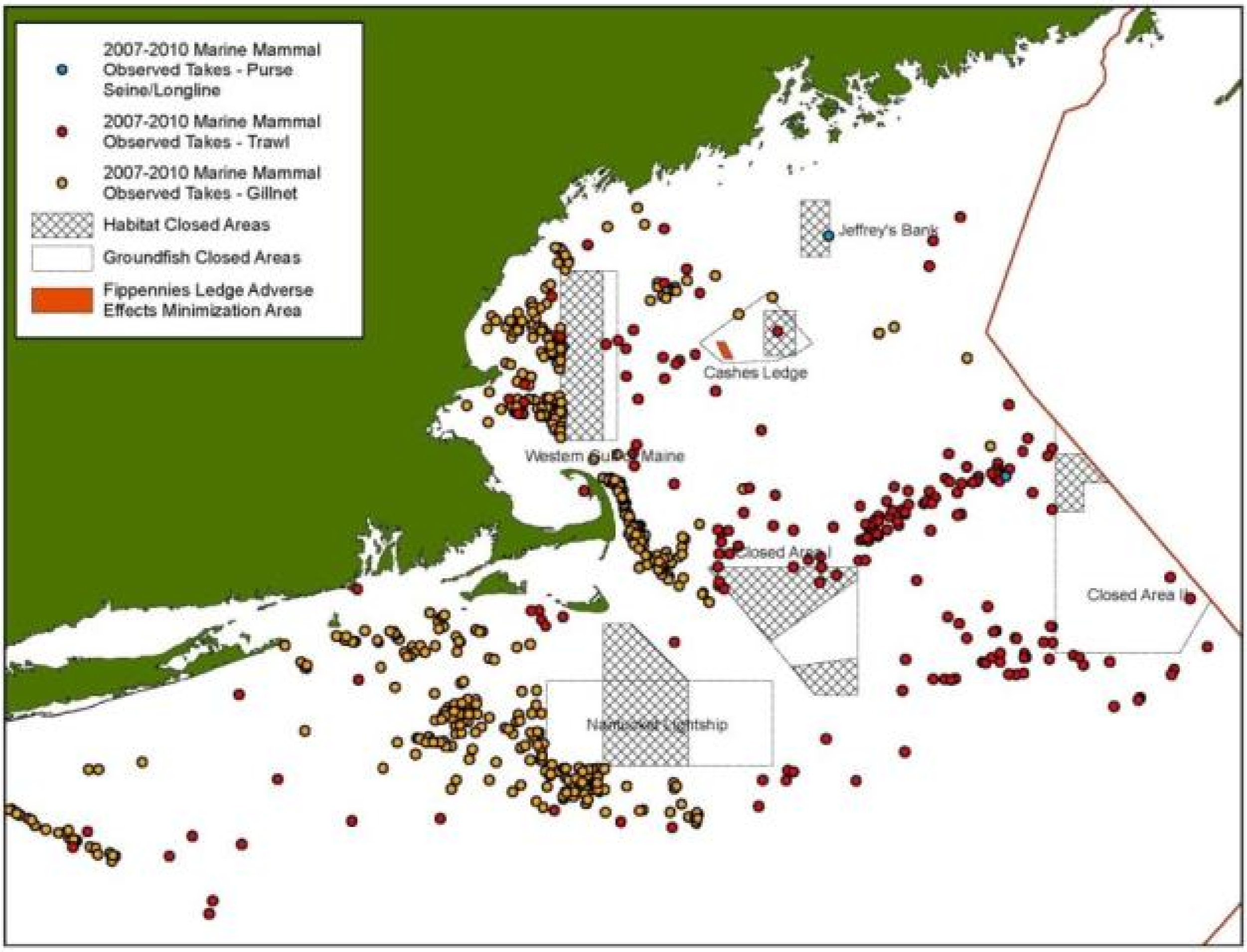
Map 69 – Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



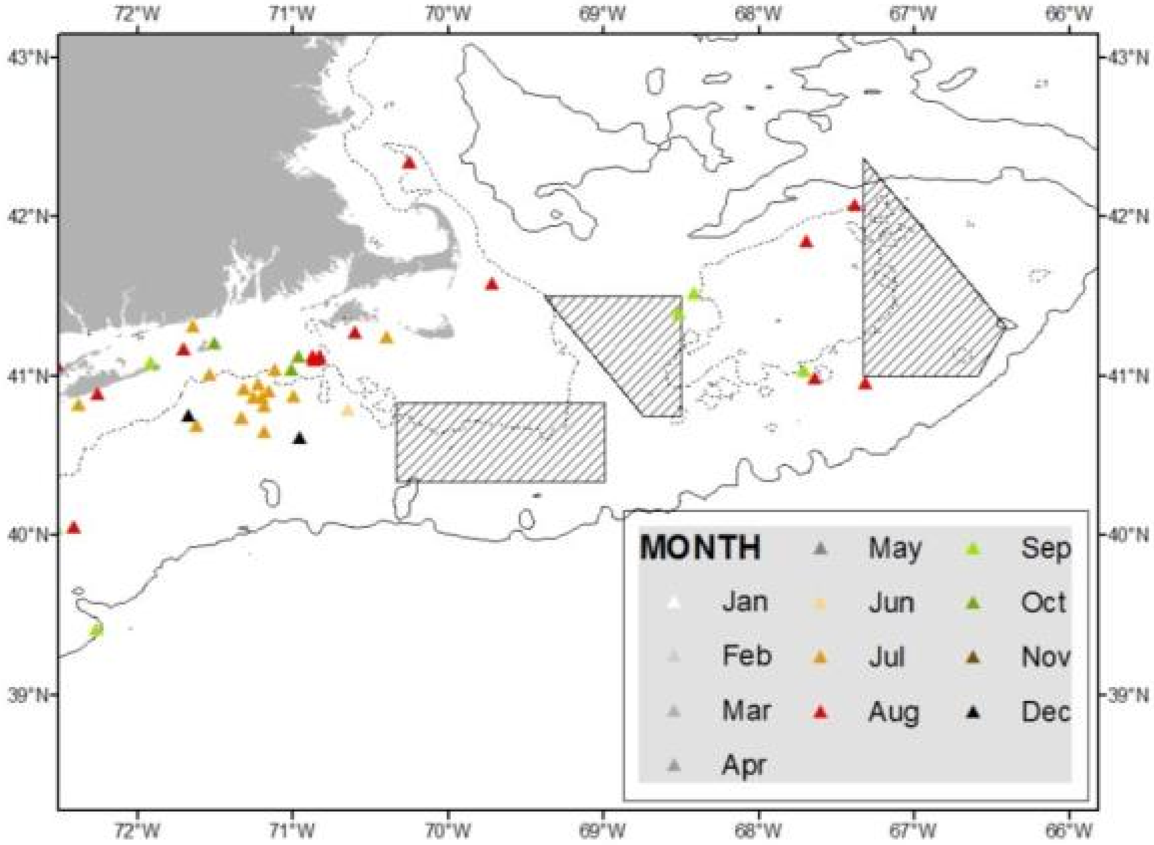
Map 70 – Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.



Map 71 – Marine Mammal Takes 2007-2010



Map 72 – Observed turtle interactions by month in gillnet, bottom trawl, and scallop dredge gears, 1989-2012



4.1.4.3 *Western Gulf of Maine*

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.

4.1.4.3.1 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.

4.1.4.3.2 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.

4.1.4.3.3 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.

4.1.4.4 *Georges Bank*

4.1.4.4.1 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 71) 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.

4.1.4.4.2 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.

4.1.4.4.3 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 72). 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.

4.1.4.5 *Great South Channel/Southern New England*

4.1.4.5.1 Impacts to Marine Mammals

There have been documented interactions with marine mammals, primarily with gillnets, in this sub-region (Map 71). 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.

4.1.4.5.2 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 72) 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.

4.1.4.5.3 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.

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 106. 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.

Table 106 – 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

4.2.1.1 *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 4.1.1.2.1 (CL) and 4.1.1.3.1 (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 4.1.1.2.3, 4.1.1.2.4, 4.1.1.3.3, 4.1.1.3.4, 4.1.1.3.5, and 4.1.1.3.6. 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.

Diversity in the different sector rolling closure 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.

4.2.1.2 *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 4.1.1.4.1 (CAI and CAII) and 4.1.1.5.1 (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, Options A and B

Direct impacts of the removal of year-round closed areas on the protection of seabed habitats in this region are discussed in 0, 0, 4.1.1.4.4, 4.1.1.4.5, 4.1.1.5.2, 4.1.1.5.3, 4.1.1.5.4, 4.1.1.5.5, and 4.1.1.5.6.

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.

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.

4.2.1.2.3 Alternative 3, Options A and B

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.

4.2.2 Large mesh groundfish stocks

The discussion below focuses on the expected direct effects of Groundfish Spawning Area measures on the 20 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 negative 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. 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. As they are currently written, 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.

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 ACLs, 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.

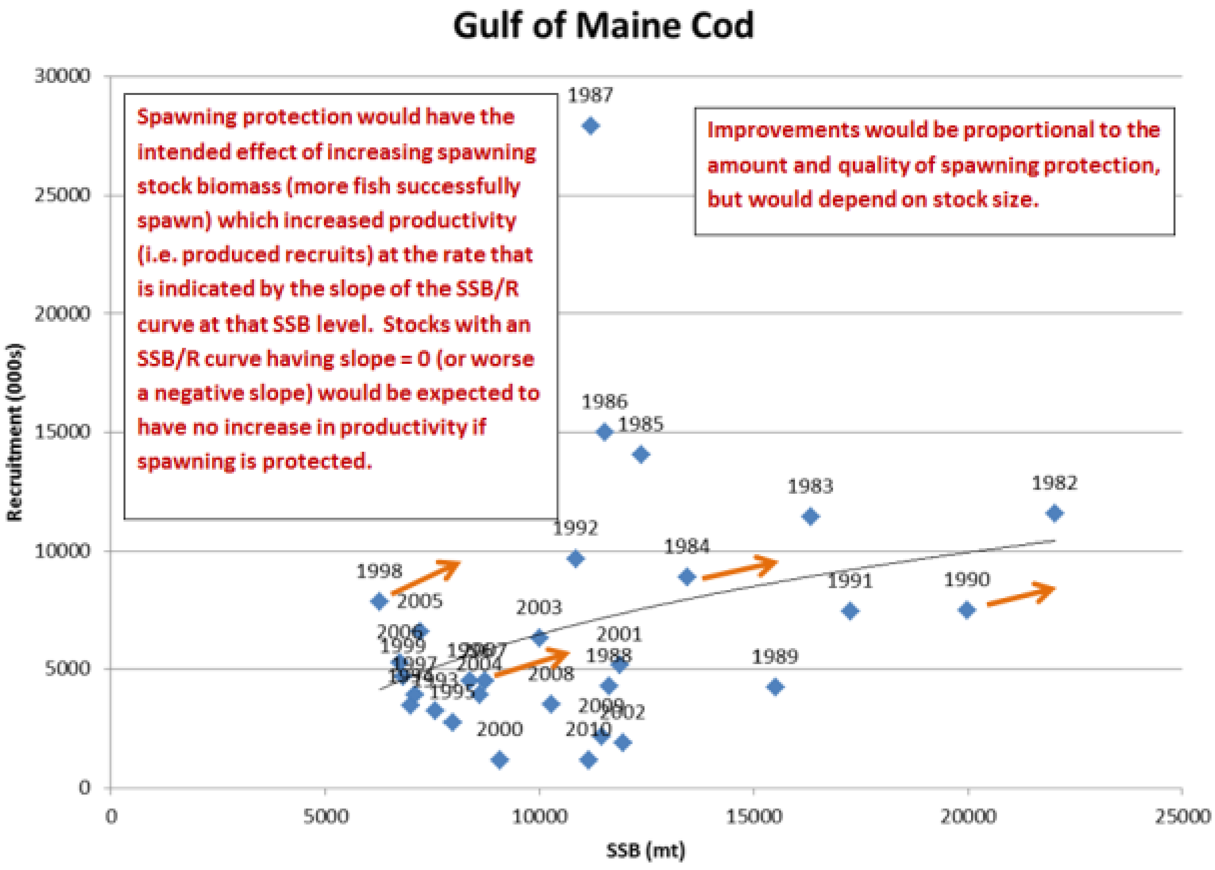
Some groundfish, particularly cod, have been observed to exhibit specific spawning behaviors (see discussion in the Affected Environment section of Volume 1). This behavior is sometimes manifested in diel separation and re-aggregation by sex. This type of behavior has been observed in acoustic cod tagging 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 ????). Deployment 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 preferred 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 could affect productivity, using estimated Gulf of Maine cod spawning stock biomass (SSB) and recruitment. A positive stock recruitment relationship indicates that improving spawning success should improve recruitment. If a reduction in fishing in spawning locations and seasons improves spawning success, 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 actual amount of increased recruitment one would expect to see will vary according to the strength of the relationship between SSB and recruitment in a given stock.

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 73), 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 fishing effort (less than 1%). 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[9] (Table 107). 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 Volume 1, Affected Environment), the distribution of developing and ripe cod and haddock, and on the distribution of survey catches of mature sized cod, 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. However, the areas don’t 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 107 – 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

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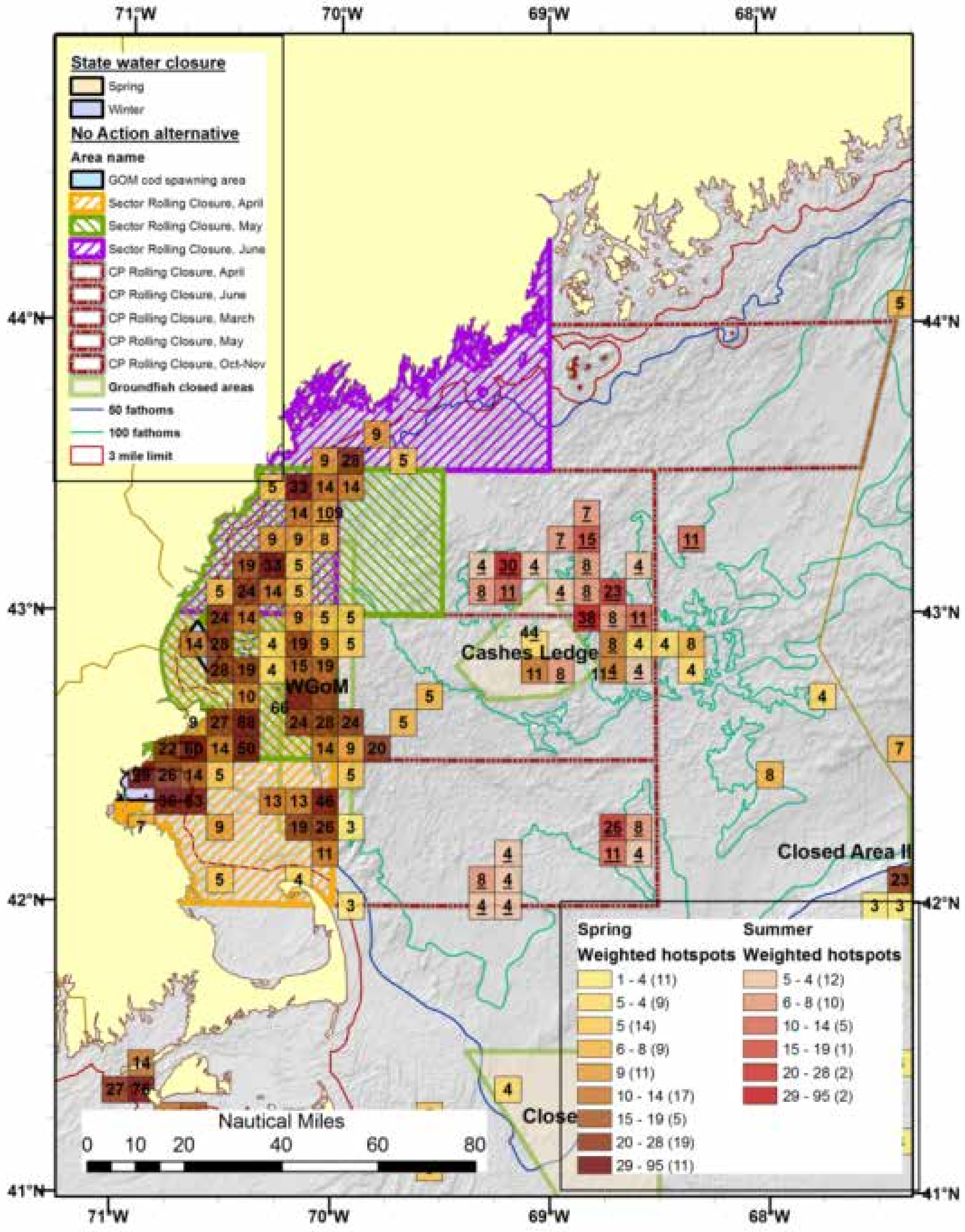
[9] Hotspots were weighed more heavily for stocks with low biomass relative to the MSY target, stocks that formed sub-populations, and stocks that were known to have resident populations.

Map 73 – 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 2002-2012 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 75). 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 75), 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 Jeffreys Ledge (Map 76). Nonetheless, a winter spawning closure in this area could complement the existing Mass Bay spawning closure in MA state waters (Map 76) and potentially other spawning protection areas in state waters that will be identified from this research.

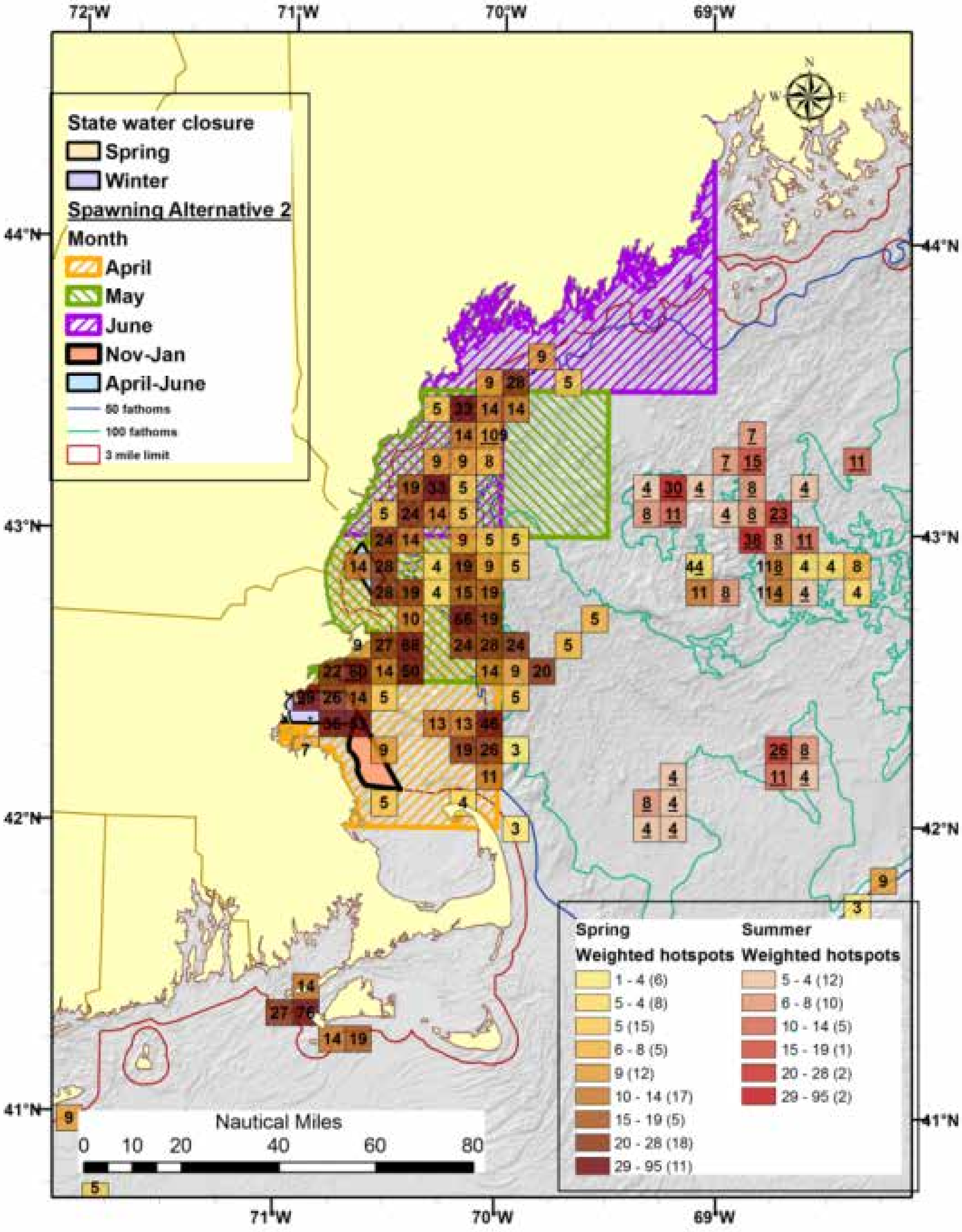
This alternative essentially protects spawning in the same areas and seasons as in Alternative 1 (No Action), but provides less protection to spawning around Cashes Ledge. Some additional spawning protection may be provided by the Mass Bay cod spawning protection area proposed by this alternative. Areas included in this alternative had about the same number of spawning hotspots as those for Alternative 1 (Table 107, Map 74).

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 under Option B. 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. During the 2012 fishing year, estimates indicate that recreational vessels harvested more GOM haddock than commercial groundfish vessels, exceeding their 2012 allocation of GOM haddock.

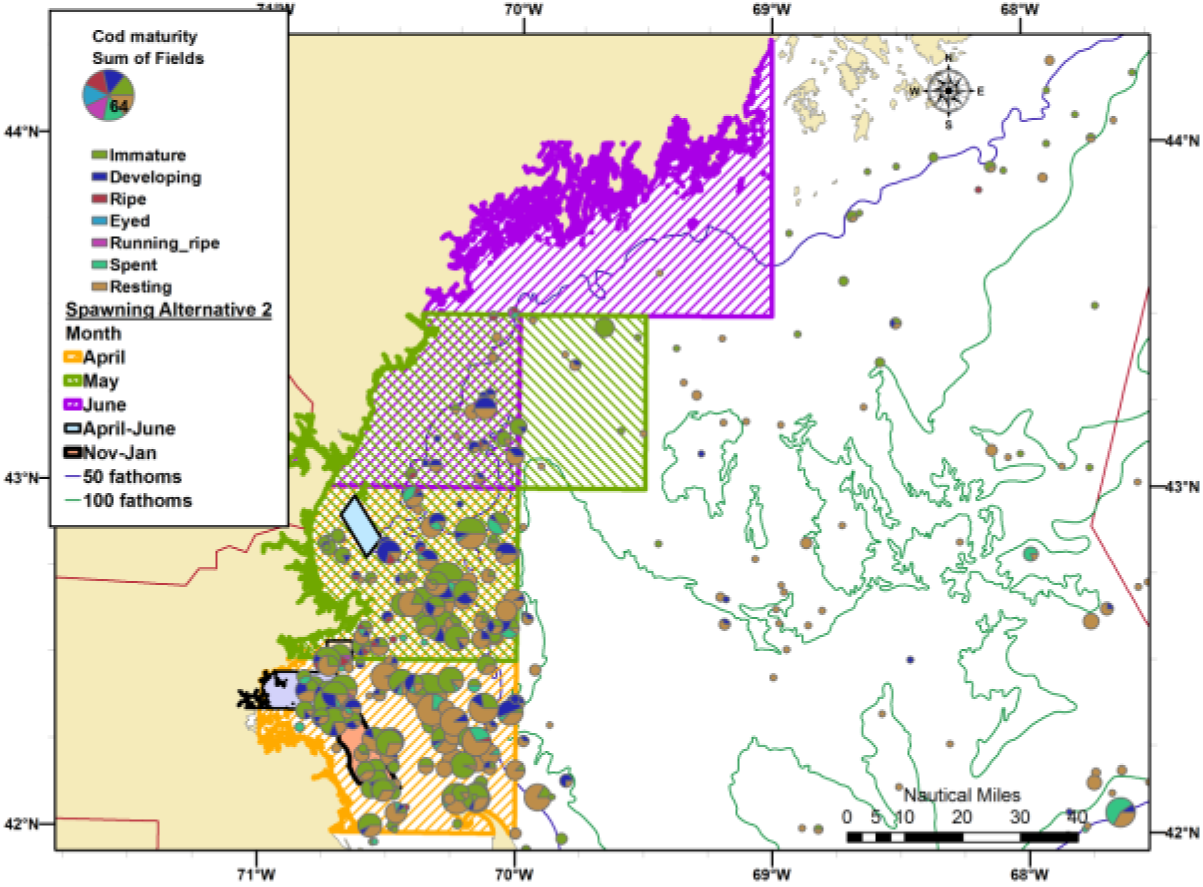
Considering these effects described above, the impact on groundfish productivity is expected to be positive compared to Alternative 1 (No Action) and to Alternative 2, Option A. Because

Option B includes measures that restrict recreational fishing effort on spawning groundfish, Option B would have more benefits than to groundfish stocks when compared to Option A.

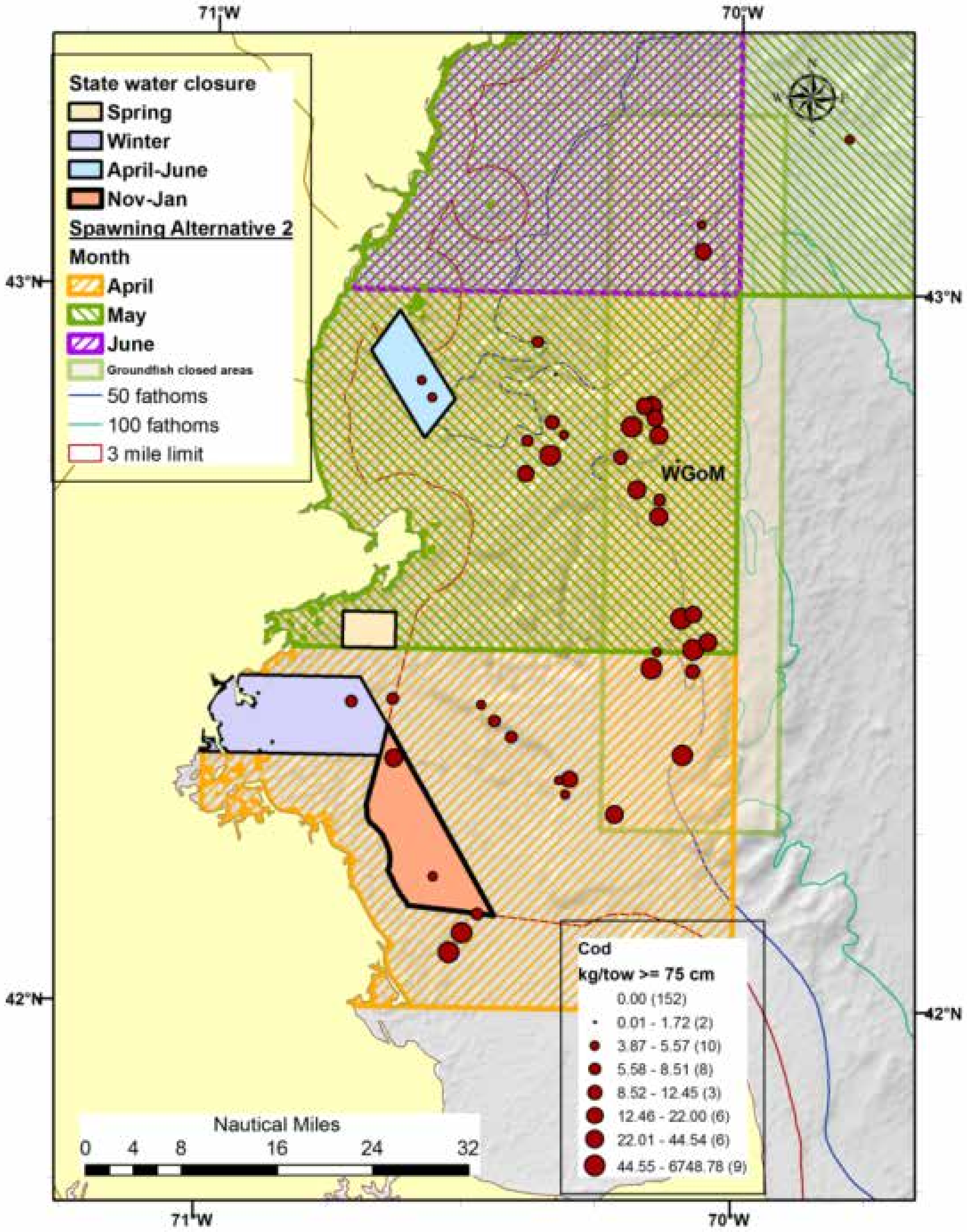
Map 74 – Alternative 2 spawning closures compared to the distribution of weighted groundfish spawning hotspots (concentrations of large spawning size groundfish) in the WGOM sub-region, using 2002-2011 spring NMFS, MADMF, ME-NH, and IBS cod survey data.



Map 75 – Proportion of cod abundance by stage of maturation during NMFS and MADMF spring trawl surveys, 2002-2011.



Map 76 – 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 occur 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 pout, 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 77), with some hotspots (22.4) in the fall (Table 108). Closed Area I had a relatively low number of large spawner hotspots in the spring (Map 77) and fall (Map 78), while the Nantucket Lightship Area had 28.1 weighted hotspots in the winter, associated with windowpane flounder.

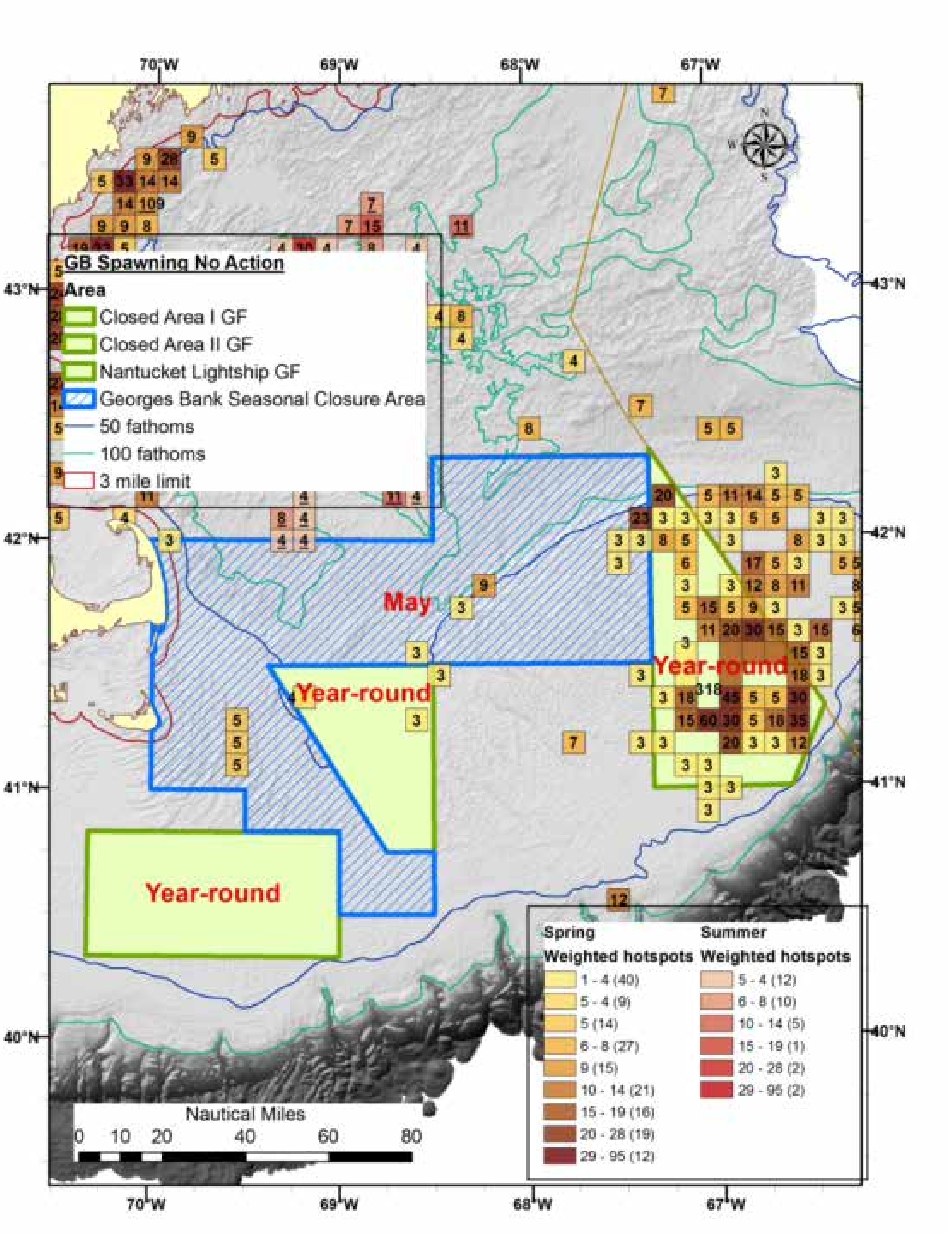
The existing year round groundfish closed areas provide a relatively high level of protection from spawning, except in areas that are open to fishing under specific groundfish and scallop access programs. The scallop access program currently allows scallop dredge fishing in these areas during the spring, 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).

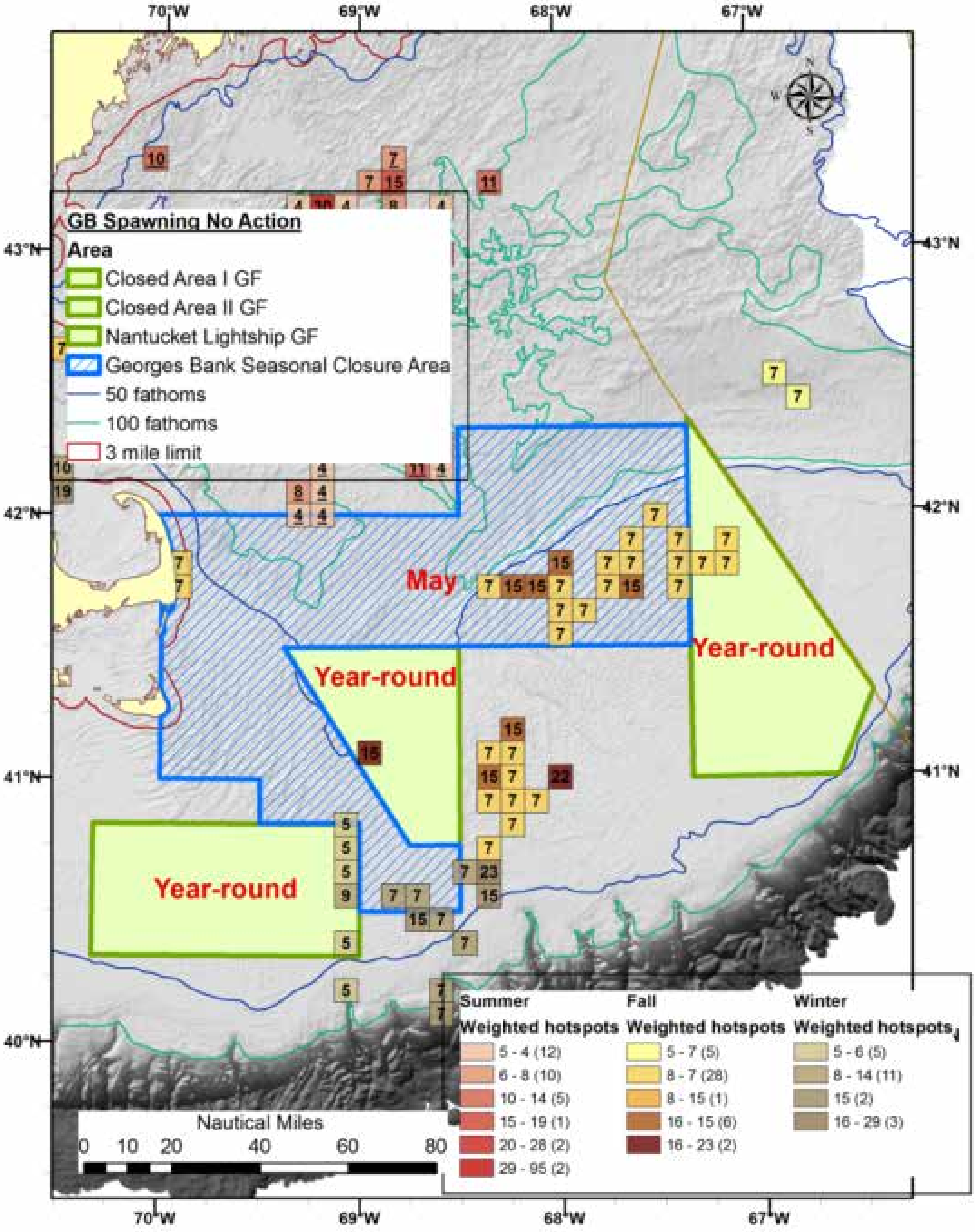
Table 108 – Seasonal summary of unweighted and weighted large spawner hotspots for the No Action alternative.

	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 77 – Distribution of weighted large spawner groundfish hotspots in spring compared to No Action alternative areas.



Map 78 – 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 109; Map 79), 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 80). 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 81, 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 81, 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.

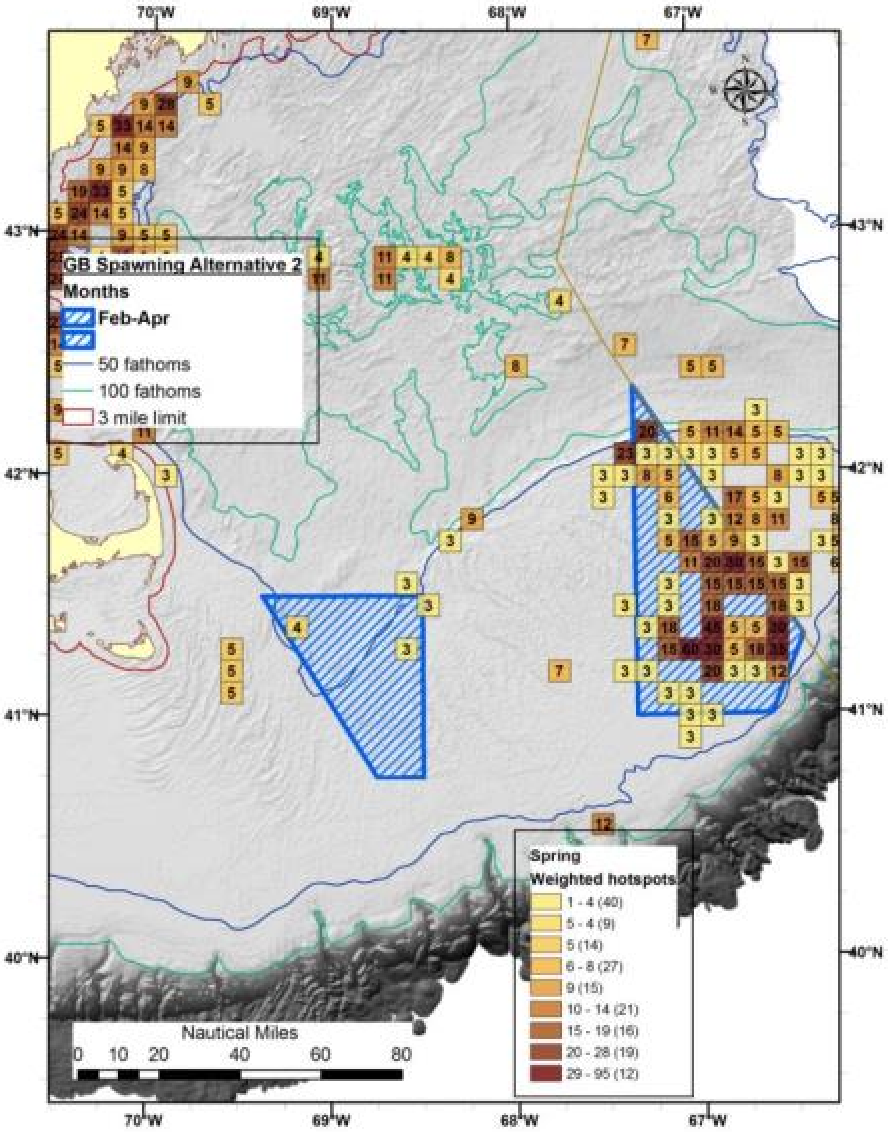
Option B differs from Option A only because it would prohibit recreational fishing for groundfish (some exemptions for pelagic fishing would apply). This measure would prevent the recreational fishery from targeting concentrations of cod and haddock in Closed Area I and II during the spring when the 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, compared to Option A.

Thus compared 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.

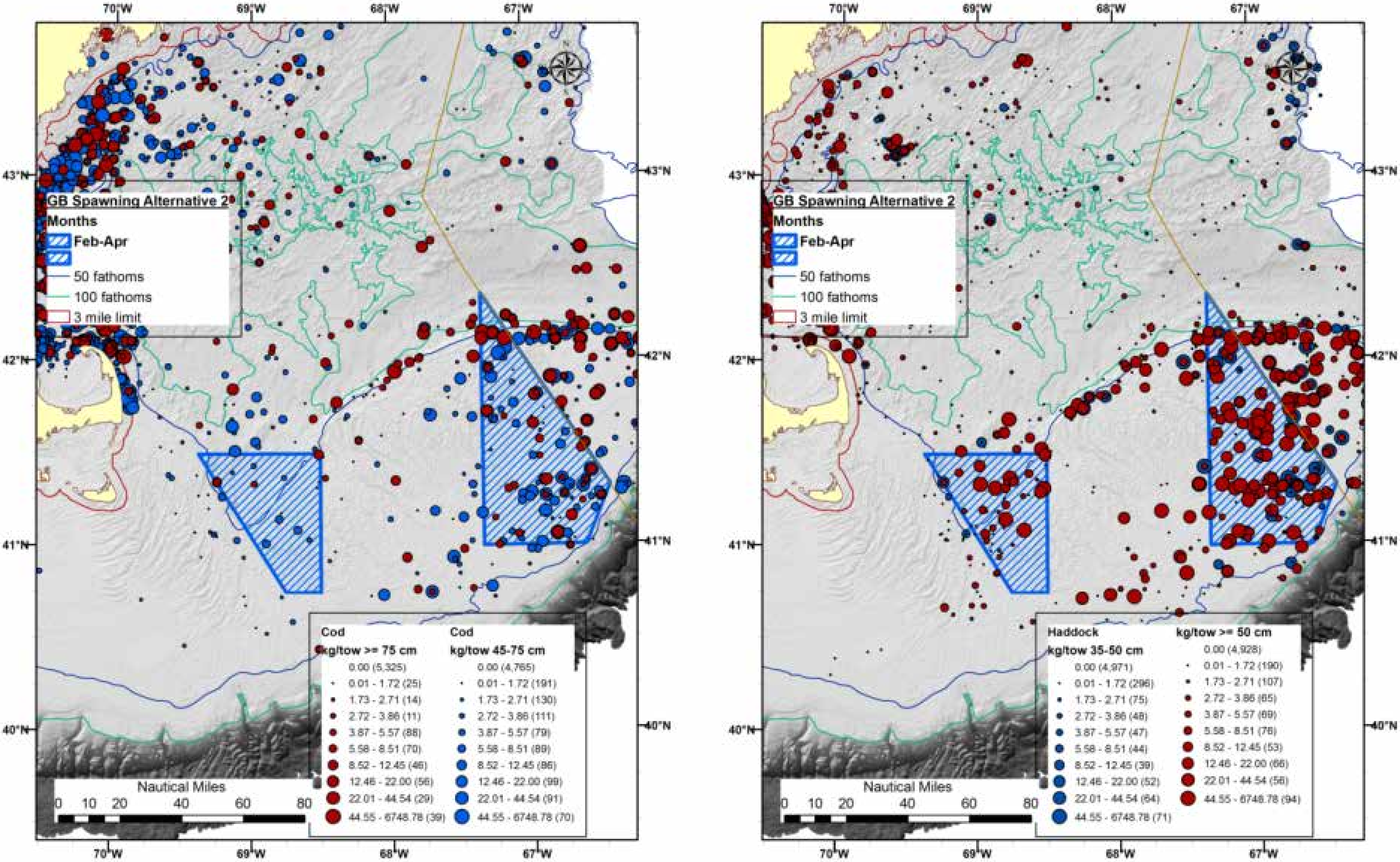
Table 109 – Summary of unweighted and weighted large spawner hotspots during spring, comparing Georges Bank Alternatives 1 (No Action), 2, and 3.

	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

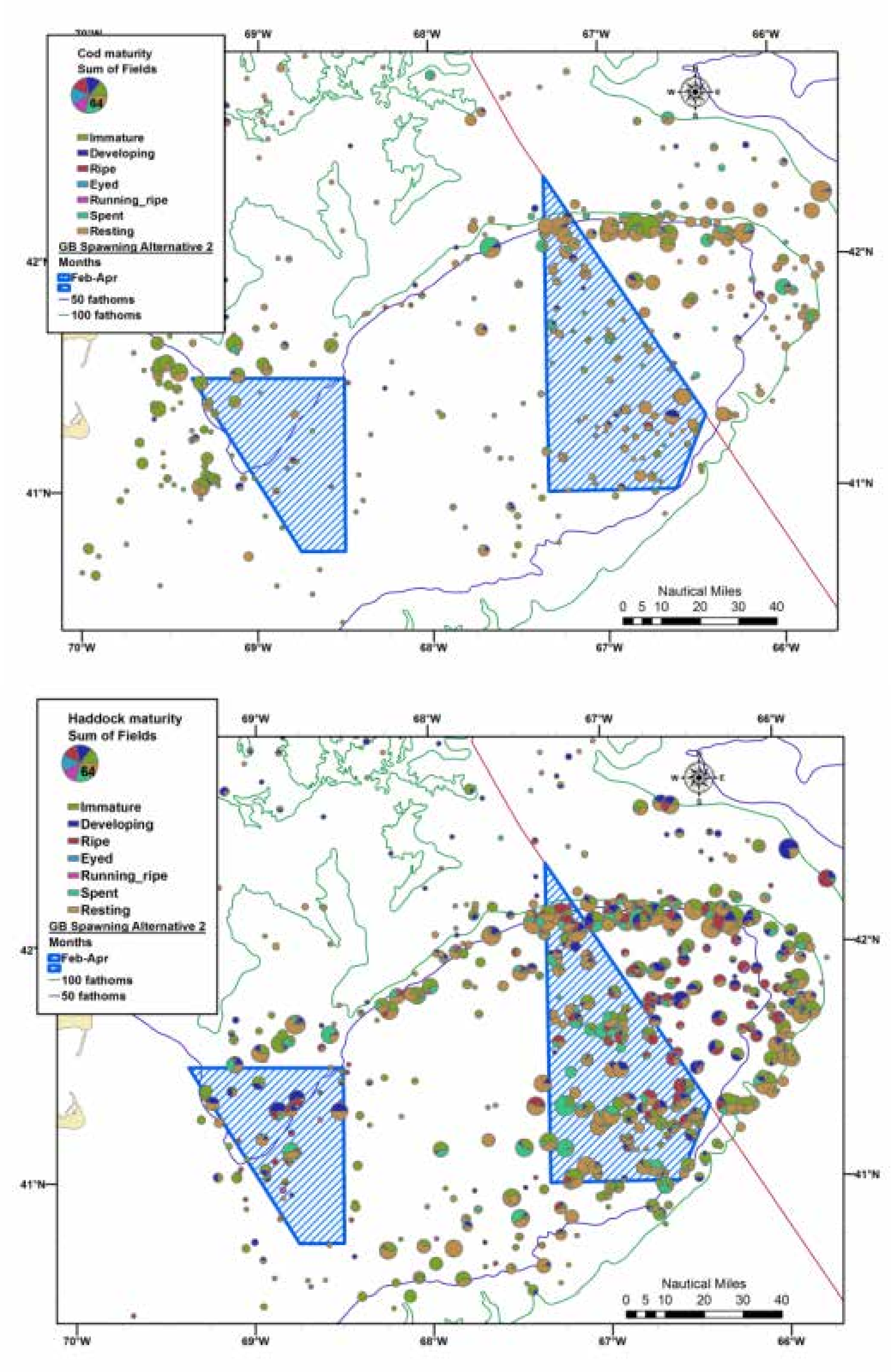
Map 79 – Distribution of weighted large spawner groundfish hotspots in spring compared to Alternative 1 areas.



Map 80 – 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 81 – 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 (Map 82). 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 80), and haddock in developing or ripe condition (Map 81).

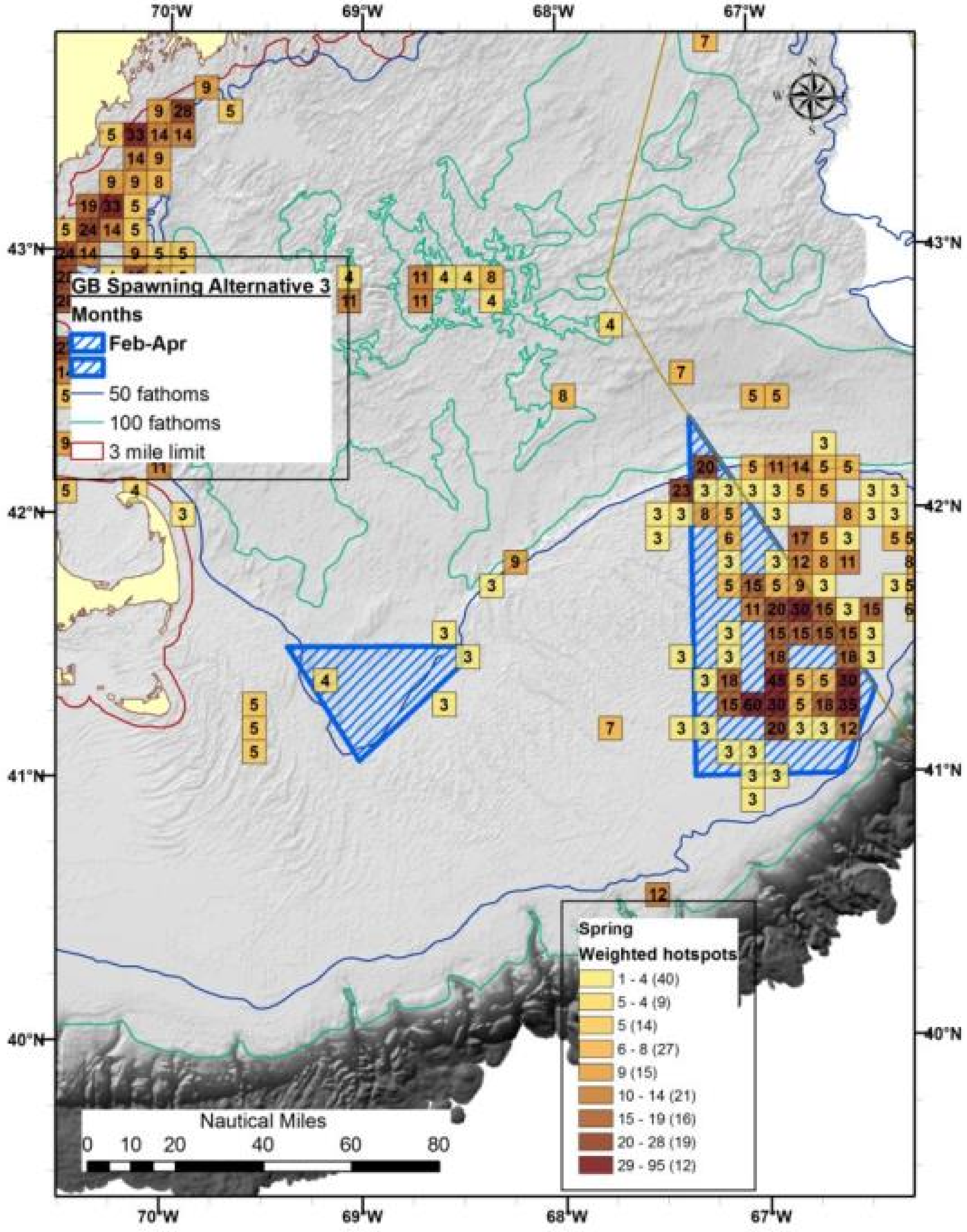
Therefore, this alternative has nearly the same impact on groundfish productivity through spawning protection as Alternative 2 Option A, slightly positive impacts on spring spawners and large negative effects on fish that spawn in other seasons.

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 Human and Community impacts 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.

Map 82 – 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 *Analytical approach and assumptions*

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. 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 *Gulf of Maine*

Tables and figures related to analysis of the social and 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

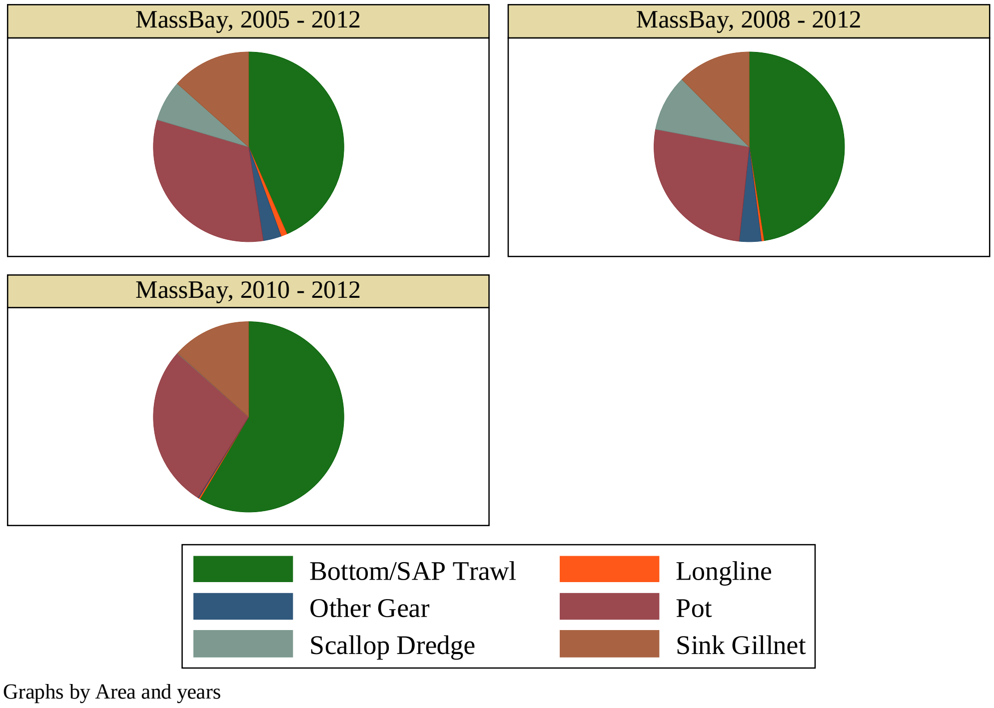


Table 110 – Gear in currently open portions of the Massachusetts Bay area of Spawning Alternative 2 potentially impacted by the management options. All variables represent annual estimates. Vessel sizes: S < 50 ft, 50 ft <= M < 70 ft, L >= 70 ft, U = unknown vessel characteristics

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 111 – Recreational fishing revenue associated with the GOM Spawning Alternative 2 in the relevant time frames being considered for closure. 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
April	2006 - 2012	1,079,749.20	68.14	7,695.29	2,523.62	1,117.74	2,424.28
April	2008 - 2012	1,054,411.55	70	7,562	2,411.74	1,117.74	2,297.45
April	2010 - 2012	966,533.19	66.67	7,005.67	2,334.62	1,117.74	2,208.30
May	2006 - 2012	1,188,660.21	60.71	10,378.71	2,313.86	1,789.8	1,957.86
May	2008 - 2012	1,247,564.94	60	10,929.8	2,345.05	1,790.25	1,970.24
May	2010 - 2012	1,331,199.46	59	11,388.33	2,392.81	1,790.25	2,050.06
June	2006 - 2012	196,061.85	23.43	1,418.14	1,506.51	894.9	1,180.85
June	2008 - 2012	188,064.71	22.6	1,380.2	1,536.48	937.75	1,146.55
June	2010 - 2012	182,662.07	22.33	1,339	1,565.68	1,023	1,124.79

Figure 36 - Recreational revenue estimated to have been generated by trips reported within the areas being considered under GOM Spawning Alternative 2, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years.

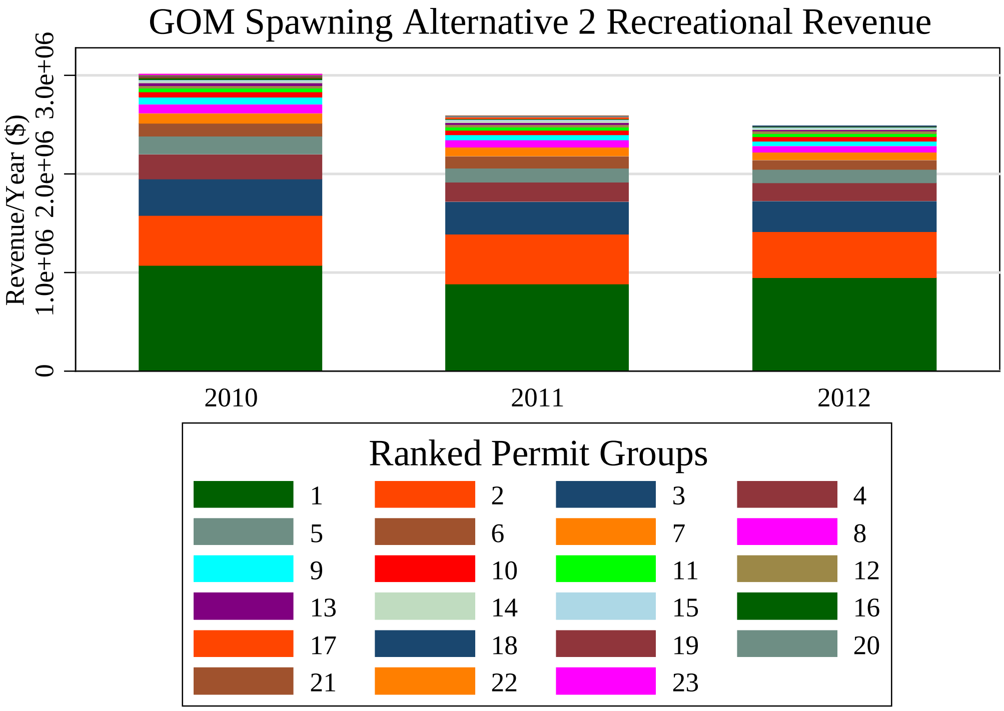


Figure 37 - Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the areas of GOM Spawning Alternative 2 during the relevant time periods.

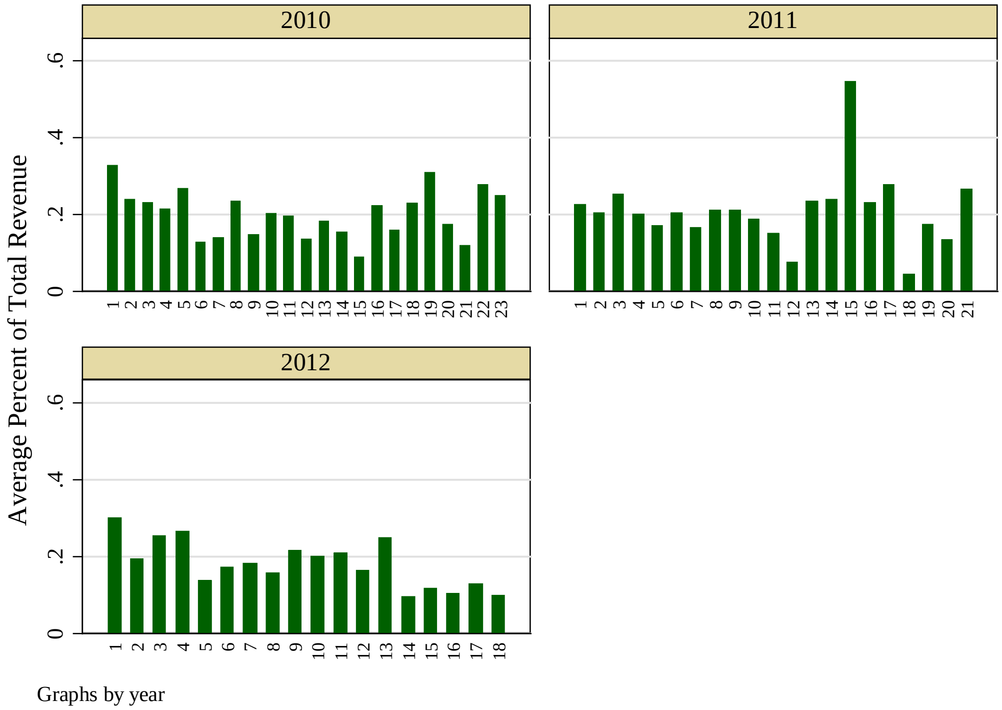


Table 112 – Total number of vessels by port of landing or city of registration associated with at least three vessels conducting trips capable of catching groundfish in 2012 in currently open portions of the Gulf of Maine potentially impacted by the Massachusetts Bay Spawning Area.

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**

Table 114 – Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the GOM Spawning Alternative 2 in the relevant time frames being considered for closure.

Gulf of Maine		Alternative 2	
State	**Community**	**Port**	**City**
MA		**55**	**54**
	Gloucester	9	9
	Marshfield	5	5
	Newburyport	8	8
	Plymouth	4	4
	Rockport	3	3
ME		**11**	**11**
NH		**24**	**25**
	Hampton	5	5
	Hampton Falls	3	3
	Rye	6	6

Table 113 – Recreational fishing revenue associated within a 10 nautical mile buffer of areas within GB Spawning Alternative 2 currently closed to recreational groundfishing. 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 data censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
CAIIbuffer	2006 - 2012	-	-	-	-	-	-
CAIIbuffer	2008 - 2012	-	-	-	-	-	-
CAIIbuffer	2010 - 2012	-	-	-	-	-	-
CAIbuffer	2006 - 2012	75,245.64	9.86	409.71	2,002.74	1,117.74	2,394.29
CAIbuffer	2008 - 2012	74,863.38	9.2	406.2	2,354.19	1,117.74	2,604.09
CAIbuffer	2010 - 2012	58,266.78	7.67	320	2,427.78	1,117.74	2,555.87

Table 113- Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated within a 10 nautical mile buffer of areas within GB Spawning Alternative 2 currently closed to recreational groundfishing. Other states and individual communities could not be identified due to privacy concerns.

Georges Bank		Alternative 2	
State	**Community**	**Port**	**City**
MA		**6**	**5**

Figure 38- Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip occurred within a period that would provide access to these areas under GB Spawning Alternative 2.

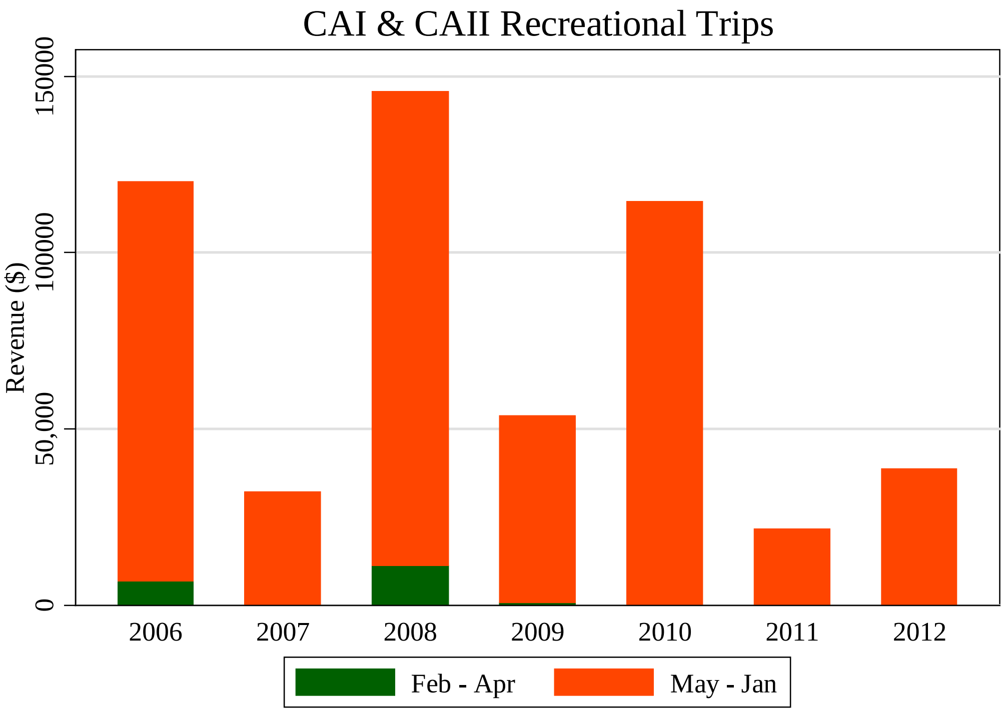
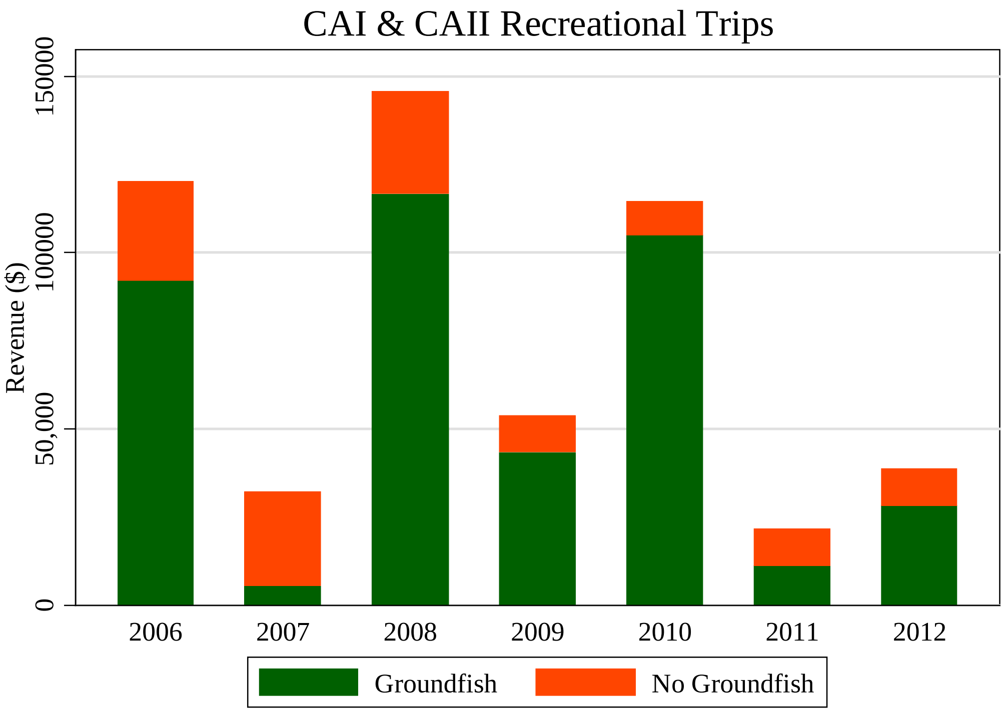


Figure 39 - Recreational revenue estimated to have been generated by trips reported within a 10 nautical mile buffer of CAI and CAII, delineated by whether the trip caught at least one groundfish.



4.2.3.2.1 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.

To the extent that spawning aggregations increase CPUE, the ongoing cost of the rolling closures to fishermen are expected to be substantial. In addition, the close proximity of the rolling closures to shore means that many of the impacted fishermen face additional steaming costs in order to reach areas of the ocean open to fishing. Nevertheless, given the expected impact of the no action Alternative 1 on groundfish habitat and productivity, the net benefit on the fisheries managed is expected to be positive.

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 Alternative 2, Options A and B

Option A and B are equivalent in their impact on commercial fishing. 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 110 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 April – June rolling closures of this alternative are a subset of the current common pool rolling closures. This alternative is thus expected to have a net positive impact on common pool vessels in the short run when compared to no action, by increasing the flexibility with which these individuals can fish. The rolling closures of Alternative 2 are identical to the current sector rolling closures, and thus a neutral impact is expected when compared to no action Alternative 1.

Additional year-round closures are being considered for Central/Western GOM, which could drastically change the overall impact analyses of this alternative. Nevertheless, as written Alternative 2 would have substantial short term positive benefits to commercial fishermen, as it would provide access to the current Western Gulf of Maine/Cashes Ledge closures. However, the long run net benefits are expected to be negative, due to the negative impact on groundfish stocks.

Option B greatly impacts recreational fishing when compared to no action, with the recreational revenue reported to have been generated in the currently open areas encompassed by Alternative 2 detailed in Table 111. The average annual revenue is consistently high, with a small number of permits consistently active in these areas. As can be seen in Figure 36, the 5 permits with the highest revenue estimated to fall within the Spawning Alternative 2 areas under consideration in the relevant months account for 36%, 34%, and 38% of the total revenue estimates in 2010, 2011, and 2012 respectively. The Whaleback closure is expected to have a neutral impact as compared to the no action Alternative 1, given that the management regime does not change between the two alternatives.

The following discussion assumes a positive correlation between the percentage of revenue a management action affects, and the costs of compliance for an individual fisherman. Thus, for example, an individual having 100% of their total annual revenue displaced by a management action is assumed to have a higher cost of compliance than someone with 10% of their revenue impacted. In reality the cost of compliance depends on an individual's next best alternative to recreational fishing in these areas during the time periods of interest. However, this next best alternative is likely different for each individual, and cannot be readily assessed with the data in hand. On average, the percentage of revenue displaced is assumed to be a good proxy for this unknown cost.

Figure 37 indicates what percentage of each rank group's total revenue, including commercial revenue, would be expected to be displaced by Alternative 2. These percentages are relatively stable across time, with no readily apparent trends. At around 20%, they also tend to be relatively large. This suggests that, in the short run, there will be large negative net benefits to the recreational fishery when compared to no action. In the long run, net benefits are expected to be negative for the recreational fishery when compared to the status quo, due to the expected impact on groundfish stocks.

The overall net benefit of this Alternative is expected to be negative in the long run when compared to no action Alternative 1, given the expected impact on groundfish stock. However, this determination ultimately depends on what management alternatives are selected in Central/Western GOM, and thus the analysis is highly uncertain in terms of a net benefit final determination.

The social impacts of Alternative 2 in comparison to the no action alternative are expected to be slightly negative. There may be some positive impacts associated with the overall reduction in closed area and the resulting flexibility and access this gives some commercial vessels. 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 79. Additionally, option B will have a negative impact on communities involved in recreational fishing.

4.2.3.3 *Georges Bank and Southern New England*

4.2.3.3.1 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.

Given the expected positive impacts on managed large mesh groundfish through the benefits of current area management to groundfish productivity, there are positive expected benefits of the no action alternative for the groundfish fishery. However, the general discussion of CAI, CAII, and Nantucket Lightship make clear that there are substantial costs of no action, primarily concentrated in the scallop fishery, which makes the expectation of the overall net benefit of no action Alternative 1 negative.

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. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.2.3.3.2 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.

A general discussion of the benefits of additional access to CAI, CAII, and Nantucket Lightship for the groundfish and recreational fleet can be found in Sections 4.1.3.5.2 and 4.1.3.6.2. Section 4.5.4.2 details the expected economic impact of Alternative 2 to the Scallop fishery.

Options A and B are equivalent for commercial fishermen. Alternative 2 would provide additional access to common pool vessels in all current closures, increasing the flexibility of where and when to fish over the no action Alternative 1, including access to CAI, CAII, Nantucket Lightship, and the May spawning closures, which is expected to have a non-negative net benefit in the short run. Sector vessels would be provided additional access to CAII, by what amounts to an extension of the Eastern US/Canada Haddock SAP season into January, and providing access to the area between latitudes 41° 30’ and 42° 10’ May – January within a FY. Although there is a current SAP in CAI, it only provides exemptions to demersal longline and tub trawl gear, and even then only to northerly portions of CAI. Alternative 2, would provide additional access for other gear capable of catching groundfish, and extend tub trawl and demersal longline access into the southern regions of CAI during the relevant time periods. The current Nantucket Lightship closures would be removed, providing additional flexibility of where and when to fish. However, the current May spawning closure only applies to common pool vessels not under a Handgear A or Handgear B permit. Thus, Alternative 2 is expected to produce positive net benefits in the short run when compared to no action Alternative 1, primarily from additional access afforded around CAII, and primarily for the scallop fishery which would gain access to the significant biomass encompassed within the existing HAPC in the northern portion of CAII.

Table 113 details the recreational fishing reported within a 10 nautical mile buffer around CAI, and CAII, for which there is no current demersal groundfish recreational exemption. It is clear that there is a very small number of permit holders currently fishing in these areas. The discussion in Section 0 indicates that only local groundfish effort is likely to be displaced if and when access to CAI and CAII would be granted. Under Alternative 2 option A some of this effort would be expected to flow into areas currently closed to recreational fishing. Figure 38 indicates that the majority of the revenue generated by trips surrounding CAI and CAII occur during periods in which both of these areas would be open to recreational fishing, and Figure 39 indicates that these trips catch groundfish. A neutral to relatively small positive net benefit to the recreational fishery would be expected from providing access to CAI and CAII, with the majority of the benefit provided by additional access to CAI. Table 113 identifies the communities associated with these trips in 2012. These are all associated with Massachusetts however due to privacy concerns individual communities are not identified.

Option B would exclude recreational groundfish fishing from Nantucket Lightship, which is currently fished recreationally for groundfish. Table 90 overviews the recreational fishing currently occurring in the Nantucket Lightship closure. The annual averages suggest a very small number of permit holders report fishing within the bounds of the current closure, particularly in recent years. This suggests that option B would have a small negative to neutral impact on recreational fishermen in the short run.

Ultimately the long-run impacts depend to some extent on the final juvenile groundfish habitat alternatives selected. Regardless, as written the longer run impact of Alternative 2 are expected to be positive, given the large concentration of scallop biomass within the HAPC area of CAII, and to a lesser extent to the northern portion of CAI and the habitat closure within Nantucket Lightship. The benefits from access for the scallop fishery is expected to vastly outweigh the benefits associated with additional groundfish habitat conservation that might accrue in the long run through no action Alternative 1. The long-run difference between option A and B are expected to be negligible, given the very small amount of recreational fishing currently reported in and around CAI, CAII, and Nantucket Lightship. The magnitude of these benefits are expected to be slightly smaller than Alternative 3.

The short-term social impacts of Alternative 2 in comparison to the no action alternative are expected to be positive. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

4.2.3.3.3 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.

A general discussion of the benefits of additional access to CAI, CAII, and Nantucket Lightship for the groundfish and recreational fleet can be found in Sections 4.1.3.5.2 and 4.1.3.6.2. Section 4.5.4.2 details the expected economic impact of Alternative 2 to the Scallop fishery. Alternative 2 above discusses the expected impact of seasonal closures for the entirety of CAI and CAII. Map 58 and Map 59 highlight the clustering of observed and reported effort around the northern edge of CAI, indicating that from the perspective of groundfish the additional access afforded by Alternative 3 likely affords only a marginal increase in benefits when compared to No Action.

Options A and B are equivalent for commercial fishermen. Alternative 3 is expected to produce positive net benefits in the short run when compared to the no action Alternative 1, primarily from additional access to the significant scallop biomass within the habitat component of Nantucket Lightship, the northern section of CAI, and more importantly the HAPC section of CAII. The magnitude of this benefit is expected to be slightly larger than Alternative 2, given the additional access around CAI. It should be noted that, when compared to the no action alternative, long term economic benefits are expected to be negative for the groundfish fishery given Alternative 3's expected impact on groundfish habitat in particular (see 4.2.2.2.3). The long-run difference between option A and B are expected to be negligible, given the very small amount of recreational fishing currently reported in and around CAI, CAII, and Nantucket Lightship, and the expectation that the opening of these areas is likely to only displace local effort.

The short-term social impacts of Alternative 3 in comparison to the no action alternative are expected to be positive. There are also potential long-term negative social impacts if benefits to fish populations from the current closed areas are lost. Given the current vulnerability in the groundfish fishery impacts to groundfish may be felt more acutely than impacts to the scallop fishery.

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 114. A summary of diversity indices within each DHRA is provided in Table 115.

Table 114 – 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 115 – Average diversity indices by DHRA alternative areas.

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	73	0.657	0.592	1.311	13	0.954	0.915	1.544	23	0.908	0.809	1.949	25	0.591	0.543	1.116
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 in the absence of an overlapping Habitat Management Area, 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 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 4.1.2, 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 4.1.2. 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 for doing habitat-related research.

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 2.1.1.3). The impacts of this alternative on groundfish habitat and productivity are summarized in Section 4.1.2.2.3. 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 116, Map 43 in HMA section) arise from redfish, windowpane flounder, winter flounder, and witch flounder (Table 117).

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 116 – 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 117 – 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 2.1.3. The impacts on groundfish habitat and productivity by HMA Alternatives 3 and 6 are evaluated in Sections 4.1.2.4.3 and 4.1.2.4.6, respectively.

Map ??? also shows the relationship between the weighted age 0/1 groundfish hotspots and the Stellwagen Bank Dedicated Habitat Research Area (purple outline). More survey catch data for cod and haddock age 0/1 and age 2+ sublegal cod and haddock are shown in Maps ??? and ???.

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 also relative to Alternative 1 (No Action).

Measures applied to DHRAs may be 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 vulnerable to fishing elsewhere.

Proposed Dedicated Habitat Research Area Reference Areas

Indirectly, it is possible that the incorporation of potential habitat research, including the effects of groundfish removals from all fisheries, into the management process would produce long term positive impacts on the groundfish resource through more informed and better management practices. These DHRA areas appear to be ideally suited for comparative research with control and experimental designs, although due to the areas' small size the effects on overall stock productivity may be difficult to detect in small areas.

Although some localized direct effects on resident populations of groundfish (to the extent that they occur) and on ecosystem function might be realized, these effects as well as population level effects are going to be very difficult to detect. Fishing within the area and in adjacent areas (including increased fishing in the Western Gulf of Maine EFH by vessels using groundfish gillnets, fishing around the border of a closed area, fishing with lobster traps and other gears that catch a small amount of groundfish, and illegal fishing by a few) are likely to overwhelm a detectable signal from reduced groundfish mortality in a 55 nm^2 area.

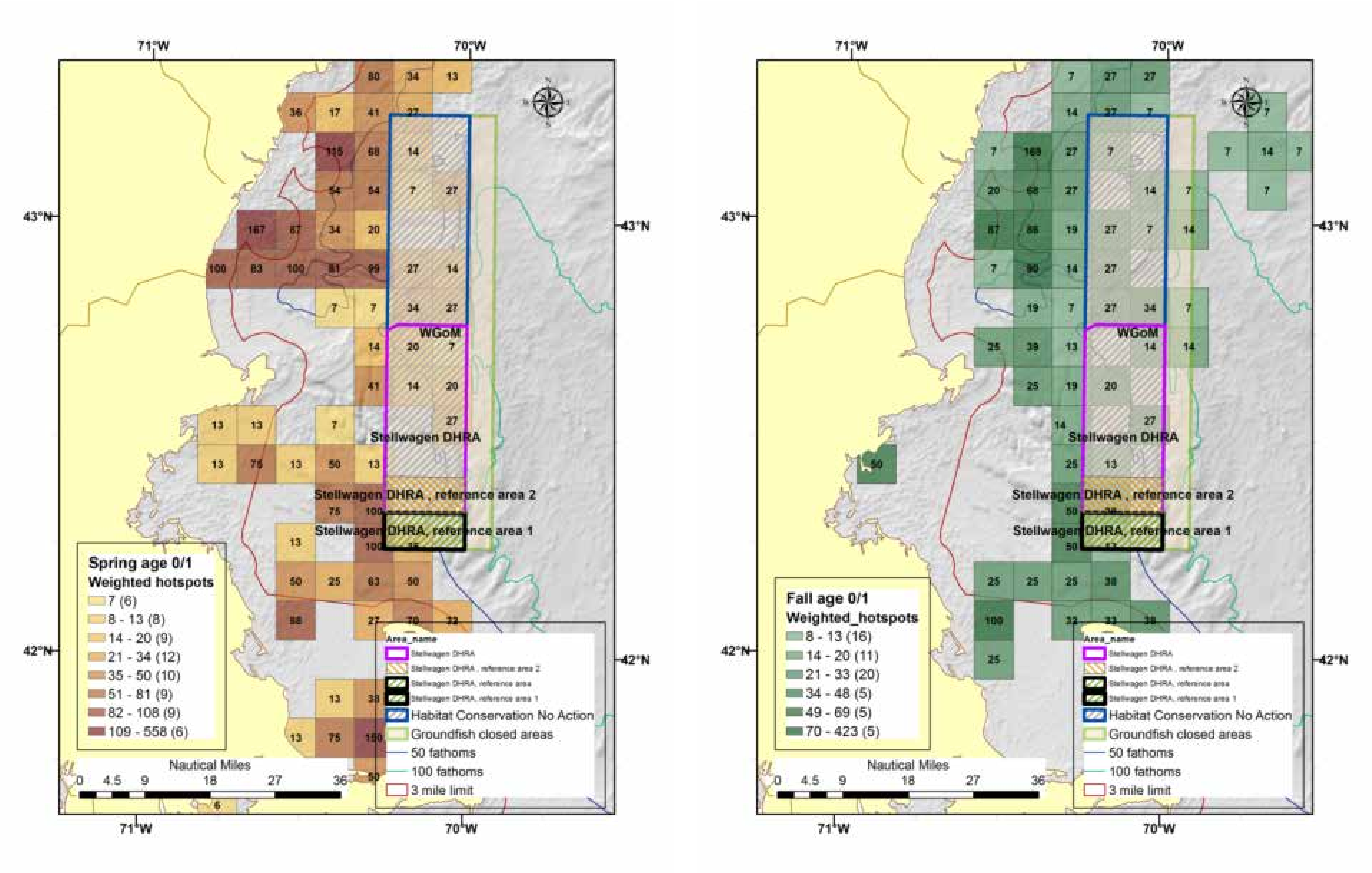
Although there are more age 0/1 groundfish hotspots inshore of the Stellwagen DHRA (Table 116; Map 83), some groundfish hotspots occur in the proposed area. Although offshore of most of the small juvenile cod and groundfish, the reference areas are closer to the hotspot concentrations of groundfish associated 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. There are few differences between the two reference areas with respect to hotspots (Map 83), sub-legal cod abundance (Map 84), and sub-legal haddock abundance (Map 85).

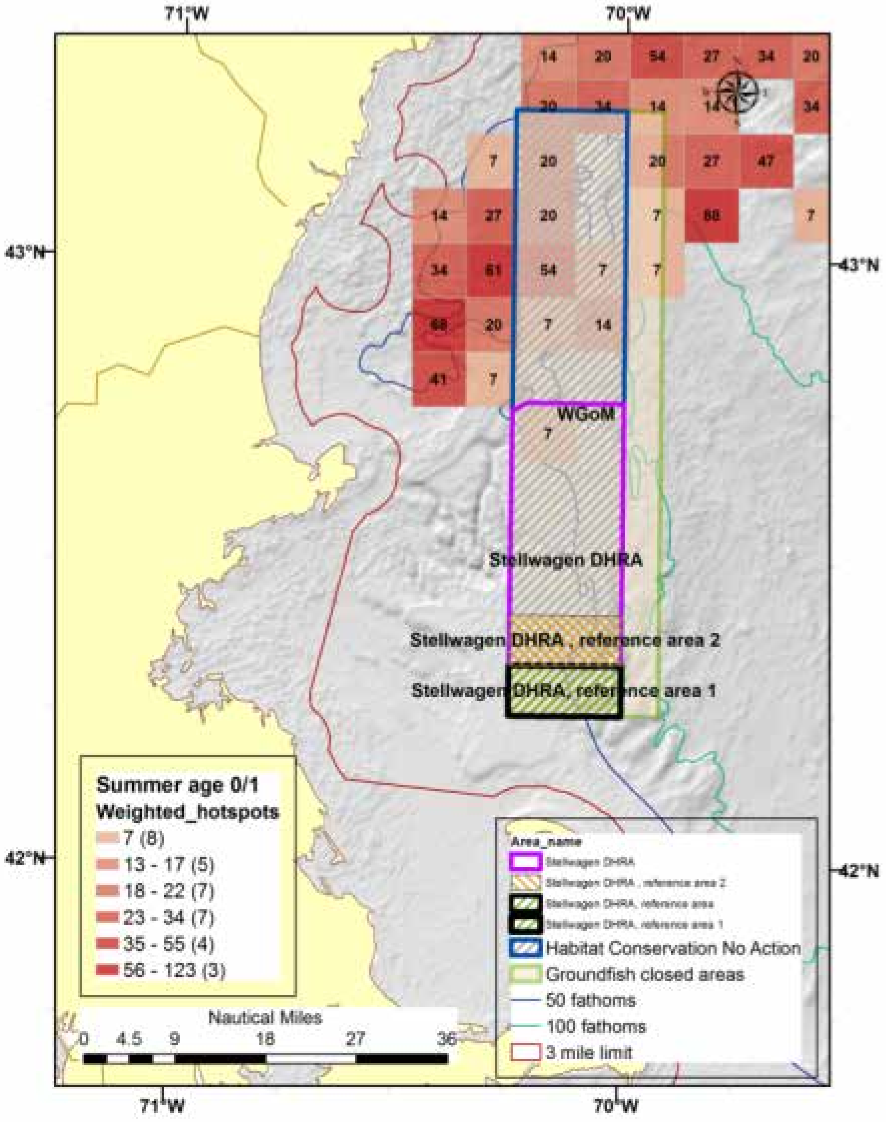
Moreover, such research may address the habitat use by different cohorts of sublegal cod and possibly other groundfish. Many of the smaller age 0/1-sized cod are typically well inshore of the larger sublegal cod in both the spring and fall surveys (Map 84). To a lesser extent, the same is true for juvenile haddock (Map 85). The inshore half of the proposed reference areas appear to contain a higher biomass of legal size cod in both the spring and fall (Map 86), 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). Legal size haddock do not appear to be quite as concentrated on the inshore half of the proposed reference areas (Map 87), but do occur within both.

Differences in legal-size cod and haddock survey catches during 2002-2012 are not readily apparent. The area is currently closed to commercial groundfish fishing, but is open to recreational fishing by private anglers and commercial party and charter boats. Map 88 shows the spatial and seasonal (by month) distribution of VTR-reported cod catch per angler on commercial party and charter boats. The data indicate that cod catches are distributed fairly widely through the center of both reference areas. Cod catches in the Reference Area 2 (northern) are a bit more widespread than in Reference Area 1. If the influence of cod mortality on groundfish habitat and on ecosystem effects is more important, than Reference Area 2 may have a greater probability of producing detectible differences than Reference Area 1.

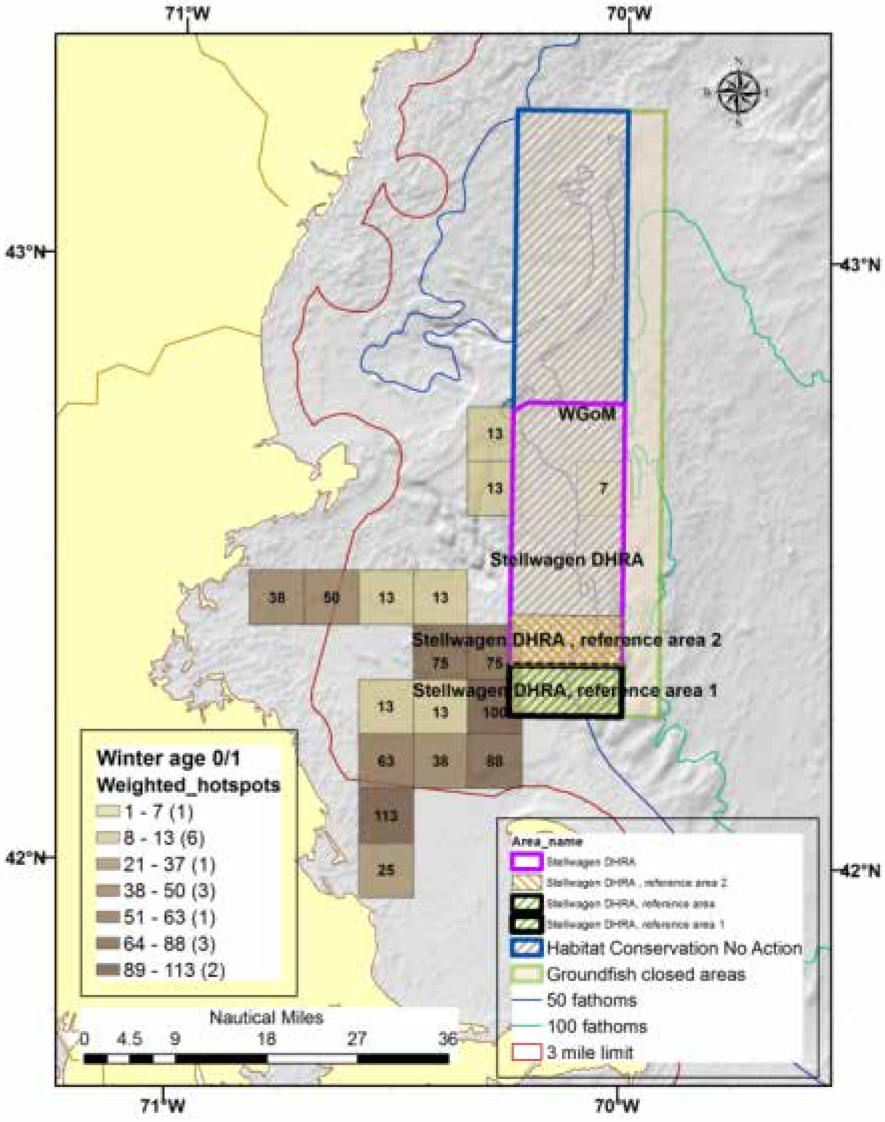
Cautious interpretation of these VTR-reported commercial party and charter boat data should be exercised, however, because many fishermen report one (average) fishing location per trip and do not represent the full range of a trip’s fishing activity, much less specifically the locations where cod (or another species) were caught.

Map 83 – 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-NH, and IBS survey data (continued on next page).



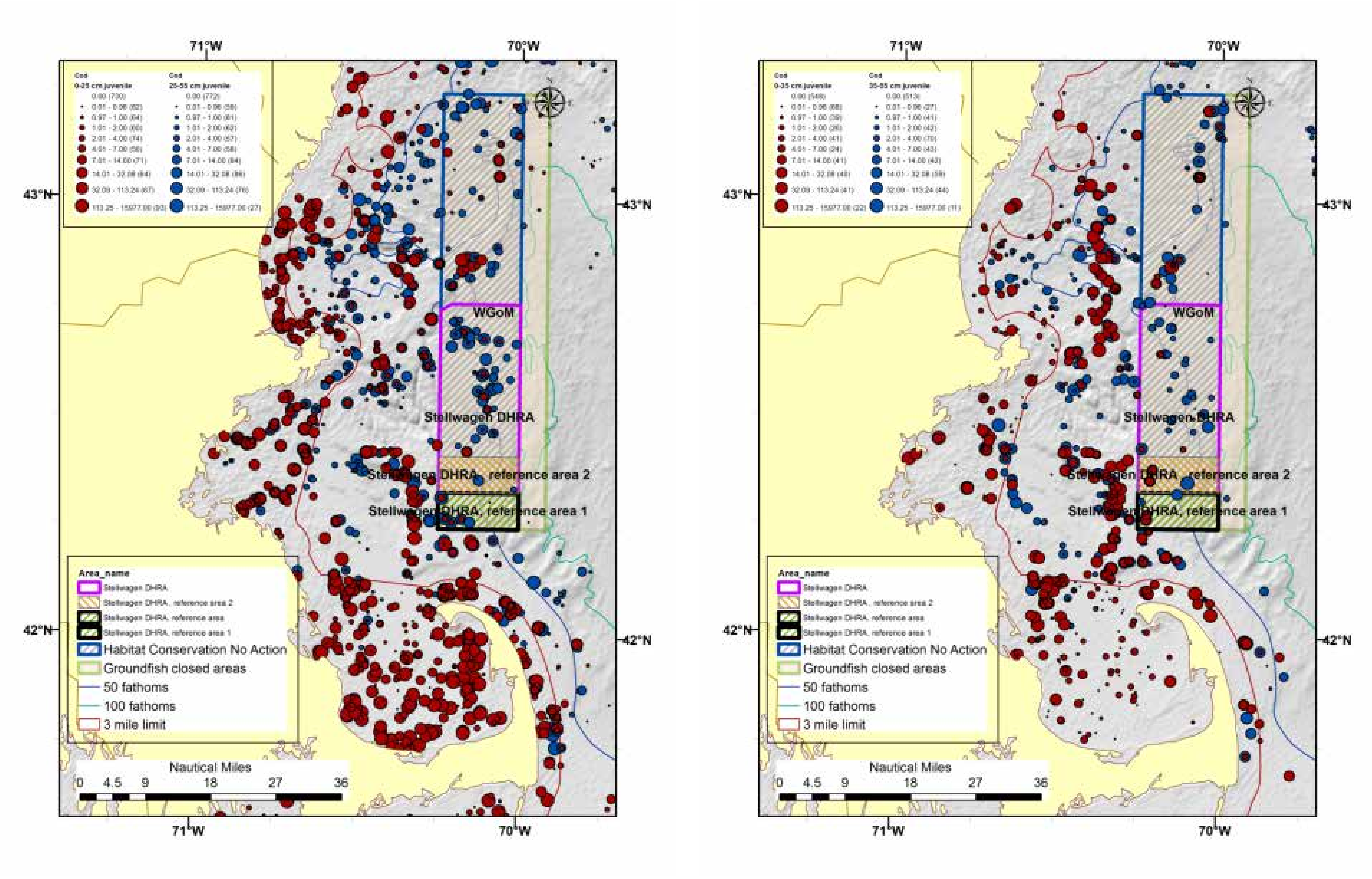


71°W
70°W
43°N
42°N
WGoM
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area 1
Summer age 0/1
Weighted_hotspots
7 (8)
13 - 17 (5)
18 - 22 (7)
23 - 34 (7)
35 - 55 (4)
56 - 123 (3)
Area_name
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area
Stellwagen DHRA, reference area 1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 4.5 9 18 27 36

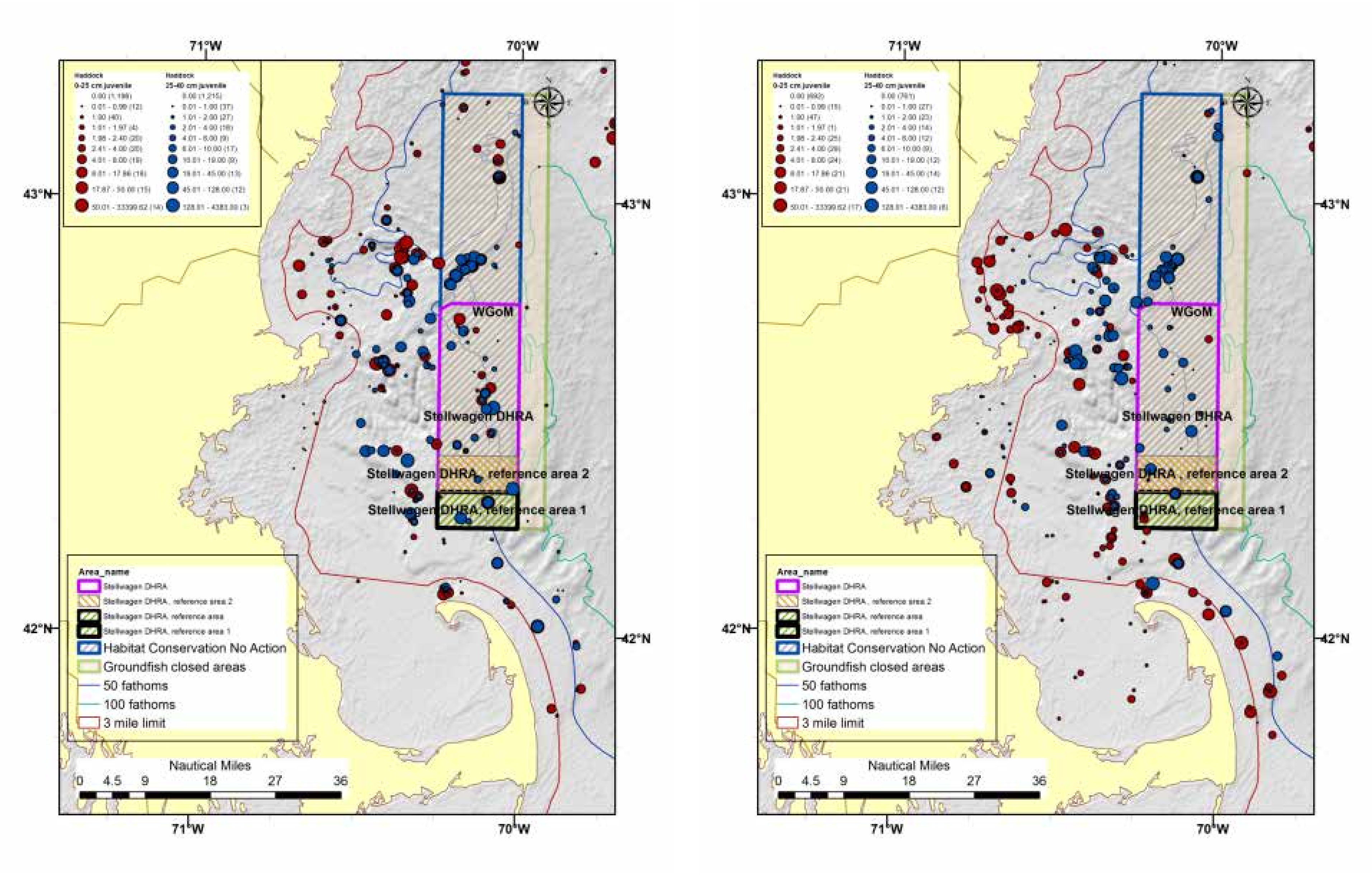


71°W
70°W
43°N
42°N
WGoM
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area 1
Winter age 0/1
Weighted_hotspots
1 - 7 (1)
8 - 13 (6)
21 - 37 (1)
38 - 50 (3)
51 - 63 (1)
64 - 88 (3)
89 - 113 (2)
Area_name
Stellwagen DHRA
Stellwagen DHRA , reference area 2
Stellwagen DHRA, reference area
Stellwagen DHRA, reference area 1
Habitat Conservation No Action
Groundfish closed areas
50 fathoms
100 fathoms
3 mile limit
Nautical Miles
0 4.5 9 18 27 36

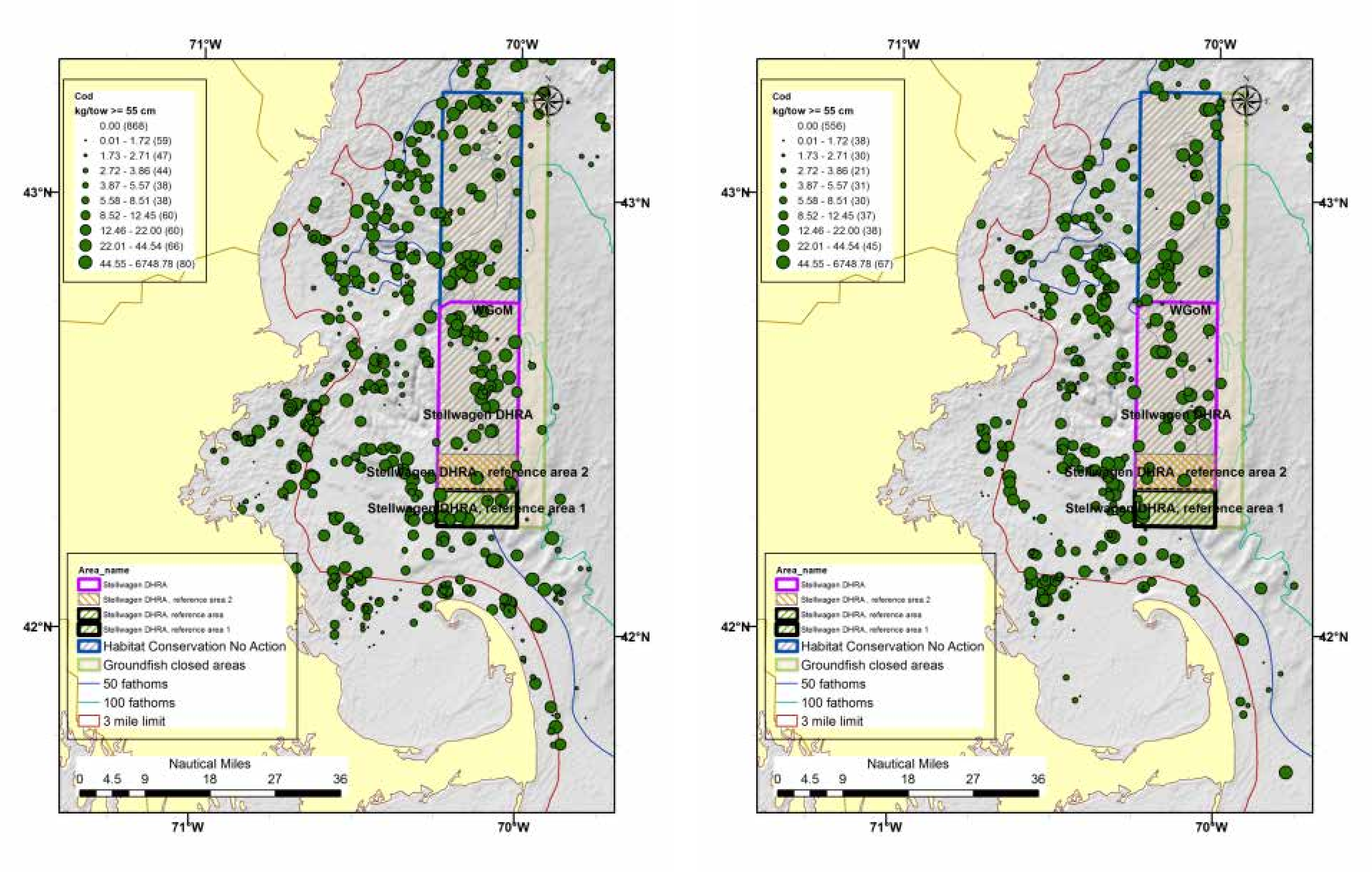
Map 84 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data (continued on next page).



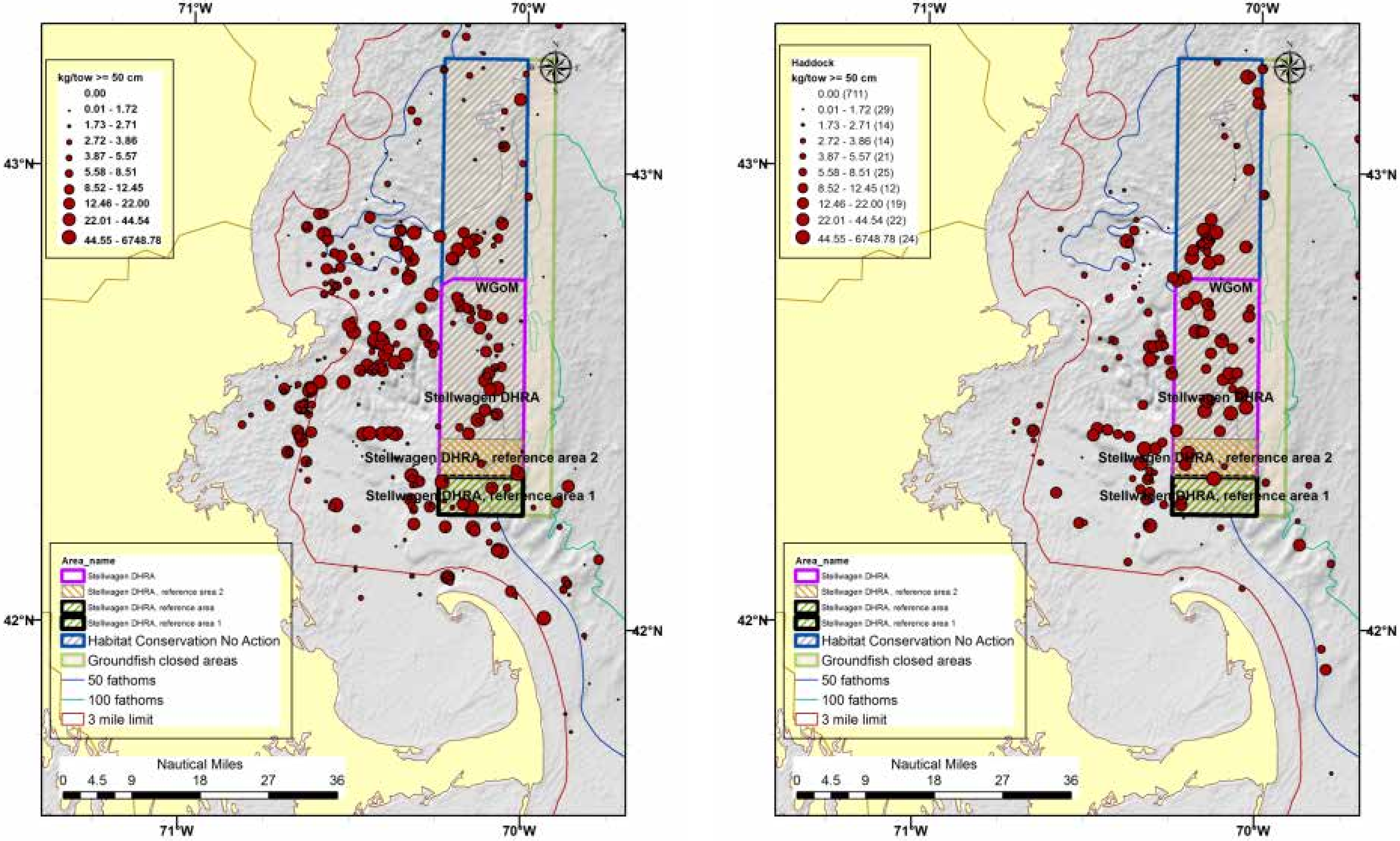
Map 85 – DHRA Alternatives 3 overlap with spring (left) and fall (right) sub-legal haddock number per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



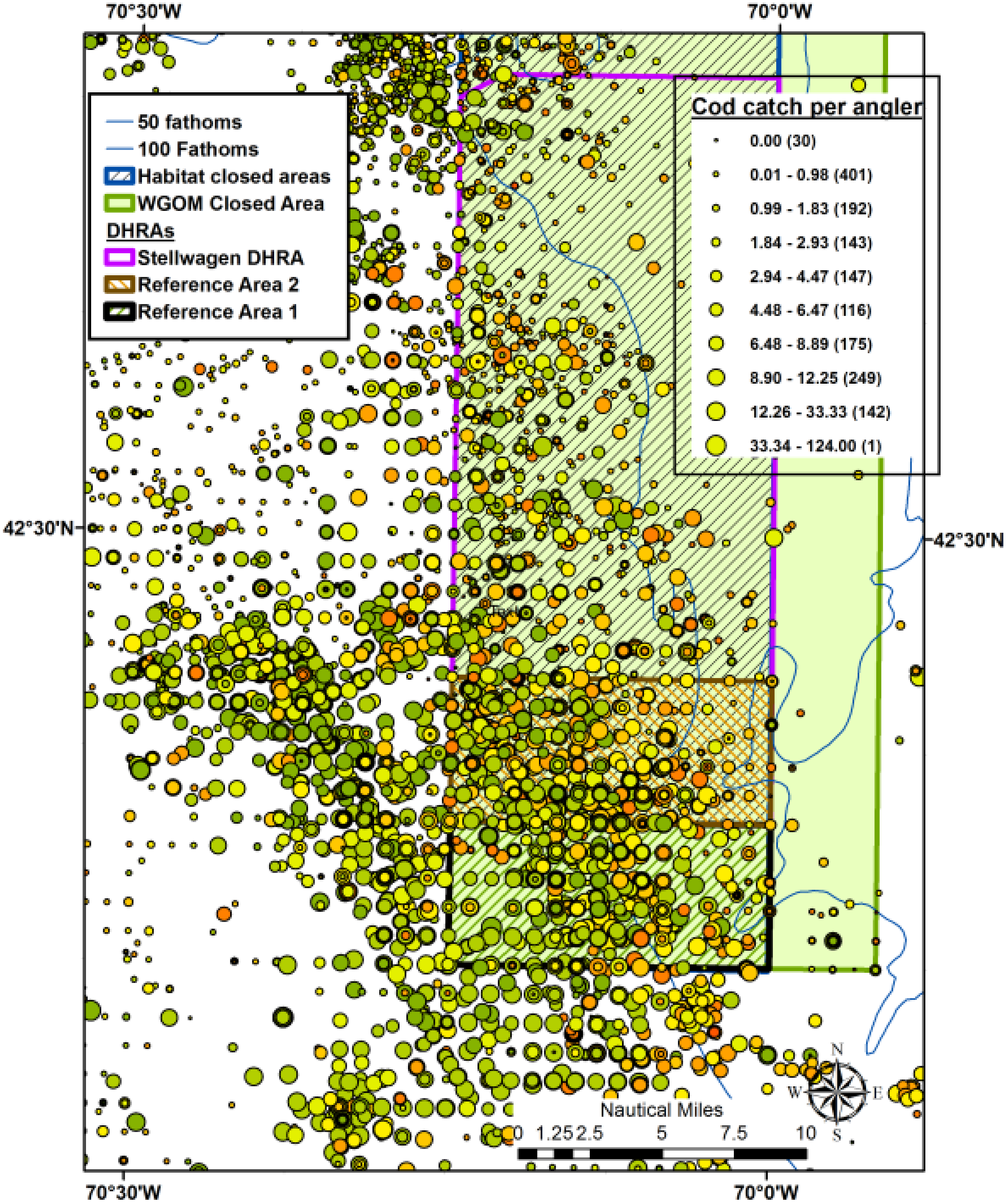
Map 86 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal cod weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



Map 87 – DHRA Alternatives 3 overlap with spring (left) and fall (right) legal haddock weight per tow from 2002-2012 NMFS, MADMF, ME-NH, and IBS survey data.



Map 88. VTR-reported cod catch per angler for commercial party and charter boats in the proposed Stellwagen Bank Dedicated Habitat Research Area and Reference Areas, 2008-2012. Catches are color coded by month, Jan (dark green) to August (yellow) to December (red). Each point represents a reported trip.



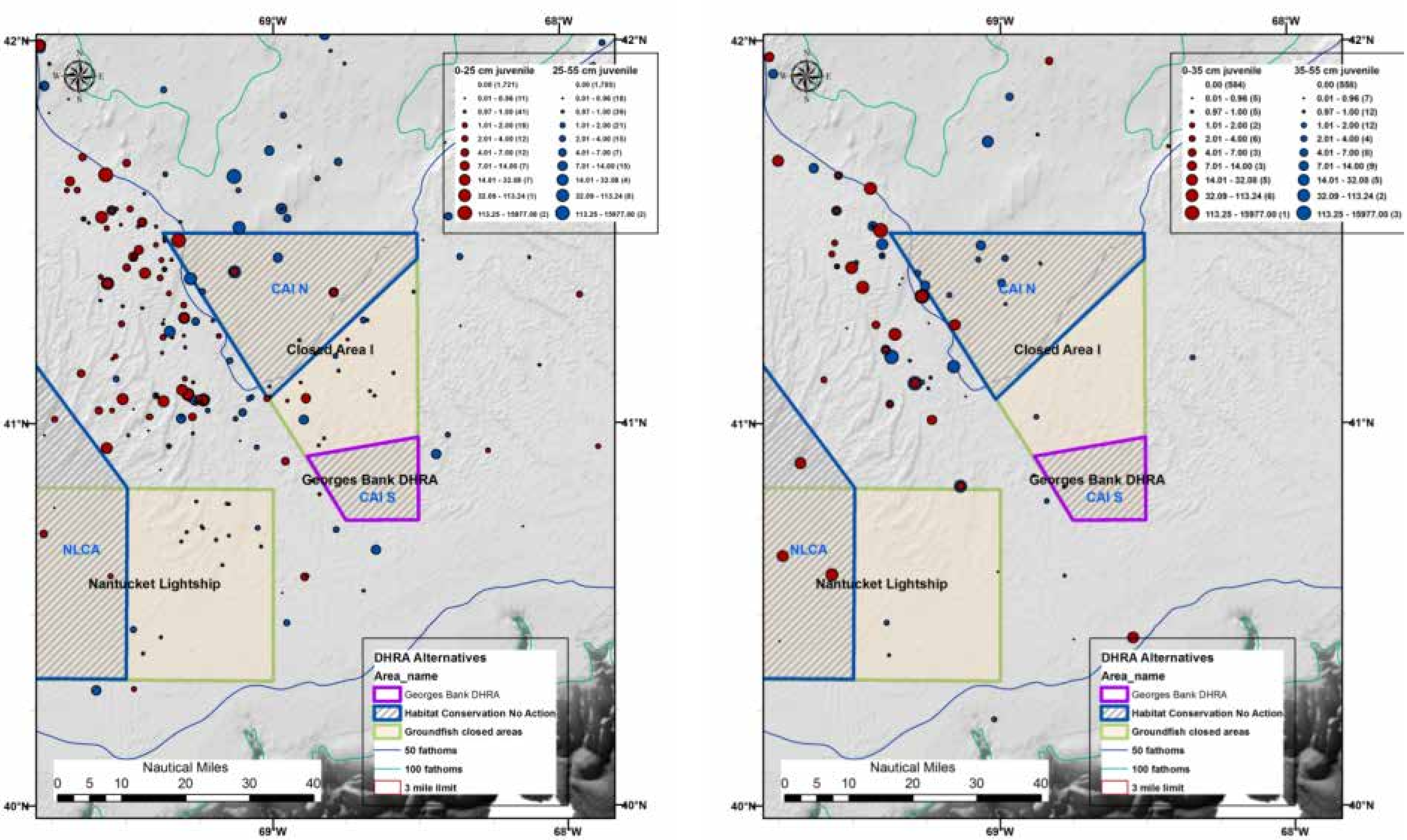
4.3.2.4 *Alternative 4*

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 2.1.4. 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.

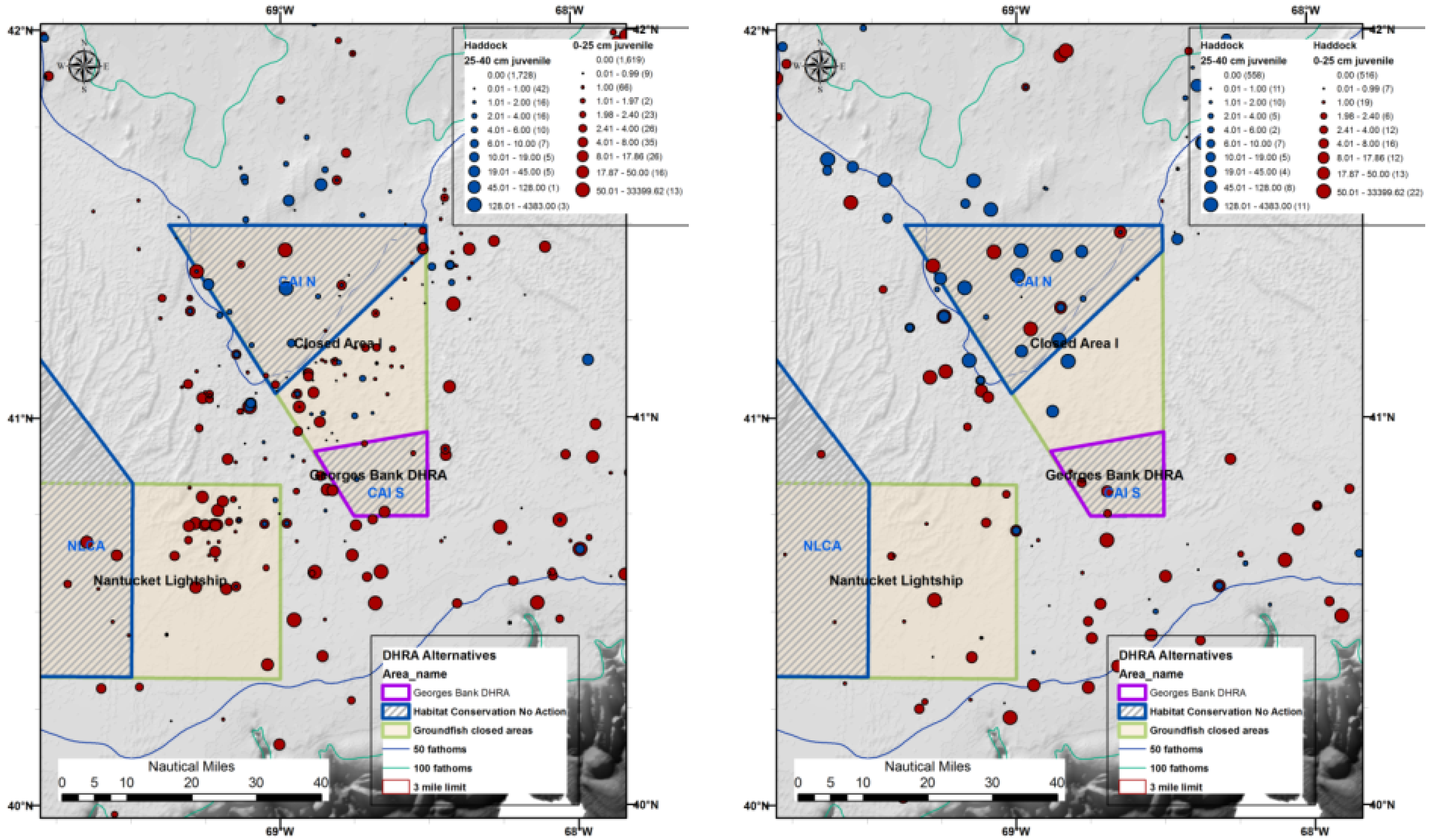
However, this area had no age 0/1 groundfish hotspots (Table 116) which suggests that any positive impact on groundfish habitat and productivity may be low. Looking more broadly at all levels of survey catch of cod and haddock for both age 0/1 and sublegal fish, this DHRA does not appear to be well suited 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 89) and haddock (Map 90) 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 with respect to potential benefits for the groundfish resource.

Map 89 – DHRA Alternatives 4 overlap with spring (left) and fall (right) sub-legal cod number per tow from 2002-2012 NMFS survey data.



Map 90 – 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

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 (0 and 4.2.3.1). 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.

4.3.3.1 *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 impact of no action Alternative 1 ultimately depends on the HMA alternatives chosen as final alternatives. Separate sections of the Amendment consider changes to the HMAs within the sub-regions being considered. The no action alternative is thus expected to have a neutral impact on fisheries management, as the DHRAs themselves are designed to provide a streamlined process by which scientists can develop the knowledge needed by managers to more effectively and efficiently manage habitat for impacts by fishing.

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 *Alternative 2*

Alternative 2 would designate a Dedicated Habitat Research Area in the eastern Gulf of Maine. Gear exclusions, and thus economic impacts, of DHRA Alternative 2 are equivalent to the impacts identified for the Small Eastern Maine HMA in the Eastern GOM Alternative 3, as detailed in section 0, Figure 17, Table 61, and Table 62. The exclusions would primarily impact shrimp/bottom trawl fishermen, although the revenue estimates, though not insignificant, suggest that the area encompassed by the Alternative 2 is not a major center of fishing even for these gears.

In comparison to no action, short term net benefits are expected to be slightly negative given the above, with long term positive benefits expected from improved resource management. The magnitude of the long run benefits ultimately depends on the quality and quantity of scientific research being generated from the DHRA. Given the large body of knowledge already accumulated on the area encompassed by Alternative 3 (and detailed in section 4.3.1.3), and the historical exclusion of MBTG from the existing WGOM and CAI closures, the magnitude of the positive benefits generated by Alternative 2 are expected to be smaller than Alternatives 3 and 4.

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.

4.3.3.3 *Alternative 3*

Alternative 3 would designate the Stellwagen DHRA with a reference area along the southern border (Option A), a reference area shifted five nm north (Option B), or no reference area (Option C).

Option A excludes recreational groundfish fishing from the southern DHRA reference area. Figure 40 summarizes the number of trips in this southern reference area, grouped by whether groundfish were caught on the trip or not. As can be seen from the graph, the majority of trips reported to have occurred within the southern reference area land at least one groundfish. The results suggest that almost all trips occurring within the reference area would be affected to some extent by this alternative.

Figure 41 presents the total revenue estimated to have been generated from trips within the southern reference area, delineated by a ranked grouping of 5 permit blocks. The graph indicates that the 5 permits with the highest revenue estimated to fall within the southern reference area account for 63% of the total revenue estimates in 2011 and 2012. The revenue in 2010 seems to have been only slightly more diffuse, with 51% of the revenue share generated by the top 5 permits.

Figure 42 indicates the average percentage of each ranked group's total revenue, including commercial revenue, that the recreational revenue within the southern reference area represents. Group 1 generates the highest annual revenue within the reference area, and the percent of total revenue that this fishing represents remains relatively constant 2010 – 2012, between 20-30% of total revenue each year. When 2012 is compared to 2010, there are fewer groups in 2012, and for the groups with the smallest revenue the percentage of total revenue coming from the reference area is lower.

Table 118 presents a longer-term summary of trips falling within the southern reference area. The statistics indicate that a slightly higher number of permit holders are currently using the reference area when compared to the longer-run averages, with an annual average consistently less than 40 permits. However, most of the other statistics are lower in the last three years when compared to longer run averages. In general, there does not seem to be a recent substantial increase in dependence on the reference area from historical patterns.

Taken together, the data suggest that the southern reference area is used intensively, and consistently, by a relatively small number of charter and party permit holders. The recreational revenue generated from the trips in southern reference area catching groundfish is a substantial portion of these individual's total fishing income, and thus the exclusion of these individuals from the reference area is likely to have a large negative impact for these individuals, when compared to no action, or to a designation of the research area without the reference area (Option C).

Table 121 identifies the communities associated with recreational trips in 2012. These are all associated with Massachusetts, however it should be noted that both Gloucester and Newburyport have a high level of engagement in recreational fishing and are likely to be more affected by these impacts.

Other fisheries are not impacted by the DHRA Alternative 3 Option A, when compared to no action. However, given that Alternatives 2 – 7 in the Western Gulf of Maine could change area management in the WGOM, the designation of the DHRA could have a broad range of economic impacts depending on the final alternative chosen. A sense of these impacts, and their magnitude, can be gleaned from the discussion of the WGOM HMA Alternative 6 economic impacts in section 0, with the caveat that commercial non-MBTG capable of catching groundfish would in addition be excluded from fishing in the Large Stellwagen area.

In the long-run, benefits are expected to accrue to all groundfish fisheries through more informed, and ostensibly better, management decisions. Option A is thus expected to generate a net positive benefit when compared to no action, with concentrated costs accruing to a small number of recreational fishermen in the short term, and diffuse positive benefits in the form of improved groundfish management in the long term. The net benefits are expected to be larger than option B, given the higher revenue estimates presented in Table 119 and Figure 44 and Figure 45. However, substantial uncertainty exists regarding both the benefits and costs of these options, as they ultimately depend on the quality and quantity of scientific research being generated from the DHRA and the ability of fishermen to change their fishing practices/location.

The social impacts of Alternative 3 option A in comparison to the no action alternative are expected to be positive. However there may be negative impacts 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 (Table 121).

Figure 40 – The total number of recreational trips (party and charter) reported within the southern reference area, grouped by whether at least one groundfish was caught on the trip

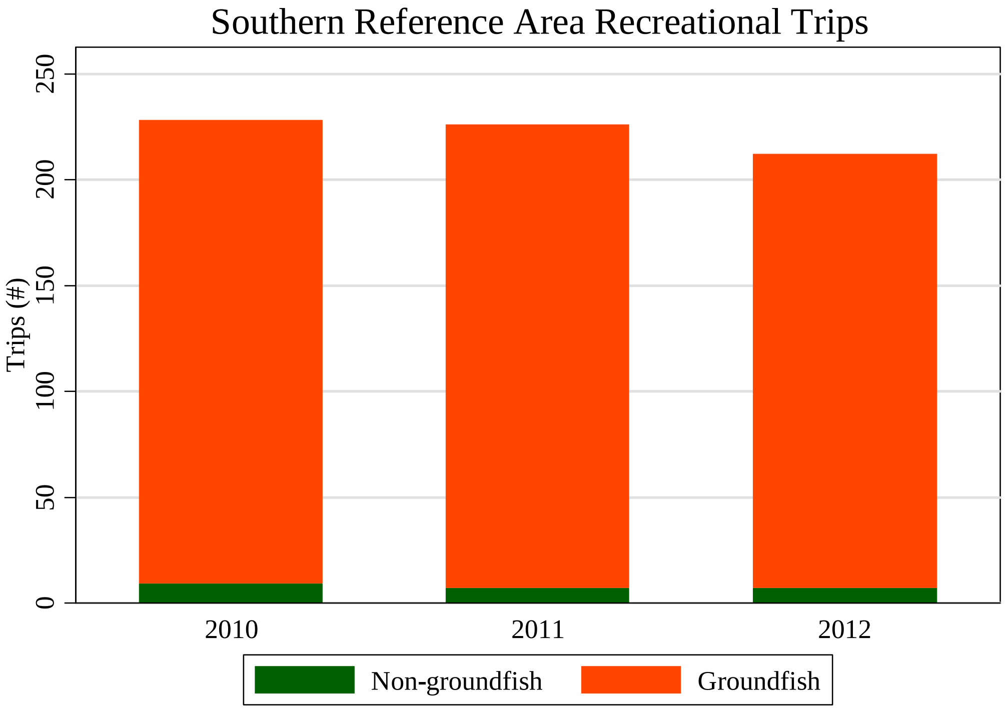


Figure 41 – Recreational revenue estimated to have been generated by trips reported within the southern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years.

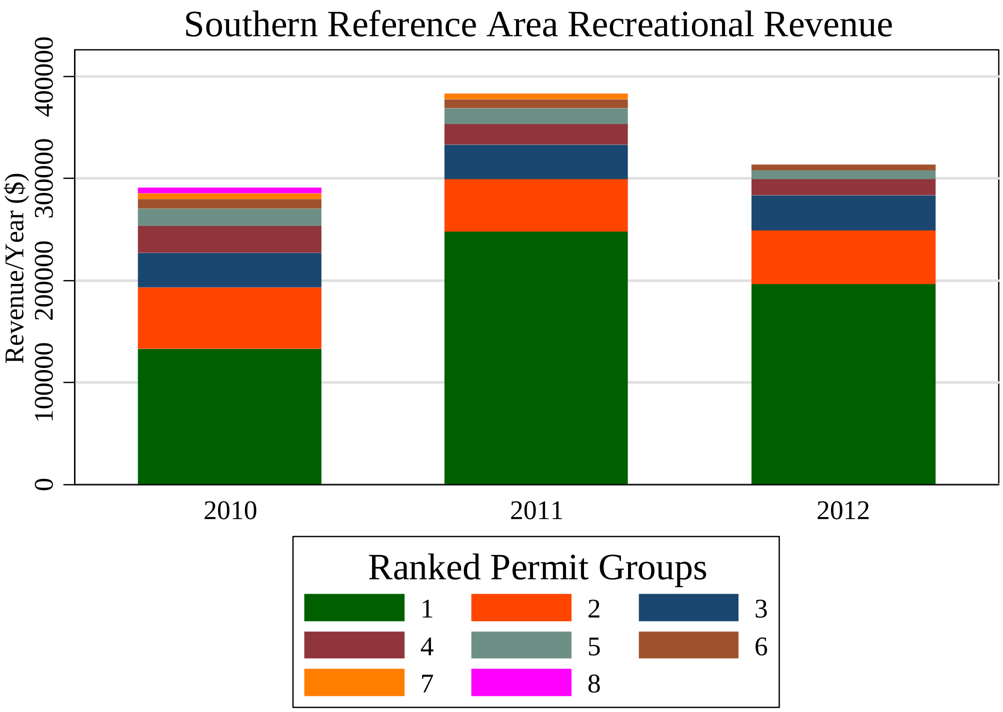


Figure 42 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the southern reference area

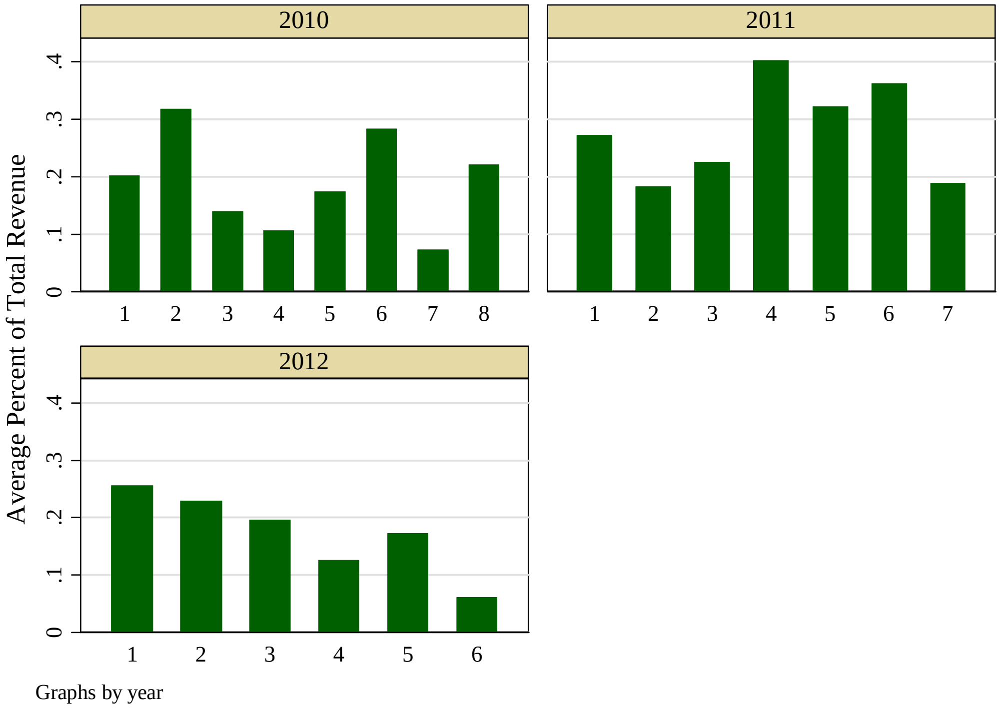


Table 118 – Recreational fishing revenue currently associated with the Southern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level. Dashes indicate information censored due to privacy concerns.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Southern Reference	2006 - 2012	387,262.61	34.14	2,094.43	1,742.18	1,117.74	2,215.63
Southern Reference	2008 - 2012	349,076.66	35.00	1,887.40	1,578.10	1,117.74	1,895.38
Southern Reference	2010 - 2012	328,839.68	36.67	1,768.00	1,481.26	1,117.74	1,737.60

Option B excludes recreational groundfish fishing from the northern DHRA reference area. Figure 43 graphs the total number of charter and party boat trips in the northern reference area, grouped by whether or not at least a single groundfish was caught on the trip. The vast majority of trips reported to fall within the northern reference area catch groundfish.

Figure 44 presents the total revenue estimated to have been generated from trips within the northern reference area, delineated by a ranked grouping of 5 permit blocks. The graph indicates that the 5 permits with the highest revenue estimated to fall within the northern reference area account for 63%, 62%, and 51% of the total revenue estimates in 2012, 2011, and 2010 respectively. This is a very similar pattern to the estimates for the southern reference area, although the total revenues in 2012 are roughly $125,000 higher in the northern area.

Figure 45 graphs the average percentage of each ranked group's total revenue, including commercial revenue, that the recreational revenue within the northern reference area represents. The importance of the northern reference area seems to be increasing for individuals fishing in this area, as defined by the percentage of total revenue generated. This seeming trend is in contrast to the southern reference area in which the percentages were relatively constant across 2010 – 2012.

Table 119 details the longer-term trends in trips within the northern reference area. Although the number of permit holders is lower than the number fishing within the southern reference area, the other statistics are consistently higher for the northern, when compared to the southern, reference area.

When compared to No Action or Option C, Option B is expected to generate a large negative impact for the charter and party boats fishing within these waters. Although the VTR data are unlikely to classify trips inside versus outside these small reference areas with any precision, they should accurately represent general trends of intensity. Thus, although some of the trips reporting latitude/longitude within the northern reference area likely expended effort in the southern reference area and vice versa, the relative magnitude should indicate which of the areas are more heavily fished. In all indicators, save the number of permit holders, the northern reference area looks to be more intensively fished when compared to the southern reference area. The magnitude of the negative impact of Option B on recreational fishermen is thus expected to be larger than Option A.

Other fisheries are not impacted by the DHRA Alternative 3 Option B, when compared to no action. However, given that Alternatives 2 – 7 in the Western Gulf of Maine could change area management in the WGOM, the designation of the DHRA could have a broad range of economic impacts depending on the final alternative chosen. A sense of these impacts, and their magnitude, can be gleaned from the discussion of the WGOM HMA Alternative 6 economic impacts in section 0, with the caveat that commercial non-MBTG capable of catching groundfish would in addition be excluded from fishing in the Large Stellwagen area.

In the long-run, benefits are expected to accrue to all groundfish fisheries through more informed, and ostensibly better, management decisions. Option B is thus expected to generate a net positive benefit when compared to no action, with additional concentrated costs accruing to a small number of recreational fishermen in the short term, and diffuse positive benefits in the form of improved groundfish management in the long term. The net benefits are expected to be smaller than option A and C, given the higher revenue estimates within the northern reference area and the expected difficulty of identifying the impact of fish removal on such a small scale (see section 4.3.1.3 for expected habitat impacts and 4.3.2.3 for expected impacts on groundfish).

The social impacts of Alternative 3 option B in comparison to the no action alternative are expected to be positive. However there may be negative impacts 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 (Table 121).

However, substantial uncertainty exists regarding both the benefits and costs of these options, as they ultimately depend on the quality and quantity of scientific research being generated from the DHRA and the ability of fishermen to change their fishing practices/location.

Option C would not restrict recreational groundfishing and is thus expected to have similar impacts to No Action in terms of the party and charter recreational groundfishing industry. For reference, Table 120 summarizes recreational revenue for the entire Stellwagen DHRA area, including both reference areas and the portion of the DHRA outside the reference areas. Given the expected difficulties in identifying the effect of removals on such a small area (see section 4.3.1.3 for expected habitat impacts and 4.3.2.3 for expected impacts on groundfish), the magnitude of benefits derived from Option C is expected to be larger than Options A and B.

Figure 43 – The total number of recreational trips (party and charter) reported within the northern reference area, grouped by whether at least one groundfish was caught on the trip

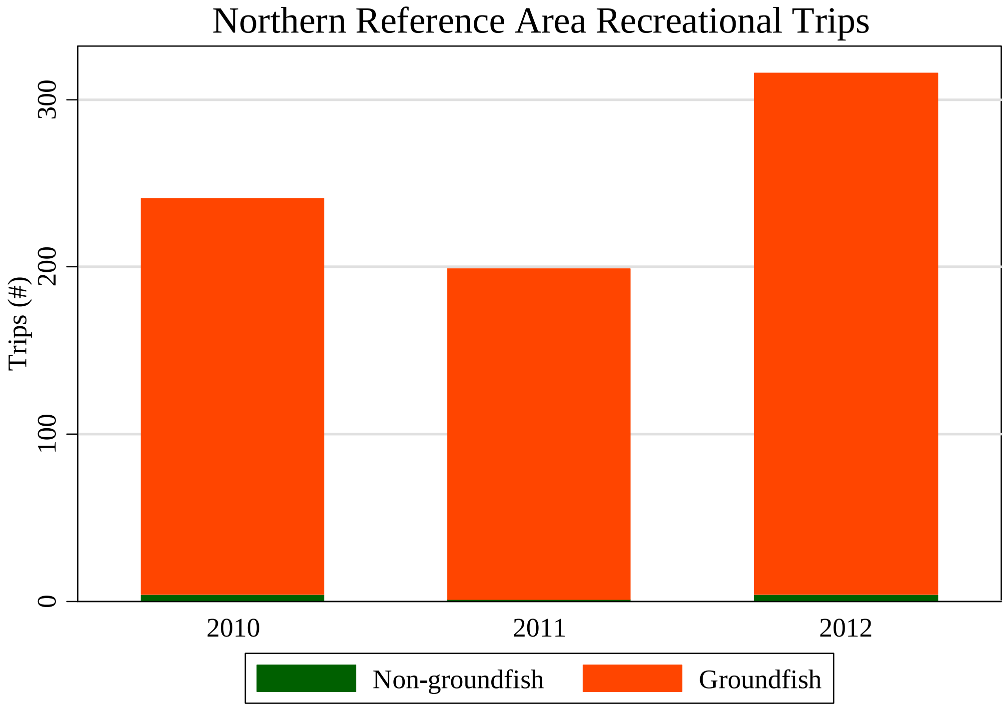


Figure 44 – Recreational revenue estimated to have been generated by trips reported within the northern reference area, with groups representing blocks of 5 permits, ranked by the revenue estimated to fall within the reference area. Note: Groups do not necessarily consist of the same individuals across years

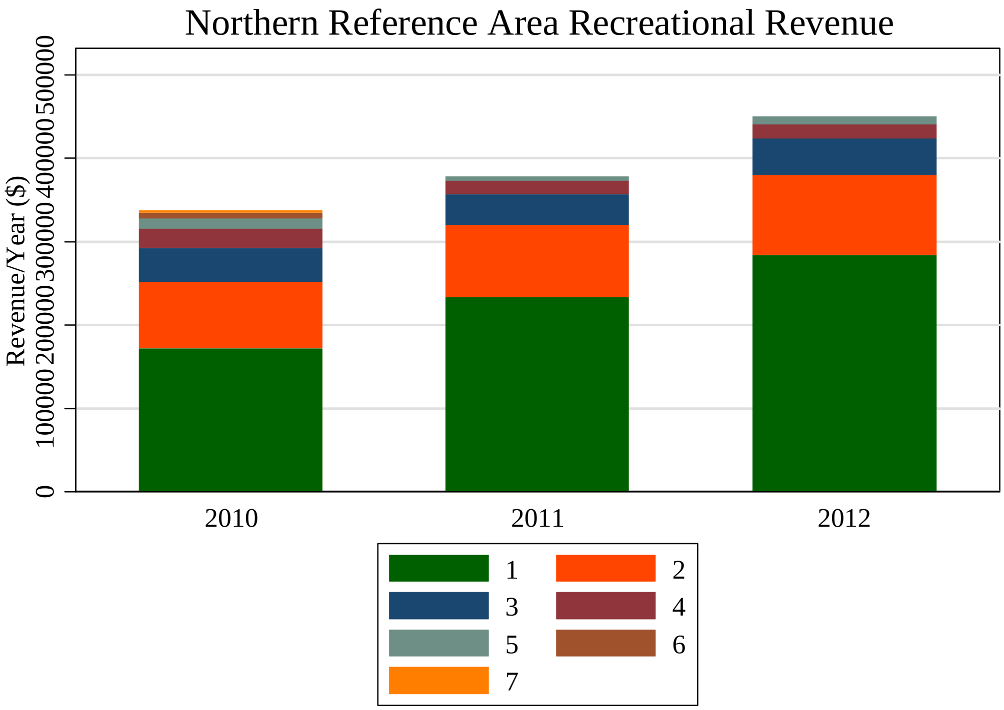


Figure 45 – Percent, averaged across permits, of each ranked group's total revenue (including commercial revenue) estimated to have been generated by recreational trips within the northern reference area

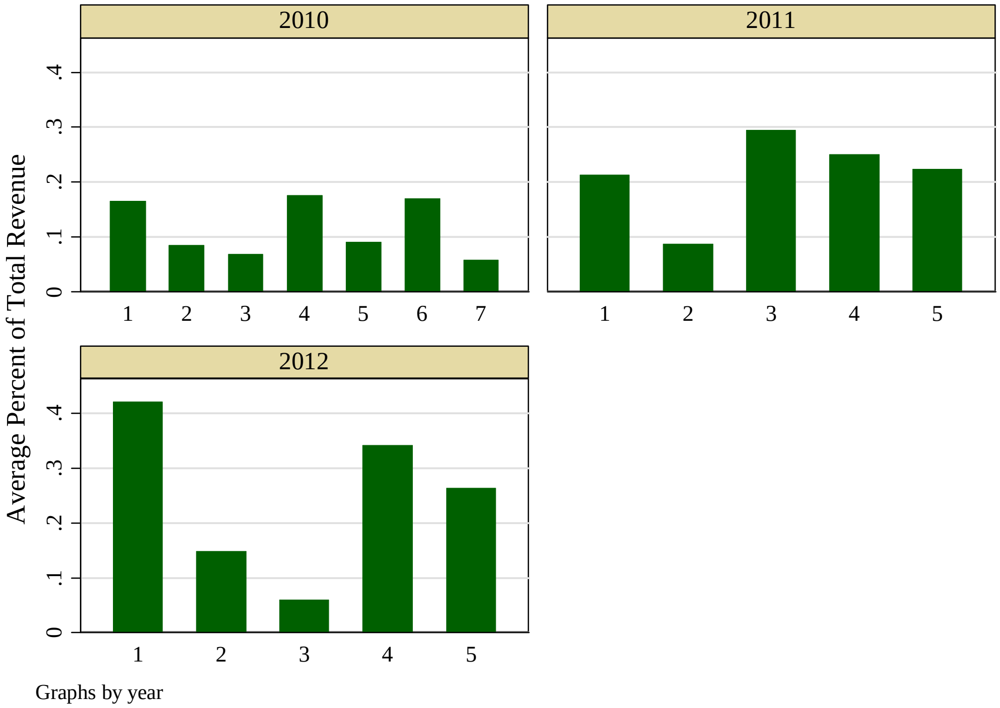


Table 119 – Recreational fishing revenue currently associated with the Northern Reference area. Revenue generated from MRIP data, using average annual revenue per angler by state. Annual Revenue is the mean annual revenue, Individuals represents the average number of permit holders fishing in the area, and Anglers represents the Average number of anglers per year. All other statistics are estimates at the trip level.

Area	Years	Annual Revenue	Individuals	Anglers	Mean Revenue	Median Revenue	SD Revenue
Northern Reference	2006 - 2012	556,480.9	30.71	3,003.00	2,077.53	1,117.74	2,665.28
Northern Reference	2008 - 2012	382,553.7	28.80	2,060.00	1,606.02	1,117.74	1,948.86
Northern Reference	2010 - 2012	388,290.5	29.00	2,084.33	1,540.84	1,117.74	1,874.70

Table 120 – Recreational fishing revenue currently associated with the entire Stellwagen DHRA. 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.

Area	Years	Annual Revenue	Indiv.	Anglers	Mean Revenue	Median Revenue	SD Revenue

StellwagenDHRA	2006 - 2012	2,101,074	72.86	12,070.71	2,466.05	1,117.74	2702.337
StellwagenDHRA	2008 - 2012	1,785,023	70.6	10,352	2,252.11	1,117.74	2429.294
StellwagenDHRA	2010 - 2012	1,767,647	71.67	10,052.33	2,213.25	1,117.74	2443.019

Table 121- Total number of permits by port of landing or city of registration associated with at least three permits conducting recreational fishing trips associated with the Northern and Southern Reference Areas.

Stellwagen		**Option A (Southern)**		**Option B (Northern)**	
State	**Community**	**Port**	**City**	**Port**	**City**
MA		**30**	**29**	**27**	**26**
	Gloucester	7	3	6	3
	Marshfield	16	6	13	6
	Newburyport				
	Plymouth		3		3
	Scituate			3	

4.3.3.4 *Alternative 4*

Alternative 4 would designate a Dedicated Habitat Research Area on Georges Bank. Alternative 4 has a neutral impact on commercial fisheries when compared to the no action, as it is fully encompassed by the southern portion of the CAI EFH and Groundfish closure, an area currently closed to both gear capable of catching groundfish and MBTG and outside of the hook and line SAP exemption area. However, the full economic impact of this alternative ultimately depends on the final alternatives selected. Maps 53-56, 59, 62, 63, 71, 72, and 83 in volume I of this action indicate that the majority of observed effort surrounding CAI does not abut the boundaries of the GB DHRA. This suggests that the negative impact of Alternative 4 on fisheries employing mobile bottom-tending gear is expected to be relatively small, regardless of the final alternative chosen. The one exception is scallop dredge effort, which is detailed in map 74. However, the scallop PDT's qualitative assessment in section 4.5.4.3 indicates that the DHRA does not host a substantial concentration of scallop biomass (~0.1% of scallop LT yield), and thus this impact is again expected to be relatively small. No recreational fishing has been reported in the area encompassed by the GB DHRA between 2006 and 2012.

Long run net benefits are expected to be positive, when compared to the no action Alternative 1, given the expected improvement in management stemming from improved scientific knowledge of biological species under federal management. The positive benefits are expected to be larger than Alternative 2, given the historical exclusion of mobile bottom-tending gear from CAI, but smaller than Alternative 3 given the substantial knowledge of the WGOM closure already amassed (see section 4.3.1.3). However, substantial uncertainty exists regarding both the benefits and costs of these options, and the trade-off ultimately depends on the quality and quantity of scientific research being generated from the DHRA.

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.

4.3.3.5 *Alternative 5*

Alternative 5 is an administrative action allowing removal of the DHRA designation on an area if no research has been initiated within three years of implementation. There is a neutral impact when compared to no action Alternative 1, as Alternative 5 is superfluous unless at least one of Alternatives 2 – 4 is also selected. However, this sunset provision helps decrease the uncertainty regarding the benefit/cost trade-off of Alternatives 2 – 4, as the cost of these other alternatives will cease if and when the positive benefits expected from increased scientific knowledge fail to materialize. Thus, Alternative 5 is expected to have positive net benefits when coupled with at least one of the Alternatives 2 – 4.

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

4.4.1 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 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.

4.5 Impacts of all spatial management alternatives on non-large mesh groundfish stocks 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[10]. 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 91 to Map 93), 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[11] (Figure 46 and Figure 47, 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.

4.5.1.1.1 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 91 and Map 93). Age 0/1 silver hake appear to be concentrated in deeper water according to the summer shrimp trawl and scallop dredge survey data (Map 92), which have a limited

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[10] 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.

[11] During 2002-2012 spring trawl surveys, all age 0 and 90% of age 1 fish were less than 20 cm.

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 93), with significant overlap with the Bigelow Bight, Toothaker Ridge, and Eastern ME Habitat Management Areas. During the spring and summer surveys (Map 91 and Map 92) 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.

4.5.1.1.2 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.

4.5.1.1.3 Georges Bank and Great South Channel Habitat Management and Dedicated Habitat Research Area alternatives

Georges Bank and Great South Channel Habitat Management and Dedicated Habitat Research Area alternatives do not overlap with age 0/1 red and silver hake hotspot distribution to any appreciable degree (Map 91 to Map 93). Thus biological impacts of these alternatives on red and silver hake appear to be neutral.

Figure 46 – 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.

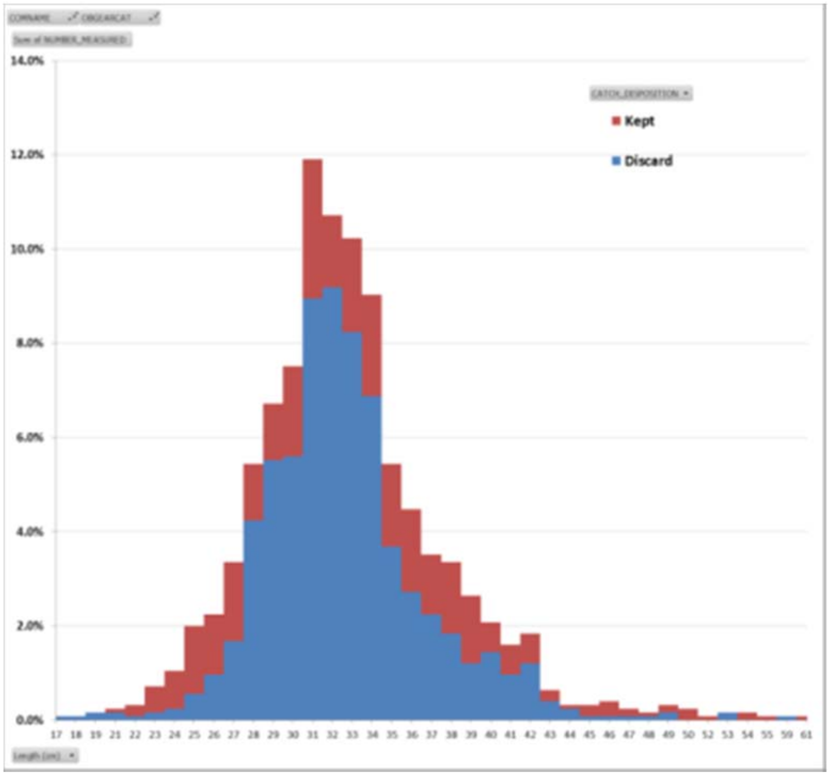
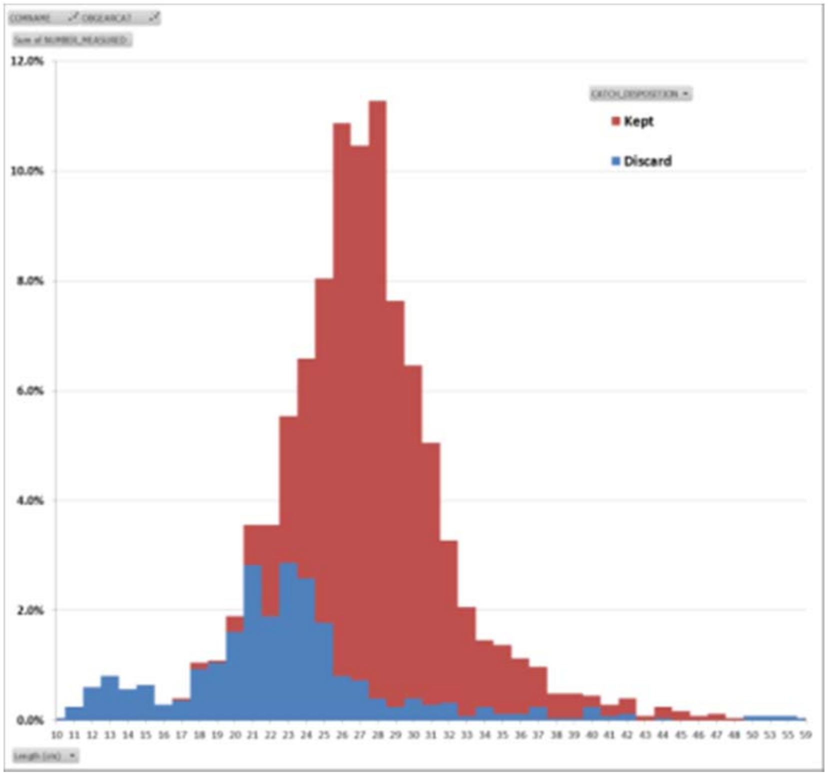
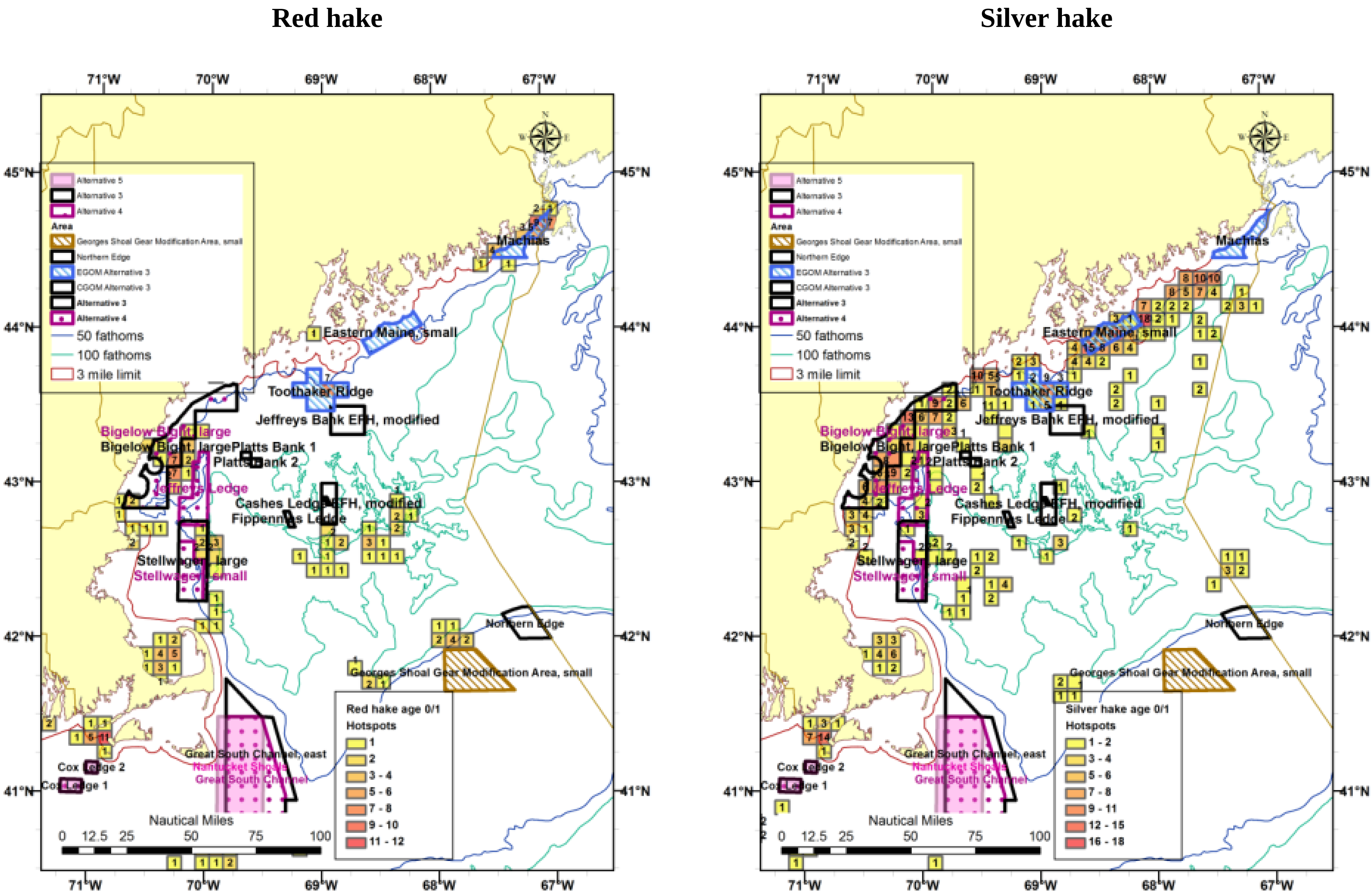


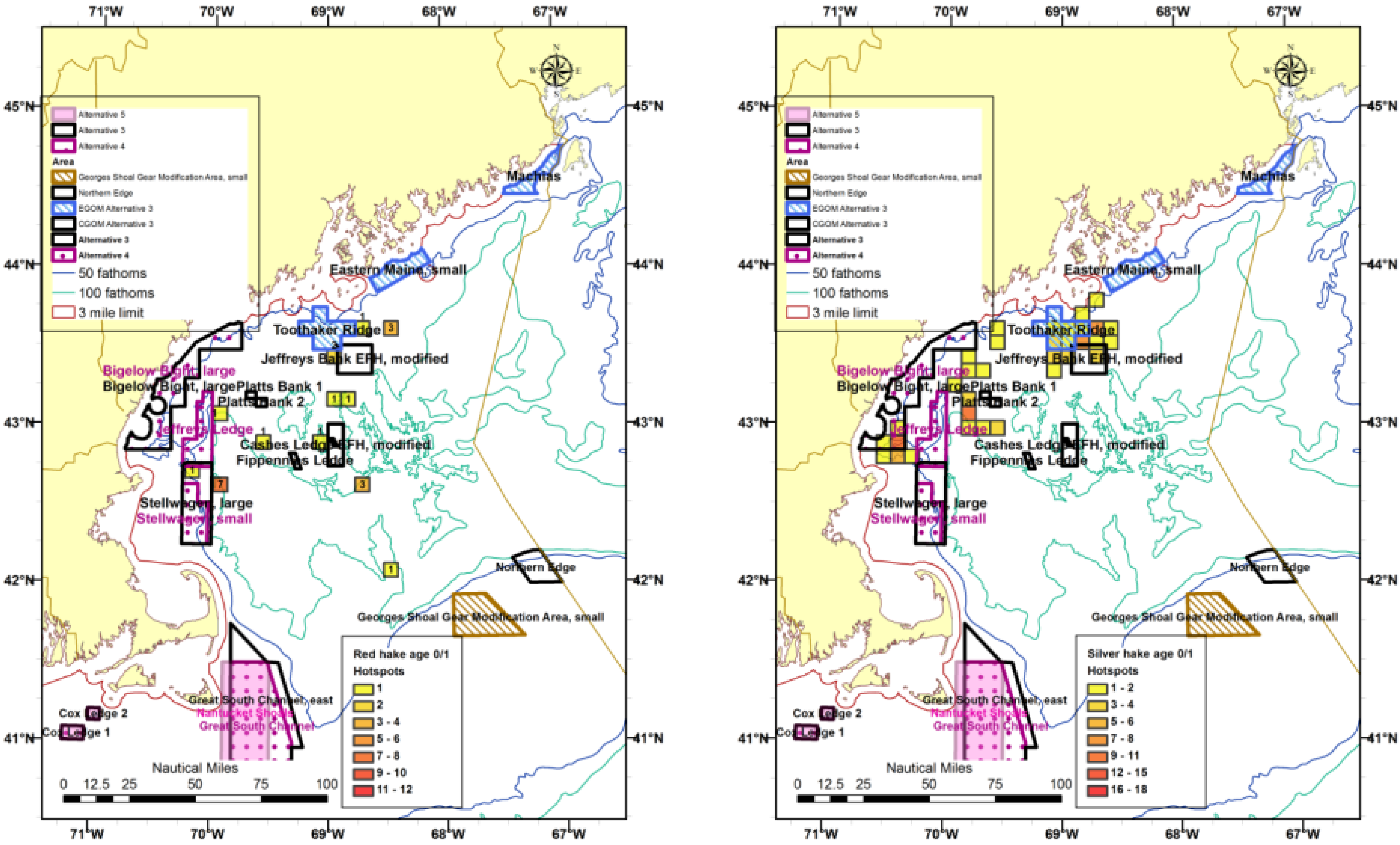
Figure 47 – Length frequency distribution of kept and discarded silver hake on 2010-2013 observed trips in statistical areas 511-515 (Gulf of Maine) by vessels using trawls.



Map 91 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 spring trawl surveys.

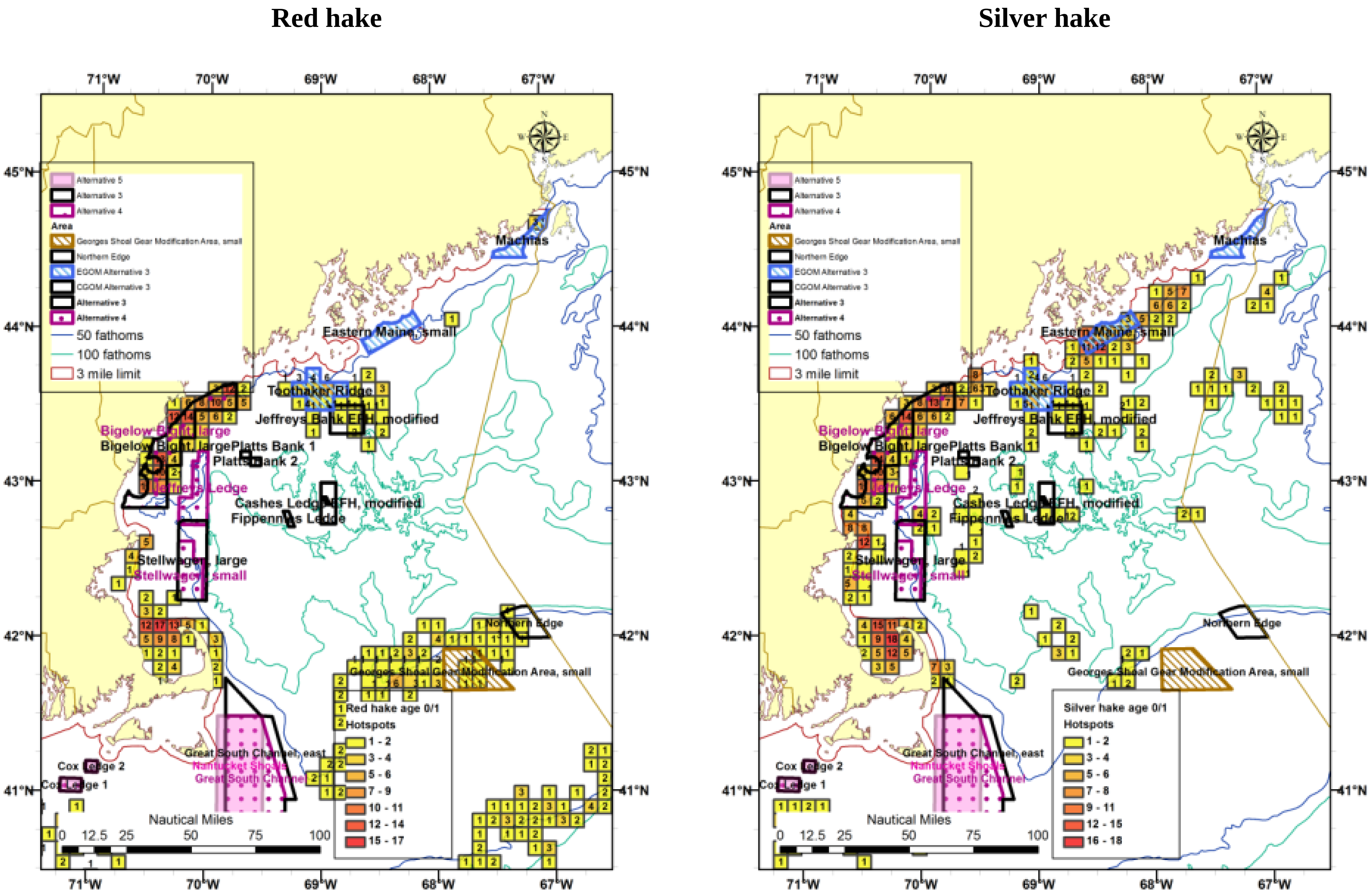


Map 92 – Distribution of age 0/1 red hake (left) and silver hake (right) hotspots from 2002-2011 summer shrimp trawl and scallop dredge surveys.



Red hake **Silver hake**

Map 93 – 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 94 to Map 97) 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 modifications 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 the 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. As a result, thus this alternative could have a small positive impact on the fishery.

4.5.1.2.1 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 94 and Map 95). 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 96). WGOM Alternative 6 has no overlap with the existing small-mesh multispecies exemption areas (Map 97).

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.

4.5.1.2.2 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 94). 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.

4.5.1.2.3 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 94). Alternative 4 has a proposed gear modification area that may affect vessels fishing in the Cultivator Shoals Area small-mesh fishery (Map 95). 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 northeast 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 GB alternatives are unlikely to have an impact on the fishery.

4.5.1.2.4 Great South Channel Habitat Management Area Alternatives

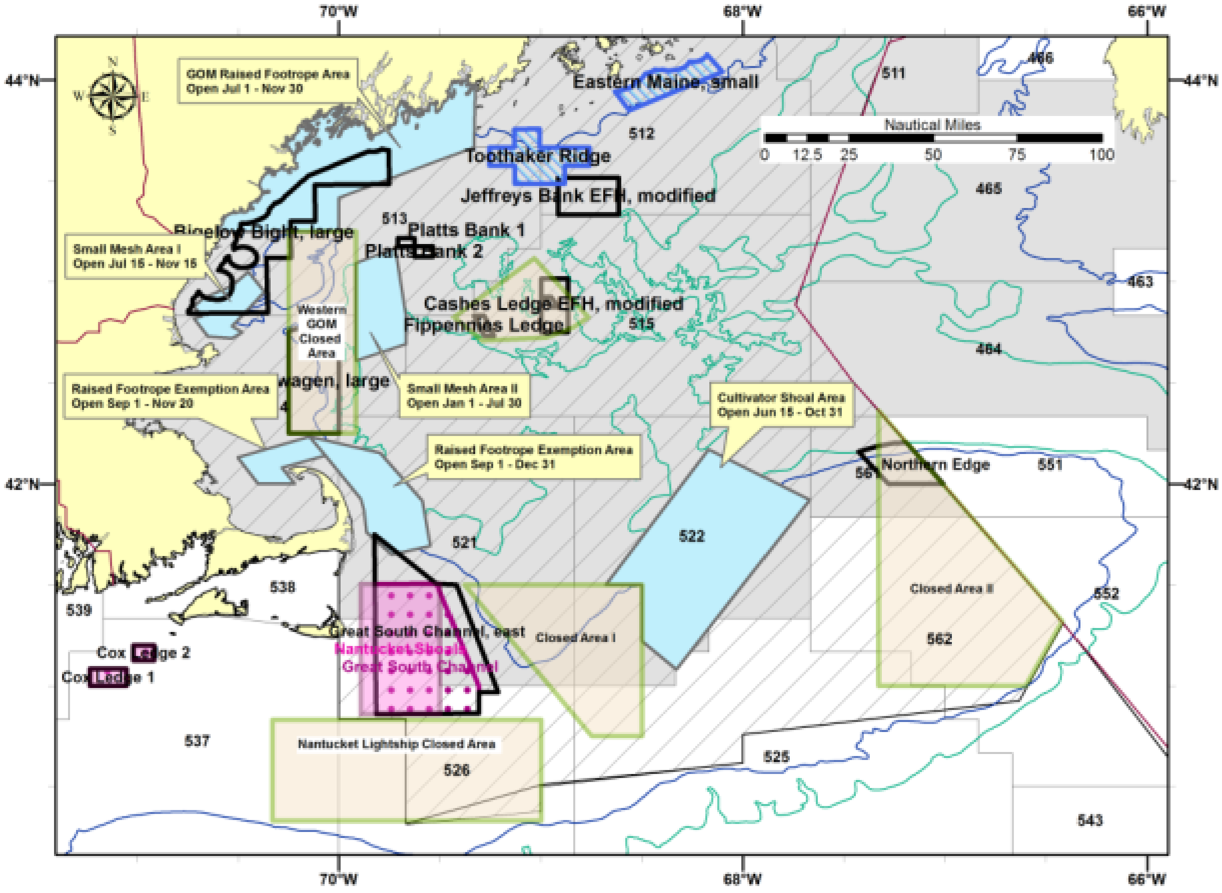
None of the Great South Channel alternatives overlap with the small-mesh multispecies raised footrope exemption areas. Thus other than the potential effort shift discussed above, all of the

Great South Channel Habitat Management Area and Dedicated Habitat Research Area alternatives are likely to have negligible impacts on the small-mesh multispecies fishery.

4.5.1.2.5 Spawning Management Area Alternatives

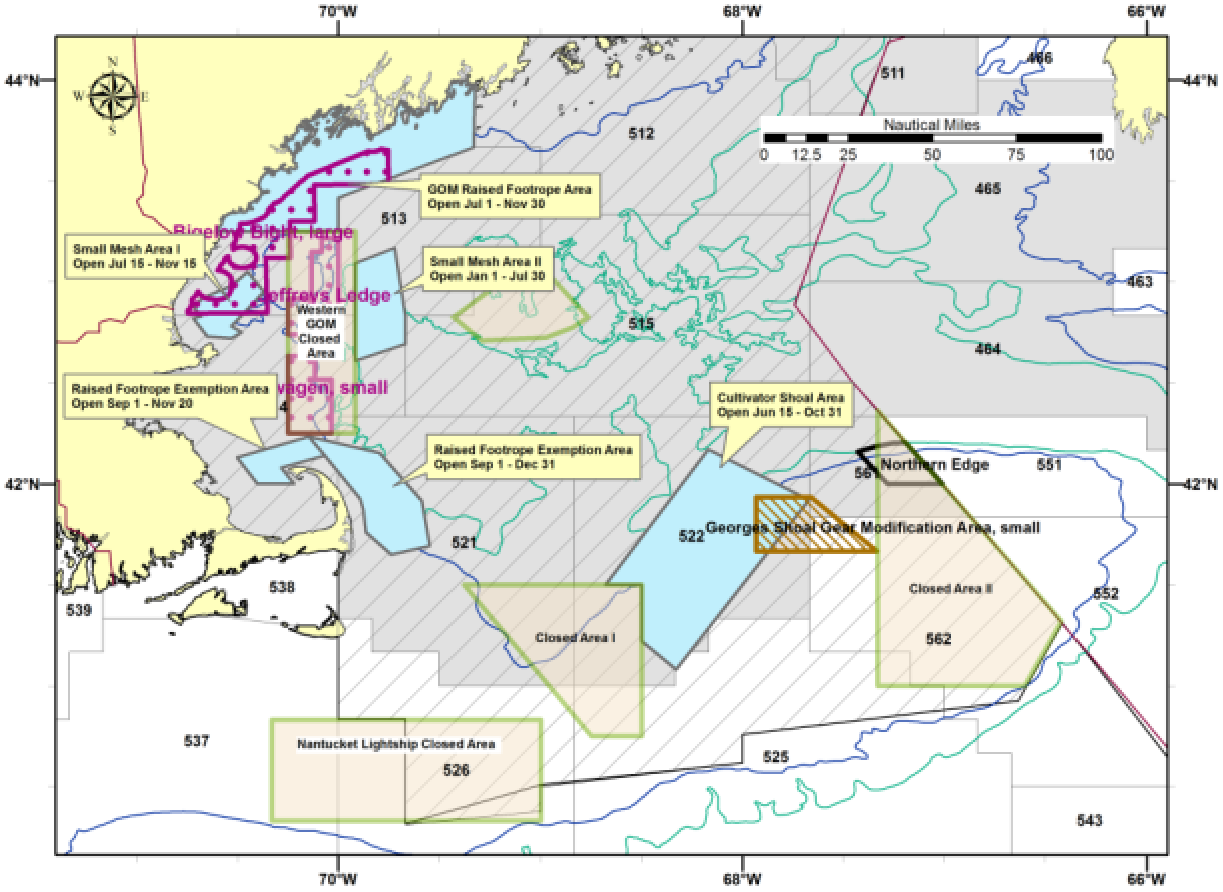
The proposed seasons when specific areas would be closed to gears capable to catching groundfish do not conflict with the open fishing seasons for the small-mesh exemption areas. Thus the Spawning Management Area alternatives are unlikely to have any impact on the small-mesh multispecies fishery.

Map 94 – 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.

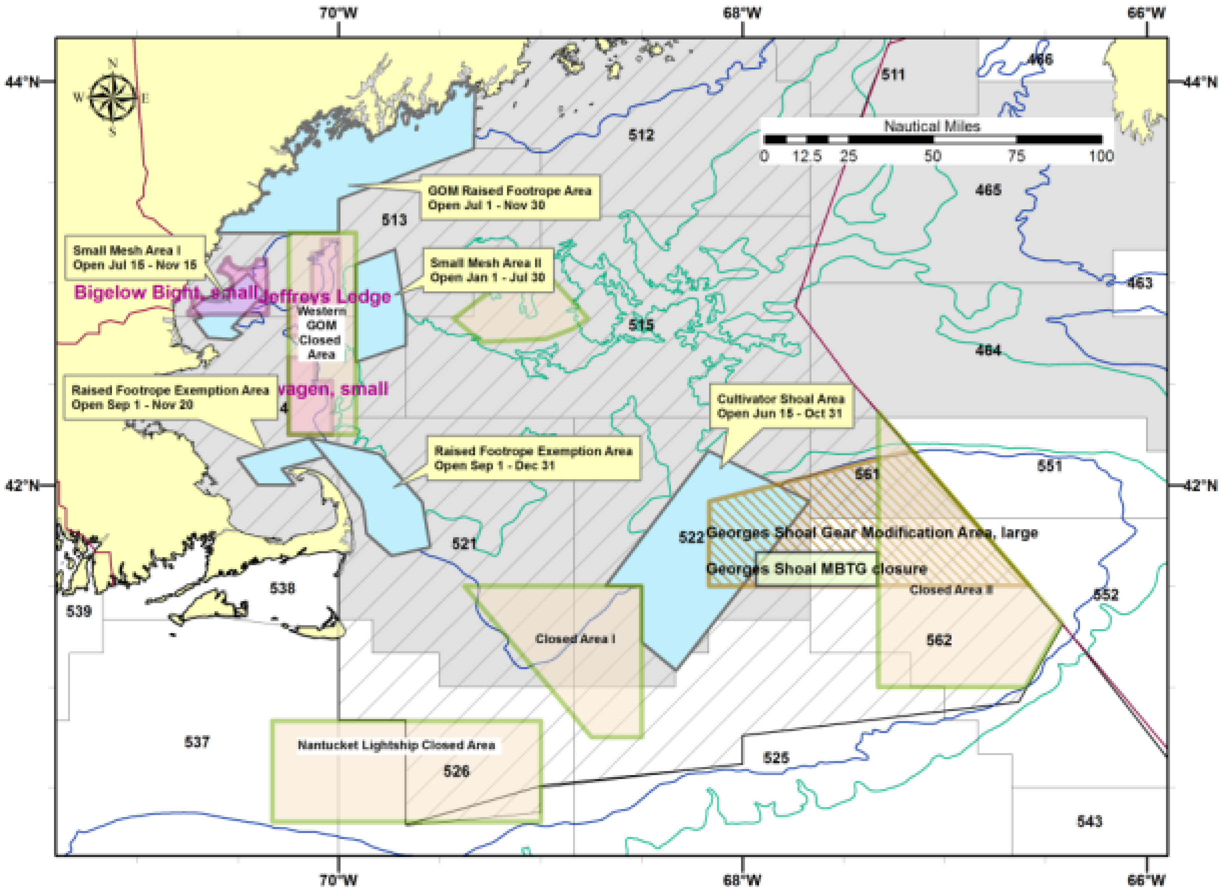


Map 95 – Small-mesh multispecies exemption area (blue) overlap with proposed habitat management area alternatives, Alternatives 4 in WGOM and GB sub-regions. Grey-shaded region represents the red and silver hake northern stock boundary. Slashed region represents the

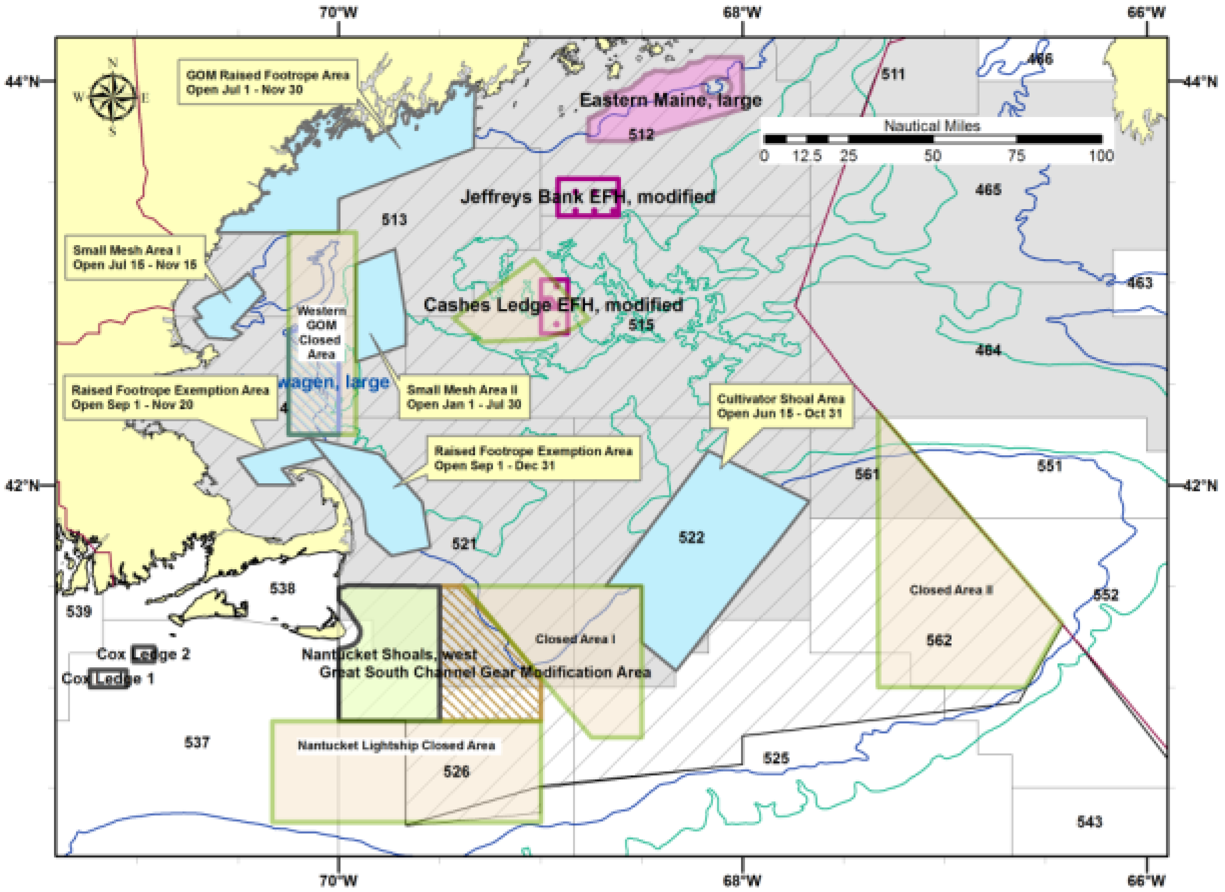
northern small-mesh fishery management area, where vessels may only use small mesh in specific exemption areas and seasons. Shown for comparison, existing year-round groundfish closures (No Action) have a green border and beige fill color.



Map 96 – 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 97 – 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

The monkfish fishery is managed jointly by the New England and Mid-Atlantic Fishery Management Councils in two management units, a Northern Management Area in the Gulf of Maine, the Great South Channel, and most of Georges Bank and a Southern Management Area covering the southwest part of Georges Bank, Southern New England, and Mid-Atlantic waters.

Use of mobile gear (trawls and dredges) to target and catch monkfish may be directly affected by the proposed habitat alternatives in this amendment. Vessels in the fishery also frequently use sink gillnets to target and catch monkfish which may be indirectly affected by the alternatives. This section evaluates the potential effects on the fishery and resource based on current fishing patterns and resource distribution.

4.5.2.1 *Monkfish management background*

The monkfish fishery is regulated in two distinct management areas, the Northern (NFMA) and Southern Fishery Management (SFMA) Areas (separated by the heavy read line shown in Map 98). The fishery is primarily managed through the issuance of limited access permits, as well as days-at-sea (DAS) allocations, landing limits, and gear restrictions that differ in each fishery management area. Monkfish DAS allocations and landing limits are reconsidered every few years to achieve the FMP mortality goals. Limited access monkfish vessels having a limited access groundfish permit are also required to comply with applicable Multispecies DAS and sector provisions. Mesh size regulations for trawls and gillnets are set to prevent the fishery from targeting small monkfish and catching groundfish when not on a Multispecies DAS. As a measure to reduce EFH impacts, regulations promulgated under Monkfish Amendment 2 require trawl vessels in the SFMA to use nets with roller gear with a diameter no larger than 6-inches[12]. Monkfish vessels fishing in the inshore WGOM roller gear restricted area, which may be modified by alternatives in this amendment (WGOM Alternatives 7A and 7B) may use roller gear with a diameter no larger than 12-inches.

Monkfish vessels may not fish with trawls or gillnets in the existing year round groundfish closed areas (WGOM, Cashes Ledge, CAI, CAII, and the NLCA; shaded areas shown in Map 100). Vessels using mobile bottom-tending gear (e.g. trawls and dredges) also may not fish in the EFH closure areas (WGOM, Cashes Ledge, Jeffreys Bank, CAII, CAIN and CAIS, and NL; hatched areas with blue borders shown in Map 100). There are also two deep water coral protection areas on the southern edge of Georges Bank that are closed to all monkfish fishing vessels, Lydonia and Oceanographer Canyon Closed Areas (Map 100).

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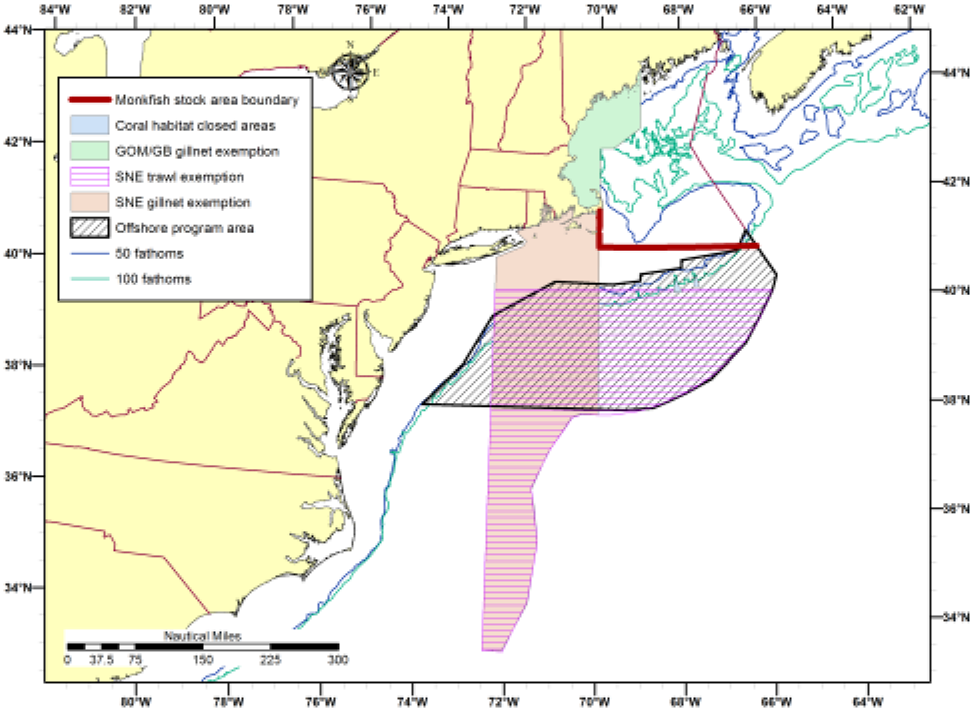
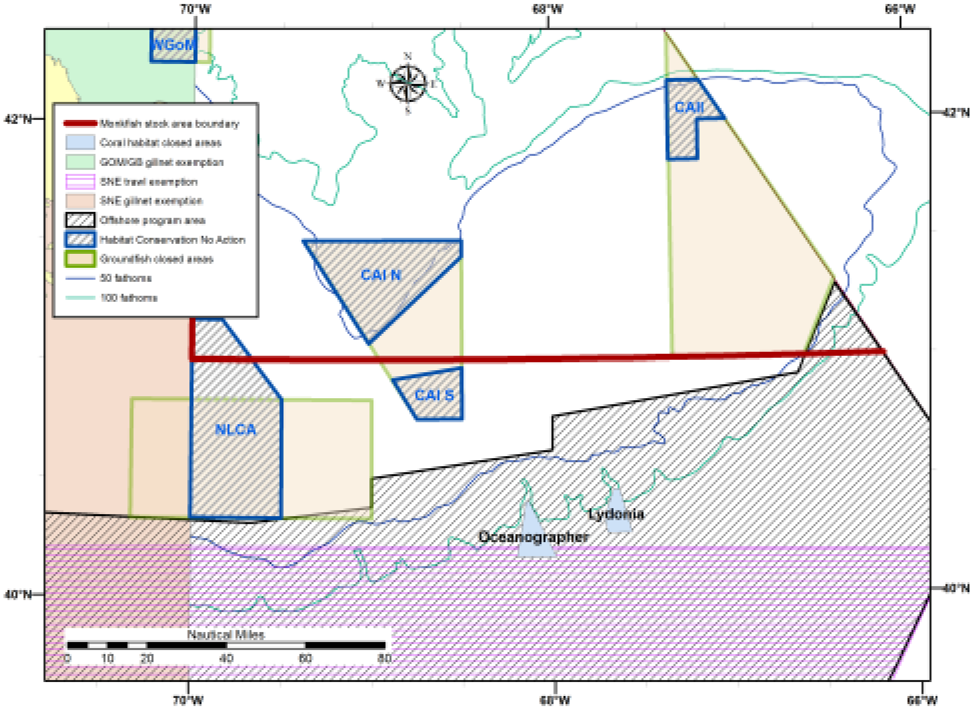
[12] See Section 4.1.8.1 in Monkfish Amendment 2, http://www.nefmc.org/monk/planamen/final_planamen2.html)

Map 98 – Monkfish management areas including the boundary between the Northern and Southern (Monkfish) Fishery Management Areas (separated by thick red line).



Map 99 – Lydonia and Oceanographer Canyon Closed Areas (areas shaded light blue).



In addition to the regulations described above, there are four special management areas that apply to vessels with monkfish limited access permits. Using trawls and gears with a minimum mesh size and during specific times to reduce the capture of regulated large-mesh groundfish, vessels may target and retain monkfish without being on a Multispecies DAS.

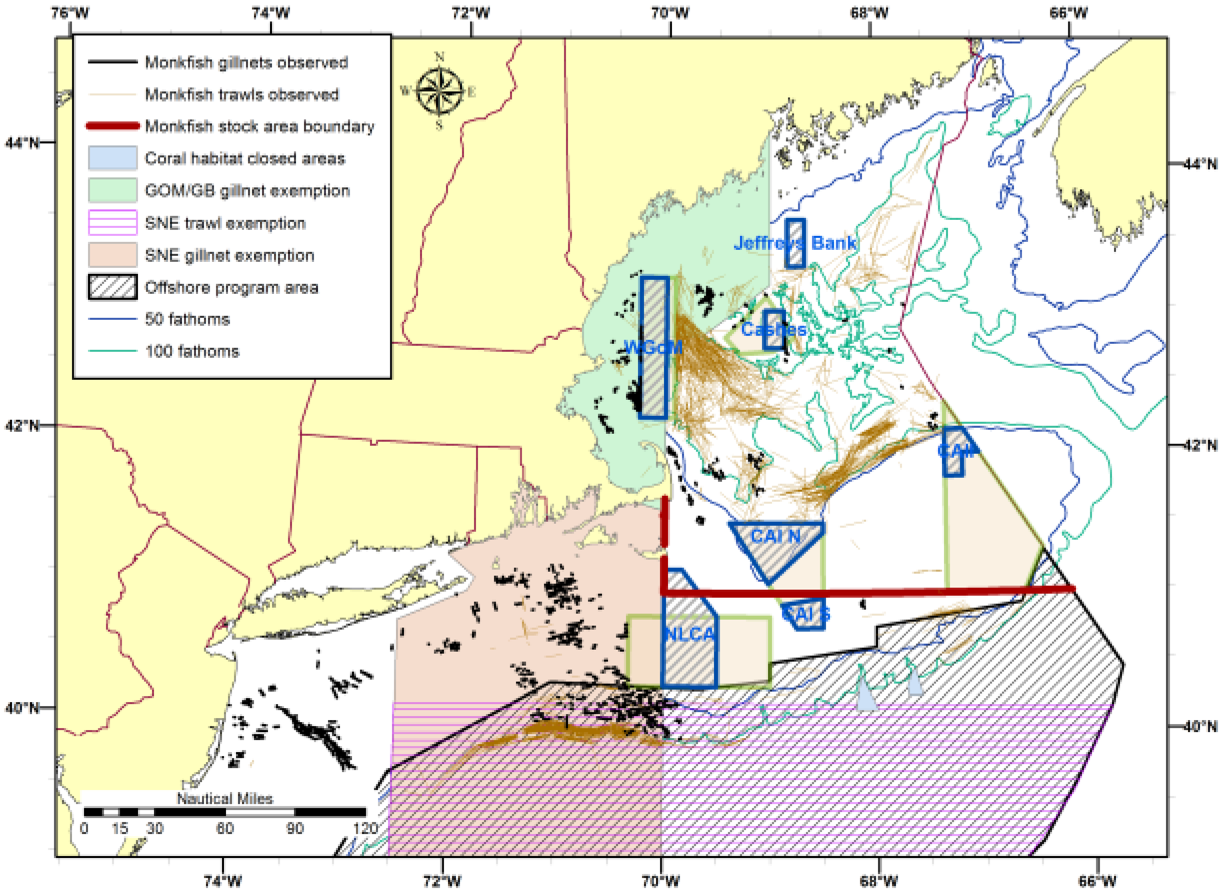
In the Western Gulf of Maine there is a "GOM/GB Dogfish and Monkfish Gillnet Fishery Exemption Area (light green shaded area in Map 100). From July 1 to September 14, vessels using gillnets with a minimum mesh size of 10-inches may target monkfish and dogfish without being on a Multispecies DAS [§648.80(a)(13)]. Overlapping this exemption, vessels may use gillnets with a minimum mesh size of 6.5-inches, but may retain monkfish up to 10% of the total weight of fish onboard [§648.80(a)(14)].

A "SNE Monkfish and Skate Trawl Exemption Area" allows vessels to target monkfish without being on a Multispecies DAS year round, provided the vessel is using a trawl with a minimum mesh of 10-inches square or 12-inches diamond. This area is shown in Map 100 with the horizontal hatching. This area overlaps the Continental Shelf edge and deeper waters of the US EEZ.

A "SNE Monkfish and Skate Gillnet Exemption Area" allows vessels targeting monkfish with gillnets with a minimum mesh size of 10-inches to fish year round without being on a Multispecies DAS. This area is shaded in Map 100 and extends from the three-mile limit between Eastern Long Island to Cape Cod, south to the offshore boundary of the US EEZ.

Lastly, vessels with a Category F monkfish permit may fish in the "Monkfish Offshore Program Area", which extends along the Continental Shelf Edge south to 38º04' N latitude (shown with a diagonal hatching in Map 100). Vessels fishing in this area with a Category F permit may fish with a higher monkfish possession limit in exchange for a reduction in their monkfish DAS allocation.

Map 100 – Distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish. No Action EFH Closures (blue outline) and year round Groundfish Closed Areas (tan background with green borders) are shown with Monkfish Fishery Exemption Areas.



4.5.2.2 *Potential effects of habitat and spawning area alternatives*

Against this background of area-specific regulations, the following discussion attempts to evaluate how the proposed habitat alternatives may affect monkfish fishing and the monkfish resource.

Although monkfish are widely distributed throughout the US EEZ from shallow to deep water (Map 101) and occur on a variety of bottom substrates, they generally prefer softer sediments in deeper water (see Section 4.4 of Framework Adjustment 7 to the Monkfish FMP for more details about monkfish EFH; see also Section 4.1.81 from Monkfish Amendment 2[13]) rather than the harder substrate (and more vulnerable seabed structure) addressed by this amendment. Fishing for monkfish with mobile bottom-tending gear (i.e. trawls) are, therefore, likely to be less affected by the proposed alternatives than fishing for other species that inhabit areas with harder

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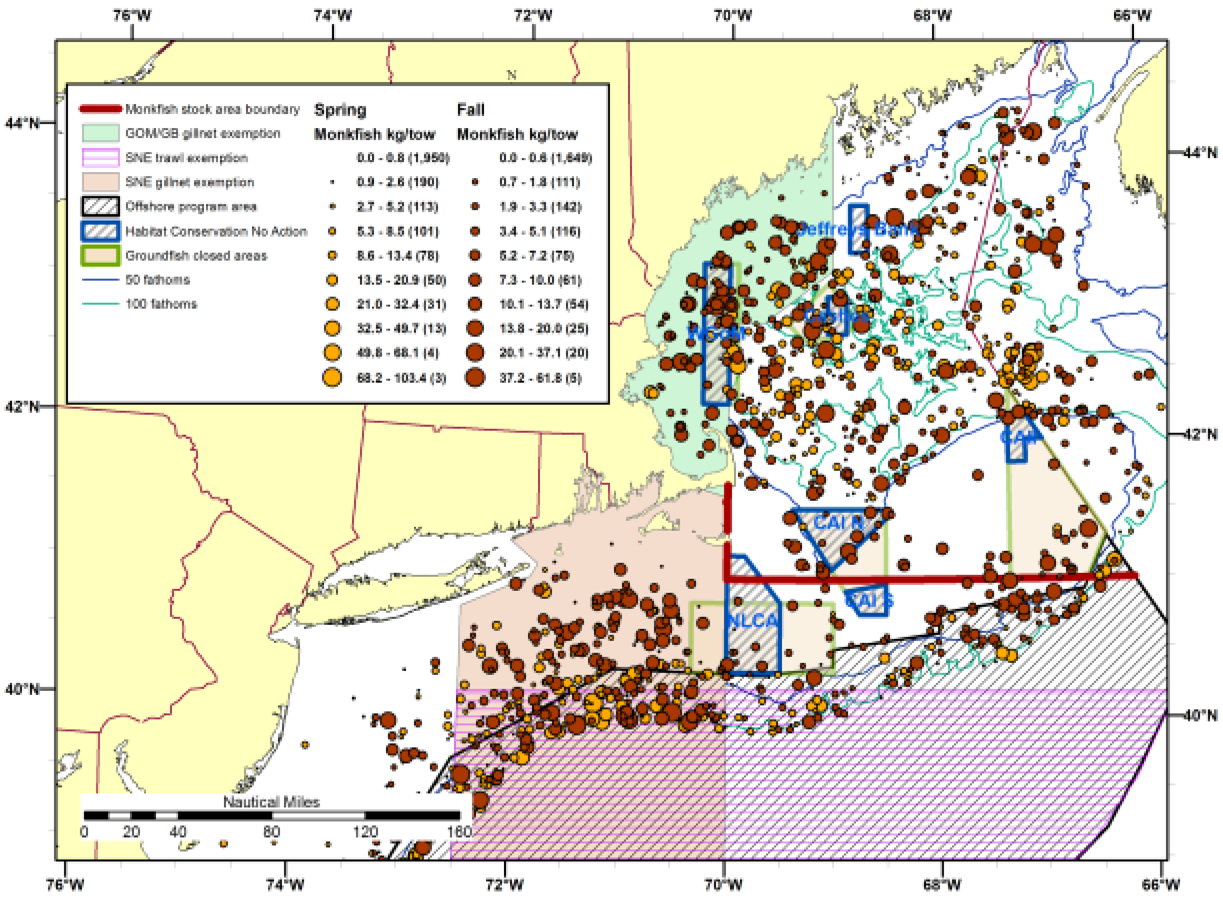
[13] "The primary sediment type in areas where directed monkfish trawling occurs is mud, in both northern and southern areas, although during migration periods monkfish are caught in sandy and more complex bottom types."

substrates. One caveat to this general conclusion is for coral habitat areas addressed in the section below.

Conversely, gillnets capture monkfish better when the fish are migrating, often for spawning. Gillnet fishing activity tends to occur in shallower areas throughout the Gulf of Maine, Southern New England, and the Mid-Atlantic. In some areas, such as around Cox Ledge and Jeffreys Ledge, the observed fishing effort also seems to focus surrounding (but not on) areas with bottom structure.

Map 101 – 2002-2012 spring (orange circles) and fall (red circles) biomass distribution with EFH closures, year round groundfish closures and monkfish exemption areas shown. Source: NMFS trawl survey data.



4.5.2.2.1 Habitat Management Alternatives in the Gulf of Maine

Generally the Habitat Management Area alternatives are expected to have a highly positive impact on the monkfish fishery, potentially opening up new areas to fishing using trawls and gillnets which are now closed primarily as year round groundfish closed areas.

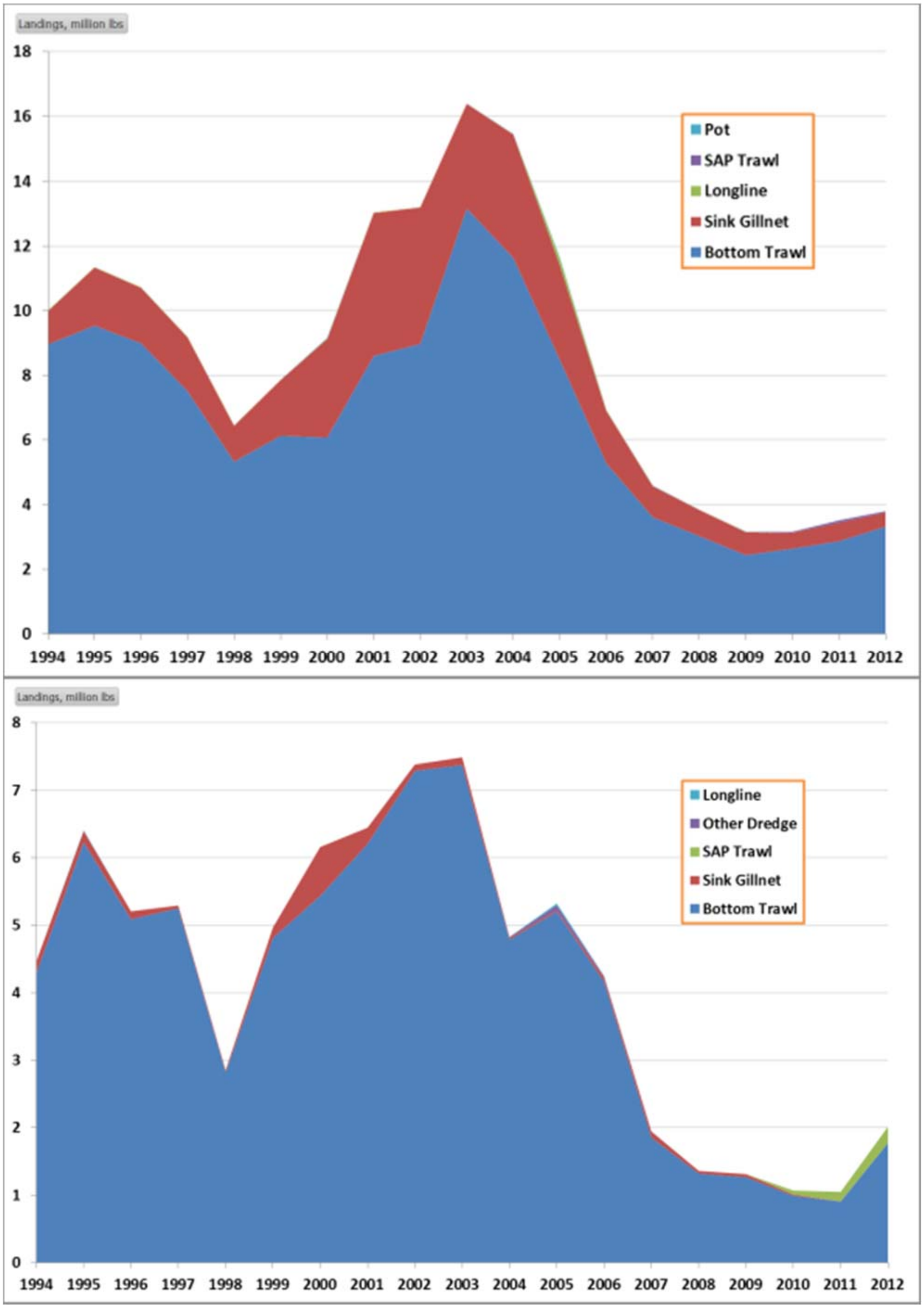
Although some shifts in fishing effort to deeper water with soft bottoms and/or to using gillnets to target monkfish in Habitat Management Areas might increase fishing for monkfish, the fishery in recent years has not harvested its ACL. Therefore modest increases in fishing effort to target monkfish in deep water or with gillnets is unlikely to harm the resource, and impacts on the monkfish resource from the Habitat Management Area alternatives are expected to be neutral.

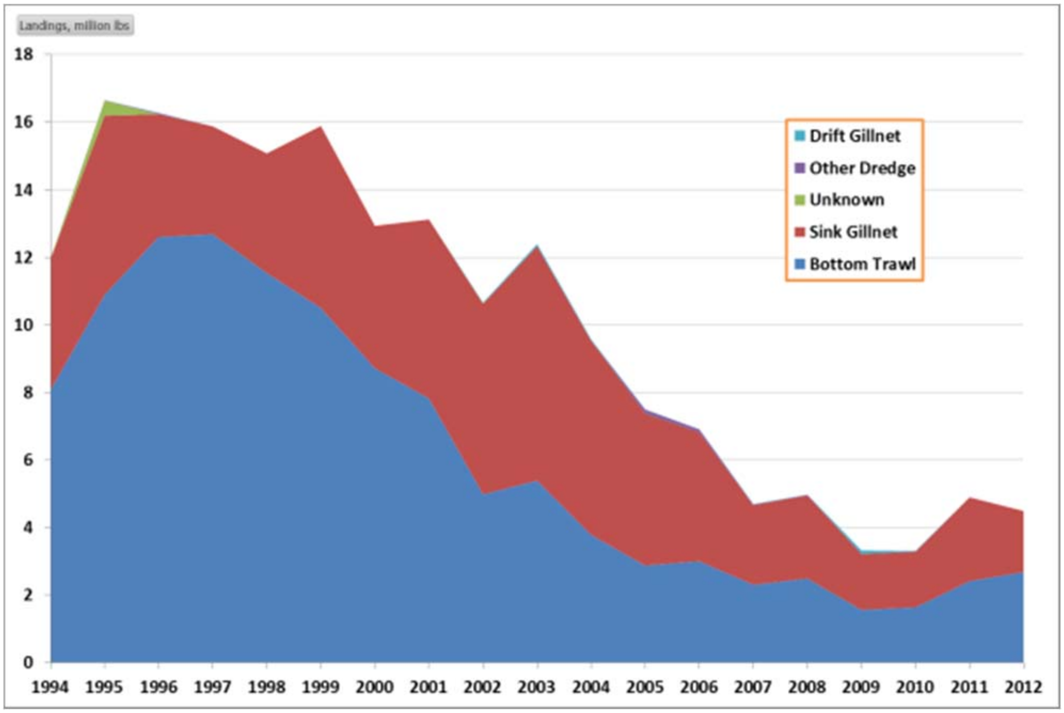
The Dedicated Habitat Research Area alternatives in the Gulf of Maine overlap with the proposed Habitat Management Areas, so any additional impacts on the monkfish fishery from the Dedicated Habitat Research Area alternatives are unlikely to occur.

Since the proposed spawning management alternatives in the Gulf of Maine already exist as rolling closure areas and are closed to all gears capable of catching groundfish (including trawls and gillnets used to catch monkfish), the proposed Spawning Management Areas are expected to have a neutral impact on the monkfish fishery.

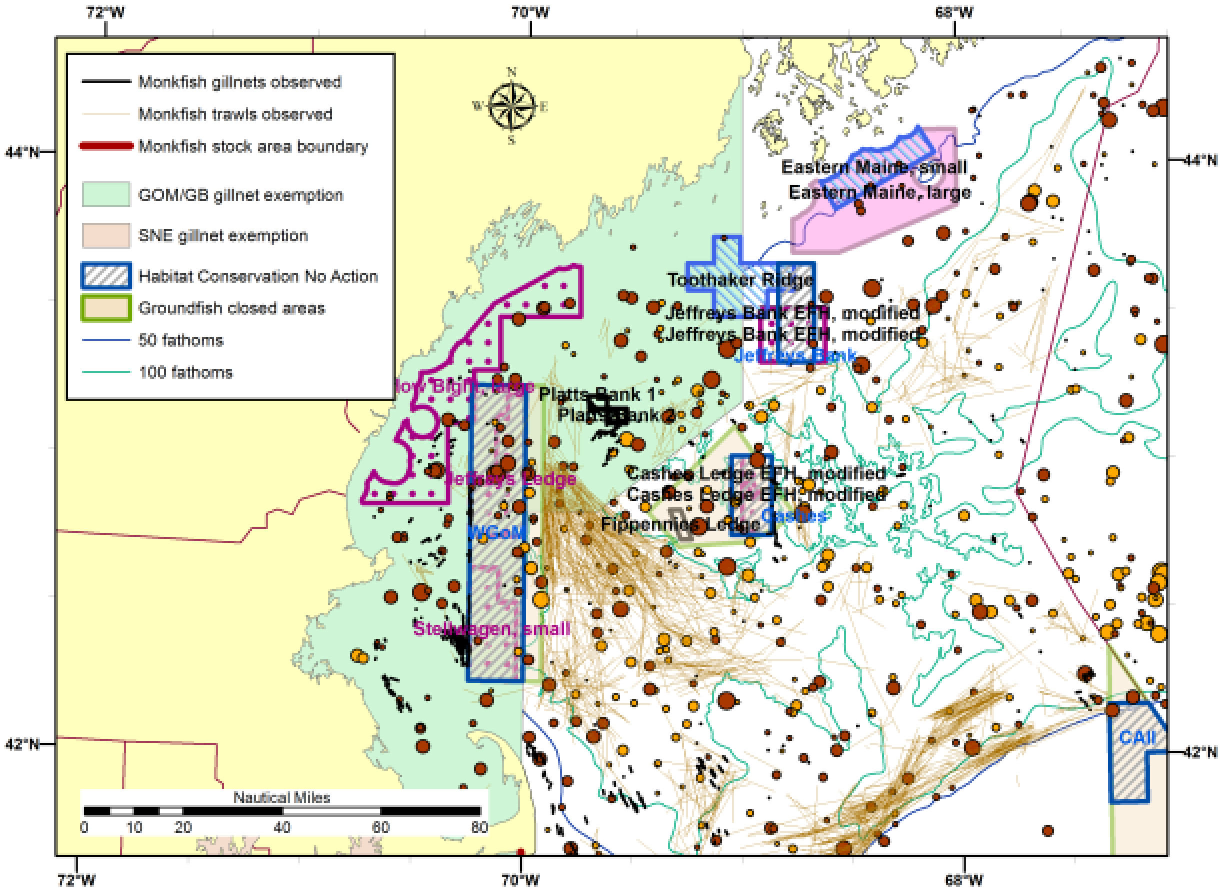
In the Gulf of Maine, 87.5% of monkfish landings on trips targeting monkfish used trawls in 2012. The large majority of monkfish fishery landings from trips in the NFMA since 1994 also used trawls (Figure 48). Most of the observed trawl fishing activity targeting monkfish since 2008 occurred in deeper water, east of the Western Gulf of Maine Closed Area and off the northern edge of Georges Bank. A smaller amount of observed trawl fishing for monkfish also occurred in the deeper basins of the Gulf of Maine. There appear to be very little overlap of observed monkfish trawl fishing activity and the proposed alternatives in the western and east/central Gulf of Maine (Map).

Figure 48 – Monkfish landings (million lbs.) by the top five gears by region, 1994-2012 (continued on next page). Source: NMFS CFDBS data. Upper panel – GOM, SAs 464, 465, 511-515. Middle panel – GB, SAs 522, 525, 542, 543, 561, and 562. Lower panel – SNE, SAs 521, 526-541.




Landings, million lbs
18
16
14
12
10
8
6
4
2
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Drift Gillnet
Other Dredge
Unknown
Sink Gillnet
Bottom Trawl

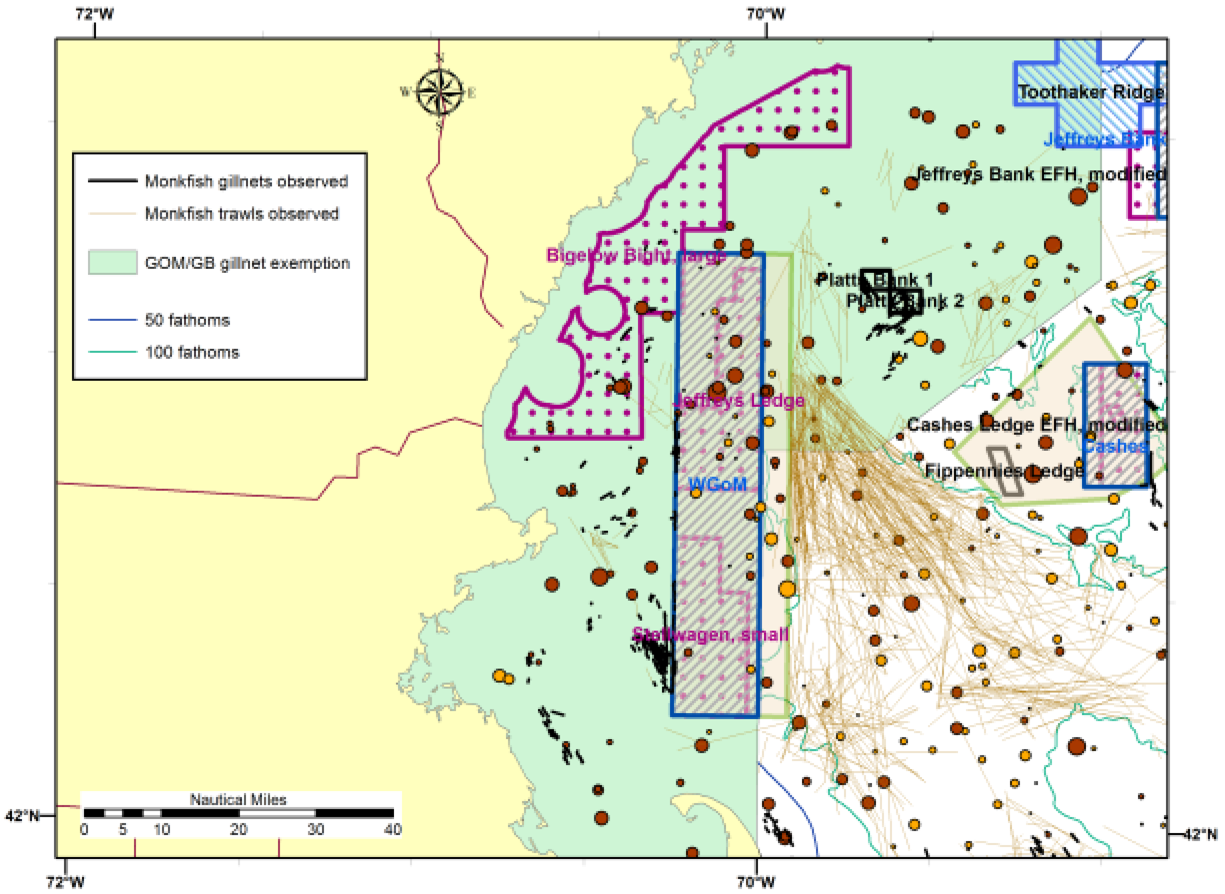
Map – Relationship between proposed Habitat Management Areas and No Action areas in the GOM. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM (Groundfish) Closed Area, as well as Alternatives 2, 3, and 4 in the Central and Eastern GOM. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Observed gillnet fishing for monkfish, on the other hand, appear to be concentrated in shallower areas, often surrounding areas with a greater amount of bottom structure. Eight (8) percent of landings on trips targeting monkfish in the Gulf of Maine used sink gillnet gear in 2012, a proportion that declined slowly since 1994 (Figure 48). Observed sets were notable west of the Western Gulf of Maine Closed Area, in the "GOM/GB Monkfish Gillnet Exemption Area" and around Platts Bank, northeast of the Western Gulf of Maine Closed Area (Map 102). Another concentration of monkfish gillnet fishing effort was observed east of Cape Cod, MA and north of Closed Area I. A little bit of observed monkfish gillnet fishing effort occurred northwest of Closed Area II, just north of Georges Bank in deeper water.

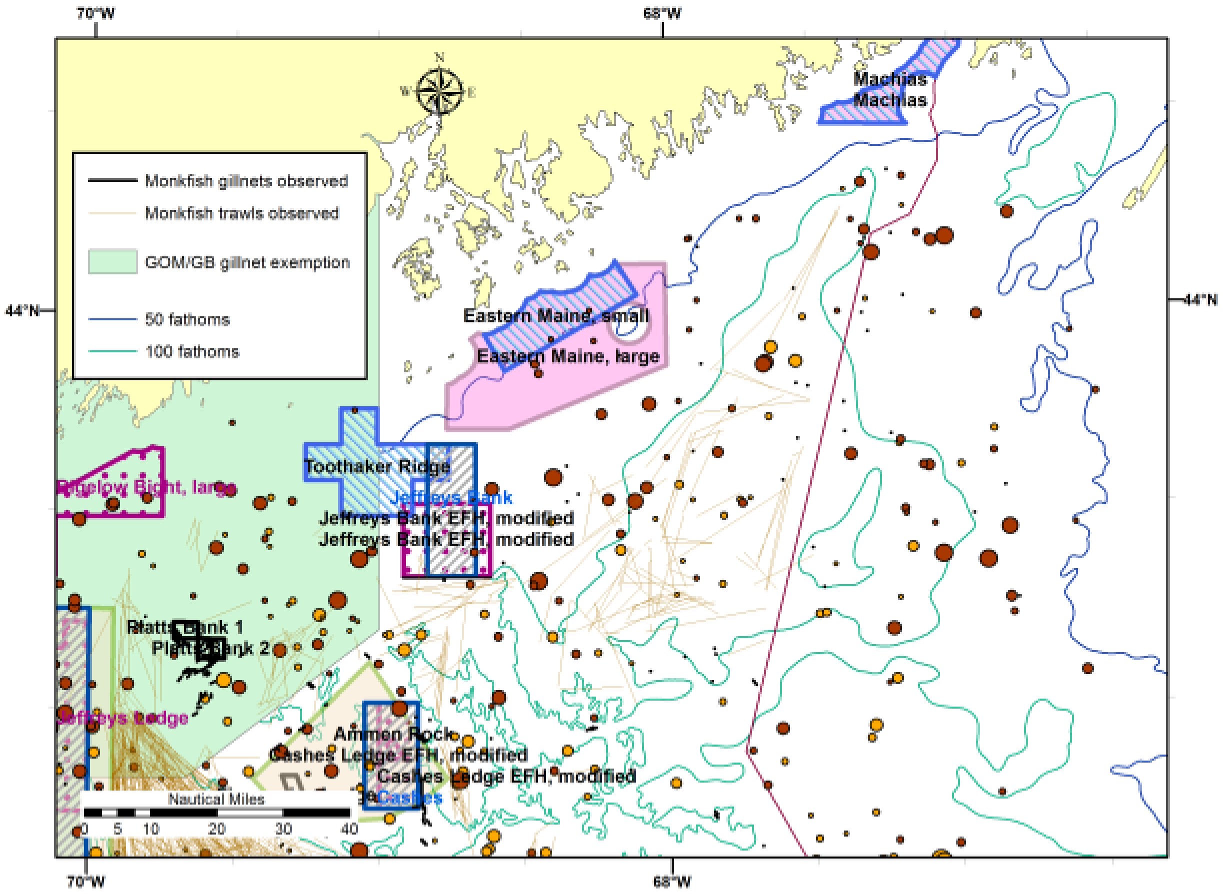
Since trawl fishing to target monkfish occurs along the eastern boundary of the Western Gulf of Maine Closed Area, it is likely that trawl fishing effort may disperse westward, potentially to the eastern boundary of the proposed Habitat Management Areas (Map 102). Otherwise, direct effects on trawl fishing are unlikely. Indirectly, a reduction in the availability to trawl in harder substrate areas may shift some effort into the deeper basins of the Gulf of Maine and increase targeting of monkfish on available DAS.

Map 102 – Relationship between proposed Habitat Management Areas and No Action areas in the WGOM. Shown are proposed HMAs associated with Alternative 4 with the existing WGOM EFH Closure Area and the WGOM (Groundfish) Closed Area. Proposed and HMAs in the Central GOM are also shown. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Lifting the restriction on fishing with gillnets in the Western Gulf of Maine Closed Area, while restricting fishing with mobile bottom-tending gear in the proposed habitat areas (Map 103) is likely to make more areas available to fishing for monkfish with gillnets, particularly on or around Jeffreys Ledge, Tillies Bank, and Stellwagen Bank (Map 103). This area is also within the “GOM/GB Monkfish Gillnet Exemption Area”. Gillnet fishing for monkfish here is very likely to expand into the Western GOM, benefiting the fishery, but possibly causing other problems such as gear conflict. Monkfish fishing with gillnets already occurs around the proposed Platts Bank Habitat Management Area (Map 103) and does not appear likely to change in distribution to fish the shallower portions of this area, if it were closed to fishing by mobile bottom-tending gear.

Map 103 – Relationship between proposed Habitat Management Areas and No Action areas in Central and Eastern Gulf of Maine. Shown are proposed Habitat Management Areas associated with Alternatives 2, 3, and 4. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



4.5.2.2.2 Habitat Management Areas for Georges Bank

Due largely to additional access to areas where monkfish occur in the southern half of Closed Area II (currently a year round groundfish closed area with some fishing allowed under groundfish and scallop special access programs) and the northern portion of Closed Area I (currently and EFH and a year round groundfish closed area), the various habitat management alternatives are likely to have a positive impact on the monkfish fishery. More areas that have monkfish would become open to fishing with trawls and gillnets, while the proposed habitat management area alternatives do not appear to have as much monkfish biomass.

Closure of the CAI and CAII during February to April is unlikely to significantly affect access to monkfish that occur in these areas. The proposed Dedicated Habitat Research Area in CAI South does not appear to have much monkfish biomass (Map 104).

Impacts on the monkfish resource is likely to be neutral to slightly negative, since the fishery does not currently harvest the monkfish ABC but some vessels targeting groundfish may shift fishing effort into areas where monkfish are more prevalent. Generally, a low proportion of monkfish biomass occurs in the areas proposed as Habitat Management Areas (Map 104).

Nearly all of the observed monkfish fishing on Georges Bank is conducted with trawls, but there are a few observed gillnet trips on Georges Bank (Map 104). During 2012, 99.9% of monkfish landings on trips targeting monkfish came from vessels using trawls (Figure 48)[14]. Most of the observed monkfish trawl fishing effort occurs along the northern edge of Georges Bank, in deeper water off the edge of the bank. Some of this effort partially overlaps and coincides with the ‘Georges Shoal Gear Modification Area, large’ (Alternative 5) and the ‘Closed Area II EFH Modified, Large and Small’ (Alternatives 6.1 and 6.2), but it appears that this fishing effort could shift into a little deeper water to the north or into Closed Area I North, mitigating the negative effects of these alternatives.

Trawl fishing along the northern edge of Georges Bank may also expand southwestwardly into the northern portion of what is now CAI, based on the distribution of monkfish biomass from survey tows (Map 104). This area is currently closed to groundfish fishing (year round closed area) and to mobile bottom-tending gear fishing (EFH closure). In any of the proposed alternatives, this area would re-open to fishing using either type of gear (trawls, gillnets, and dredges), except for February-April when the area would be closed to groundfish fishing gears during spawning.

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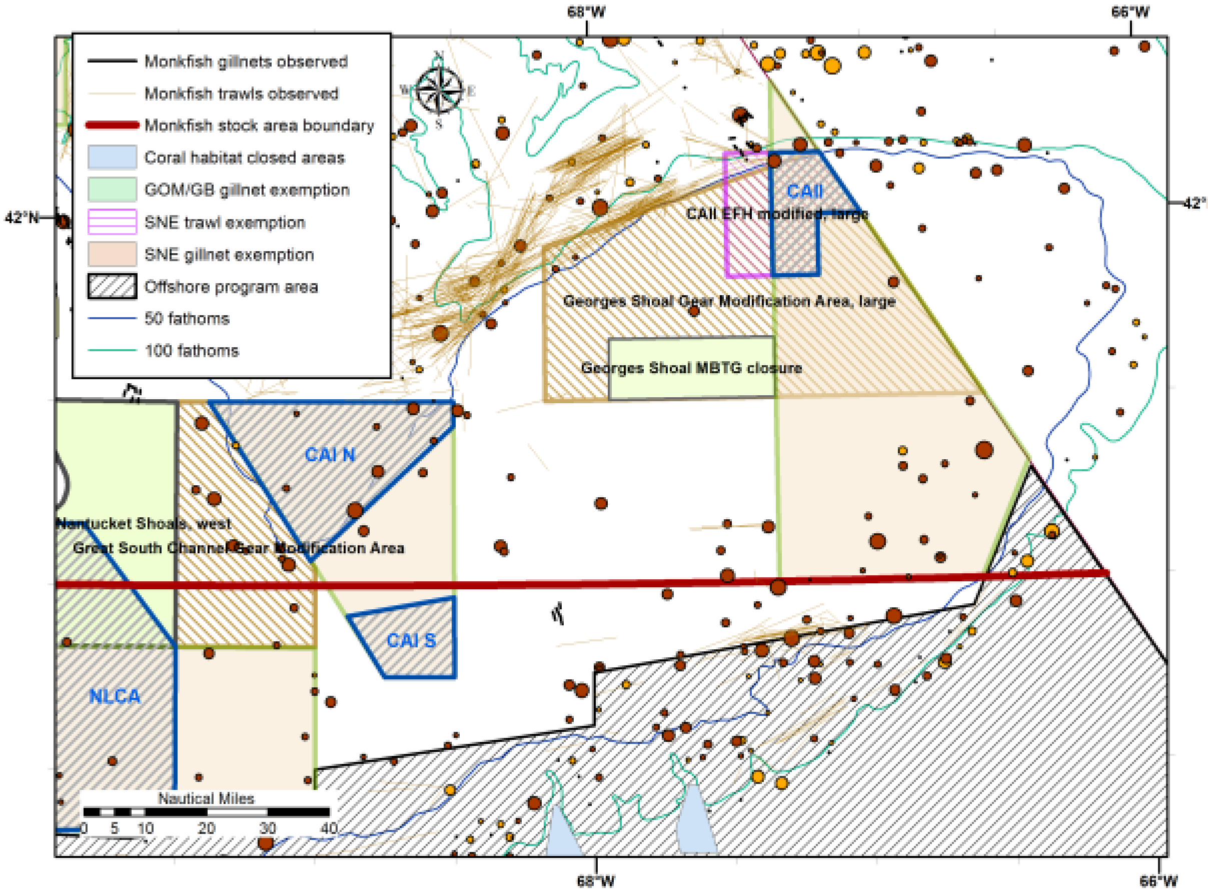
[14] 11.9% of monkfish were from vessels in SAP fisheries using Ruhle or separator trawls.

Map 104 – Relationship between proposed Habitat Management Areas and No Action areas on Georges Bank. Shown are proposed HMAs associated with Alternatives 5 and 6.1. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



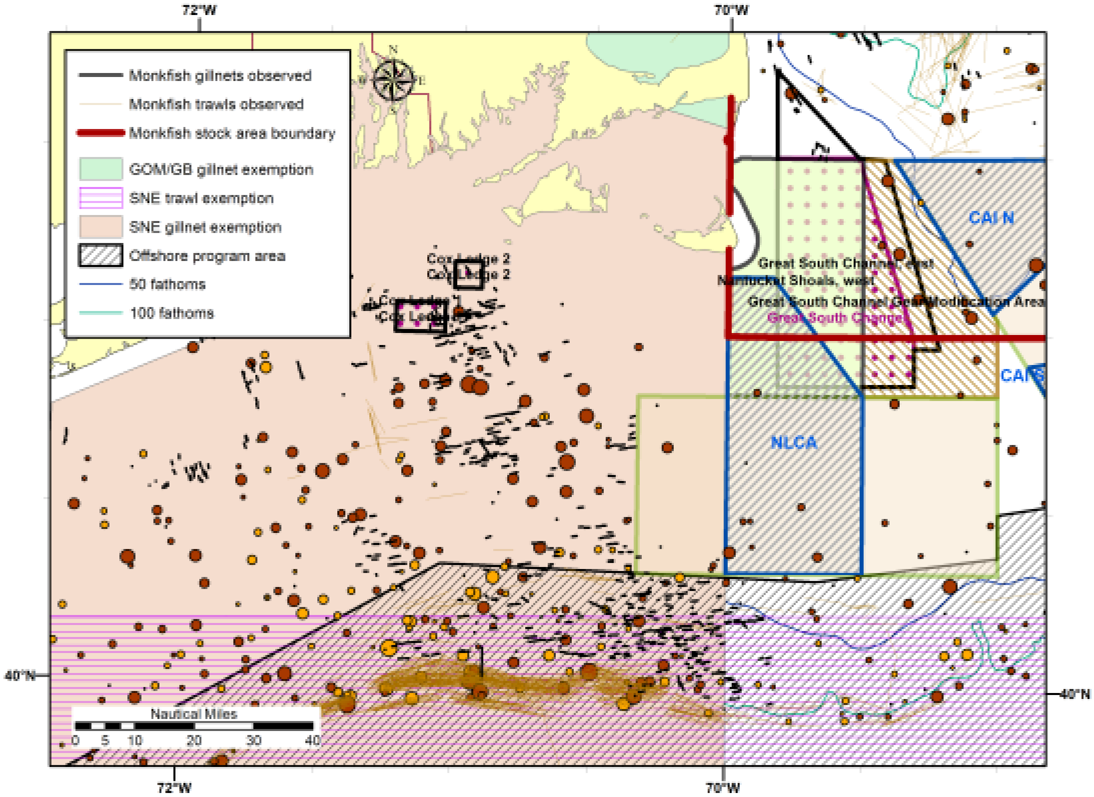
4.5.2.2.3 Habitat Management Areas for Southern New England

Impacts of the proposed alternatives on the monkfish fishery appears to be neutral to slightly positive due to the low amount of overlap between the proposed Habitat Management Areas and little bit of additional fishing area available to monkfish gillnet vessels in the southern and western portion of the Nantucket Lightship Area (Map 105).

Impacts of the proposed Habitat Management Area alternatives on the monkfish resource are likely to be neutral to slightly positive. There appears to be some amount of fishable monkfish biomass within the proposed Great South Channel Gear Modification Area (Map 105). It is unknown whether there are concentrations of monkfish in the relatively unsampled Nantucket Lightship Shoals region that is included in some of the Habitat Management Area alternatives. Nonetheless, these areas might be fished more heavily by vessels using gillnets to target monkfish if trawling in the area were more restricted by the Habitat Management Area alternatives. Fishing this area with gillnets may be challenging due to heavy currents and high bottom relief.

Monkfish fishing in the SNE region is conducted using gillnets inshore more frequently than in the GOM or on GB. Vessels using trawls typically target monkfish along the continental shelf edge, next to canyons and in deeper water than vessels fish with gillnets. Still, 59.7% of monkfish landings in 2012 were from vessels using trawls and 40.3% were from vessels using gillnets (Figure 48). Except for the Cox Ledge areas, there is very little overlap between observed fishing activity and the proposed HMA alternatives (Map 105). Gillnet fishing activity around the two Cox Ledge areas has been observed, but this effort appears to primarily fall outside of the proposed areas and may have little effect on fishing activity. Gillnets would be allowed in the Cox Ledge HMA.

Map 105 – Relationship between proposed Habitat Management Areas and No Action areas in SNE. Shown are proposed HMAs associated with Alternatives 3, 4, and 6. These areas are compared with the distribution of 2008-2012 observed trawl (tan lines) and gillnet (black lines) fishing for monkfish with 2002-2012 spring (orange circles) and fall (red circles) NMFS trawl survey weight per tow. Monkfish fishery exemption areas which do not require vessels to be on a Multispecies DAS under certain regulatory constraints are also shown for comparison.



Although not part of this amendment, some additional coral protection areas that could affect the monkfish fishery are proposed in Omnibus Habitat Amendment 3 (OHA3). This amendment is under development. In addition to possible modifications the existing Oceanographers and

Lydonia Canyon Coral Protection Areas to improve their coral protection, OHA3 proposes 10 additional areas ranging from Alvin Canyon to the west to Heezen Canyon to the east. None of the proposed coral protection areas in OHA3 overlap or appear to compromise the proposed Habitat Management Areas in this amendment. It also does not appear that the areas have a significant amount of overlap or conflict with the monkfish trawl and gillnet fisheries, or the monkfish resource[15].

4.5.3 Skates

4.5.3.1 *Biological impacts*

Clearnose and rosette skate are generally distributed south of the no action and alternative habitat, spawning, and research management areas (see maps for each species in the Affected Environment and EFH alternatives sections) and constitute a small fraction of landings in the skate fishery, so none of the spatial management alternatives are expected to have a significant impact on these stocks.

4.5.3.1.1 Habitat management alternatives

Habitat management areas in the Gulf of Maine overlap with the distribution of thorny and smooth skates, so changes in the boundaries of habitat management areas or the fishing restriction measures within these areas could impact these stocks. Smooth skate is not overfished/overfishing not occurring but is in a rebuilding plan, and thorny is overfished with overfishing occurring. Due to their status, impacts on thorny skate are of greater concern. Thorny skate have a somewhat shallower and more inshore distribution as compared to smooth skate, and greater overlap with the various habitat management areas, which tend to occur in shallower waters and do not generally overlap with deeper mud basins.

In the last decade especially, thorny skate have become concentrated in the western Gulf of Maine, both inside and outside of the WGOM closed area (Map 106). Increases in either trawl or gillnet effort within the area of highest thorny skate abundance could lead to negative impacts on thorny skate. Increased trawl effort in areas where thorny skate occur in large numbers could result from removal of the existing habitat and groundfish closed areas, although this would be mitigated if new HMAs are designated as mobile gear closures nearby, for example the Bigelow Bight, Stellwagen, or Jeffreys Ledge HMAs in Alternatives 3-6. However, no year-round habitat management areas are proposed south of Cape Ann and west of the current WGOM habitat closure to overlap with the areas of highest density in the figure below. Increases in gillnet effort could result from removal of the WGOM groundfish closure, since with no management areas (WGOM Alt 2) or only habitat management areas that restrict mobile bottom-tending gears (WGOM Alts 3-6), the use of gillnets and other fixed gears would be permitted, apart from any spawning closures or protected resource-related management measures that restrict this gear.

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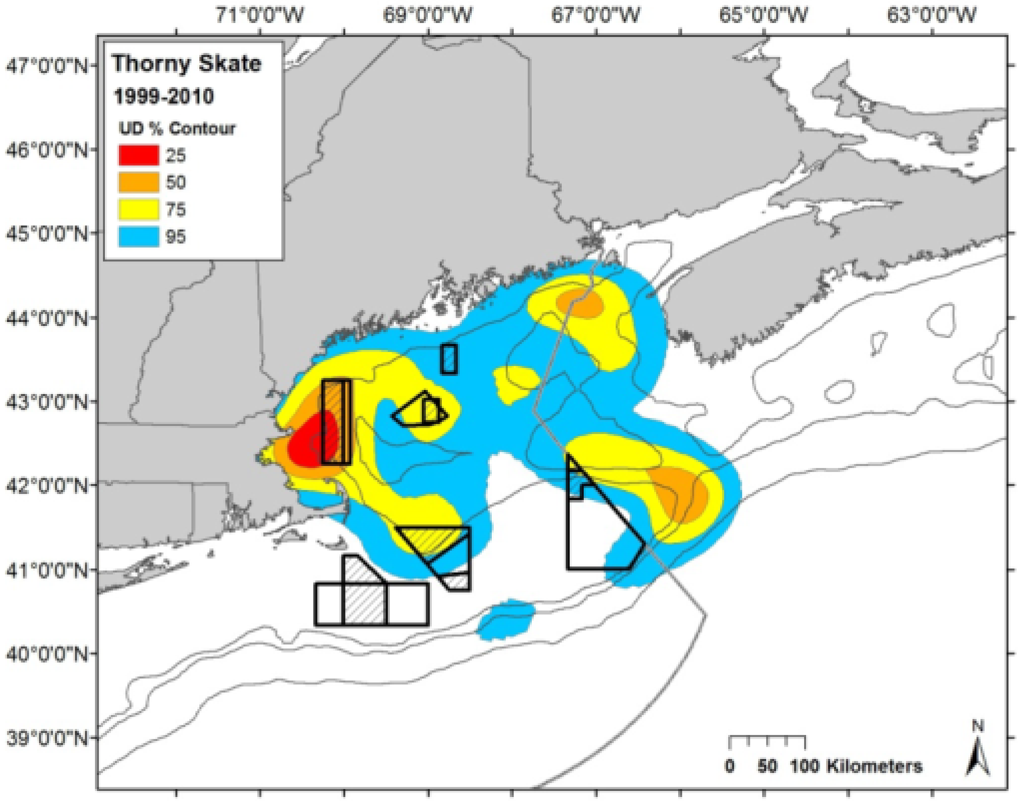
[15] An important caveat to this conclusion is that the survey tows are often limited by depth and few occur in the deeper portions of the offshore canyons of Southern New England and Georges Bank. Further investigation using the periodic monkfish trawl survey is warranted.

Map 106 – Fixed kernel utilization distribution (UD) of positive thorny skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



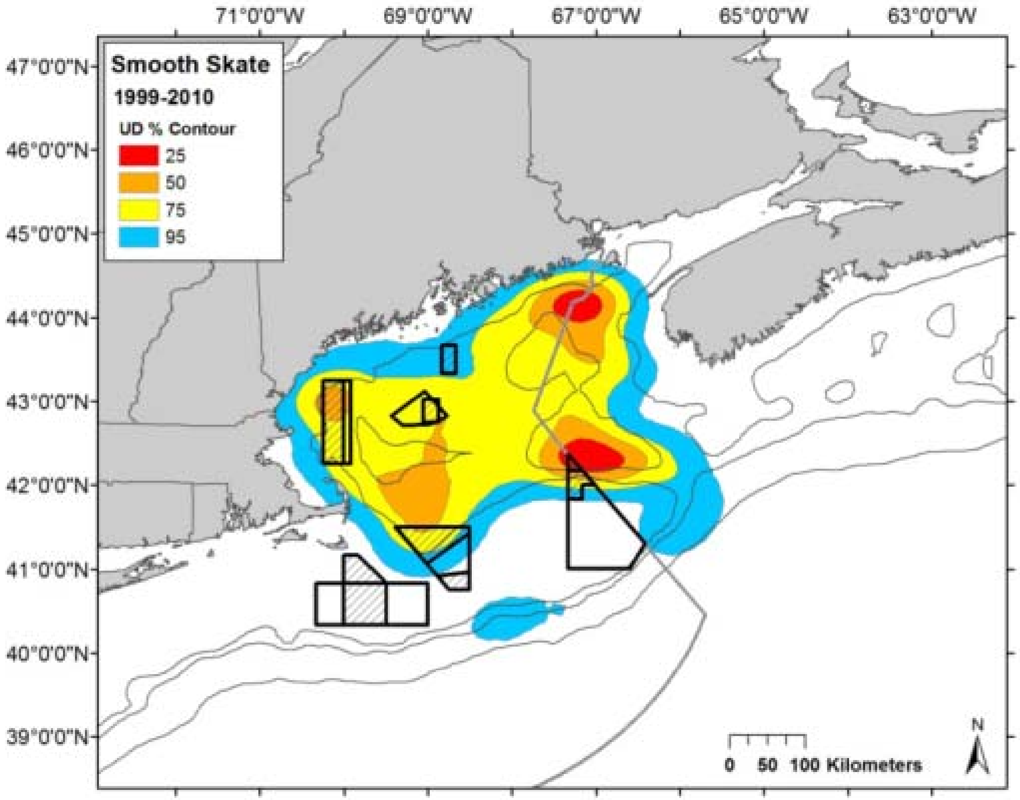
Thorny skate have a zero possession limit, so presumably increases in effort in areas where they are more abundant would not lead to directed fishing on the stock, but they are caught incidentally in various gears (Table 121). Because reporting at the species level is incomplete, these discard values are estimates based on fishing location and discarded to kept catch ratios on observed trips. The overall skate complex Total Allowable Landings (TAL) is a combined value that is primarily based on a moving survey biomass index across the seven skate species. Different species contribute different fractions of the TAL depending on their current stock size. For reference, thorny skate contribute 229 mt to the skate complex TAL under the alternative specifications currently under development. In total, the thorny skate bycatch estimates are of similar magnitude (estimated discards for otter trawl, gillnet and scallop dredge in 2012 was 409 mt). Since it is a skate complex TAL, catch and landings are not managed directly according to an individual species' TAL contribution. However, with current bycatch of thorny skate estimated to be above the fraction they contribute to the TAL, additional bycatch of the species as a result of alternatives proposed in this amendment is of concern, as it could compromise rebuilding of the stock. Fixed gear discards are lower than mobile gear discards, so alternatives that increase the potential for fixed gear use in areas of high thorny skate abundance (i.e. Alternatives 3-6 as MBTG closures) would have smaller negative impacts than those that increase mobile bottom-tending gear use in areas of high thorny skate abundance (Alternative 2, Alternatives 3-6 as gear modification areas). Currently, the specifications process assumes a 23% discard mortality rate of otter trawl-caught thorny skates, but this may be an underestimate. A higher discard mortality rate would mean that increased catches of thorny skate result in a higher fishing mortality rate on the stock. The assumed discard rate in fixed gear (e.g. gillnets) is 50%, but this is based on limited data.

Table 121 – Estimated total discards of thorny skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	3	1	90	31	125
2009	8	1	179	18	206
2010	6	3	268	22	299
2011	4	1	149	22	176
2012	8	2	326	73	409

Smooth skate have a somewhat different distribution than thorny skate, with the highest concentrations of survey catch north of Jordan Basin and in Georges Basin (Map 107). Moderate concentrations of catch (50% contour on the kernel utilization plots) are found on Jeffreys Ledge and between Wilkinson Basin and Closed Area I.

Map 107 – Fixed kernel utilization distribution (UD) of positive smooth skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



Impacts of habitat management alternatives on smooth skate are somewhat less concerning than for thorny skate, as the status of the stock is better relative to biological reference points, but it is still below the target. Like thorny skate, smooth skate have a zero possession limit, so presumably increases in effort in areas where they are more abundant would not lead to directed fishing on the stock, but they are caught incidentally in various gears (Table 122). For reference, smooth skate contribute 644 mt to the skate complex Total Allowable Landings (TAL) under the alternative specifications currently under development. In total, these bycatch estimates are of similar magnitude.

Otter trawls and scallop dredges make the greatest contribution to estimated smooth skate discards, so alternatives that increase use of these gears in areas of high smooth skate abundance could have a negative impact on the stock. The assumed discard mortality rate for smooth skate in otter trawls is 60%, but 50% for all other gear types. This could be the case if year-round mobile gear restrictions are eliminated on Jeffreys Ledge (Alternative 2, 3, or 6), or if gear modification are the preferred management option for Alternatives 4 or 5, which include the Jeffreys Ledge HMA.

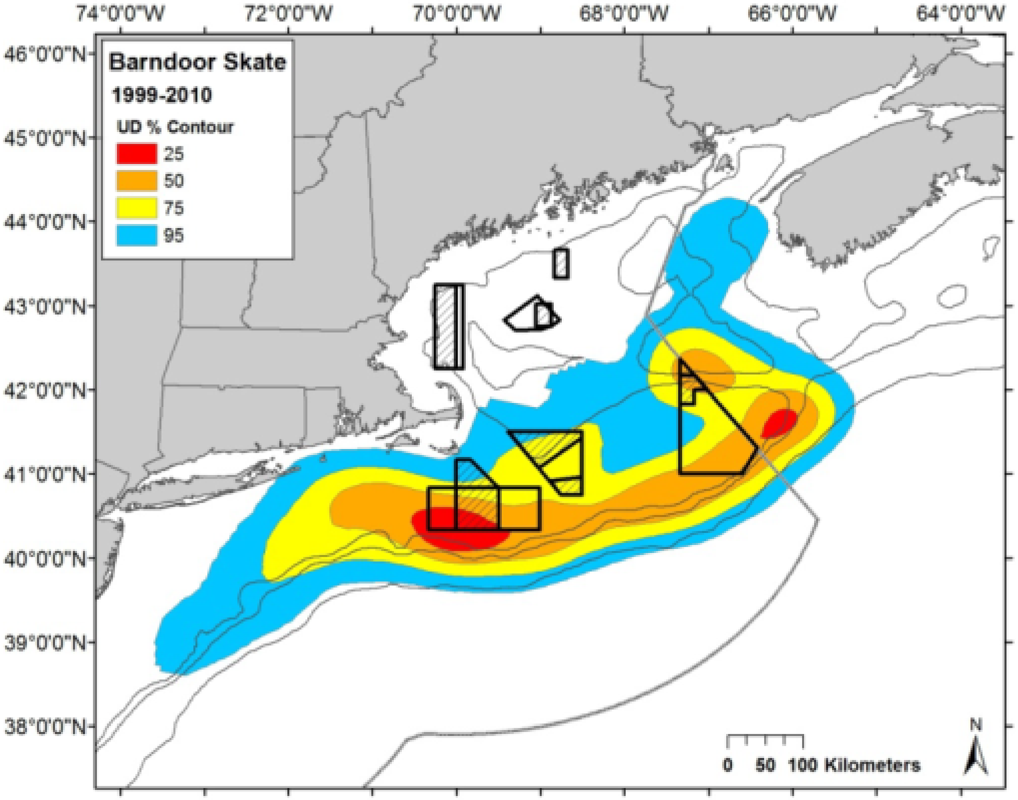
Table 122 – Estimated total discards of smooth skate in four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	18	4	591	250	863
2009	23	3	591	48	665
2010	15	15	577	52	659
2011	25	11	637	128	801
2012	20	3	596	172	791

Habitat management alternatives on Georges Bank and in Southern New England overlap with winter, little, and barndoor skate distributions. Both winter and little skate are currently very abundant, although overfishing is occurring on winter skate as of 2012, based on the percent change in three year moving average survey indices for the species. It is not known whether these species are resident in closed areas, such that the historic presence of closures may have contributed to their currently high biomass. Both species are very widely distributed over the bank, such that any combination of management areas will overlap their distribution. Altogether, it is unlikely that changing habitat management areas in Georges Bank and Southern New England will have a negative impact on winter skate or little skate. Trip limits and overall TALs for the wing and bait fisheries will likely control overall mortality on these stocks, regardless of changes in spatial management, although it should be noted that the approach to developing trip limits and TALs could change in the future. Furthermore, recent studies of discard mortality rates (Mandelman et al. 2013) indicate that these rates are lower than previously believed.

Barndoor skate occur in all of the current closed areas, but are most abundant along the margin of the bank, including the southwestern part of the Nantucket Lightship Closed Area and Closed Area II (Map 108). Barndoor skate abundance is increasing, and although it has not yet reached the biomass target, barndoor skate is not overfished and overfishing is not occurring. Retention of barndoor is still prohibited, and additional conservation of the stock may be helpful as it continues to rebuild. Based on its distribution, alternatives that reopen the southern part of Closed Area II and the NLCA would probably have the greatest effect on discards of barndoor skate.

Map 108 – Fixed kernel utilization distribution (UD) of positive barndoor skate tows from the 1999-2010 NEFSC bottom trawl survey relative to the Northeast Multispecies year-round closed areas and habitat closed areas. Warmer colors indicate higher density of thorny skate presence.



Like thorny and smooth skates, because barndoor skate have a zero possession limit, it is assumed that increases in effort in areas where they are more abundant would not lead to directed fishing effort on the stock. However, they are caught incidentally in various gears so fishing does contribute to mortality (Table 123). The highest discard rates are in the otter trawl and sink gillnet fisheries, and at least some of the effort in those fisheries is directed on skates. If barndoor abundance continues to increase and retention is allowed at some point in the future, these discards would likely be converted to landings, at least in the wing fishery which targets larger animals. For reference, barndoor skate contribute 3,221 mt to the skate complex Total Allowable Landings (TAL) under the alternative specifications currently under development.

Table 123 – Estimated total discards of barndoor skate iin four bottom-tending gear types, reported annually on a calendar year basis in metric tons. Table adapted from data provided in the 2014-2015 skate specifications document.

	Fixed gears		Mobile gears		
Year	Sink gillnet	Longline	Otter trawl	Scallop dredge	Total
2008	742	39	3258	290	4329
2009	188	29	1492	335	2044
2010	764	121	2544	303	3732
2011	1660	36	4370	570	6636
2012	965	9	3413	503	4890

Table 124 summarizes the potential impacts of the various habitat management alternatives on each of the skate stocks, with the exception of rosette and clearnose which do not overlap the current or alternative management areas.

Table 124 – Summary of the impacts of habitat management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate.

<table>
<tr><th>Sub-region</th><th>Alt</th><th>Thorny</th><th>Smooth</th><th>Little</th><th>Winter</th><th>Barndoor</th></tr>
<tr><td rowspan="3">EGOM</td><td>1</td><td colspan="2">Neutral</td><td colspan="3" rowspan="12">Few to no impacts – based on survey data, these three species have very limited distributions in the GOM</td></tr>
<tr><td>2</td><td colspan="2" rowspan="2">Neutral to slightly positive – some overlap between species and management areas such that elimination of MBTG fishing would benefit the stock</td></tr>
<tr><td>3</td></tr>
<tr><td rowspan="4">CGOM</td><td>1</td><td colspan="2">Slightly positive</td></tr>
<tr><td>2</td><td colspan="2">Slightly negative</td></tr>
<tr><td>3</td><td colspan="2" rowspan="2">Slightly positive</td></tr>
<tr><td>4</td></tr>
<tr><td rowspan="5">WGOM</td><td>1</td><td>Positive</td><td>Slightly positive</td></tr>
<tr><td>2</td><td>Negative</td><td>Neutral to slightly negative</td></tr>
<tr><td>3</td><td>Slightly negative – removal of management areas on Jeffreys Ledge could cause increased fishing on the stock. Bigelow Bight area would provide some conservation benefits.</td><td rowspan="3">Neutral to slightly negative – less so than Alt 2</td></tr>
<tr><td>4</td><td rowspan="2">Neutral – similar protection compared to current management area, although fixed gear</td></tr>
<tr><td>5</td></tr>
</table>

Sub-region	Alt	Thorny	Smooth	Little	Winter	Barndoor
		fishing would be allowed throughout areas				
	6	Slightly negative – removal of management areas on Jeffreys Ledge could cause increased fishing on the stock				
	7a and 7b	Uncertain, probably neutral				
GB	1	Slightly positive – limited distribution of these species in northern parts of existing CAI and CAII which would be retained under no action		Neutral – species are abundant and found throughout sub-regions, and fishing mortality is controlled via other means		Neutral to slightly positive
	2	Slightly negative – limited distribution of these species in northern parts of existing CAI and CAII which would be eliminated under these alternatives				Slightly negative – increases in fishing could increase bycatch in southern part of CAII; however stock not overfished
	3					
	4					
	5					
	6					
GSC-SNE	1	None – very limited distributions of these species in these areas				Neutral – highest abundance areas along southern margin of GB, not in this sub-region
	2					
	3					
	4					
	5					
	6					

4.5.3.1.2 Spawning management alternatives

The spawning management alternatives would maintain existing year round and seasonal closures (No Action), or modify these areas (GOM Alternative 2, GB Alternatives 2 and 3). Specifically, GOM Alternative 2 would remove the WGOM and Cashes Ledge year round closures, as well as the common pool rolling closures. Depending on the habitat management alternatives selected for these areas, changes to the WGOM closure could negatively impact thorny skate, and to a lesser extent, smooth skate. Portions of these areas would still be closed to many gears capable of catching groundfish on a seasonal basis (April-June, depending on the area).

Georges Bank Alternative 2 would remove the Nantucket Lightship Closure, and make CAII seasonal in the spring. This could increase discards of barndoor skate, and thereby cause negative impacts on the stock relative to no action.

Table 125 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted).

Region	Alt	Thorny	Smooth	Little	Winter	Barndoor
GOM	1	Positive	Neutral to slightly positive	None – very limited distributions of these species in these areas		
	2A and 2B	Negative	Neutral to slightly negative			
GB	1	Slightly positive – limited distribution of these species in northern parts of existing CAI and CAII which would be retained under no action		Neutral – species are abundant and found throughout sub-regions, and fishing mortality is controlled via other means		Positive – NLCA and southern part of CAII may limit bycatch on the stock, although there are access programs currently in place in CAII
	2A and 2B	Slightly negative – limited distribution of these species in northern parts of existing CAI and CAII which would be made seasonal under action alternatives				Slightly negative – CAII would only be in place 3 months of the year; however stock not overfished; NLCA would be removed.
	3A and 3B					

4.5.3.1.3 Dedicated Habitat Research Area alternatives

Although they may have costs and benefits due to associated restrictions on fishing, these types of impacts of Dedicated Habitat Research Areas are considered in analysis of their corresponding Habitat Management Areas. Therefore, DHRA impacts are relative to any additional fishing restrictions that might provide enhanced conservation, and to the expected benefits of completing research projects.

Table 126 – Summary of the impacts of research alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3.

Alt	Thorny	Smooth	Little	Winter	Barndoor
1 – No DHRA	Neutral – no research areas designated, but these locations may be managed for habitat or spawning purposes				
2 – E Maine	Slightly positive – limited overlap between stocks and this DHRA such that research is likely to generate only limited information about skates in this area.		None – stocks do not occur in DHRA		

3A, 3B, 3C – Stellwagen	Positive – thorny skates are abundant in this area, such that research should provide information to help better manage the skate resource.	Slight positive – lesser overlap with distribution of smooth skates.	None – limited overlap between stocks and this DHRA	
4 – Georges Bank	None – no overlap between stocks and this DHRA		Positive – species are common in this area and research could provide information to help better manage the skate resource.	Neutral to slightly positive– DHRA is not an area of high abundance for barndoor skate
5 – Sunset provision	Neutral. This alternative is designed to remove a DHRA if it is not being used, and a DHRA that is not in use will not be producing positive benefits in terms of increased information.			

4.5.3.1.4 Framework and monitoring alternatives

No action measures would be expected to have neutral impacts on the skate resource. Under Alternative 2, enhanced data collection and timely review and strategic decision making on spatial management issues could indirectly benefit the skate resource.

4.5.3.2 *Fishery impacts*

4.5.3.2.1 Habitat management alternatives

Skates are caught on both directed and incidental trips in the multispecies, monkfish, and to a much lesser extent, scallop fisheries, in trawl, sink gillnet, and scallop dredge gear. The habitat management alternatives generally restrict mobile bottom-tending gears, so there would be no restrictions on directed or incidental catch of skates using gillnets except where such catches are already prohibited under no action (i.e. in the current year-round groundfish closed areas). Statistical areas 521 and 537 have the highest catches of skates in gillnets, and some of this effort likely occurs within the proposed Cox Ledge and Great South Channel HMAs. Restrictions on mobile gears in these areas could potentially increase opportunities for gillnetting, although currently gillnet fishing occurs in conjunction with mobile gear fishing as these are open areas.

The greatest concentration of skate trawl effort is in statistical area 539 south of Rhode Island, but there are relatively high levels of skate trawl effort in areas 537, which includes Cox Ledge, and 522 and 561, which contain the various Northern Edge, Georges Shoal, and CAII HMAs (GB Alternatives 1, 3, 4, 5, and 6). Restrictions on trawling in these areas could negatively impact the skate fishery. However, reopening the NLCA, CAI, and CAII groundfish and habitat closures could provide increased fishing opportunities for the skate fishery (GB Alternatives 2-6 and GSC/SNE Alternatives 2-6). Although it is difficult to predict future effort distributions, winter and little skate occur throughout these areas and observed haul locations indicate that trawling for skates occurs along the boundaries of the areas. However, because these two stocks are so widely distributed throughout the Georges Bank and Southern New England region, many skates are still available to the fishery even in the presence of area closures.

With the exception of some gillnet activity in statistical area 514, skate landings from the GOM are generally fairly limited. Therefore, changes to habitat management areas in the GOM would likely have only minimal impacts on the skate fishery, except to the extent that negative biological impacts on thorny skate, and to a much lesser extent, smooth skate, affect the fishery in the long run.

Table 127 – Summary of the impacts of habitat management alternatives on the skate fishery. No impacts are expected on rosette skate or clearnose skate.

Sub-region	Alt	Fishery impacts
EGOM	1	None. There is no fishing using trawls in this sub-region.
	2	
	3	
CGOM	1	Neutral to slightly negative. There are small amounts of skates landed with trawl gear in statistical area 515 overlapping Cashes Ledge, so the no action management areas may limit skate fishing somewhat.
	2	Slightly positive. This alternative would remove current management areas and allow skate fishing throughout the region with trawl and gillnet gears, but since there are zero possession limits on smooth and thorny skates, such benefits are likely to be limited.
	3	Neutral to slightly positive; uncertain. This alternative would adjust current management areas, remove the Cashes Ledge groundfish closure, and would add a management area on Platts Bank. It is unclear how this would affect fishing opportunities for skates.
	4	Neutral to slightly positive; uncertain. This alternative would adjust current management areas and remove the Cashes Ledge groundfish closure. It is unclear how this would affect fishing opportunities for skates.
WGOM	1	Neutral. Little and winter skate do not occur in any abundance inside the WGOM or Cashes Ledge closed areas, so impacts of these areas on the skate fishery are probably minor.
	2	Neutral. Providing access to current closures is unlikely to benefit the skate fishery given the distribution of little and winter skates.
	3	Neutral. The various updated closures in these alternatives are unlikely to impact the the skate fishery given the distribution of little and winter skates.
	4	
	5	
	6	
	7a and 7b	Neutral. Adjustments to gear measures are unlikely to impact the skate fishery since there is limited trawl fishing for skates in this region to begin with. Also, the 12-inch roller gear restriction already applies to Multispecies vessels, which probably contribute most of the skate landings in this location.
GB	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to CAI and CAII, but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions

Sub-region	Alt	Fishery impacts
		may not in fact be very limiting to the fishery.
	3	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to Northern Edge area only. Impacts depend on measure selected for northern edge area; a gear restriction would still allow trawl use.
	4	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to Northern Edge area and smaller Georges Shoal Gear Modification Area. Impacts depend on measure selected for northern edge area; a gear restriction would still allow trawl use.
	5	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to larger Georges Shoal GMA and Georges Shoal MBTG area. Trawling with restricted gear would be allowed throughout, except within the Georges Shoal MBTG area, which contains a relatively small fraction of the overall revenue shown for the entire Georges Shoal Gear Modification Area.
	6A and 6B	Overall positive impacts of shifting from CAI and CAII areas (habitat and groundfish) to modified CAII habitat area. Some fishing effort likely to be displaced by the modified area (either Option A or Option B).
GSC-SNE	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to NLCA, but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions may not in fact be very limiting to the fishery.
	3	Neutral – these alternatives would remove the NLCA habitat and groundfish areas and create new areas further north and on Cox Ledge. In statistical area 526, observer hauls are concentrated in the south along the edge of the bank. Some trawl effort might be displaced in Area 521, but most of the skate landings in this area are from gillnets, which would not be restricted under these alternatives.
	4	
	5	
	6	

4.5.3.2.2 Spawning management alternatives

In general the action alternatives will increase access to fishing grounds and make some year-round areas seasonal. This should provide benefits to the fishery, although given the ubiquitous distribution of little and winter skate, the No Action closed areas may not be especially limiting to the fishery.

Table 128 – Summary of the impacts of spawning management alternatives on skate stocks. No impacts are expected on rosette skate or clearnose skate. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A (recreational fishing restricted from spawning areas) and B (recreational fishing exempted).

Region	Alt	Fishery impacts
GOM	1	Neutral to slightly negative. There are small amounts of skates landed with trawl gear in statistical area 515 overlapping Cashes Ledge, so the no action management areas may limit skate fishing somewhat.

	2A and 2B	Neutral to slightly positive. This alternative would remove the current WGOM and Cashes Ledge groundfish management areas and allow skate fishing with trawl and gillnet gears, but since there are zero possession limits on smooth and thorny skates, such benefits are likely to be limited.
GB	1	Slightly negative to neutral. This alternative restricts trawl and gillnet access to CAI, CAII, and NLCA but little and winter skate are broadly distributed so this may not be limiting to the fishery.
	2A and 2B	Neutral to slightly positive – this alternative would generally increase access to fishing areas, although little and winter skate are broadly distributed so current restrictions may not in fact be very limiting to the fishery.
	3A and 3B	

4.5.3.2.3 Dedicated Habitat Research Area alternatives

As noted above, DRHA impacts are relative to the expected benefits of completing research projects.

Table 129 – Summary of the impacts of research alternatives on the skate fishery. Because skates are only infrequently caught in recreational gear, no difference in impacts expected between options A, B, and C in Alternative 3.

Alt	Fishery impacts
1 – No DHRA	Neutral – no DHRAs specifically designated, although there may be management measures in these locations because they have overlapping habitat or spawning management designations.
2 – E Maine	None – there do not appear to be any significant skates or skate landings in this area such that research would provide a benefit to this fishery.
3A, 3B, 3C – Stellwagen	Positive – there are thorny and smooth skate in this area and research on fish and their ecosystem interactions could help in development of management strategies to rebuild these stocks, especially thorny skate.
4 – Georges Bank	Slightly positive – little, winter, and barndoor skate occur in this area, and and research on fish and their ecosystem interactions could help in development of management strategies. This is less critical for these stocks as their status is better than for thorny skate.
5 – Sunset provision	Neutral – if beneficial research is not being conducted, areas would sunset.

4.5.3.2.4 Framework and monitoring alternatives

The skate fishery is closely tied to the multispecies fishery, so adjustments to management areas, especially those focused on groundfish, could indirectly affect skate fishing opportunities. Improved data collection and a more explicit process for developing management adjustments would indirectly benefit the skate fishery to the extent that they participate in the management process and benefit from better management that results from improved data collection.

4.5.4 Atlantic sea scallop

These sections describe potential impacts of the alternatives on the scallop resource and fishery.

4.5.4.1 *Habitat management alternatives*

4.5.4.1.1 Gulf of Maine

The federal survey and assessment model do not include the Gulf of Maine, and there is relatively limited resource there relative to Georges Bank and areas further south. In general, the GOM habitat management alternatives are expected to have neutral impacts on the scallop resource relative to No Action. In the Central GOM sub-region, action alternatives could remove area closures on Fippennies Ledge (CGOM Alt. 2 and 4), and Cashes Ledge (CGOM Alt 2). Both areas contain sea scallops (Stokesbury et al 2010) that could be subject to fishing pressure if the areas reopen. Impacts to the resource as a whole would not be expected, but there could be local effects on these populations of scallops. Similarly, in the Western GOM sub-region, Alternatives 2, 3, and 6 could remove area closures on Jeffreys Ledge, an area which also contains sea scallops (Stokesbury et al 2010). Again, local population effects could result but impacts to the resource as a whole would not be anticipated.

Fishery impacts, GOM? Closing Platts Bank (Central GOM Alternative 3)? Opening Fippennies Ledge? (CGOM Alternatives 2 and 4)? Opening Jeffreys Ledge (WGOM Alts 2, 3, and 6)?

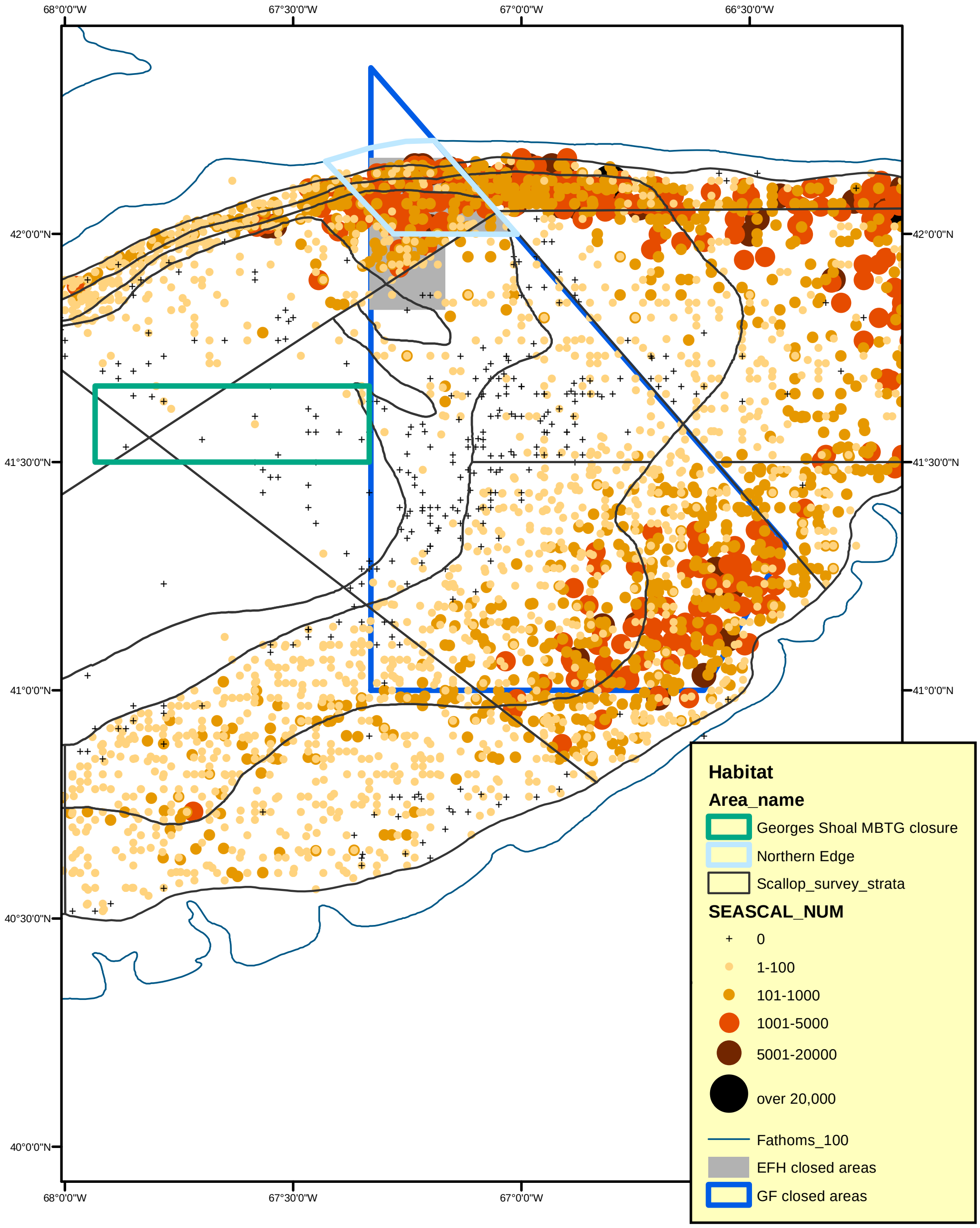
The potential impacts of Habitat Management Area alternatives in the Georges Bank and Great South Channel/Southern New England sub-regions on the scallop resource and fishery were assessed using the results of the long term and short term potential yield analysis, as well as the results from the SAMS model projections.

4.5.4.1.2 Georges Bank and Great South Channel

4.5.4.1.2.1 Long and short term yield estimates

The long term yield per Habitat Management Area was calculated by multiplying the recruitment in each area by the maximum yield per recruit. A stratified mean was calculated since yield per recruit varies in each strata because of depth. First, the area (in nm^2) of each habitat alternative was calculated, as well as the area within each NEFSC shellfish survey strata. This was done so that a stratified mean could be calculated for each Habitat Management Area since yield varies by depth and because all shellfish strata are not sampled equally over time. Map 109 shows the NEFSC shellfish survey strata in and around habitat management alternatives on the Northern Edge of GB, and Map 110 shows the Great South Channel. Orange circles indicate the total number of scallops per tow from all survey years combined (1966-2013).

Map 109 – NEFSC shellfish survey strata with EFH areas under consideration (Georges Bank) with scallop numbers from all survey years (1966-2013)



Map 110 – NEFSC shellfish survey strata with EFH areas under consideration (GSC/SNE) with scallop numbers from all survey years (1966-2013)

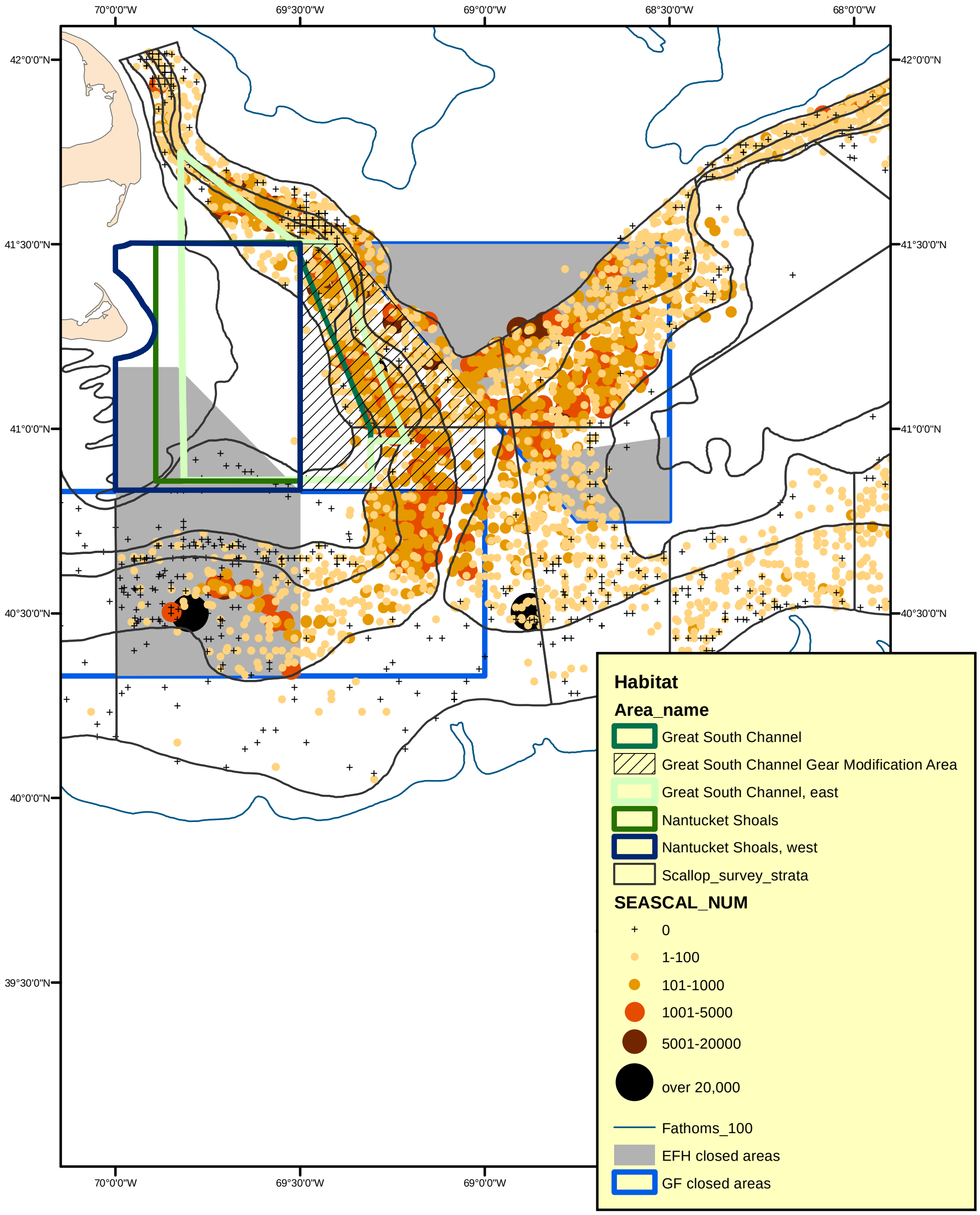


Table 130 summarizes the long-term (LT) and short-term (ST) yield potential per area. The long-term yield values vary since the recruitment data is very variable, and one or two years with very high recruitment heavily influence the mean. The mean estimate is always higher and can be viewed as an upper bound, while the median is a more conservative estimate. For reference, the mean estimated LT yield from the entire scallop resource in all open and closed areas on GB and the MA is about 25,000 mt per year.

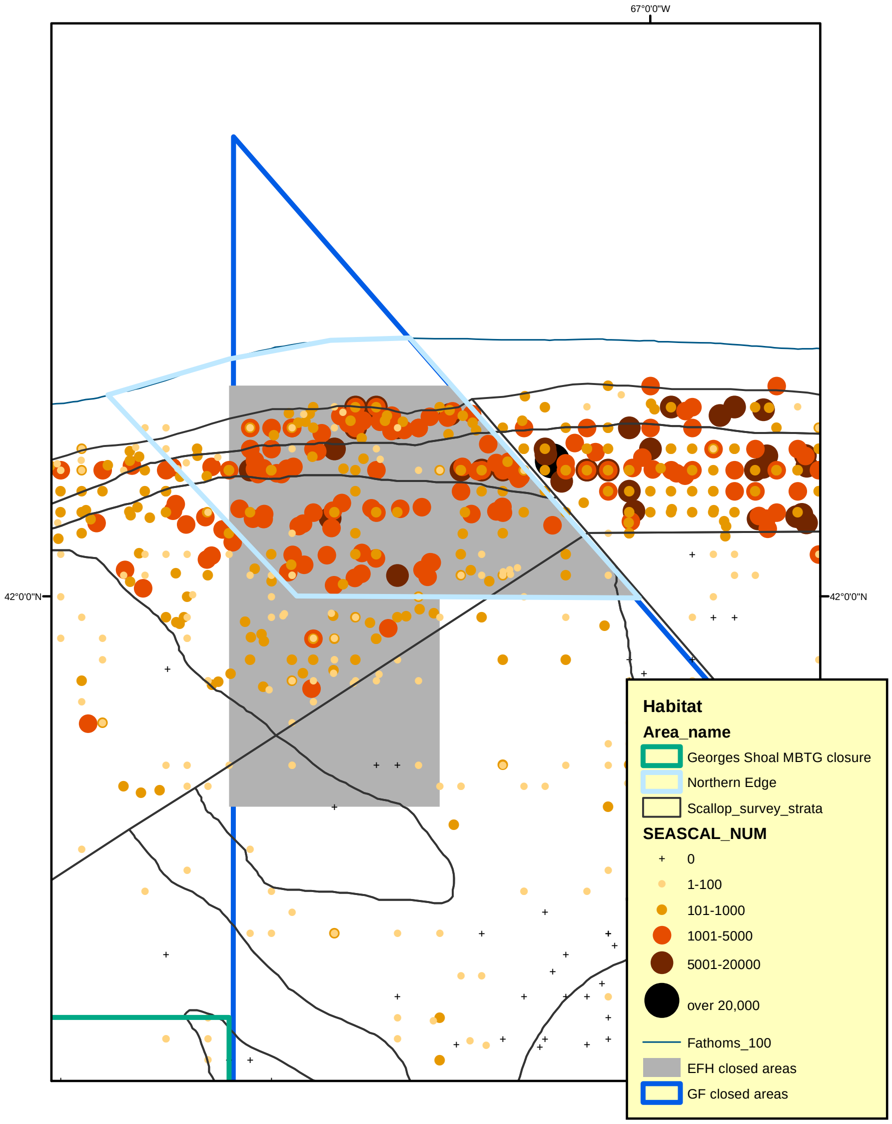
Table 130 – Long-term and short-term yield potential from current EFH closed areas and several new areas under consideration

Sub-region	Area	Status	Long-term yield (mean)	Long-term yield (median)	Biomass 2013	Short-term yield
GB	CAII North (Habitat Closure plus northern triangle of CAII groundfish closure, Alt 1)	Current	1,254	536	8,630	2,589
GB	CAI-N Habitat Closure (Alt 1)	Current	601	42	4,841	1,452
GB	CAI-S Habitat Closure (Alt 1)	Current	29	11	1,658	497
GB	Northern Edge HMA (Alts 3 and 4)	Proposed	1,214	502	7,433	2,230
GB	CAII Extended (Alt 6A)	Proposed	1,858	800	11,519	3,456
GB	CAII Extended with area removed along EEZ (Alt 6B)	Proposed	825	324	4,493	1,348
GSC-SNE	Nantucket Lightship Habitat Closure (Alt 1)	Current	552	3	93	28
GSC-SNE	Great South Channel HMA (Alt 4)	Proposed	313	64	100	30
GSC-SNE	Great South Channel East HMA (Alt 3)	Proposed	4,034	1,101	4,460	1,338

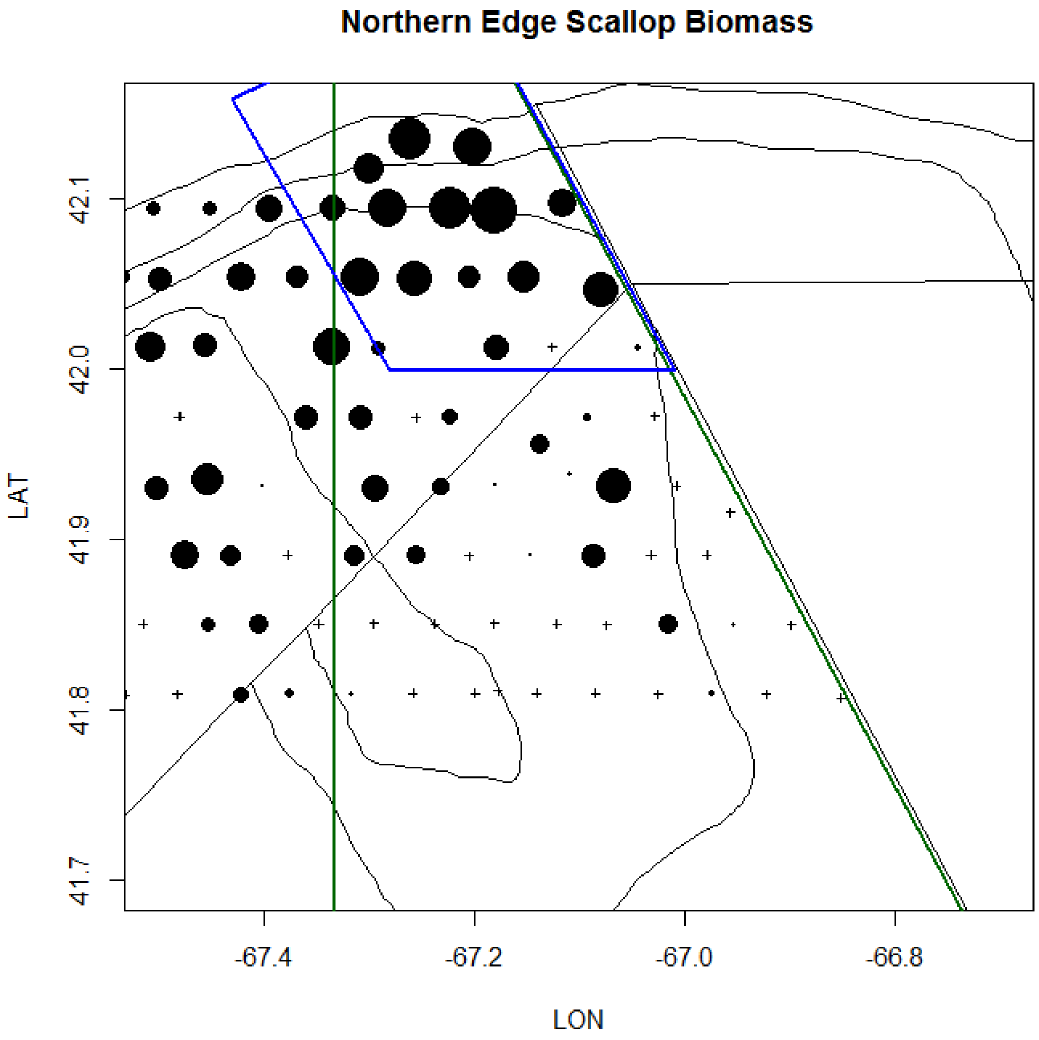
In the Georges Bank sub-region, the extended version of CAII (Alternative 6A) has the highest LT yield potential, followed by CAII North (1,254 mt), the Northern Edge HMA (1,214 mt), and CAII extended with the area along the EEZ removed (Alt 6B, 825 mt). The CAII EFH closure and all of the areas overlapping it have high short term yield estimates as well. In general, 2,500 mt is equivalent to about one 18,000 pound trip per vessel, or about 6 million pounds overall. CAIN has only 601 mt LT yield potential, and CAIS does not have much yield potential at all. When the three existing EFH closures on GB are combined, the LT yield potential is about 1,884 mt. Therefore, about 7% of the total potential LT yield for the entire scallop resource is within the current EFH closed areas, using the mean LT yield estimates.

The Northern Edge HMA area under consideration has similar long term yield potential (1,214 mt) as the No Action CAII north area (all of CAII north, 1,254 mt). The majority of the yield potential in the new area comes from a very small “triangle” in shallower waters along the western boundary of CAII within the new Northern Edge HMA (indicated by green arrow in Map 111), and not the deeper waters along the northern part of the new area. The western part of the new Northern Edge HMA which is currently open to the scallop fishery likely has higher LT yield potential than the southern part of the No Action EFH area that would potentially open if the No Action EFH area is eliminated. Specifically, in terms of LT yield potential, the additional area closed in the Northern Edge HMA is more productive than the area that would open in the southern part of the existing EFH closure on the northern edge. Therefore, the potential impacts of the Northern Edge HMA (Alternatives 3 and 4) on the scallop fishery would likely be slightly negative but similar to No Action/Alternative 1. The long term yield potential of the extended version of CAII (Alternative 6A) is about 50% greater than the existing area or the Northern Edge HMA. Opening a buffer zone along the EEZ (Alternative 6B) lowers the long term yield potential. Thus Alternative 6A is expected to have negative impacts on the fishery relative to No Action due to reduced access to high abundance scallop areas, and Alternative 6B is expected to have positive impacts relative to No Action.

Map 111 – Scallop (number/tow) from NEFSC surveys (all years) with EFH areas on the northern edge of Georges Bank. There is substantial long term yield potential in the area outlined in blue and west of the grey shaded area. This triangle would close under the new Northern Edge HMA (Alternative 3 or 4) or under Alternative 6A or 6B.



Map 112 – 2013 scallop biomass relative to Northern Edge HMA (Alternatives 3 and 4)



The three areas in the Channel, NL EFH (Alt 1), GSC East (Alt 3), and GSC(Alt 4), have very different results in terms of LT and ST yield potential. The No Action NL EFH area has relatively low LT yield potential, 552 mt based on the mean and 3 mt based on the median estimate (Table 130). This large difference suggests that the yield potential from this area is dominated by a few years with high levels of observed recruitment, and most years with relatively low levels of recruitment. The GSC alternative has even less, 313 mt based on the mean and 64 based on the median.

In contrast, the GSC East HMA is a very productive scallop yield area. The LT and ST yield potential from this area is very high. Even though the boundary only extends slightly farther east than the GSC area, it includes scallop survey strata 50 which is very productive. The estimated potential yield from this area is over 4,000 mt based on the mean. That is 16% of the 25,000 mt total potential yield for the entire scallop fishery. The percentage of total yield is lower, under 5%, using the median LT yield estimate instead (1,101 mt), but both are substantial.

Furthermore, this area is roughly 2-3+ times as productive as the Northern Edge HMA, depending on whether the LT median or LT mean is compared. The other Channel areas (Nantucket Shoals and Nantucket Shoals east) have not been evaluated for LT and ST impacts the same way. However, since they are shallower that the GSC alternative, the impacts on the scallop resource and fishery are expected to be lower than the GSC HMA alternative.

In summary, for both the GB and GSC-SNE sub-regions combined, about 10% of the total LT yield for the scallop fishery is estimated to be within the No Action EFH closed areas, (2,500 mt/25,000 mt). If all No Action EFH areas are eliminated in this action the overall yield available to the scallop fishery could increase by about that amount. If the No Action CAII EFH area is replaced with the Northern Edge HMA in this action, similar impacts overall would be expected since the estimates of LT yield for the areas are very similar. About 5% of the total estimated LT yield is within both areas (1,200 mt/25,000 mt), based on median estimates of LT yield.

All of the HMAs under consideration in the GSC are currently open to the scallop fishery. If the GSC HMA is closed, about 1% of the total LT yield would no longer be available to the fishery (313 mt / 25,000 mt). On the other extreme, GSC East HMA contains about 16% of the total LY yield for the fishery.

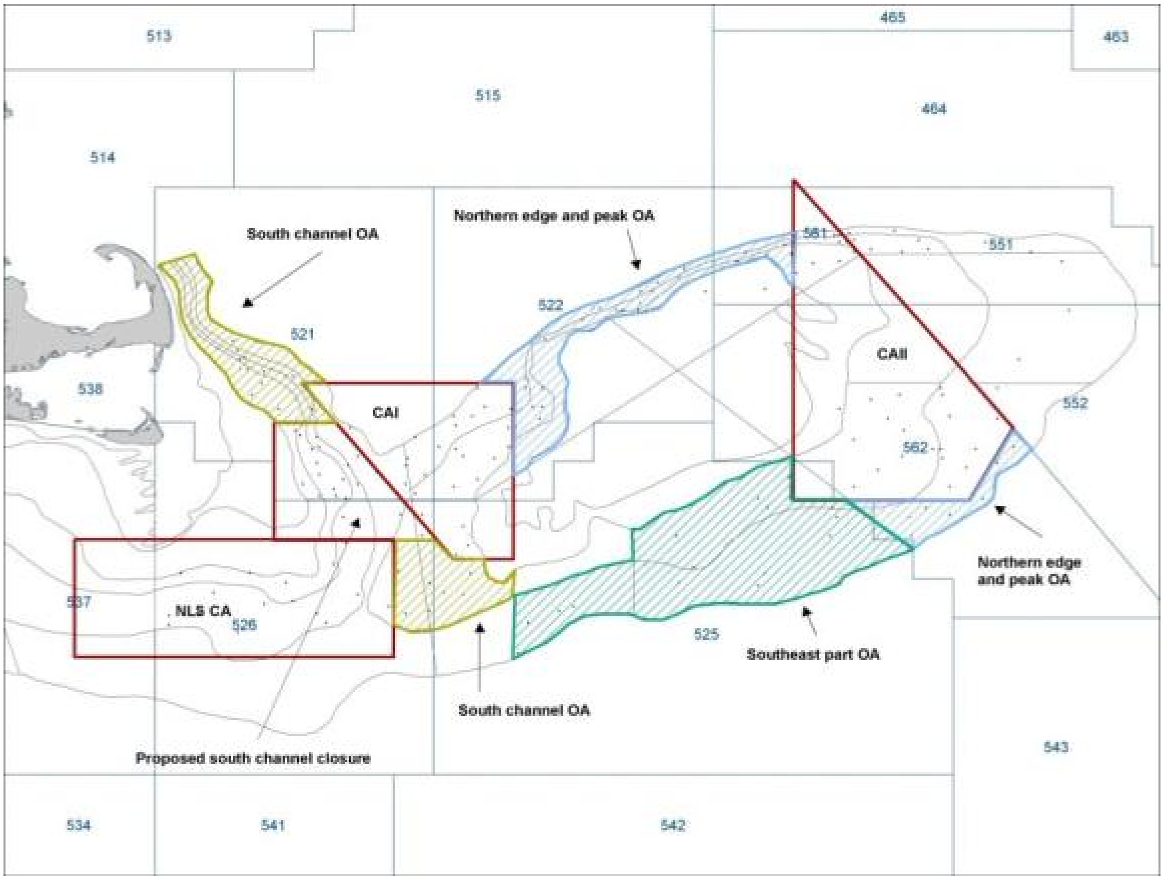
4.5.4.1.2.2 Model projected biomass and catch

The projected impacts on scallop biomass and catch are based on results from an updated version of the SAMS (Scallop Area Management Simulator) model. This model has been used to project scallop biomass and catch to aid management decisions since 1999. SAMS is a size-structured model that forecasts scallop populations in a number of areas. In this version of the model, the PDT modified the boundaries of the typical areas (Map 113) to include a handful of the alternatives under consideration. This allows the model to estimate the long term biomass inside and outside of various Habitat Management Areas. Modifying boundaries in the SAMS model is difficult and time consuming, so the PDT identified a feasible number of areas to assess, and did not run a separate SAMS projection for all groupings of Habitat Management Areas under consideration. These results were not updated to include GB Alternative 6A/B.

The final runs include:

1. No Action: EFH areas closed by Amendment 13 remain closed to the scallop fishery. Note that under No Action all of CAII north of 41° 30’ is considered closed to the scallop fishery because it is closed to the scallop fishery under the Multispecies FMP.
2. No HMAs closed, open all A13 EFH areas. The model run assumes that all existing EFH areas would be fished at a fishing mortality rate similar to an access area for several years (0.4), and then be fished at a more controlled level of access just below Fmsy for GB for the remainder of the time period.
3. New Northern Edge HMA (GB Alt 3) closed and other A13 EFH areas open
4. New GSC HMA in Channel (GSC Alt4) closed and A13 EFH areas open
5. Combination of Northern Edge HMA (GB Alt3) and GSC HMA (GSC Alt4) closed and A13 EFH areas open

Map 113 – SAMS model areas, with statistical areas and NEFSC shellfish stratum boundaries on Georges Bank



These analyses are more dynamic than the results presented in the previous section because they do not simply focus on the area being assessed, rather these analyses simulate fishing activity and associated impacts to the fishery overall. The model makes assumptions about where effort will be displaced based on fleet dynamics observed in the fishery and estimated catch rates in various areas. When reviewing the results it is important to keep in mind that there are a handful of constraints placed on the model in terms of how much effort is allowed in a certain area. Mainly, the principles used in the Scallop FMP to set target catches (total F cannot exceed 0.28 in all areas and open area F cannot exceed 0.38) are maintained in these simulations. Therefore, these results show the potential impacts of the HMAs under consideration, but as constrained by the area management principles in the Scallop FMP.

For example, if the EFH areas are removed in OA2, the SAMS model would not simply keep open area effort as it has been, and add effort into newly opened EFH at an uncontrolled level. The FMP would still constrain the overall limit at 0.28; the fishing mortality associated with the Annual Catch Target, or the fishing mortality rate that has a 25% chance of exceeding than Annual Catch Limit. Since the overall catch for the fishery would still need to be within these limits, open area DAS would need to be reduced to keep overall F under 0.28. Thus, some of the trends in the results, especially the first few years, are an artifact of F_{target} limits used in the FMP. However, since those limits are how specifications are set in the scallop fishery, these results are more realistic than if effort simply adjusted based on available resource, without consideration for spatial and overall limits.[16]

4.5.4.1.2.2.1 Short-term results

Table 131 summarizes short-term impacts (FY2015). The No Action alternative, keeping the current EFH areas closed to the scallop fishery, has the lowest 2015 projected landings (19,366 mt). Open area DAS and associated F in open areas are higher, compared to alternatives that open current EFH areas. The overall constraint on effort in 2015 for the No Action Alternative is the open area F limit of 0.38. That is the same for Run 3 and Run 5, the runs that close the Northern Edge HMA. Because the current CAII EFH area and the new Northern Edge HMA have such similar levels of biomass and potential yield, those runs overall are very similar. Run 3 and Run 5 provide higher landings with lower bottom area swept in 2015 primarily because the CA1N EFH area is available to the scallop fishery, which has a substantial amount of exploitable biomass in 2015.

The overall constraint on effort in Run 2 and Run 4 is that total F cannot exceed 0.28. When more areas become open to the scallop fishery the main constraint becomes the total F limit of 0.28, and not the open area F limit of 0.38, which is the main constraint when scallop biomass is within closed areas. For example, in Run 2 with no EFH closures, most catch is estimated to come from MA access areas and newly opened EFH areas. That represents a large portion of the total F for the fishery, leaving less F available for open areas. n Run 2, open area F falls to 0.27 and 18 DAS in areas outside of MA access areas and newly opened EFH areas. Furthermore, in 2016 open area F would need to be reduced further to keep total F below 0.28. Specifically, the model projects open area F would need to be reduced to 0.13, or 10 DAS per FT vessel in 2016, to keep total F below 0.28 since F would be higher in MA access areas and newly opened EFH areas. While these DAS allocations are much lower than present values, the total landings for this scenario is higher than current levels because substantial catches are expected in both MA access areas and newly opened EFH areas. For example, for Run 2 – no closures- total landings is projected to be 21,927 mt and 22,013 in 2016. This run has the lowest bottom area swept because more effort is in MA access areas and newly opened EFH areas, which have higher LPUEs compared to open areas.

Run 3 and Run 5 have very similar short-term results again because the GSC HMA does not impact the analyses very much, so adding the GSC HMA area in Run 5 is not very different than Run 3, which is NE HMA only. Run 3 has the highest ST landings because of the windfall catch available in the southern portion of the CAII EFH area and CA1N EFH area. This could provide more landings in 2015 (about 3,500 mt or 7.7 million pounds) compared to No Action (current EFH areas remain closed). This “additional catch” does not impact open area DAS like it did in Run 2 because in Run 3 NE HMA is still closed and contains a large amount of biomass.

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[16] These analyses include five overall scenarios. It is possible after the public hearing process to run more scenarios based on additional input received. For example, different combinations can be run to help describe the potential cumulative impacts of several HMA alternatives together. FY 2015 is the first year that OA2 is expected to be implemented; therefore, that is the first fishing year that is included in the results. SAMS is run through 2027 to capture long-term impacts. The Scallop PDT discussed that this time period is the length of time used to assess the impacts of specification alternatives in the Scallop FMP, but an even longer time period may be more appropriate for assessing the potential impacts on long-term EFH closures. If time permits, the Scallop PDT may run these scenarios even longer to further assess the long-term impacts of these closures.

Keeping substantial biomass in a closed area allows open area F to increase; therefore, open area DAS for Run 3 (25 DAS) are the same as Run 1 (No Action). However, in Run 2 with no closures open area DAS did need to be reduced from 25 to 18 to keep overall F below 0.28.

Table 131 – Summary of 2015 results for several scenarios under consideration in OA2 based on SAMS

	Overall fishing mortality	Open area fishing mortality	Landings	Open area DAS	Full-time DAS	Bottom Area Swept
Run 1: No Action	0.2	0.38	19,366	9,186	25	2,024
Run 2: No EFH Closures	0.28	0.27	21,937	6,648	18	1,833
Run 3: NE HMA only	0.24	0.38	22,860	9,080	25	2,334
Run 4: GSC HMA only	0.28	0.27	22,069	6,829	19	1,839
Run 5: NE and GSC HMAs combined	0.24	0.38	22,798	9,068	25	2,315

4.5.4.1.2.2.2 Long-term results

The SAMS model is even more useful for assessing the potential long-term impacts. Figure 49 - Figure 51 compare the projected landings, biomass, and bottom area swept results for the five EFH runs.

Figure 49 – Projected scallop landings (mt) for 2015-2027 for the five model runs

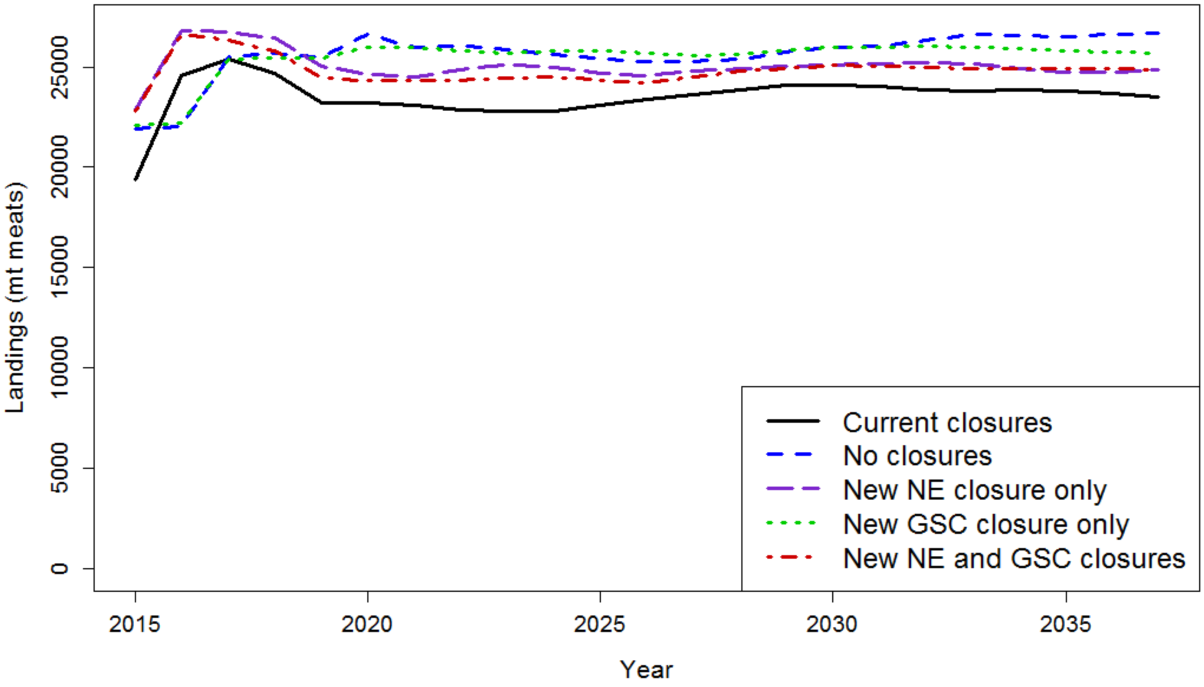


Figure 50 – Projected scallop biomass (mt) for 2015-2027 for the five model runs

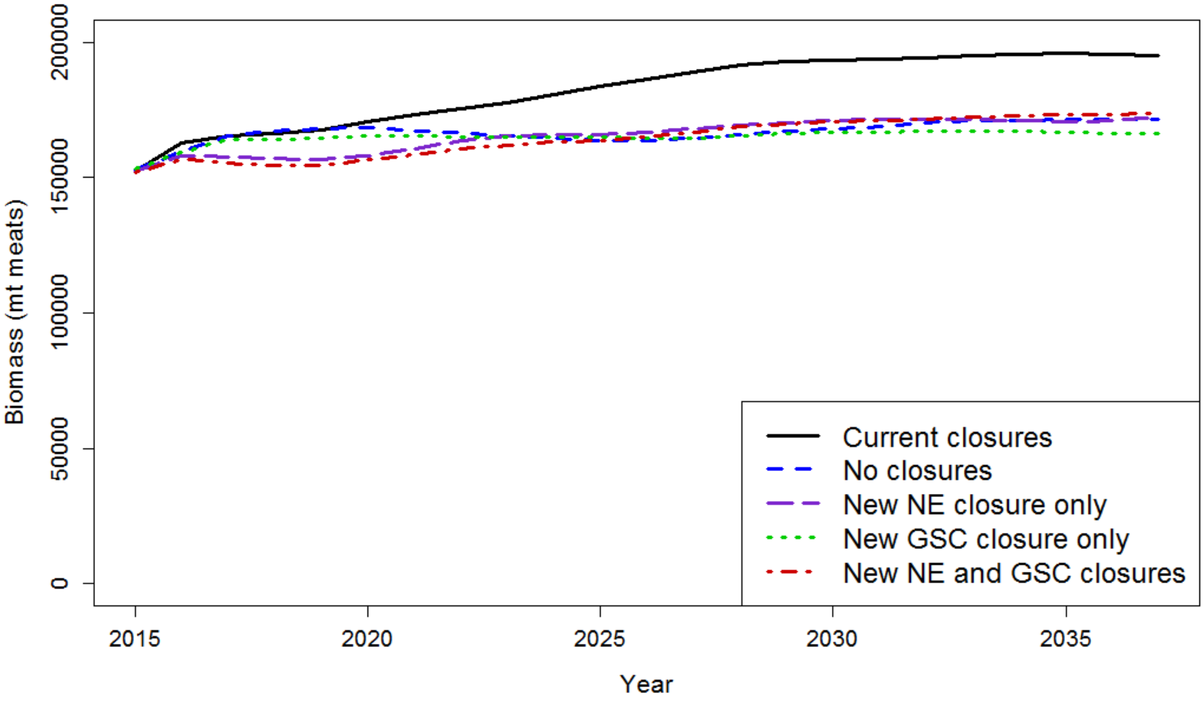
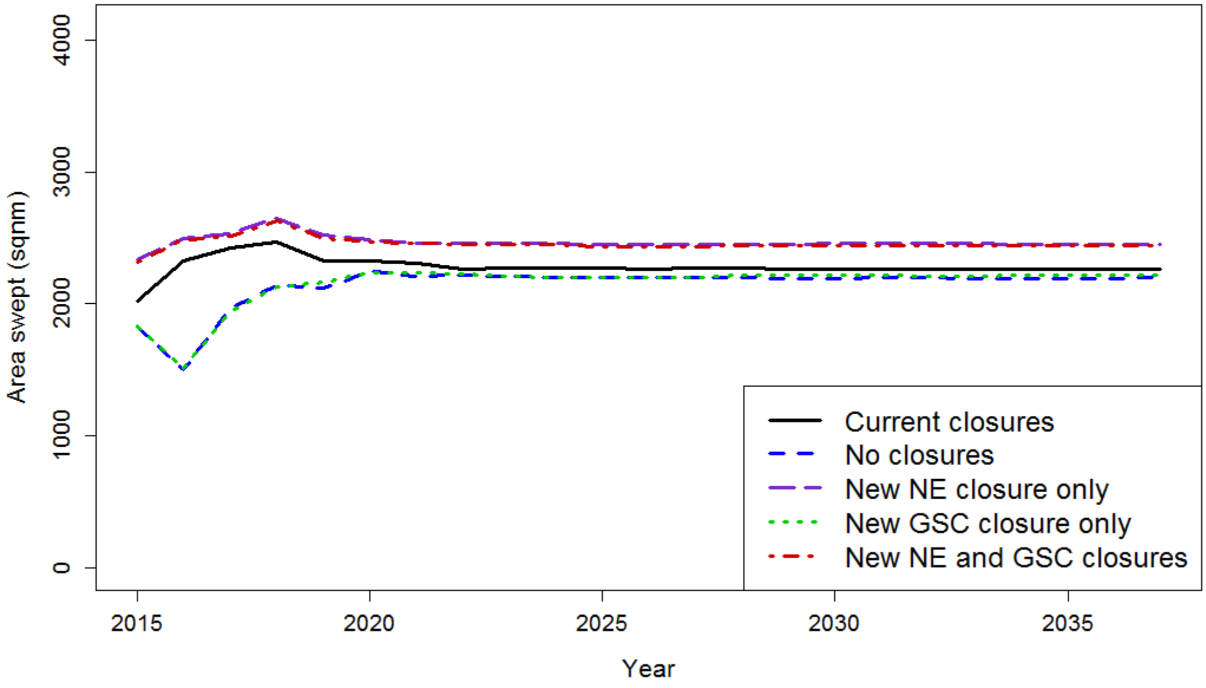


Figure 51 – Projected area swept (nm2) for 2015-2027 for the five model runs



The No Action run has the lowest projected landings at first, landings increase in 2016-2018 when the MA access areas open, and long-term landings are lower for this run compared to all the others (Figure 49). This scenario is limited by the open are F constraint (max of 0.38) in all years because a substantial amount of biomass is contained in the current EFH closed areas.

The results for Run 2 (no EFH closures) and Run 4 (GSC HMA only) are very similar because there is very little potential yield in the GSC HMA. Therefore, Run 4 is only slightly below Run 2 because there is some scallop biomass in GSC, but not a substantial amount. For Run 2, no closures, the total F limit of 0.28 is already the constraining factor for fishery allocations. Because all areas are available to the fishery, open area DAS are not higher to compensate for biomass in closed areas. Therefore, DAS and landings are lower for this run in the first few years because relatively little scallop biomass is in closed areas (22,000 mt in 2015 and increasing to 25,000 mt in 2017 and beyond).

However, long-term the projected landings for Run 2 (no closures) and Run 4(GSC HMA only) are the highest. This is evident after 2018 when the high biomass that is presently in the MA access areas is fished during 2015-2018. Not surprisingly, these results suggest that long-term landings would be higher if long-term closures did NOT overlap productive scallop grounds. Since Run 2 (no closures) and Run 4 (GSC HMA only) do not close very productive scallop grounds, long-term landings are higher compared to other runs that close portions of relatively productive scallop grounds. Run 1 (current EFH closures) has the lowest LT landings since it closes more area, and Run 3 and 5 have similar LT landings because they both close the Northern Edge HMA.

In terms of long-term biomass, Run 1 (No Action- current closures) would provide the highest LT biomass (Figure 50). For the most part, all the other runs have similar LT biomass. Run 2 (no closures) and Run 4 (GSC HMA only) have higher biomass at first, but after about 10 years the estimated biomass is similar for Runs 2-5. After 20 years it does seem that the runs with the NE HMA included (Runs 3 and 5) may provide higher biomass than the runs with no EFH closed areas (Runs 2 and 4), but the differences are not very large.

The projections of area swept are quite different for the EFH runs in the first few years (Figure 51). But again some of these trends are an artifact of how F_{target} is set in the Scallop FMP and the fact that a large proportion of total biomass is in the MA access areas that are expected to open in 2015. These factors have a large impact on future landings and F, regardless of how EFH areas are potentially modified in OA2. In brief, runs that have no EFH closures have lower ST and LT bottom area swept because the fishery has access to all areas, so catch would be concentrated in areas with highest catch rates.

Runs that close the NE HMA (Runs 3 and 5) have the highest ST and LT area swept estimates because these runs close a relatively productive scallop area, but also provide access to more fishing grounds than the No Action alternative increasing overall bottom time. Run 2 (no closures) and Run 4 (GSC HMA only) have the lowest estimates of bottom area swept, especially in the first few years when most fishing is estimated to occur in the MA access areas and newly opened EFH areas that have high catch rates.

When more area is closed to the fishery, effort is higher in open areas (up to max of 0.38), and higher open area DAS increases overall bottom area swept. The model suggests that closing the NE HMA (Run 3 and Run 5) would increase overall bottom time long-term compared to all the No Action EFH areas combined (No Action – Run1). This is the case because under Runs 3 and 5 more area is open to the fishery. Area swept in open areas is similar for all three of the runs that close part of the northern edge (Run 1, 3, and 5). But Run 1 (No Action) also closes CA1 north and other EFH and GF closed areas that have some level of scallop resource. Since those areas are open under Run 3 and 5 fishing activity is higher for those runs, thus total area swept is higher. Overall, the difference in area swept between all the runs is relatively minor. Run 2 with no EFH closed areas is about 2,100 square nautical miles overall, and Run 3 (NE HMA only) is about 2,400 square nautical miles overall.

4.5.4.1.2.2.3 Economic results

The following sections use the output results from SAMS to estimate both ST and LT economic impacts. The Scallop PDT has developed a price model that estimates revenues. The EFH runs in this section are generally described with the same nomenclature as the above section, but Table 132 shows the meaning of the terms used in the economic tables below.

Table 132 – Names used in analysis sections for various EFH scenarios

Run 1 – No Action	No Action
Run 2 – NOC	No EFH Closures
Run 3 – NE	NE HMA only
Run 4 - SCHCL	GSC HMA only
Run 5 - NESCH	NE and GSC HMAs combined

Landings and open area effort

The landings for scenarios that open current EFH areas (Run 2 to Run 5) are projected to exceed the landings for No Action scenario (that keeps those areas closed to the scallop fishery) both in 2015 and over the long-term from 2015 to 2037 (Table 133). The scenarios that include Northern Edge HMA (Run 3 and Run 5) results in higher landings (50.4 and 50.3 million lb.) in 2015 compared to other scenarios. The difference in the projected landings from the No Action levels ranges from 6 million lb. (for Run 2 and Run 4) to close to 8 million lb. (for Run 3 to Run 5) for 2015 fishing year (Table 134).

Over the long-term from 2015 to 2037 fishing years, Run 2 (no EFH closures) results in the highest landings (1298.9 million lb.) followed by Run 4(SCHCL) and Run 3(NE) (Table 133). Overall, the total landings are projected to exceed the no action landings by 65.2 million lb. (for Run 5- NESCH) or more (for Run 2, 3, and 4) (Table 134).

Projected open area DAS per limited access vessel in 2015 is lower for Run 4 (SCHCL, 19 days) and Run 2 (NOC, 18 days) compared to No Action (25) and Run 3 and Run 5 for reasons explained above. That is, because these runs have more areas open to the scallop fishery (or less biomass is closed to the fishery), the open area F limit of 0.28 becomes the constraining factor. For the same reason, over the long-term as well, total open area DAS per full time vessel is lower for Run 4 and Run 2 compared to other scenarios (Table 135).

Table 133 – Estimated landings (million lb.)

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		42.7	48.4	50.4	48.7	50.3
2016-2018	2016	54.1	48.5	59.0	49.0	58.7
	2017	56.0	56.3	59.0	55.9	58.0
	2018	54.4	56.6	58.3	56.1	56.9
2016-2018 Total		164.5	161.4	176.4	161.0	173.6
2019-2027	2019	51.2	56.3	55.2	56.1	53.8
	2020	51.1	58.6	54.3	57.2	53.6
	2021	50.9	57.3	54.0	57.3	53.6
	2022	50.3	57.4	54.8	56.9	53.6
	2023	50.2	57.0	55.3	56.7	53.8
	2024	50.3	56.4	55.0	56.8	54.1
	2025	50.9	55.9	54.4	56.8	53.6
	2026	51.5	55.7	54.2	56.6	53.4
	2027	52.1	55.7	54.6	56.3	54.0
2019-2027 Total		458.5	510.4	491.8	510.8	483.5
2028-2037 Total		525.9	578.7	550.7	570.3	549.5
Grand Total		**1191.7**	**1298.9**	**1269.2**	**1290.7**	**1256.9**

Table 134 – Estimated landings net of No Action landings (million lb.)

Sub-period	Fishing year	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH

2015 Total		5.7	7.7	6.0	7.6
2016-2018	2016	-5.6	4.9	-5.1	4.5
	2017	0.2	3.0	-0.1	2.0
	2018	2.2	4.0	1.7	2.5
2016-2018 Total		-3.1	11.8	-3.5	9.0
2019-2027	2019	5.1	4.0	4.9	2.7
	2020	7.5	3.2	6.1	2.5
	2021	6.4	3.1	6.4	2.7
	2022	7.1	4.5	6.6	3.3
	2023	6.8	5.1	6.5	3.7
	2024	6.1	4.8	6.5	3.8
	2025	5.0	3.4	5.9	2.6
	2026	4.2	2.7	5.1	1.9
	2027	3.6	2.6	4.3	1.9
2019-2027 Total		51.9	33.3	52.3	25.0
2028-2037 Total		52.8	24.8	44.4	23.6
Grand Total		**107.3**	**77.5**	**99.1**	**65.2**

Table 135 - Estimated open area DAS per limited access vessel (not including effort in newly opened EFH areas – catch from those areas is not considered in these DAS estimates)

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		25.0	18.0	25.0	19.0	25.0
2016-2018	2016	27.0	10.0	25.0	11.0	25.0
	2017	28.0	23.0	28.0	23.0	27.0
	2018	29.0	27.0	30.0	27.0	28.0
2016-2018 Total		84.0	60.0	83.0	61.0	80.0
2019-2027	2019	29.0	29.0	30.0	29.0	29.0
	2020	29.0	30.0	29.0	30.0	29.0
	2021	29.0	29.0	29.0	29.0	29.0
	2022	28.0	29.0	30.0	29.0	29.0
	2023	28.0	28.0	30.0	29.0	29.0
	2024	28.0	28.0	29.0	29.0	29.0
	2025	29.0	28.0	29.0	28.0	29.0
	2026	29.0	27.0	28.0	28.0	28.0
	2027	30.0	27.0	29.0	28.0	29.0
2019-2027 Total		259.0	255.0	263.0	259.0	260.0
2028-2037 Total		298.0	285.0	288.0	284.0	291.0
Grand Total		**666.0**	**618.0**	**659.0**	**623.0**	**656.0**

Price and Revenue

The annual scallop revenues expressed in 2013 constant prices (undiscounted values) show that the revenues in 2015 fishing year will be considerably higher for scenarios that open current EFH areas (Run 2 to Run 5) compared to the No Action scenario both in the short- and the long-term (Table 137).

The present value of the revenues are projected to exceed the No Action values by over 50 million for scenarios with no EFH closures (RUN 2 –NOC) or with a new closure in South Channel (RUN 4 – SCHL) and by over $60 million for the scenarios that include a new closure on the Northern Edge (Run 3 and Run 5) in 2015 fishing year using a 3% discount rate. These values are slightly lower if the present values were calculated using a 7% discount rate, ranging from $47 million for RUN 2 (SCHCL), $50 million for RUN 4 (SCHCL) and to about $57 million to $58 million for scenarios that include a new EFH Closure on the Northern Edge (RUN 3 and RUN 5).

From 2015 to 2037, Run 2 (no EFH closures) would result in the largest cumulative revenues ($9,174 million) followed by Run 4 (SCHCL, $9,137 million) and Run 3 (NE, $9,035 million) estimated using a 3% discount rate (Table 138). Present value of cumulative revenues will be lower when estimated using a 7% discount rate (Table 140).

Over the long-term from 2015 to 2037, the present value of the projected revenues for the no closure scenario will exceed the no action values by $640 million ($399 million) using a 3% discount rate (7% discount rate). This is followed by the scenario that includes a South Channel closure (RUN 4, SCHCL), which is estimated to increase the present value of scallop revenues by $602 million ($381 million) using a 3% discount rate (7 % discount rate) at the 2013 inflation adjusted constant values. The present value revenues for other scenarios with new EFH closures (Run 5, NESCH and Run 3, NE) will exceed the no action values by $422 million or more compared to levels for No Action (Table 139) over the long-term using a 3% discount rate. The ranking of the revenues is not expected to change if instead a 7% discount rate is used to estimate the present value, with RUN 2 estimated to result in largest revenues and RUN 5 with the smallest revenue gains. Nevertheless, all these new EFH scenarios will have significant positive economic impacts on the scallop fishery over the long-term.

Table 136 – Preliminary projections for price (in 2013 inflation adjusted prices; average price in 2012=$9.77)

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		10.7	10.5	10.4	10.5	10.4
2016-2018	2016	10.1	10.5	10.0	10.5	10.0
	2017	10.0	10.1	9.9	10.1	10.0
	2018	10.1	10.1	10.0	10.1	10.1
2016-2018 Total		10.1	10.3	10.0	10.3	10.0
2019-2027	2019	10.3	10.2	10.2	10.2	10.2
	2020	10.3	10.1	10.2	10.1	10.3
	2021	10.4	10.2	10.3	10.2	10.3
	2022	10.4	10.2	10.3	10.2	10.3
	2023	10.4	10.2	10.3	10.2	10.3
	2024	10.5	10.3	10.3	10.2	10.3
	2025	10.4	10.3	10.3	10.2	10.4
	2026	10.4	10.3	10.4	10.3	10.4
	2027	10.4	10.3	10.3	10.3	10.4
2019-2027 Total		10.4	10.2	10.3	10.2	10.3
2028-2037 Total		10.4	10.2	10.3	10.2	10.3

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
Grand Total		**10.4**	**10.2**	**10.3**	**10.2**	**10.3**

Table 137 – Preliminary revenue projections (in 2013 inflation adjusted values prices, undiscounted)

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		456	510	522	513	521
2016-2018	2016	546	511	589	515	586
	2017	560	569	587	566	579
	2018	550	573	584	569	573
2016-2018 Total		1656	1653	1759	1650	1738
2019-2027	2019	527	572	562	570	552
	2020	528	591	556	581	551
	2021	528	583	556	583	552
	2022	525	586	564	581	553
	2023	524	583	567	580	556
	2024	527	579	566	582	558
	2025	532	576	562	582	555
	2026	536	575	561	580	555
	2027	540	575	565	579	559
2019-2027 Total		4767	5219	5059	5218	4992
2028-2037 Total		5456	5911	5681	5844	5666
Grand Total		**12335**	**13293**	**13022**	**13224**	**12918**

Table 138 – Cumulative present value of total scallop revenue (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	430	481	492	483	491
2016-2018	1,472	1,468	1,564	1,465	1,545
2019-2027	3,556	3,896	3,774	3,893	3,725
2028-2037	3,078	3,330	3,205	3,296	3,195
Grand Total	**8,535**	**9,174**	**9,035**	**9,137**	**8,957**

Table 139 – Present value of total scallop revenue net of no action revenue (using 3% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	51	63	54	62
2016-2018	(4)	92	(7)	74
2019-2027	340	219	337	169
2028-2037	253	127	218	118
Grand Total	**640**	**500**	**602**	**422**

Table 140 – Present value of total scallop revenue (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	398	446	456	448	455
2016-2018	1,265	1,260	1,345	1,258	1,329
2019-2027	2,458	2,695	2,610	2,692	2,575
2028-2037	1,487	1,606	1,548	1,592	1,543
Grand Total	**5,608**	**6,007**	**5,959**	**5,989**	**5,903**

Table 141 – Present value of total scallop revenue net of no action revenue (using 7% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	47	58	50	57
2016-2018	(5)	79	(7)	64
2019-2027	238	152	234	117
2028-2037	119	61	105	56
Grand Total	399	351	381	295

LPUE and Area Swept

LPUE for all areas are estimated to exceed 2700 lb. per DAS and to be slightly higher for RUN 2 (NOC) and RUN 4 (SCHCL) compared to other scenarios both in the short- and the long-term (Table 142). The same scenarios also result in the lowest values for area swept by providing access to a larger open area but allocating lower open area DAS compared to the other scenarios (Table 143).

Table 142 – Average LPUE for all areas

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		2729	2840	2742	2837	2745
2016-2018	2016	2803	2921	2809	2921	2813
	2017	2816	2927	2823	2934	2825
	2018	2806	2928	2809	2934	2804
2016-2018 Total		2808	2925	2814	2930	2814
2019-2027	2019	2839	2977	2839	2971	2829
	2020	2847	2970	2848	2956	2837
	2021	2854	2967	2847	2954	2848
	2022	2866	2964	2855	2954	2851
	2023	2868	2964	2869	2951	2854
	2024	2860	2963	2875	2953	2859
	2025	2865	2959	2875	2959	2862
	2026	2871	2954	2866	2961	2858
	2027	2873	2951	2866	2959	2856
2019-2027 Total		2860	2963	2860	2958	2850
2028-2037 Total		2890	2964	2872	2959	2872
Grand Total		**2861**	**2953**	**2854**	**2949**	**2850**

Table 143 – Area Swept

Sub-period	Fishing year	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015 Total		2,024	1,833	2,334	1,839	2,315
2016-2018	2016	2,325	1,503	2,498	1,516	2,487
	2017	2,424	1,970	2,528	1,939	2,517
	2018	2,472	2,142	2,648	2,133	2,628
2016-2018 Total		7,221	5,615	7,674	5,588	7,632
2019-2027	2019	2,328	2,119	2,525	2,165	2,500
	2020	2,322	2,248	2,484	2,238	2,469
	2021	2,308	2,207	2,460	2,239	2,456
	2022	2,268	2,221	2,457	2,227	2,453
	2023	2,272	2,213	2,457	2,214	2,451
	2024	2,275	2,205	2,458	2,205	2,454
	2025	2,270	2,201	2,448	2,200	2,434
	2026	2,267	2,203	2,452	2,199	2,432
	2027	2,275	2,200	2,453	2,201	2,436
2019-2027 Total		20,585	19,817	22,194	19,888	22,085
2028-2037 Total		22,655	21,961	24,557	22,157	24,417
Grand Total		**52,485**	**49,226**	**56,759**	**49,472**	**56,449**

Present Value of Producer Surplus

Producer surplus (benefits) for a particular fishery shows the net benefits to harvesters, including vessel owners and crew, and is measured by the difference between total revenue and operating costs. Present values of the producer surplus for scenarios other than No Action are expected to range from $449 million (RUN 2 - NOC) to $459 million (RUN 3 - NE), and to be about $49 - $57 million higher than the producer surplus for no action ($401 million) values for 2015 fishing year using a 3% discount rate (Table 144 and Table 145). Present value of the producer surplus estimated using a 7% discount rate are shown in Table 146 and Table 147. Although using a higher discount rate lowers the present values of the producer surplus, the ranking of the scenarios are not affected by the discount rate. In both cases, RUN 3(NE) results in largest producer surplus followed by RUN 5 (NESCH) in the short-term.

Over the long-term from 2015 to 2037, the present value of the projected producer for the no closure scenario (RUN 2) will exceed the no action values by $611 million ($ 383 million) using a 3% discount rate (7% discount rate). The scenario that includes both a Northern Edge and South Channel closure (RUN 5 – NESCH) are estimated to result in the smallest increase the present value of the producer surplus (by $388 million using a 3% discount rate) at the 2013 inflation adjusted constant values compared to other scenarios (RUN 2 to RUN 4) with the exception for the No Action values. For other scenarios with new EFH closures, the present value of the producer surplus will exceed the no action values by $460 million (RUN 3, NE) or more (RUN 4, SCHCL) compared to levels for No Action (Table 145) using a 3% discount rate and by a lower amount ($271 million or higher) using a 7% discount rate (Table 147). In short, all the new EFH scenarios (other than No Action) will have significant positive economic impacts on the producer surplus over the long-term, with RUN 2 (NOC) and RUN 4 (SCHCL) resulting in largest increases compared to No Action values.

Table 144 – Present value of producer surplus (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	401	449	459	452	458
2016-2018	1,370	1,372	1,455	1,370	1,438
2019-2027	3,322	3,644	3,524	3,641	3,477
2028-2037	2,877	3,115	2,993	3,083	2,985
Grand Total	**7,970**	**8,581**	**8,430**	**8,546**	**8,358**

Table 145 – Present value of producer surplus net of No Action values (using 3% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	49	58	51	57
2016-2018	2	85	(0)	68
2019-2027	322	201	319	155
2028-2037	238	116	206	108
Grand Total	**611**	**460**	**576**	**388**

Table 146 – Present value of producer surplus (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	371	417	425	418	424
2016-2018	1,178	1,178	1,251	1,176	1,237
2019-2027	2,296	2,521	2,436	2,518	2,404
2028-2037	1,390	1,503	1,446	1,489	1,442
Grand Total	**5,235**	**5,619**	**5,558**	**5,602**	**5,506**

Table 147 – Present value of producer surplus net of No Action values (using 7% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	45	54	47	53
2016-2018	0	73	(2)	59
2019-2027	225	140	222	108
2028-2037	113	56	99	51
Grand Total	**383**	**323**	**366**	**271**

Present Value of Total Economic Benefits

Economic benefits include the benefits both to the consumers and to the fishing industry and equal the sum of benefits to the consumers and producers. The cumulative present value of the total economic benefits for each run is summarized in Table 148 (3% discount rate) and Table 149 (7% discount rate).

The estimated present value of total economic benefits will be about $722 million higher in 2015-2037 with RUN 2 (No EFH closures) compared to the no action (Table 148, 3% discount rate). Similarly, total economic benefits for RUN 4 (SCHCL) would exceed no action levels by $679 million in 2015-2037 (3 % discount rate). RUN 3 (NE) and RUN 5 (NESCH) would result in smaller total economic benefits compared to RUN 2 and RUN 4 in the long-term whether a 3% or a 7% discount rate used although total economic benefits would still be higher than the No Action values. Table 150 shows the corresponding values by using a 7% discount rate to calculate the cumulative present value of the total economic benefits. Again, RUN 2 (No EFH closures) and RUN 4 (SCHCL) would result in largest economic benefits compared to No Action and other scenarios over the long-term (Table 149 and Table 151).

Table 148 – Present value of total economic benefits (using 3% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	436	492	505	495	503
2016-2018	1,522	1,518	1,623	1,515	1,603
2019-2027	3,655	4,040	3,894	4,036	3,838
2028-2037	3,170	3,455	3,306	3,415	3,297
Grand Total	**8,783**	**9,504**	**9,329**	**9,462**	**9,241**

Table 149 – Present value of total economic benefits net of no action values (using 3% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	56	69	59	67
2016-2018	(4)	101	(7)	81
2019-2027	385	239	381	183
2028-2037	285	137	246	127
Grand Total	**722**	**546**	**679**	**458**

Table 150 – Present value of total economic benefits (using 7% discount rate)

Sub-period	Run 1 No Action	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	404	456	468	458	466
2016-2018	1,309	1,303	1,396	1,301	1,378
2019-2027	2,526	2,795	2,693	2,791	2,653
2028-2037	1,532	1,666	1,597	1,650	1,592
Grand Total	**5,770**	**6,221**	**6,153**	**6,200**	**6,091**

Table 151 – Present value of total economic benefits net of no action values (using 7% discount rate)

Sub-period	Run 2 NOC	Run 3 NE	Run 4 SCHCL	Run 5 NESCH
2015	45	54	47	53
2016-2018	0	73	(2)	59
2019-2027	225	140	222	108
2028-2037	113	56	99	51
Grand Total	**383**	**323**	**366**	**271**

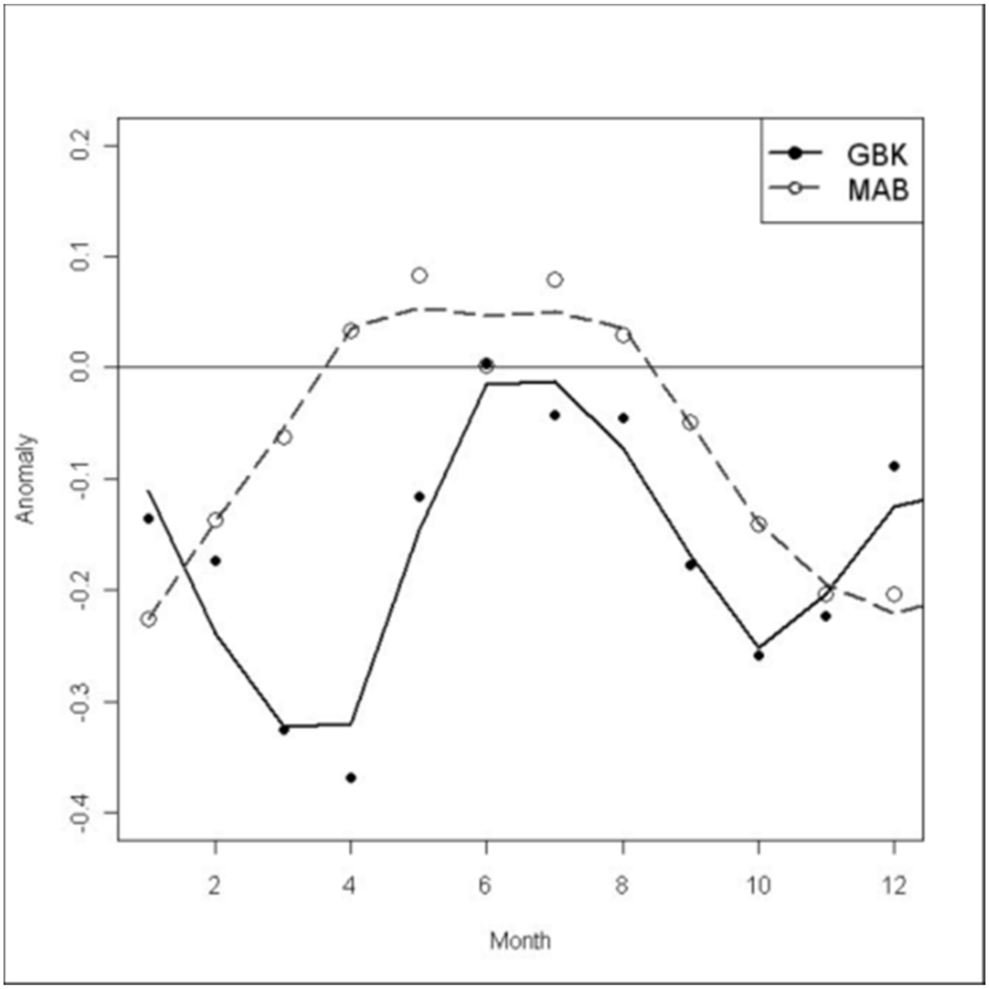
4.5.4.2 *Spawning management alternatives*

As with the GOM habitat management alternatives, the areas included in the GOM spawning management alternatives have little overlap with the scallop resource. The action alternative, Alternative 2, would remove the WGOM and Cashes Ledge groundfish closures, which could allow fishing on scallops living within those areas, unless prevented by one of the habitat management alternatives. Locally, removing these two groundfish closures could impact scallop populations, but global effects on the resource as a whole would not be expected.

In the Georges Bank region, the action alternatives (Alternatives 2 and 3) would eliminate the Nantucket Lightship Groundfish Closure Area and make CAI and CAII Groundfish Closure Areas seasonal, closed February 1 through April 30. The primary source of information used to assess the potential biological impacts of a seasonal closure to improve groundfish spawning protection is seasonal changes in scallop meat weights. Over the course of a year the scallop meat weights increase and decrease based on spawning and other factors. If a seasonal closure is during a time of year when meat weights are higher there could be negative impacts on the resource, but if the seasonal closure is when meat weights are lower there could be positive impacts.

First, shell height/meat weight data from observed trips were summarized for GB and the MA by month, and a model was generated to predict meat weight by month and region. Those estimates were compared to the month with the highest average meat weights on GB, June, to calculate a monthly meat weight anomaly (Figure 52).

Figure 52 – Scallop shell height: meat weight anomaly for GB and MA (Hennen and Hart, 2012)



Second, a Research Set-Aside (RSA) project (CFF bycatch survey) has been evaluating the seasonal changes in bycatch rates in the scallop fishery in both Closed Area I and II for over two years. Shell height/meat weight samples were collected during the monthly cruises. Data have been collected during most months since March 2011. In the first year of this study (2011) about 3,000 scallops were measured, and when all available data are combined for March 2011 through September 2013 almost 9,000 scallops have been measured to date. The meat weight model includes the following fixed effects: shell height, area (Eastern GB, Western GB), month and an interaction between month and area. Non-parametric smoothers were used to display annual and inter-annual trends in the relationship for the two areas analyzed and interpolate across any missing months.

Based on the meat weight anomaly figure, the month with the highest meat weights on GB is typically June, and the lowest is October (Figure 52). The average meat weights are about 20% greater in June than in October. There seems to be a bimodal pattern on GB for meat weights, with peaks in December and June, and lower meat weights in April and October (Hennen and Hart, 2012). One source of uncertainty with these data is that the number of observed trips is very low on GB for the months under consideration for the spawning closure (Feb-April). Most fishing activity on GB during those months is in the Channel, not CAI and CAII. The access areas on GB were closed from Feb1-June14 for most of the years in this data set. Therefore, there are fewer data for these months as compared to the months with higher fishing levels and when CAI and CAII were open (June15-Jan31).

Figure 53 and Figure 54 display trends from the RSA study for the two areas together as well as each area separately with the proposed temporal closures specific to each resource area. Results graphically depict the relative position of temporal closures with respect to observed patterns in meat weight maxima and minima. Overall, it seems that CAI has higher meat weights than CAII, at least for the first year of the study. This could be related to depth differences between the stations since scallops have different growth rates at different depths. But for these analyses depth was not considered separately. In general, the spawning season seems to overlap when scallops on GB are ascending to their max weight in June/July.

It is important to keep in mind that this data set is only 2.5 years long. The spring cycle of scallop growth does vary from year to year based on a variety of factors, so the monthly meat weight variation may not match up precisely with the observer data analyses in Figure 52, which is from a larger area (all of GB) and longer time series.

Figure 53 – Model generated estimate of meat weights for scallops larger than 125mm for Eastern and Western GB (based on scallops measured in CFF bycatch survey)

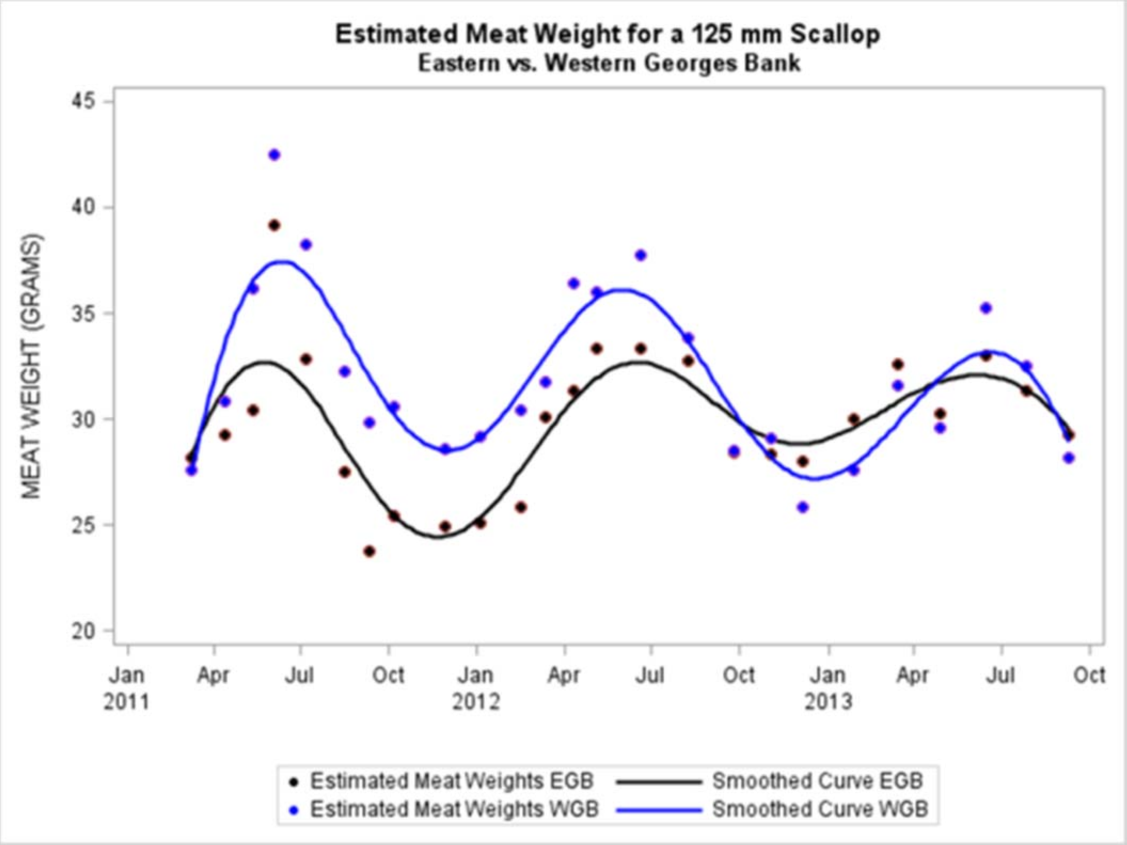
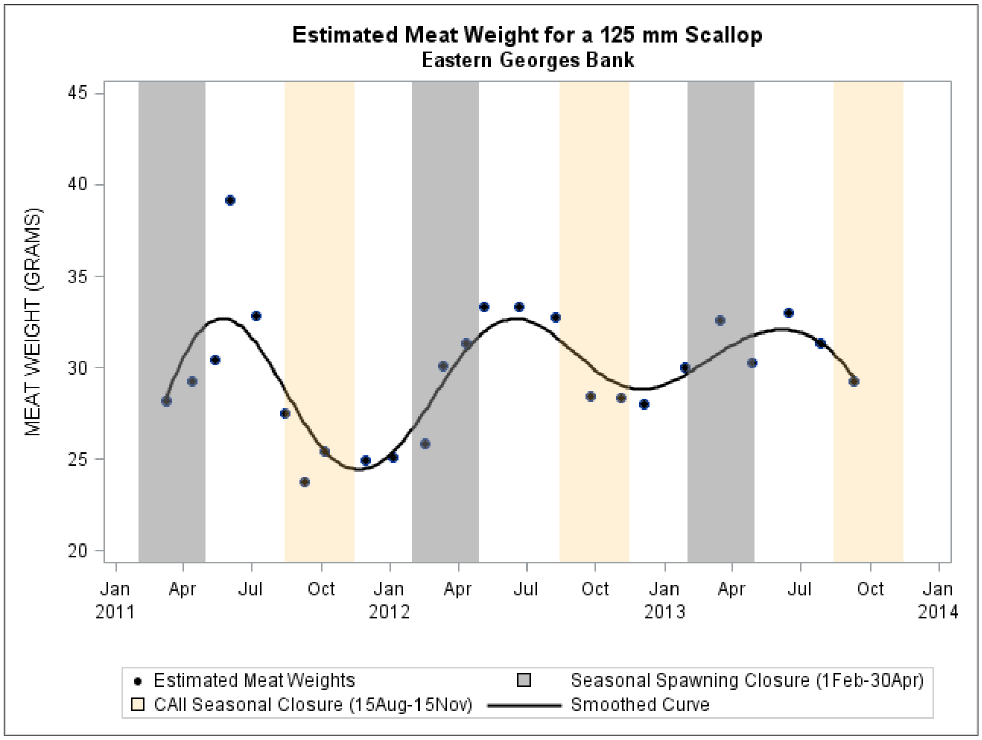
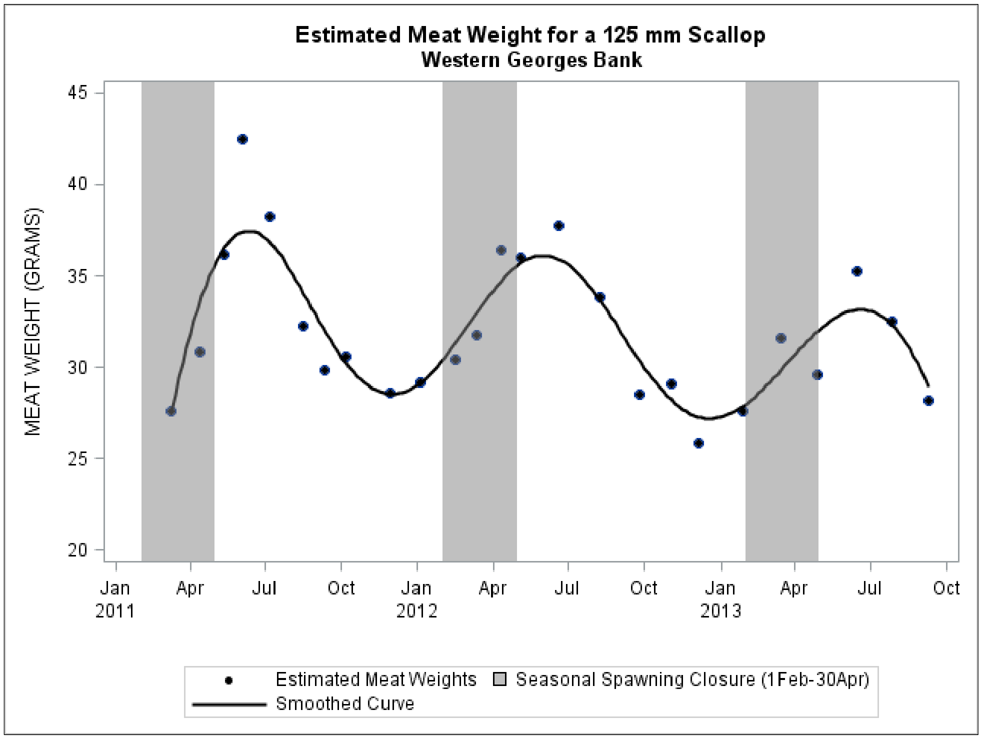


Figure 54 – Model generated estimates of meat weights for scallops larger than 125mm for Eastern (top) and Western GB (bottom) with potential seasonal closures included. Grey is spawning closure under consideration and yellow is in effect already for CAII to reduce yellowtail bycatch.





In general, the overall impacts of seasonal closures are difficult to assess because vessels shift effort differently as a result of a seasonal closure. The closed season will dictate when fishing will not occur in that area, but it could impact fishing patterns in other areas, i.e. open area fishing. Therefore, while a seasonal closure could benefit the scallop resource in that particular area, it could cause effort patterns in other areas to change by season, impacting overall scallop mortality.

Since there is a possession limit (number of pounds per trip) for access area trips, the greater the meat weight per animal the fewer scallops will be harvested. This reduces fishing time compared to fishing when scallop meats weights are less. This translates into less potential bycatch and lower scallop fishing mortality compared to months with lower scallop meat weights in the fall and winter. Because the season under consideration, Feb-April, includes several months with lower scallop meat weights, GB Spawning Alternatives 2 and 3 may have positive impacts on the scallop resource and fishery in those areas. In particular, the months of February and March are lower meat weight months, so preventing scallop effort in access areas during these months would potentially shift effort to months with higher meat weights. April is not as clear; meat weights are approaching higher levels in April based on the RSA monthly bycatch data. Note that GB Spawning Alternative 3 only includes the northern part of CAI, so fishing in the southern part of the area would be unrestricted during Feb-April. Therefore, fewer positive impacts would be expected from Alternative 3 vs. Alternative 2.

It is important to consider this seasonal restriction in combination with one that is already in place for Closed Area II under the access area regulations in the scallop FMP. Since FW24, CAII south is closed to the scallop fishery from Aug15 – Nov 15 to reduce YT bycatch. If the two seasonal restrictions are implemented, the area would only be open to the scallop fishery for 6 months of the year, May 1 – Aug 14 and again from Nov 15 – Jan 31. Having both seasonal restrictions could shift more effort into the winter when scallop meat weights are lower, having negative impacts on the resource and fishery. However, seasonal closures tend to shift effort right before or after a closure, so if effort is mostly concentrated in May, impacts on the resource could be positive. Finally, six months is generally enough time for a vessel to make a trip or two in CAII if allocated access, but it does reduce flexibility for the fishery, which can have potentially negative impacts.

Overall, seasonal closures have tradeoffs: limiting flexibility for the fishery, but if closures are during periods of time when scallop meat weights are lower, there can be positive impacts on the resource by maximizing yield. Since this closure season is primarily when meat weights are lower, the overall impacts are expected to be positive on the resource and fishery by potentially maximizing yield.

4.5.4.3 *Dedicated habitat research area alternatives*

The potential impacts of alternatives to designate Dedicated Habitat Research Areas (DHRAs) on the scallop resource and fishery were assessed qualitatively related to the potential indirect impacts on the scallop resource and fishery from research that may be conducted in the various areas. In addition, some input has been provided about potential fishery displacement from these candidate research areas.

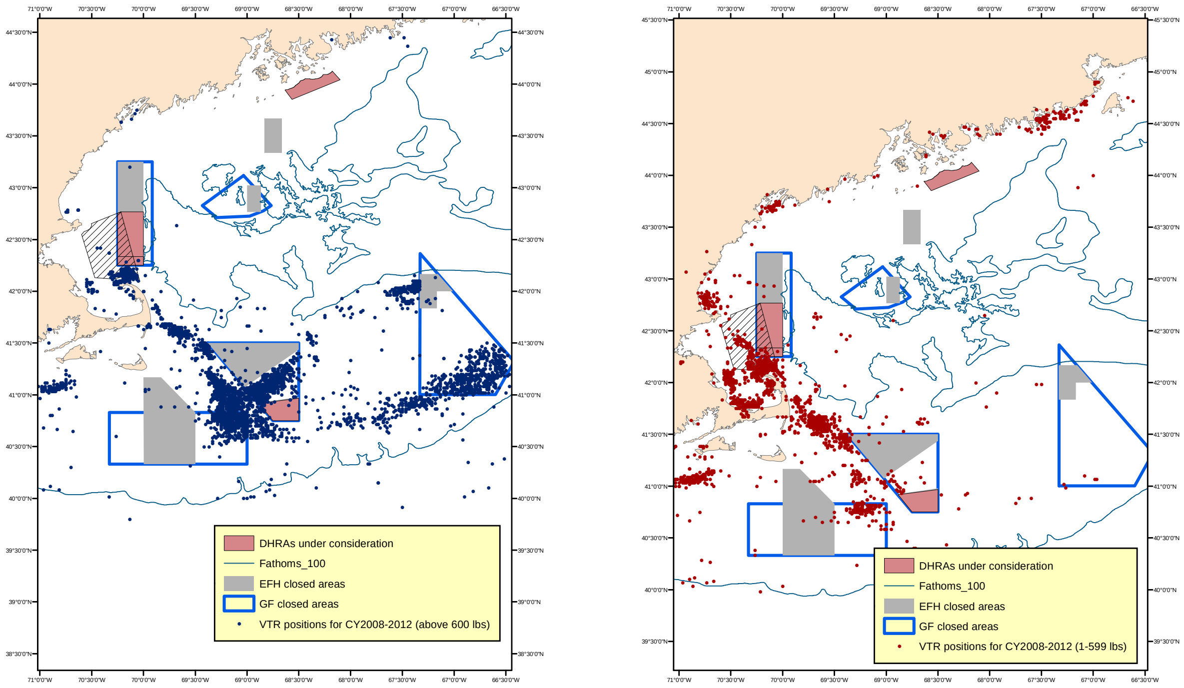
The PDT considered the scallop resource and level of fishing activity in each dedicated habitat research area alternative. For the area in Closed Area I (Georges Bank DHRA, Alternative 4) the NEFSC dredge survey was used to get a sense of the scallop biomass within that alternative. For the areas in the GOM (Eastern Maine DHRA, Alternative 2, and Stellwagen DHRA, Alternative 3), results from a 2012 RSA project were used. Sampling was not very dense in this survey. In addition, VTR data for the scallop fishery were plotted to get a sense of the level of LA and LAGC fishing activity inside these areas.

In general, the dedicated habitat research areas are not expected to have major impacts on the scallop resource or fishery because none of the proposed areas overlap major concentrations of scallop biomass. Two of the areas (Alternatives 3 and 4) are within current EFH closed areas and the one in the Eastern GOM (Alternative 2) is not a major area for scallop abundance. There may be indirect benefits to the scallop resource or fishery if research is conducted in these areas, which improves the understanding of fishery impacts on EFH etc. There is one study already proposed for the area in Closed Area I south that is looking at scallop recruitment. To the extent this designation would help support research that has beneficial impacts on the scallop resource or fishery, Alternative 4 could have a positive impact.

If this amendment modifies the CAI and WGOM EFH closed areas it is possible that some scallop vessels would want to prosecute those areas. Again, scallop abundance in these areas is relatively low, but closing the areas for research could have negative impacts on the fishery if scallop catch rates are higher in those areas compared to other areas. Table 130 in the habitat alternatives section above shows the LT yield potential from CAI South to be 29 mt (mean estimate), and 11 mt (median estimate). This is a very small proportion of total scallop LT yield (about 0.1%). Therefore, the potential impacts on the scallop resource and fishery for a designation in this area are minimal.

The Stellwagen and Eastern Maine DHRAs are closer to shore so could have potentially higher impacts on smaller vessels that are homeported near these areas. VTR has been plotted for trips over 600 pounds to represent LA trips as well as trips less than 600 pounds to represent LAGC trips (Map 114). Based on these data there has been very little scallop fishing activity in any of the three DHRAs. However, any activity in the Stellwagen or Georges Bank DHRAs are likely misreported because these two areas have been closed to scallop vessels since 1998 and 1994, respectively.

Map 114 – VTR effort CY2008-2012 for LA scallop fishery (blue on left) and LAGC scallop fishery (red on right). VTR catch 600 pounds and less considered LAGC effort and trips above 600 pounds considered LA effort



4.5.5 Atlantic herring

4.5.5.1 *Biological impacts*

The action will have limited impacts on the Atlantic herring resource. With the exception of their demersal egg beds, herring are a pelagic species, so measures that restrict mobile bottom-tending gears to protect seabed habitats are not expected to have much benefit for herring stocks. Some Habitat Management Areas do overlap with the preferred alternative herring egg Essential Fish Habitat designation, which is shown in bright blue on Map 115. Alternatives that include these areas would provide positive benefits for herring eggs. Spawning generally begins in July (earlier in northern GOM) and lasts until December, so the HMAs would have a benefit if they displace mobile bottom-tending gear fishing activities that occur during the second half of the calendar year.

Map 115 – Herring egg EFH overlap with Habitat Management Areas

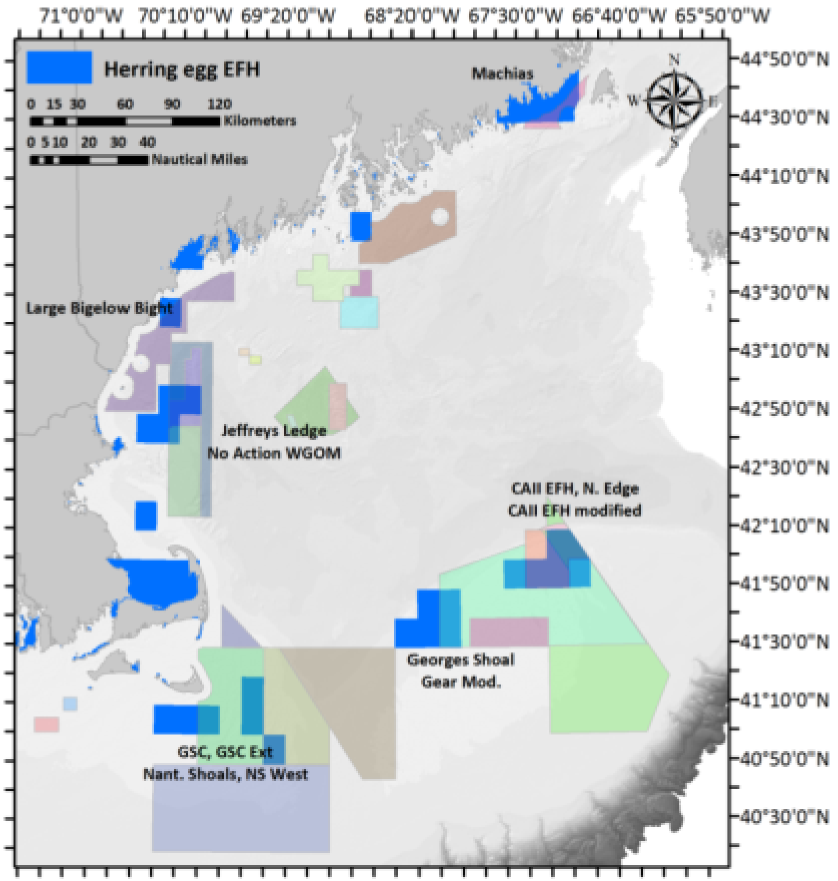


Table 152 – Impacts of spatial management alternatives on the Atlantic herring resource

Alternative type	Alternative	Impacts
Habitat Management Alternatives	EGOM Alts 1	Neutral – currently no management areas that restrict MBTG in region, this would maintain no action
	EGOM Alts 2, 3	Positive – adds Machias HMA, which would restrict MBTG
	CGOM Alts 1-4	Neutral – no herring egg beds in this region
	WGOM Alts 1, 3, 4, 5	Positive – maintains or adds MBTG protections in areas with herring egg beds
	WGOM Alts 2, 6	Negative – removes current MBTG protections in areas with herring egg beds
	GB Alts 1, 3, 4, 5, 6	Positive – maintains or adds MBTG protections in areas with herring egg beds
	GB Alt 2	Negative - removes current MBTG protections in areas with herring egg beds
	GSC-SNE Alts 1, 3, 4, 5, 6	Neutral - no herring egg beds overlap the NLCA
	GSC-SNE Alt 2	Negative - removes current MBTG protections in areas with herring egg beds
Spawning	GOM Alt 1, GB Alt 1	Positive – maintains MBTG protections in areas with herring

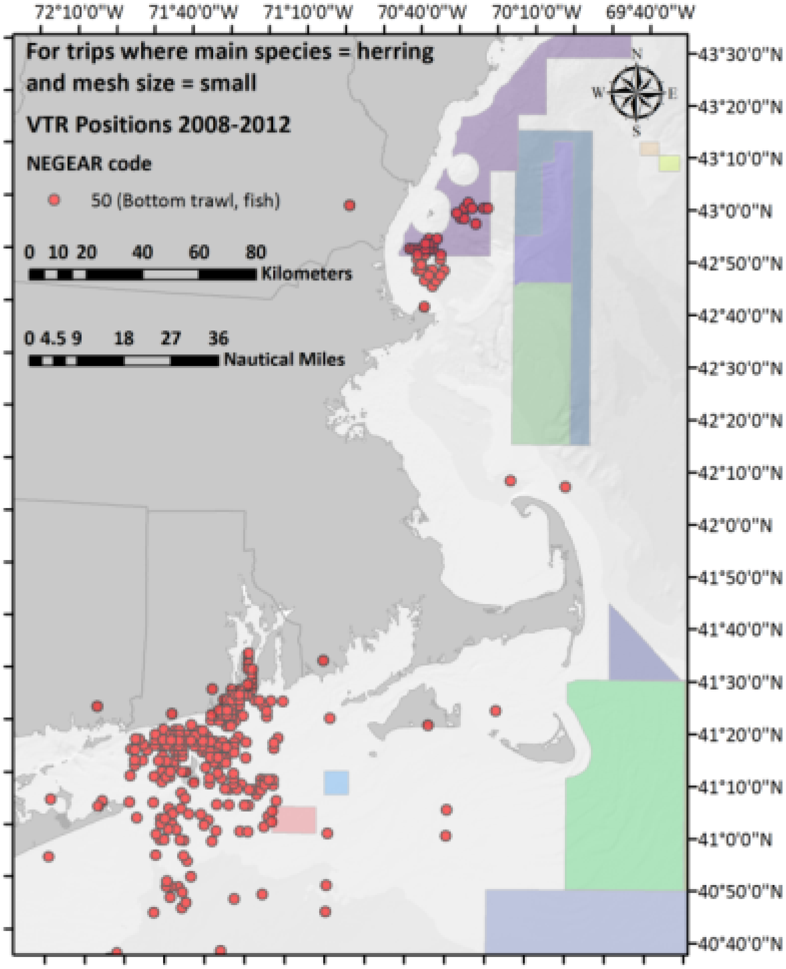
Alternative type	Alternative	Impacts
Management Alternatives		egg beds
	GOM Alt 2, GB Alt 2, 3	Negative – makes CAII seasonal, which will not protect herring eggs
Dedicated Habitat Research Area Alternatives	1-5	Neutral – little to no overlap between potential DHRAs and herring egg beds
Framework and monitoring Alternatives	1, 2	Neutral – alternatives do not/will not have a direct effect on the herring management process and indirectly on the herring resource

4.5.5.2 *Fishery impacts*

This action will likely have fairly limited impacts on the Atlantic herring fishery, as the fishing restrictions associated with the alternatives generally do not extend to gears used to target herring, with the exception of small mesh bottom trawls used in specific locations. Small mesh bottom trawls would be restricted under all three types of alternatives, habitat, spawning, and research. Generally, the trawls are used in the Gulf of Maine to catch relatively small amounts of herring under a Category C permit, and in Southern New England off the coast of Rhode Island to target larger amounts of herring under Category A and B permits. Between 2008 and 2011, these small mesh bottom trawls represented 4% of herring landings, so they constitute a small fraction of the fishery (2013-2015 Herring Specifications, NEFMC 2013). These landings are spatially concentrated, with the majority (roundly 14 mt) coming from Area 2, representing 16% of Area 2 landings during that same period.

Given the general fishing location of these small mesh bottom trawls, in terms of evaluating the impacts of the management alternatives in this amendment on this component of the fishery, the question is the extent to which these boats fish within the two Cox Ledge HMAs or in the GOM HMAs currently open to fishing. Category A and B vessels with higher possession limits may be directing effort on Atlantic herring in the Cox Ledge areas, and Category C vessels with lower possession limits may be fishing in the GOM HMA areas in addition to or incidental to fishing for whiting. Map 116 indicates that there appears to be limited overlap between small mesh bottom trawl trips where the main species was identified as herring and the Cox Ledge area. There are small mesh bottom trawl trips in the southern part of the Large Bigelow Bight HMA and the Small Bigelow Bight HMA that would be excluded from those areas if one or the other of them is closed to mobile bottom-tending gears. These trips probably represent a low value relative to the herring fishery overall, assuming that they are landing small amounts of herring, which is a low value species.

Map 116 – VTR locations (red circles) of small mesh bottom trawl trips where the main species was noted as 'herring', 2008-2012.



Currently, there are impacts to the herring fishery associated with monitoring programs in the year round groundfish closed areas. If the Council chooses, these monitoring programs could be eliminated if one or more of the corresponding management areas are removed or made seasonal under the habitat or spawning action alternatives. In this case, the action alternatives would reduce impacts on the herring fishery in terms of monitoring costs because the year round groundfish closures are eliminated or made seasonal under the sub-regional/regional habitat and spawning action alternatives. Alternatively, a trailing action might be needed to adjust or specify herring monitoring areas so that groundfish bycatch, specifically haddock bycatch, can continue to be monitored. If the intent is to continue with monitoring approaches specified by Atlantic Herring Amendment 5 regardless of whether the year round groundfish closures are adjusted, then the action alternatives will have neutral impacts on the fishery.

Table 153 – Impacts of spatial management alternatives on the Atlantic herring fishery

Alternative type	Alternative	Impacts
Habitat	EGOM Alts 1-3	Neutral.

Alternative type	**Alternative**	**Impacts**
Management Alternatives	CGOM Alts 1-4 WGOM Alts 1, 2, 6, 7 GB Alts 1-6 GSC-SNE Alt 1-2	
	WGOM Alts 3, 4, 5	Slightly negative – small mesh bottom trawling for herring overlaps the large and small Bigelow Bight HMAs, which are included in these alternatives
	GSC-SNE Alt 3-6	Slightly negative – if small mesh bottom trawl herring fishing occurs on Cox Ledge it would be displaced, but it appears that this effort does not occur within the management areas
Spawning Management Alternatives	GOM Alt 1; GB Alt 1	Negative - maintains year round groundfish closures which would maintain existing monitoring requirements
	GOM Alt 2A, 2B; GB Alt 2A, 2B, 3A, 3B	Neutral or positive – removing groundfish closures might not impact monitoring (neutral), or might eliminate monitoring requirements (positive)
Dedicated Habitat Research Area Alternatives	1-5	Neutral – no effect on herring operations, probably limited research to benefit herring management
Framework and monitoring Alternatives	1, 2	Neutral – alternatives do not/will not have a direct effect on the herring management process

4.5.6 Deep-sea red crab

4.5.6.1 *Biological impacts*

Deep-sea red crabs are found in deep water areas of the Gulf of Maine and along the continental slope south of Georges Bank to the Gulf of Mexico. There may be limited overlap between their Gulf of Maine distribution and some of the habitat and spawning areas, but generally speaking red crabs occur in deeper waters than are contained within the management areas, particularly the habitat management areas which tend to be identified in waters shallower than 100m. Thus, there are likely no impacts of the spatial management alternatives on this stock.

4.5.6.2 *Fishery impacts*

The red crab fishery operates entirely along the continental slope in depths between 600-640 m. There is no overlap between this fishery and any of the spatial management alternatives proposed in this amendment, so therefore no impacts to the fishery are expected.

4.5.7 Surfclams and ocean quahogs

4.5.7.1 *Biological impacts*

Atlantic surfclams are found in the western North Atlantic from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. They are most abundant on Georges Bank, the south shore of Long Island, New Jersey, and the Delmarva Peninsula. EFH for juveniles and adults is found throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys. Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

Ocean quahogs are common around Iceland, in the eastern Atlantic as far south as Spain, and in the western Atlantic as far south as Cape Hatteras, North Carolina. Ocean quahogs live in water between 25 and 1,300 feet. In the northern part of their range, they are found in shallower water closer to shore. The U.S. stock is almost entirely within federal waters (3 to 200 miles from shore), except for a modest amount off the coast of Maine and in waters between 65 and 260 feet deep.

EFH for juveniles and adults is found throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys. Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60° F, and occur progressively further offshore between Cape Cod and Cape Hatteras. While the surfclam and ocean quahog juvenile and adult life stages are benthic, they are not considered highly susceptible to impacts from bottom tending fishing gears.

In US waters, ocean quahogs are most abundant in the southern New England, Long Island, and Georges Bank regions. However, these regions have recently seen a loss of overall biomass, except Georges Bank where harvesting has historically been prohibited. The ocean quahog fishery has shifted north over the last three decades away from the original fishing grounds off Delmarva and New Jersey, and followed the concentrations of quahogs. In the 1980s, the bulk of the fishing effort was off Delmarva and southern New Jersey. In the 1990s, effort moved northward to the Long Island and Southern New England regions. For the past ten years, the majority of fishing effort has been in the Long Island region. The Georges Bank region, which has not been open to ocean quahog fishing since 1990 due to the risk of paralytic shellfish poison (PSP) contamination, contains about 43% of total ocean quahog fishable biomass (2011 NEFSC survey data) and was recently reopened to harvesting.

4.5.7.1.1 Habitat management alternatives

As described above, while there is overlap with surfclam and ocean quahog EFH and distributions and habitat management alternative areas, surfclam and quahog life stages are not susceptible to bottom tending mobile gears other than hydraulic and toothed dredges designed specifically to harvest clams. Therefore, these species would not likely be impacted (either positively or negatively) by shifts in effort associated with prohibitions on use of trawls or scallop dredges in habitat management areas. Thus, adopting new Habitat Management Areas with Option 2 measures, which would restrict mobile bottom-tending gears but exempt hydraulic clam dredges, would have neutral impacts on surfclams and ocean quahogs. The same conclusion would hold for HMAs implemented with Options 3 or 4, which require trawl gear modifications but do not restrict clam (or scallop) dredges.

Habitat Management Areas implemented with Option 1 (MBTG closure) could influence spatial patterns of fishing with of clam dredges and could have an effect on the clam resource. However, because the commercial fisheries for surfclams and ocean quahogs are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable, the biological impacts of the proposed habitat management alternatives on surfclams and ocean quahogs are expected to be neutral. Specifically, the resource overall is not expected to be affected by the distribution of clam removals, given overall limits on catch.

Clam dredges are prohibited from the existing habitat closure areas identified in each of the sub-regional No Action alternatives. The Nantucket Lightship (NL) Habitat Closure Area contains both surfclams and quahogs, and would be open to clamming if not for the habitat closure (i.e. it is not a food safety or PSP closure). Thus, adopting one of the action alternatives in the Great South Channel/Southern New England region could shift clam dredging effort into the current NL Habitat Closure Area. If Option 1 is adopted for any of these new habitat management areas, clam dredges would be prohibited. This would shift harvest of surfclams and ocean quahogs out of any newly designated habitat management areas and into other areas.

The existing CAI N habitat closure (Alternative 1 GB) and the habitat closures in the GOM (Alternative 1 CGOM and WGOM) do not contain either species. In addition, newly proposed or modified habitat management areas in the GOM do not contain either species, with the exception of the Machias area in the eastern GOM, which contains quahogs. Because these quahogs are harvested with toothed dredges and not hydraulic dredges, effort would shift out of the Machias area and into nearby areas if that HMA were adopted under EGOM Alternative 2 or 3 and managed with Option 1 (MBTG closure) or Option 2 (MBTG closure with hydraulic clam dredge exemption).

The CAI S habitat closure contains both surfclams and quahogs, and the CAII habitat closure contains surfclams, but these areas are closed as part of the Georges Bank PSP closure, and would remain closed to the harvest of clams even if reopened to mobile bottom-tending gears by this amendment. However, adoption of some of the other GB alternatives with management Option 1 could preclude clam dredging in recently opened portions of the PSP closure. Specifically, surfclams occur in the Georges Shoals MBTG closure included in GB Alternative 5, and in the western part of the modified CAII habitat closure (Alternatives 6a and 6b). The various gear modification areas would not affect use of clam dredges, and the Northern Edge Area (GB Alternatives 3 and 4) is inside a part of the PSP closure that remains closed.

Alternatives that influence spatial patterns of fishing with of clam dredges could have a biological effect on the clam resource. The commercial fisheries for surfclams and ocean quahogs are managed using catch limits, which limit overall removals (landings and discards) to levels that are sustainable. However, there may be the potential with both stocks for localized depletion of surfclams or ocean quahogs in some areas depending on the spatial distribution of fishing effort. These stocks are susceptible to local depletion because of their sessile nature and the manner in which the fisheries operate; fishing an area until catch rates decline. The recent stock assessment for Atlantic surfclam at SAW 56 suggested there are source/sink dynamics relative to recruitment for this stock. The Georges Bank portion of the stock appears to be its own source for recruits, and does not appear to receive significant recruit contributions from other areas. In addition, the recruitment dynamic for ocean quahogs are poorly understood. These dynamics, particularly at a small, local scale are not well understood for both stocks. The closure of some areas to dredging for both surfclam and ocean quahogs has the potential to result in positive impacts on the stock. Similarly, there is the potential for negative impacts if substantial fishing effort shifts to areas not previously fished, potentially resulting in some areas of localized depletion. Impacts would be expected to be slight given these areas proposed for closures are small relative to the overall distribution of the stock. The biological impacts of the proposed habitat management alternatives on surfclams and ocean quahogs could vary from slight negative to slight positive, and these impacts may be localized and heterogeneous in nature.

4.5.7.1.2 Spawning management alternatives

Clam dredges would be exempt from spawning closures and therefore patterns of clam harvest would not be affected by these alternatives. As described above in section 1.1.1.1, while there is overlap with surfclam and ocean quahog EFH and distributions and spawning management alternative areas, surfclam and quahog life stages are not susceptible to gears other than hydraulic and toothed clam dredges, and would not likely be impacted (either positively or negatively) by any prohibitions on use of other gear types. Therefore, the biological impacts of the proposed spawning management alternatives on surfclams and ocean quahogs are expected to be neutral when compared to the status quo.

4.5.7.1.3 Dedicated Habitat Research Area alternatives

Dedicated Habitat Research Areas would restrict all MBTG fishing, including clam dredging. The only DHRA that contains either surfclams or quahogs is the GB DHRA. Clam dredges are currently prohibited from the CAI S Habitat Closure Area, which could become the Georges Bank DHRA, so designation of this DHRA as a mobile bottom-tending gear closure would have neutral impacts relative to No Action (this area is also inside the GB PSP closure). Because the Eastern Maine and Stellwagen DHRA areas do not contain surfclams or quahogs, adoption of these alternatives (Alternative 2 and 3, respectively) would not have any effect on the clam resource.

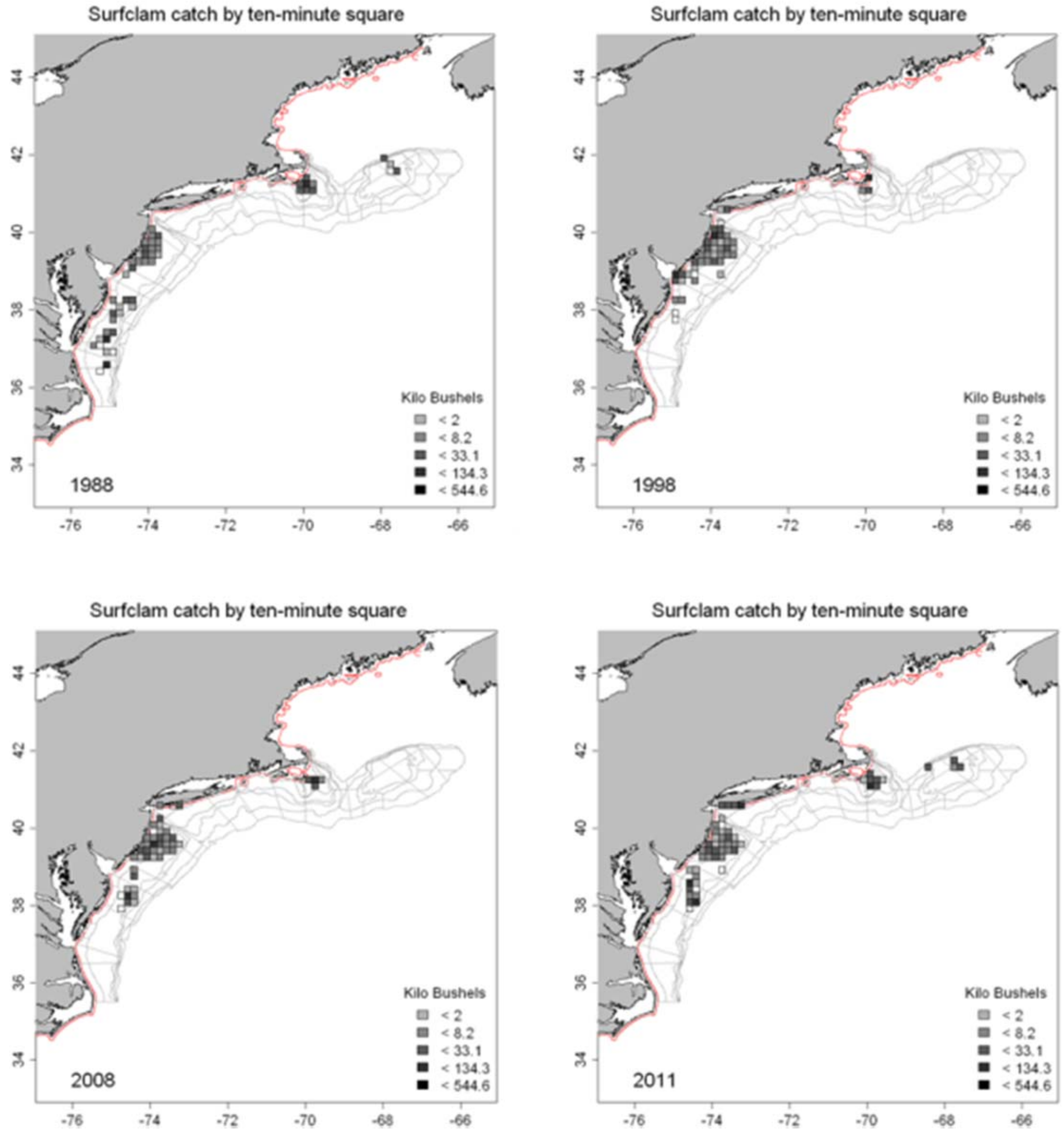
4.5.7.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes of Atlantic surfclams and ocean quahogs; therefore no biological impacts are expected on these species when compared to No Action.

4.5.7.2 *Fishery impacts*

The commercial fishery for Atlantic surfclams and ocean quahogs in Federal waters is prosecuted with large vessels and hydraulic dredges, except in Eastern Maine where toothed dredges are used to harvest quahogs. The distribution of the surfclam fishery has changed over time, as shown in Map 117. The distribution of the ocean quahog fishery has changed over time, with the bulk of the fishery from 1980-1990 being prosecuted off the Delmarva region, to more Northern areas (Map 118).

Map 117 – Surfclam landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, by year (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Summary (NEFSC 2013)[17]



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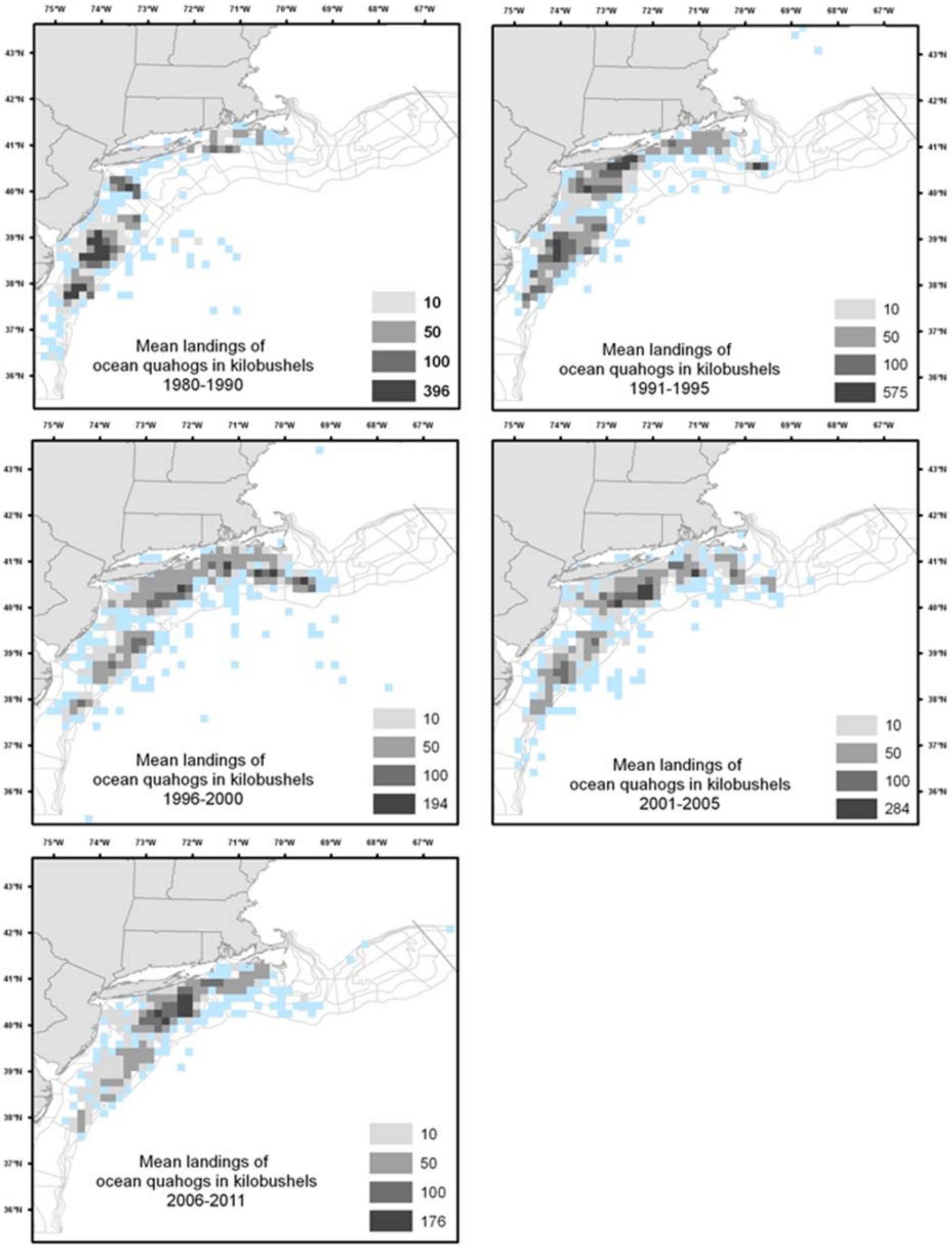
[17] Northeast Fisheries Science Center. 2013. 56th Northeast Regional Stock Assessment Workshop (56th SAW) Assessment Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-04; 42 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Map 118 – Ocean quahog landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, and time period. TMSQ in light blue had reported landings, but from fewer than three vessels (1 kilobushel = 1000 bu y-1). Source: Stock Assessment Update (Chute at al. 2013)[18]



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[18] Chute A, Hennen D, Russell R, Jacobson L. 2013. Stock Assessment Update for Ocean Quahogs (Arctica islandica) through 2011. NEFSC Ref Doc 13-17; 156 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

4.5.7.2.1 Habitat management alternatives

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. 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). Depending on the options selected, these areas could include a complete prohibition of bottom tending mobile gear use, including exclusion of hydraulic dredges (clam dredges), or hydraulic clam dredges could be exempted from the requirements in those areas.

The commercial fisheries for Atlantic surfclam and ocean quahog have expanded into the Georges Bank area now that portions of that area are accessible to the fishery (previously closed due to PSP). However, thus far this shift has not been significant due to the increased costs associated with a longer steam time to the GB grounds and the costs to comply with PSP testing protocols. Also, the fishery overlaps with the areas proposed in the Great South Channel. The greatest shift in effort is expected for surfclams. The catch rates for surfclams in the Mid-Atlantic Bight have decreased over time and are lower than the catch rates expected in the previously unfished areas of Georges Bank. Therefore, industry has indicated they will be shifting substantial amounts of effort to these newly opened areas, and away from areas with lower catch rates. It is unclear whether current effort for surfclams fishing on Nantucket Shoals would shift to Georges Bank, or continue in those areas. Fishing conditions on Georges Bank are more hazardous and the steam time is longer, therefore small clam dredge fishing vessels are not expected to shift their effort to Georges Bank. For quahog, there is not the disparity in catch rates between the near shore area catch rates versus Georges Bank. Industry has indicated that they will be fishing for ocean quahogs on Georges Bank; however, it is not clear if the incentive to shift effort to these areas is as strong for the quahog fishery.

The extent of overlap between these HMAs and the clam fishery, relative to the total extent of the fishery, is expected to be small. However, catch rates for clams in these areas are higher than other areas of the fishery. The year round closure of one or more of these areas (Great South Channel/SNE alternatives 3-6, and Georges Bank alternatives 3-6) to mobile bottom-tending gear would prohibit clam dredges from being used in these areas and has the potential for negative impacts on these fisheries (Table 154). Impacts will depend on whether fishermen using clam dredges would have chosen to dredge in these areas and would be excluded under the alternatives. Alternatively, they may not have chosen to fish these areas because catch rates are not optimal and would have fished other areas regardless of whether they have access to these areas. Generally, the impacts of the habitat management alternatives for Great South

Channel/SNE and Georges Bank are expected to be neutral to negative, when compared to No Action (Table 154).

However, if hydraulic dredging is exempted from these restrictions (management Option 2), or if dredges are not restricted generally (management Options 3 or 4) impacts on the fishery would be neutral.

Because of the lack of overlap of the fishery within other areas under consideration in the Gulf of Maine, impacts from other alternatives in this section are expected to be neutral for these fisheries. The exception to this is the Machias HMA, included in EGOM Alternatives 2 and 3. While fishing effort appears to be more concentrated south of the Machias area boundary, if an action alternative is selected in this sub-region and the area is managed as a MBTG closure (Option 1 or 2), there may be some displacement of quahog catches. As stated in the economic impacts section of this document (4.1.3.1.1 Eastern GOM and the Scotian Shelf), "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 quahog 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 dredge fishery activity, the majority of the clam dredge activity in the area, as represented by the logbook data, looks to occur outside of the Machias management area alternative."

Table 154 – Current and future clam dredge effort in GSC/SNE and GB habitat areas

Area	**Alternative**	**Species**	**Current clam effort**	**Potential for future clam effort**	**Impacts on clam fishery of removing current area or adding new area**
CAII groundfish (current closure)	GB1	SC and OQ	None – PSP closure	None – PSP closure	Neutral
CAII EFH (current closure)	GB1	SC	None – PSP closure	None – PSP closure	Neutral
CAI groundfish (current closure)	GB1	SC and OQ	None – PSP closure	None – PSP closure	Neutral
CAI N EFH (current closure)	GB1	Neither	None – PSP closure	None – PSP closure	Neutral
CAI S EFH (current closure)	GB1	SC and OQ	None – PSP closure	None – PSP closure	Neutral
Northern Edge (new area)	GB3 and GB4	SC	None – PSP closure	None – PSP closure	Neutral

Area	**Alternative**	**Species**	**Current clam effort**	**Potential for future clam effort**	**Impacts on clam fishery of removing current area or adding new area**
Georges Shoal MBTG closure (new area)	GB5	SC	Yes – recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
CAII EFH modified	GB6a and GB6b	SC	Yes – recently reopened part of GB PSP area	Yes – substantial shift to these areas, as stated by industry	Negative
NL groundfish (current closure)	GSC-SNE1	SC and OQ	Yes – especially quahogs	Yes	Neutral – area already accessible to gear
NL EFH (current closure)	GSC-SNE1	SC and OQ	No – gear prohibited by EFH closure	Yes	Positive
GSC East HMA (new area)	GSC-SNE3	SC	Yes	Yes	Negative
GSC HMA (new area)	GSC-SNE4	SC	Yes	Yes	Negative
Nantucket Shoals HMA (new area)	GSC-SNE5	SC	Yes	Yes	Negative
Nantucket Shoals West HMA (new area)	GSC-SNE6	SC	Yes	Yes	Negative

4.5.7.2.2 Spawning management alternatives

Many types of fishing gears are currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31. Under Georges Bank spawning Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have restrictions in place during 3 months of the year (February-April) as opposed to year round. The surfclam and ocean quahog gear (clam dredges) were already an exempted gear in these areas. Therefore, changes to these measures do not have an impact on this fishery. These alternatives do not alter other aspects of the fishery, including the limits on catch and landings in this fishery. Therefore, the impacts of the spawning management alternatives on the surfclam and ocean quahog fisheries are expected to be neutral.

4.5.7.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would restrict mobile bottom-tending gears including clam dredges. The commercial fisheries for Atlantic surfclam and ocean quahog have expanded into the Georges Bank area now that those areas are accessible to the fishery (previously closed due to PSP). However, no overlap between the Georges Bank DHRA (Alternative 4) and the clam fishery is expected because this area remains a PSP closure. PSP closure status of this area is unlikely to change in the near term. Because of the lack of overlap within other areas under consideration in Alternatives 2 and 3, impacts from these alternatives are expected to be neutral for these fisheries. It is however possible that if the spawning closure areas I and II on George's Bank were eliminated or reduced in size, the current PSP closure area may be expanded. In this case, it is possible that the surfclam or ocean quahog fishery would expand effort into these small expanded areas, resulting in slight positive impacts for the fishery.

4.5.7.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on Atlantic surfclam and ocean quahog fisheries. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.5.8 Atlantic bluefish

4.5.8.1 *Biological impacts*

Bluefish (*Pomatomus saltatrix*) are found along the entire east coast of the United States from Maine through Florida. Bluefish travel in schools of like-sized individuals and undertake seasonal migrations, moving into the Middle Atlantic Bight (MAB) during spring and south or farther offshore during fall.

North of Cape Hatteras, EFH for bluefish eggs and larvae is pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) most commonly above 49 ft (15 m), from Montauk Point, New York south to Cape Hatteras, in the highest 90% of the area where bluefish larvae were collected during the MARMAP surveys. For bluefish juveniles EFH is pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the NEFSC trawl survey. EFH for adult bluefish is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey. All bluefish life stages are pelagic and are therefore not highly susceptible to impacts from bottom tending fishing gears.

4.5.8.1.1 Habitat management alternatives

As described above in section 1.1.2.1, there is minimal to nil overlap between bluefish distribution and EFH and the proposed habitat management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic and not susceptible to mobile bottom tending gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, the commercial fishery for bluefish is managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on bluefish are expected to be neutral when compared to No Action.

4.5.8.1.2 Spawning management alternatives

As described above in section 1.1.4.1, there is minimal to nil overlap between bluefish distribution and EFH and the proposed spawning management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic not susceptible to mobile bottom tending gears or fixed gears used to catch groundfish and prohibited from spawning areas, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, the commercial fishery for bluefish is managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed spawning management alternatives on bluefish are expected to be neutral when compared to No Action.

4.5.8.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). As described above in section 1.1.2.1, there is minimal to nil overlap between bluefish distribution and EFH and the proposed DHRA management alternatives. The areas proposed are in the upper end of the seasonal migratory range. In addition, bluefish life stages are pelagic not susceptible to bottom tending gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives on bluefish are expected to be neutral when compared to No Action.

4.5.8.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological process of bluefish; therefore no biological impacts are expected on bluefish when compared to No Action.

4.5.8.2 *Fishery impacts*

About 98% of the fishery for bluefish is prosecuted with gill nets (sink or anchored) and hook and line. About 2% of the fishery landings are in "other" gears such as bottom tending mobile gear. However, bottom tending mobile gear is not an efficient gear type for catching bluefish, which are highly mobile, pelagic, schooling fish. Bluefish are not typically targeted with trawls or other bottom tending mobile gear and are considered incidental catch in those gear types.

Table 155 – Commercial gear types associated with bluefish harvest by federally permitted vessels in 2011.

Commercial Gear Type	Trips	Landings (lbs)	Pct Total
Gillnet	818	1,494,252	93.4%
Hook and line	545	72,404	4.5%

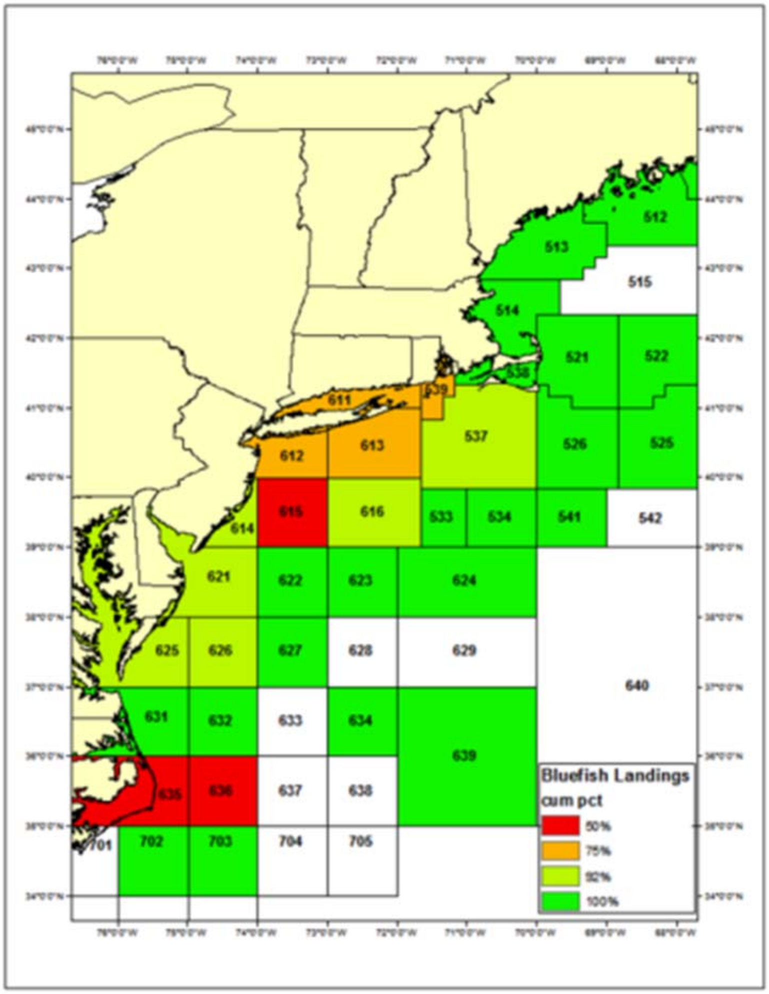
Other	20	33,319	2.1%
Total	1,383	1,599,975	100%

Source: VTR Data as of Nov 20, 2012.

4.5.8.2.1 Habitat management alternatives

The Northeast Region is divided into 46 statistical areas for Federal fisheries management. According to VTR data, bluefish were commercially harvested in 40 statistical areas in 2011 (Map 117). Seven statistical areas, however, collectively accounted for 75.1% of VTR-reported landings in 2011, with individual areas contributing 7% to 14% of the total. These areas also represented 69.6% of the trips that landed bluefish. Because the core of the commercial fishery does not coincide with the areas under consideration, it is unlikely to be impacted by any proposed measures that restrict or prohibit the use of mobile bottom-tending gear under the habitat management alternatives proposed.

Map 119 – Bluefish catch by NMFS Statistical Areas. Shading reflects the cumulative percentage of landings with red and orange being the primary areas where the commercial landings are taken.



4.5.8.2.2 Spawning management alternatives

The core of the commercial fishery (about 92% of the landings) is prosecuted in areas south of Nantucket Island. The only area of overlap is the Nantucket Lightship Closure Area, which was intended to protect groundfish spawning. The use of sink or anchored gillnets is currently prohibited in this area year round. Under alternatives 2 and 3, the Nantucket Lightship Closure Area would be eliminated. Therefore, there is the potential for slight positive impacts on the bluefish fishery, if fishermen choose to expand the use of sink or anchor gillnets used to catch bluefish into this area. For the recreational fishery, party and charter vessels may obtain a letter of authorization to fish in these areas, and recreational vessels are exempted. Therefore, impacts on the recreational fishery are not expected. Recreational fishermen will continue to have the opportunity to fish in these areas under the proposed spawning management alternatives.

4.5.8.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3).. Sink or anchored gillnets would be prohibited in the Stellwagen DHRA.However, because the core of the bluefish commercial fishery (about 92% of the landings) is prosecuted in areas South of Nantucket, Island, it is unlikely the fishery will be impacted by these proposed measures.

4.5.8.2.4 Framework and monitoring alternatives

These alternatives are administrative and are unlikely to have impacts on the bluefish fishery because of minimal overlap with the directed fishery.

4.5.9 Atlantic mackerel, squids and butterfish

4.5.9.1 *Biological impacts*

Atlantic mackerel (*Scomber scombrus*) are found on both sides of the North Atlantic Ocean, including the Baltic Sea. In the western Atlantic, they are found from Labrador to North Carolina. Atlantic mackerel are common in cold and temperate waters over the continental shelf. They swim in schools near the surface, and travel to and from spawning and summering grounds.

Butterfish (*Peprilus triacanthus*) range from Florida to Newfoundland, but are primarily found from Cape Hatteras to the Gulf of Maine. Butterfish are sensitive to and migrate in response to seasonal changes in water temperature. During summer, butterfish move northward and inshore to feed and spawn. During winter, butterfish move southward and offshore to avoid cold waters. Butterfish are semi-pelagic, and form loose schools that feed upon small squid, and crustaceans.

The northern shortfin squid (*Illex illecebrosus*, referred to in this section as Illex) is a highly migratory, transboundary species that is distributed in the Northwest Atlantic Ocean from the Florida Straits to Newfoundland. The southern and U.S. stock component extends from the Gulf of Maine to Florida.

Longfin squid (*Doryteuthis (Amerigo) pealei*) is found from Newfoundland to the Gulf of Venezuela. In the northwest Atlantic Ocean, longfin squid are most abundant between Georges

Bank and Cape Hatteras, North Carolina. Squid eggs are attached to rocks and small boulders or aquatic vegetation on sandy or muddy bottoms. Larvae are found in surface waters. Juveniles also live in the upper water column in water 165 to 1,650 feet deep. Adults live over mud or sand/mud substrates of the continental shelf and upper continental slope in waters up to 1,300 feet deep.

EFH for life stages for Atlantic mackerel, longfin squid, Illex, and butterfish are pelagic (water column itself), and the species have temperature and prey preferences/needs that drive the suitability of any particular area/depth, thus fishing activity has minimal impacts on their habitats. Longfin squid also use hard bottom, submerged vegetation, other natural or artificial structure, and sand or mud to attach/anchor eggs, but there are no known preferences for different types of substrates or indications that fishing activity may negatively affect longfin squid egg EFH.

4.5.9.1.1 Habitat management alternatives

As described above in section 1.1.3.1, there is overlap between Atlantic mackerel, longfin squid, Illex (shortfin squid), and butterfish distribution and EFH and the proposed habitat management alternatives. However, because EFH for Atlantic mackerel, longfin squid, Illex, and butterfish life stages are not susceptible to bottom tending mobile gears, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. If these gear restrictions go into place, it is expected that fishing effort with bottom tending mobile gear would likely shift to other unrestricted areas. In addition, the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on these species are expected to be neutral when compared to No Action.

4.5.9.1.2 Spawning management alternatives

Because EFH for Atlantic mackerel, longfin squid, Illex, and butterfish life stages are not susceptible to bottom tending gears regulated in spawning areas, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types under the spawning management alternatives. In addition, the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed spawning management alternatives on these species are expected to be neutral when compared to No Action.

4.5.9.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3).Because EFH for Atlantic mackerel, longfin squid, Illex, and butterfish life stages are not susceptible to bottom tending mobile gears, or other gear types, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. The commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measure proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives management alternatives these species are expected to be neutral, when compared to No Action.

4.5.9.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes of Atlantic mackerel, longfin squid, Illex, and butterfish; therefore no biological impacts are expected on these species when compared to the status quo.

4.5.9.2 *Fishery impacts*

Mackerel are primarily caught by mid-water trawls, but longfin squid, Illex, and butterfish are primarily caught with bottom trawls (mobile bottom-tending gear).

A small recreational fishery exists for Atlantic mackerel and butterfish. While there is a recreational fishery for longfin squid, information on the recreational landings of invertebrates is not collected.

4.5.9.2.1 Habitat management alternatives

The core of the fishery for Atlantic mackerel is prosecuted in four statistical areas in the Mid-Atlantic Bight (Table 156).

Table 156 – Mackerel landings (mt) in statistical areas with at least 1,000 mt of mackerel caught in at least one recent year.

YEAR	612	616	622	621
2010	5759.72	383.46	1260.19	1130.74
2011	3.64	99.85	17.95	59.25
2012	2392.64	1526.66	2.81	-

Source: Unpublished NMFS vessel trip reports

The core of the commercial fishery for butterfish and longfin squid is in the Mid-Atlantic region; however, significant catch and landings occur in the Southern New England and Georges Bank area in statistical areas 522, 525, and 562 for butterfish (Table 157), and 525 and 562 for longfin squid (Table 158).

Table 157 – Butterfish landings (mt) in statistical areas with substantial recent butterfish catch.

YEAR	_537	_611	_539	_616	_613	_525	_522	_562	_612
2010	127.6	54.14	65.42	36.86	29.09	25.69	20.46	27.61	12.3173
2011	105.3	81.37	61.69	72.45	31.19	31.03	10.34	8.884	8.5012
2012	102.9	57.98	64.37	36.93	44.31	31.18	18.87	12.58	23.4897

Source: Unpublished NMFS vessel trip reports

Table 158 – Longfin squid catch in statistical areas with at least 250 mt of longfin squid caught in at least one year of last three.

YEAR	_616	_537	_622	_612	_613	_539	_538	_626	_525	_623	_611	_632	_562	_526
2010	2,505	604	1,043	475	474	333	199	173	348	52	226	275	224	51
2011	1,321	1,252	1,608	1,630	642	327	114	417	459	235	313	137	110	324
2012	1,419	2,501	1,244	1,765	1,699	407	722	385	114	433	174	130	95	12

Source: Unpublished VTR reports

During summer through fall, a bottom trawl fishery for Illex occurs on the U.S. shelf, primarily in the Mid-Atlantic Bight. 2012 landings by state are given in Table 159.

Table 159 – 2012 Illex landings (mt) by state

STATE	MetricTons	Percentage
NJ	6054.1	52%
RI	5365.83	46%
VA	287.66	2%

Source: unpublished NEFSC dealer reports

Because the core of the commercial fisheries for Atlantic mackerel and Illex do not coincide with the habitat management areas under consideration, these fisheries are unlikely to be significantly impacted by proposed measures that restrict or prohibit the use of bottom tending mobile gear under the habitat management alternatives proposed. There are areas of overlap in the butterfish and longfin squid fisheries on Georges Bank and in Southern New England area. Any prohibitions on bottom tending mobile gear may affect landings of these species in these areas, resulting in slight negative impacts. Therefore, the impacts on the directed butterfish and longfin squid fisheries are expected to be neutral to slightly negative. The impacts are expected to be slight, because these areas only represent a small portion of the overall area over which these fisheries are prosecuted. The impacts on the Atlantic mackerel and Illex fisheries are expected to be neutral.

4.5.9.2.2 Spawning management alternatives

Many types of fishing gears are currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31. Under Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have these gear prohibitions in place during 3 months of the year (February-April) as opposed to year round. The core of the Atlantic mackerel and Illex fisheries are not prosecuted in these areas. There is the potential for neutral to slight positive impacts on the butterfish and longfin squid fisheries. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of bottom trawls into these areas during the open times of the year. These impacts are considered slight because these areas only represent a small portion of the overall area over which these fisheries are prosecuted. These alternatives do not alter other aspects of these fisheries, including the limits on catch and landings. Therefore, expected impacts range from neutral to slight positive, resulting in increased flexibility and area in which butterfish and longfin squid fishermen can choose to use bottom otter trawling gear.

Impacts on the recreational fisheries are not expected. For the recreational fishery, party and charter vessels may obtain a letter of authorization to fish in these areas, and private recreational vessels are exempted. Recreational fishermen will continue to have the opportunity to fish in these areas under the proposed spawning management alternatives.

4.5.9.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Because the core of the commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish do not overlap to a large extent with the DHRAs proposed, these fisheries are unlikely to be significantly impacted by proposed measures. The butterfish and longfin squid fishery overlap with the Georges Bank DHRA. However, the extent of overlap of these fisheries with the Georges Bank DHRA, relative to the total extent of the fishery, is small. The commercial fisheries for Atlantic mackerel, longfin squid, Illex, and butterfish are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the impacts of the proposed dedicated habitat research area alternatives on longfin squid and butterfish are expected to be neutral to slight negative, when compared to the status quo. The impact on Atlantic mackerel and Illex are expected to be neutral.

4.5.9.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on Atlantic mackerel, longfin squid, Illex, and butterfish fisheries. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.5.10 Spiny dogfish

4.5.10.1 *Biological impacts*

Spiny dogfish (*Squalus acanthias*) in the Northwest Atlantic are found from Labrador to Florida and are most abundant between Nova Scotia and Cape Hatteras. Spiny dogfish live inshore and offshore, usually near the bottom but also in mid and upper water column and at the surface. They are also found in enclosed bays and estuaries. Spiny dogfish swim in large schools and migrate seasonally, with changes in water temperature. Much of the population travels north in the spring and summer and south in the fall and winter. Some spiny dogfish remain in northern waters throughout the year and move offshore during the winter.

North of Cape Hatteras, EFH is:

Juveniles (male and female, <36 cm): Pelagic and epibenthic habitats, primarily in deep water on the outer continental shelf and slope between Cape Hatteras and Georges Bank, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Recently-born dogfish (neonates,

<24 cm in length) have been collected in bottom trawl survey tows in nearshore waters, but less often and/or in fewer numbers than on the outer shelf.

Female Sub-Adults (36-79 cm): Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, sub-adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 8 to 14°C and 50-160 meters. The females are more widely distributed over the continental shelf than the males.

Male Sub-Adults (36-59 cm): Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, sub-adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 8 to 14°C and 50-160 meters. The males are not as widely distributed over the continental shelf as the females and are generally found in deeper water.

Female Adults: Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 7 to 15°C and 20-160 meters. Young are born mostly on the offshore wintering grounds from November to January, but new borns (neonates or "pups") are sometimes taken in the Gulf of Maine or southern New England in early summer.

Male Adults: Pelagic and epibenthic habitats throughout the region, as depicted in figures provided in Amendment 3 to the Spiny Dogfish FMP. Generally, adult females are most commonly found in full salinity seawater (32-35 ppt) where bottom depths and temperatures range from 7 to 15°C and 20-160 meters.

4.5.10.1.1 Habitat management alternatives

As described above in section 1.1.4.1, there is overlap between spiny dogfish distribution and EFH and the proposed habitat management alternatives. Because EFH for all the spiny dogfish life stages are not susceptible to mobile bottom-tending gears, their EFH would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. If these gear restrictions go into place, it is expected that fishing effort with bottom tending mobile gear would likely shift to other unrestricted areas. It is expected that spiny dogfish will continue to be incidentally caught in bottom tending gears (such as bottom trawls). However, the commercial fishery for spiny dogfish is managed using catch limits, which limit removals of spiny dogfish (landings and discards) to levels that are sustainable. Therefore, the biological impacts of the proposed habitat management alternatives on spiny dogfish are expected to be neutral when compared to No Action.

4.5.10.1.2 Spawning management alternatives

The use of sink or anchored gillnets is currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 for common pool groundfish vessels. Under alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated.

In addition, Closed Area I and II would only have sink or anchored gillnet gear prohibitions in place during 3 months of the year (February-April) as opposed to year round.

Because EFH for all the spiny dogfish life stages are not susceptible to bottom tending mobile gears, their EFH would not likely be impacted (either positively or negatively) by any expansion of gear types used in these areas. There is the potential that spiny dogfish fishermen will choose to expand the use of sink or anchor gillnets into these areas during the open times of the year. However, the commercial fishery for spiny dogfish is managed using catch limits, which limit removals of spiny dogfish (landings and discards) to levels that are sustainable. Therefore, biological impacts are expected to be neutral on spiny dogfish as a result of the proposed spawning management measures.

4.5.10.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3).Spiny dogfish life stages are not generally targeted bottom tending mobile gears, and would not likely be impacted (either positively or negatively) by any prohibitions on use of those gear types. In addition, these measures are not expected to alter the sustainability of spiny dogfish. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives on spiny dogfish are expected to be neutral when compared to No Action.

4.5.10.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological processes associated with spiny dogfish; therefore no biological impacts are expected on spiny dogfish when compared to No Action.

4.5.10.2 *Fishery impacts*

Sink and anchored gear nets produced about 71% of the landings for spiny dogfish from 2008-2012 (Table 160). Bottom trawls followed by hook and line were responsible for the bulk of the landings that remained. Spiny dogfish are not typically targeted with trawls or other gears and are considered incidental catch in those gear types. No significant recreational fishery exists for spiny dogfish, although some retention of recreationally caught spiny dogfish does occur.

Table 160 – Commercial gear types associated with spiny dogfish harvest for calendar years 1996-2011. Note that vessels with state issued permits only are not required to complete VTRs so total VTR landings are less than total dealer-reported landings.

Year	Gillnet	Bottom trawl	Hook and line	Other*	Total
1996	29,579,961	6,037,302	3,732,568	145,104	39,494,935
1997	24,878,433	4,134,679	3,540,179	97,497	32,650,788
1998	24,794,310	4,892,602	3,413,065	47,220	33,147,197
1999	17,527,898	4,529,311	5,396,759	50,270	27,504,238
2000	6,147,934	5,750,119	4,200,552	15,678	16,114,283

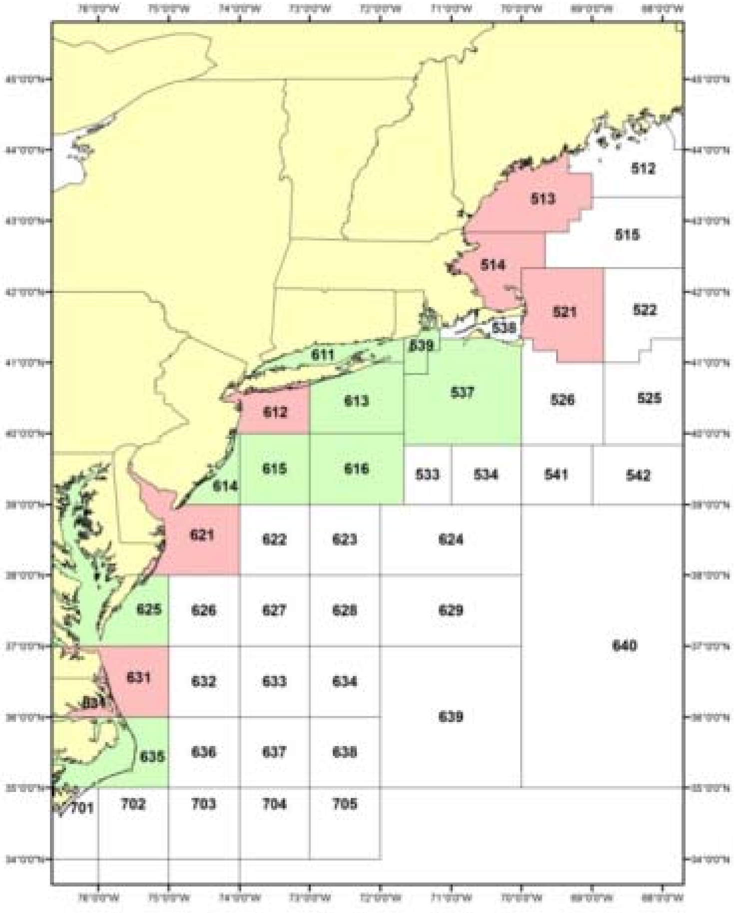
2001	853,473	348,285	2,620,863	2,300	3,824,921
2002	644,303	348,885	808,597	55,631	1,857,416
2003	262,022	121,372	194,133	250	577,777
2004	904,811	339,833	74,693	3,282	1,322,619
2005	1,083,057	531,236	182,620	2,411	1,799,324
2006	2,252,631	1,052,690	373,964	6,472	3,685,757
2007	1,861,738	410,407	341,601	6,219	2,619,965
2008	2,619,441	531,572	336,444	24,114	3,511,571
2009	6,144,699	1,904,194	766,083	22,338	8,837,314
2010	5,892,778	1,533,946	1,225,233	10,004	8,661,961
2011	10,757,661	2,381,889	1,542,412	53,513	14,735,475
2012	12,367,393	1,791,693	3,067,743	29,962	17,256,791
Average % 2008-2012	71.4%	16.2%	12.1%	0.3%	100.0%

* Combined landings which may include unknown, mid-water trawl, beam trawl, seine, pots and traps, and dredge.

4.5.10.2.1 Habitat management alternatives

VTR data indicate that six statistical areas collectively accounted for 73.04 % of spiny dogfish landings in 2010, with each contributing greater than 5.0 % of the total (Map 120). These areas also represented 73.5% of the trips that landed spiny dogfish.

Map 120 – Spiny dogfish catch by NMFS Northeast statistical areas. Shaded areas indicate where spiny dogfish harvest occurs. Red areas comprise 5% or more of harvest and green areas 1% to 5% of harvest.



Statistical areas 513, 514, and 521 do coincide with areas proposed for habitat management alternatives. However, the directed fishery for spiny dogfish is prosecuted primarily with sink or anchored gillnets. The directed fishery is unlikely to be impacted by any proposed habitat management measures that restrict or prohibit the use of mobile bottom-tending gear. It is expected that spiny dogfish will continue to be incidentally landed in smaller amounts in other gear types such as trawls or hook and line while targeting other species, wherever that fishing effort may occur. Therefore, the habitat management alternatives are expected to have neutral impacts on the fishery when compared to No Action.

4.5.10.2.2 Spawning management alternatives

The use of sink or anchored gillnets is currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 for common pool vessels only. Under Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have sink or anchored gillnets gear prohibition in place during 3 months of the year (February-April) as opposed to year round. Therefore, there is the potential for neutral to slight positive impacts on the spiny dogfish fishery. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of sink or anchor gillnets into these areas during the open times of the year. These alternatives do not alter other aspects of the fishery, including the limits on catch and landings in this fishery. Therefore, the slight positive impacts are a result of increased flexibility and less constraint on where and when the spiny dogfish fishermen choose to use sink or anchored gillnets to target spiny dogfish.

Impacts on the recreational fishery are not expected. For the recreational fishery, party and charter vessels may obtain a letter of authorization to fish in these areas, and recreational vessels are exempted. Recreational fishermen will continue to have the opportunity to fish in these areas under the proposed spawning management alternatives. As stated above, no significant recreational fishery exists for spiny dogfish.

4.5.10.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Sink or anchored gillnets would be prohibited in the Stellwagen DHRA. Because the core of the spiny dogfish commercial fishery overlaps with these areas, there is the potential for slight negative impacts if use of this gear continues to be prohibited in the Stellwagen DHRA (sink/anchored gillnets are currently prohibited in the WGOM closure area, of which the Stellwagen DHRA is a subset). However, given that the research areas proposed are relatively small, it is likely that spiny dogfish fishermen would shift their effort to other surrounding areas that are not under such gear restrictions. On that basis, the impacts on the spiny dogfish fishery are expected to range from neutral to slight negative, depending which research areas are implemented and how fishermen respond to the prohibition of sink or anchored gillnets use in those areas. Bottom otter trawl catches of spiny dogfish would be restricted in all DHRAs, but this is expected to have a smaller impact on the fishery as this gear contributes a smaller amount of overall landings.

4.5.10.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on the spiny dogfish fishery. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.5.11 Summer flounder, scup, and black sea bass

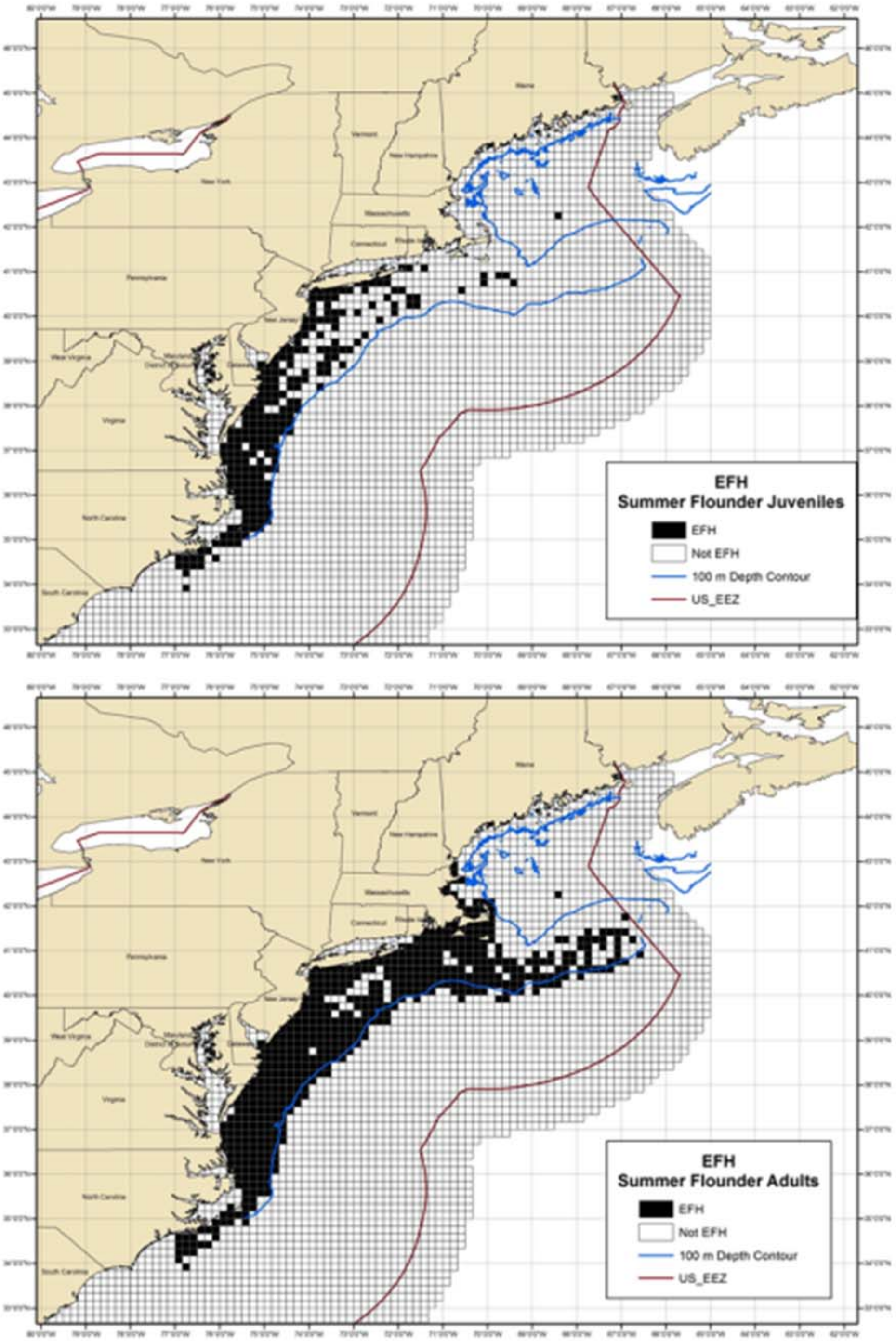
4.5.11.1 *Biological impacts*

Summer flounder are found in the Atlantic Ocean from Nova Scotia to the east coast of Florida. In U.S. waters, summer flounder are most common in the Mid-Atlantic region from Cape Cod, Massachusetts, to Cape Fear, North Carolina. Larval summer flounder live in estuaries and coastal lagoons. Juveniles bury in the sediment in marsh creeks, seagrass beds, mud flats, and open bays, notably Pamlico Sound and Chesapeake Bay. Adult summer flounder migrate inshore and offshore seasonally with changes in water temperature. In the winter and early spring, they are found offshore along the outer edge of the continental shelf. In late spring and early summer, they move inshore into shallow coastal waters and estuaries. Summer flounder migrate back offshore in the fall. Both summer flounder juvenile and adult EFH are considered vulnerable to bottom tending mobile gears. The distribution of EFH for those life stages is shown in Map 121.

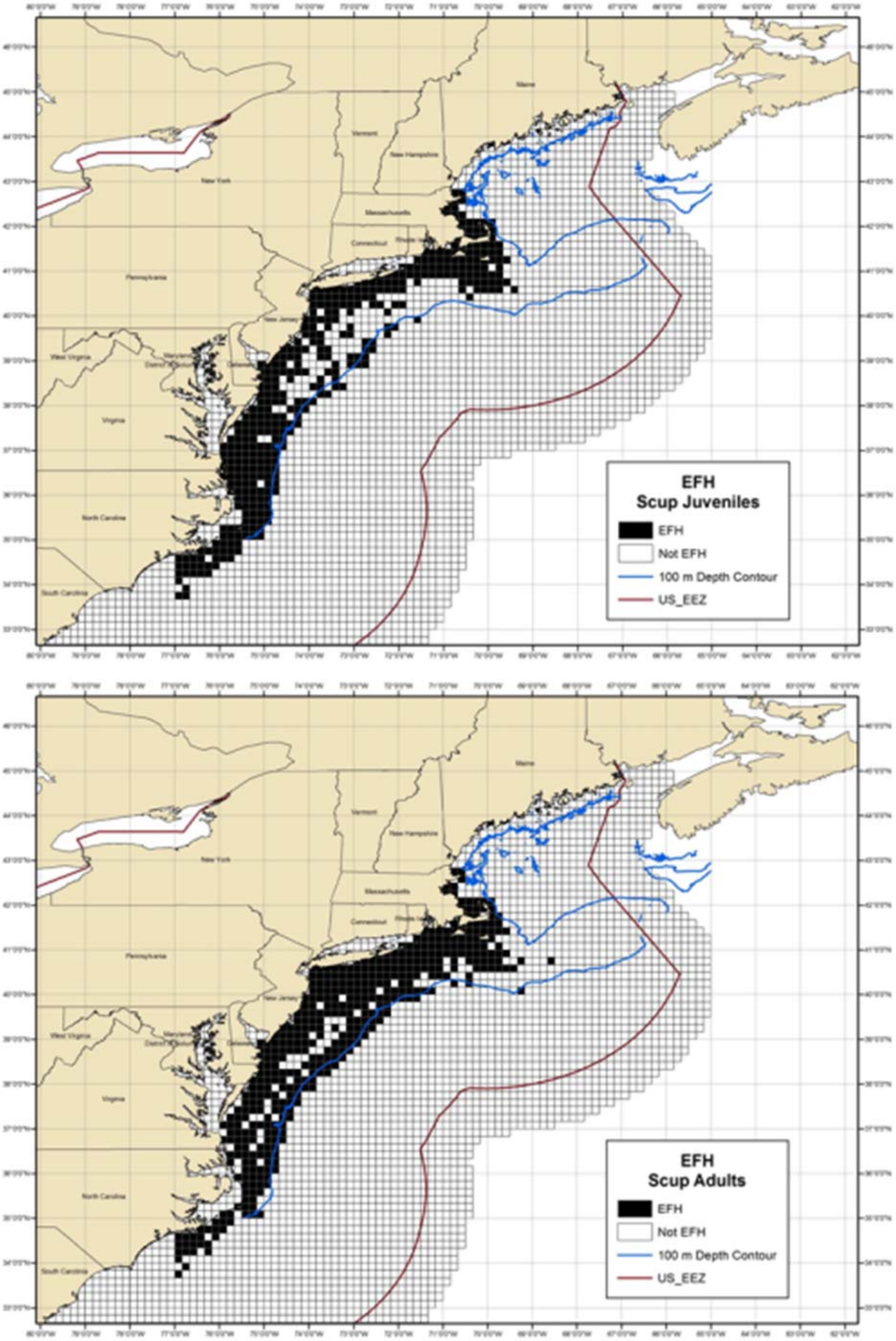
Scup are found in the Northwest Atlantic Ocean, primarily between Cape Cod and Cape Hatteras. Their eggs and larvae are found in the water column in coastal waters during warmer months. As larvae mature, they settle to the seafloor and develop into juveniles. Juveniles live in a variety of habitats including rocky ledges, artificial reefs, mussel beds, sand, silty-sand, shell, and mud bottoms, and eelgrass. During the summer and early fall, juveniles and adults are common in large estuaries, open sandy bottoms, and structured habitats such as mussel beds, reefs, or rock rubble. Scup migrate north and inshore to spawn in the spring, then migrate south and offshore in autumn as the water cools, arriving by December in offshore areas where they spend the winter. Both scup juveniles and adult EFH are considered vulnerable to bottom tending mobile gears. The distribution of EFH for those life stages is shown in Map 122.

Black sea bass are found along the U.S. East Coast from Cape Cod to the Gulf of Mexico. They prefer structured habitats such as reefs, wrecks, or oyster beds in temperate and subtropical waters. In the Mid-Atlantic (north of Cape Hatteras, North Carolina), black sea bass migrate seasonally as water temperature changes. They generally migrate to inshore coastal areas and bays in the spring and offshore in the fall. Both black sea bass juveniles and adult EFH are considered vulnerable to bottom tending mobile gears. The distribution of EFH for those life stages is shown in Map 123.

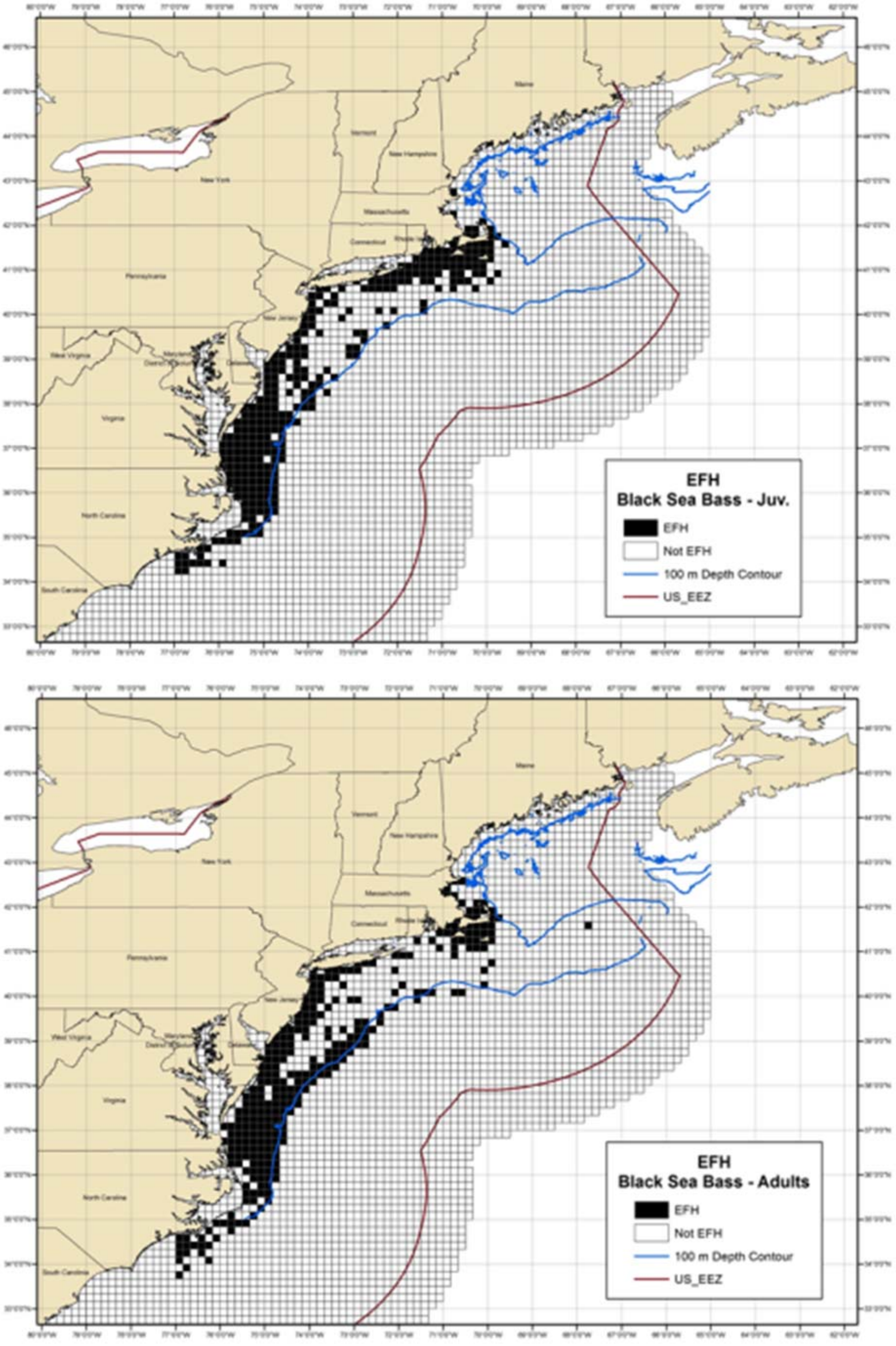
Map 121 – Distribution of EFH for juvenile and adult summer flounder.



Map 122 – Distribution of EFH for juvenile and adult scup.



Map 123 – Distribution of EFH for juvenile and adult black sea bass.



4.5.11.1.1 Habitat management alternatives

As shown above in section 4.5.11.1, the summer flounder juvenile and adult distributions and EFH overlap with some of the proposed habitat management alternatives. In particular, the juvenile and adult summer flounder EFH extends through Southern New England and the Great South Channel, with adult EFH extending out to Georges Bank. Because juvenile and adult summer flounder EFH are susceptible to bottom tending mobile gears, their EFH would likely be positively impacted by prohibitions on use of these gear types. If these gear restrictions go into place, it is expected that fishing effort with bottom tending mobile gear would likely shift to other unrestricted areas, which would offset possible impacts of reduced impact to EFH. Because summer flounder juvenile and adult distribution and EFH has minimal to no overlap with the Western and Eastern Gulf of Maine, the proposed habitat alternatives in those areas are expected to have neutral biological impacts on summer flounder. The commercial fishery for summer flounder is managed using catch limits, which limit removals of summer flounder (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed habitat management alternatives on summer flounder are expected to be neutral to slightly positive when compared to no action.

Juvenile and adult scup and black sea bass distributions and EFH overlap with some the proposed habitat management alternatives. In particular, the scup and black sea bass EFH extends through Southern New England/Great South Channel and the Western Gulf of Maine. Because juvenile and adult scup black sea bass EFH are susceptible to bottom tending mobile gears, their EFH would likely be positively impacted by prohibitions on use of these gear types. If these gear restrictions go into place, it is expected that fishing effort with bottom tending mobile gear would likely shift to other unrestricted areas, which would offset possible impacts of reduced impact to EFH. Because juvenile and adult scup and black sea bass distribution and EFH has minimal to no overlap with the Eastern Gulf of Maine and Georges Bank, the proposed habitat alternatives in those areas are expected to have neutral biological impacts on scup and black sea bass. The commercial fishery for scup and black sea bass is managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed habitat management alternatives on scup and black sea bass are expected to be neutral to slightly positive when compared to no action.

4.5.11.1.2 Spawning management alternatives

The use of many gears capable of catching groundfish is currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31(common pool vessels only) . Under Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have the bottom tending mobile gear prohibition in place during 3 months of the year (February-April) as opposed to year round.

As shown above in section 4.5.11.1, adult summer flounder, juvenile and adult scup, and juvenile and adult black sea bass distributions and EFH overlap with the proposed spawning management alternatives. Because these EFH life stages are susceptible to bottom tending fishing gears, there is potential for neutral to slightly negative impacts on summer flounder, scup, and black sea bass. The impacts are considered slight as these measures have the potential to affect a small portion of the species ranges. The extent of impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of mobile bottom-tending gears in particular into these areas during the open times of the year. The commercial fisheries for summer flounder, scup, and black sea bass are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed spawning management alternatives on summer flounder are expected to be neutral to slightly negative when compared to no action.

4.5.11.1.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4), or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3).Summer flounder adult and juvenile EFH overlaps with the Georges Bank DHRA. Scup and black sea bass EFH does not. Adult and juvenile summer flounder EFH is susceptible to mobile bottom-tending gears, and would likely be impacted positively by any prohibitions on use of those gear types in the Georges Bank DHRA. However, the extent of overlap with the Georges Bank DHRA when compared to the overall extent of the species range is quite small. The commercial fisheries for summer flounder, scup, and black sea bass are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the biological impacts of the proposed dedicated habitat research area alternatives management alternatives on summer flounder are expected to be neutral to slightly positive, and neutral for scup and black sea bass, when compared to no action.

4.5.11.1.4 Framework and monitoring alternatives

These alternatives are administrative and do not have any impacts on the biological process of summer flounder, scup, and black sea bass; therefore, no biological impacts are expected on these species when compared to the status quo.

4.5.11.2 *Fishery impacts*

Based on VTR data for 2012, the bulk of the summer flounder landings were taken by bottom otter trawls (over 97 percent), with other gear types (e.g. hand lines, scallop dredges, sink gill nets) each accounting for less than 1 percent of landings. The bulk of scup landings in 2012 were taken by bottom otter trawls (96 percent), followed by pots and traps (~1 percent), and hand lines (~1 percent). Other gear types each accounted for less than 1 percent of landings. The majority of black sea bass landings were taken by bottom otter trawls (51 percent), followed by pots and traps (30 percent), hand lines (10 percent), and offshore lobster pots and traps (6 percent). Other gear types each accounted for less than 1 percent of landings.

4.5.11.2.1 Habitat management alternatives

Six statistical areas individually accounted for greater than 5 percent of the summer flounder catch in 2012 (Table 161). Collectively, these six areas accounted for 71 percent of the summer flounder catch. There were five statistical areas, which individually accounted for greater than 5 percent of the scup catch in 2012 (Table 161). Collectively, these five areas accounted for 82.5 percent of the scup catch. There were five statistical areas, which individually accounted for greater than 5 percent of the black sea bass catch in 2012 (Table 161). Collectively, these four areas accounted for 60.3 percent of the black sea bass catch.

Table 161 – Statistical areas that accounted for at least 5 percent of the summer flounder, scup, or black sea bass catch in 2012, NMFS VTR data.

Statistical Area	Summer Flounder (percent)	Scup (percent)	Black Sea Bass (percent)
616	18.55	9.02	16.56
537	18.15	26.79	6.99
613	11.36	18.73	4.90
612	9.79	2.24	2.38
626	6.85	0.02	3.67
622	6.32	0.09	9.20
539	4.60	13.02	4.52
621	3.82	0.06	16.52
615	3.27	1.54	11.05
611	1.90	14.95	2.37

The bulk of the commercial fishery landings for all three species occur in statistical areas south of Cape Cod, as indicated by the 2012 VTR data. Because the core of the commercial fisheries for summer flounder, scup, and black sea bass do not coincide with the habitat management areas under consideration, the fishery is unlikely to be significantly impacted by proposed habitat management measures that restrict or prohibit the use of mobile bottom-tending gear. Some areas of overlap include Georges Bank and in the Southern New England area, where mixed fishery bottom trawls may catch summer flounder, scup, or black sea bass. Any prohibitions on mobile bottom-tending gear may affect landings of these species in these areas, resulting in slightly negative impacts. Therefore, the impacts on the directed summer flounder, scup, and black sea bass fisheries are expected to be neutral to slightly negative.

4.5.11.2.2 Spawning management alternatives

The use of various gears capable of catching groundfish, such as bottom trawls, is currently prohibited in the Nantucket Lightship Closure Area, Closed Area I, and Closed Area II year round, and in the Georges Bank Seasonal Closure from May 1 to May 31 (common pool vessels only). Under Alternatives 2 and 3, the Nantucket Lightship Closure Area and the Georges Bank Seasonal Closure would be eliminated. In addition, Closed Area I and II would only have these gear prohibitions in place during 3 months of the year (February-April) as opposed to year round. Therefore, there is the potential for neutral to slightly positive impacts on the summer flounder, scup, and black sea bass fisheries. The impacts will depend on whether fishermen chose to take advantage of the newly open areas and expand the use of bottom trawls into these areas during the open times of the year. For scup and black sea bass, the use of pots and traps to catch these species was already an exempted gear type. These impacts are considered slight because the areas under consideration are a small portion of these species range and their EFH. These alternatives do not alter other aspects of the summer flounder, scup, or black sea bass fisheries, including the limits on catch and landings in this fishery. Therefore, expected impacts range from neutral to slightly positive, resulting increased flexibility and area in which summer flounder, scup, and black sea bass fishermen can choose to use bottom otter trawling gear.

Impacts on the recreational fishery are not expected. For the recreational fishery, party and charter vessels may obtain a letter of authorization to fish in these areas, and private recreational vessels are exempted. Recreational fishermen will continue to have the opportunity to fish in these areas under the proposed spawning management alternatives.

4.5.11.2.3 Dedicated Habitat Research Area alternatives

Dedicated habitat research areas would be closed to mobile bottom-tending gears (Alternatives 2 and 4, or mobile bottom-tending gears and other demersal gears capable of catching groundfish (Alternative 3). Because the core of the commercial fisheries for summer flounder, scup, and black sea bass do not coincide (i.e., statistical areas in which they are prosecuted) do not overlap with the DHRAs proposed, the fishery is unlikely to be significantly impacted by proposed measures that restrict gear use or put constraints on commercial fishing access in these areas. Some areas of overlap with a small part of the fishery may include Georges Bank, where mixed fishery bottom trawls may catch summer flounder, scup, or black sea bass. However, the extent of overlap of the fisheries with the Georges Bank DHRA, relative to the total extent of the fishery, is small. The commercial fisheries for summer flounder, scup, and black sea bass are managed using catch limits, which limit removals (landings and discards) to levels that are sustainable. None of the measures proposed would alter that aspect of the management program. Therefore, the impacts of the proposed dedicated habitat research area alternatives management alternatives on summer flounder, scup, and black sea bass are expected to be neutral to slightly negative, when compared to No Action.

4.5.11.2.4 Framework and monitoring alternatives

These measures are focused on describing the process by which the habitat, spawning, and dedicated habitat research alternatives would be reviewed and modified in the future. These alternatives are administrative and are unlikely to have impacts on the summer flounder, scup, and black sea bass fishery. Action that results from application of this process (e.g., modifications to boundaries for areas, changes to gear restrictions within areas, etc.) would be proposed and implemented through a Framework or other actions which would include an analysis of the impacts for that specific action.

4.5.12 Golden tilefish

4.5.12.1 *Biological impacts*

Golden tilefish (*Lopholatilus chamaelonticeps*) are found along the outer continental shelf and upper continental slope of the entire U.S. East Coast and Gulf of Mexico. They are most abundant from Nantucket Island, Massachusetts to Cape May, New Jersey. Tilefish typically live at depths of 250 - 1,500 feet (76 m - 457 m) where water temperatures range from 49 to 58^{o}F. They are often found in and around submarine canyons where they burrow in mud or sand sediment. Some tilefish build large sand and rubble mounds, which provide habitat for other bottom-dwelling creatures and fishes. Tilefish eggs and larvae are found along similar isobaths as the adults.

There is minimal to nil overlap between tilefish distribution and EFH and the proposed habitat management, spawning management, or research area alternatives. Therefore, the biological impacts of the proposed alternatives on tilefish are expected to be neutral when compared to No Action. The framework and monitoring alternatives are administrative and do not have any impacts on the biological processes of tilefish; therefore no biological impacts are expected on tilefish when compared to the status quo.

4.5.12.2 *Fishery impacts*

The fishery is prosecuted where tilefish are found, at depths of 250 - 1,500 feet (76 m - 457 m) where water temperatures range from 49 to 58° F. The Northern areas for this fishery are typically prosecuted in deeper waters within the range.

There is no overlap between the tilefish fishery and the habitat management, spawning management, or research area alternatives proposed in this amendment; therefore, no impacts to the fishery are expected. The framework and monitoring alternatives are administrative and do not have any impacts on the tilefish fishery because there is no overlap with the fishery.

4.5.13 Northern shrimp

4.5.13.1 *Biological impacts*

4.5.13.1.1 Habitat management alternatives

The management alternatives selected will influence the distribution of mobile bottom-tending gear fishing effort including shrimp trawl effort. With the exception of shrimp trawls and traps, catch rates of shrimp in fishing gears are very minimal. Shrimp traps would not be restricted by any of the alternatives. Therefore, the redistribution of effort by gears other than shrimp trawls will have no impacts positive or negative on the shrimp resource. The shrimp fishery begins on or around December 1, when many shrimp have already hatched their eggs for the breeding season. Therefore, no particular biological impacts are expected if the management alternatives lead to shifts in the distribution of shrimp trawling effort.

4.5.13.1.2 Spawning management alternatives

As noted above, there is little to no bycatch of shrimp in gears other than shrimp trawls and shrimp traps, and the spawning management alternatives will not affect the use of shrimp trawl or trap gears. Therefore no impacts to the shrimp resource are expected to result from the spawning alternatives.

4.5.13.1.3 Dedicated Habitat Research Area alternatives

There is some overlap between the shrimp fishery and the two DHRAs in the Gulf of Maine, Eastern Maine (Alternative 2) and Stellwagen (Alternative 3), but neither of these areas is a center of shrimp fishing effort. The conclusions above under the habitat management alternatives section apply here as well.

4.5.13.1.4 Framework and monitoring alternatives

As none of the above alternative types are expected to impact the shrimp resource, the schedule and approach to adjusting these impacts will also have no impacts.

4.5.13.2 *Fishery impacts*

The shrimp fishery is prosecuted out of Massachusetts, New Hampshire, and Maine ports in the inshore Gulf of Maine during the winter months. The stock status and specifications are evaluated annually. Due to collapse of the stock, there will not be a fishery during the 2013-2014 season. It is not known whether a fishery will be possible in 2014-2015, or if not then, when a fishery may be resumed. Therefore, in the short term, the spatial management alternatives will not affect prosecution of the shrimp fishery.

Prior distributions of shrimp trawl effort relative to the various management areas are discussed in the human community and fishery impacts sections for each type of alternative, and shrimp trawl effort is generally separated out as a separate gear type, unless data confidentially issues caused shrimp trawl data to be pooled with other bottom trawls. The intent of this section is to briefly summarize the information already provided specifically with respect to the shrimp trawl fishery, but the reader interested in impacts to the shrimp fishery should also review the human and community impacts sections for the Gulf of Maine habitat, spawning, and research area alternatives.

4.5.13.2.1 Habitat management alternatives

If management option 1 or 2 is selected for a particular alternative set of habitat management areas, shrimp trawl vessels would be prohibited along with other mobile bottom-tending gears. One metric that can be used to assess the impacts of these habitat management alternatives on the shrimp fishery is the amount of shrimp trawl effort in currently open HMAs. If areas currently fished are closed, that effort would have to be displaced to other locations. Another consideration is how much effort might occur in areas that are now closed that might reopen to the fishery under an alternative action. This is more difficult to assess because it requires an inference about future fishing effort based on past effort and/or a distribution of the shrimp stock.

Because shrimp undergo inshore/offshore migrations seasonally, the distribution of shrimp and therefore shrimp fishing effort relative to habitat management areas may vary from year to year. Mature female shrimp move inshore in early winter and offshore following larval hatching. The shrimp assessment defines inshore vs. offshore using a depth of 55 fathoms (about 100 m). Much of the Small and Large Bigelow Bight areas are considered inshore according to this definition. In seasons where the fishery occurs earlier in the calendar year, there would presumably be a greater overlap with this area, and therefore a greater displacement of effort if it were adopted as a mobile bottom-tending gear closure (WGOM Alternatives 3, 4, or 5 with Options 1 or 2; Alternatives 3 and 4 include the larger area, and Alternative 5 includes the smaller area).

The revenue data in the table below are excerpted from the WGOM human communities and fishery impacts section. Mean annual revenues are for calendar years 2010, 2011, and 2012. According to the 2013 assessment update, overall commercial landings of northern shrimp during the shrimp seasons ending in 2010, 2011, and 2012 were 6.99 million, 10.63 million, and

5.21 million dollars, respectively, or an average of 7.61 million dollars across the three seasons (ASMFC NSTC 2013). Given total Large Bigelow Bight revenues estimated at 1.55 million, this means this area accounted for roughly 20% of revenues in the fishery across these years. Revenues from the Small Bigelow Bight area, which is a subset of the Large Bigelow Bight area, accounted for about 4% of total shrimp fishery revenues across the three years. These percentages may be slight underestimates because only federal VTRs were used in the revenue analysis, and some shrimp vessels report on state VTRs only. Overall, federal VTRs used in the revenue analysis accounted for approximately 82% of total shrimp trawl revenues in the dealer data during 2012; somewhat less than this during 2010 and 2011 (see VTR/observer/dealer comparison section in Volume 1). Also note that the shrimp season generally starts December 1 of the previous year (i.e. the 2010 season started on December 1, 2009, whereas the VTR revenue analyses are based on a calendar year).

Table 162 – Shrimp trawl revenue in the Large and Small Bigelow Bight areas, calendar years 2010-2012. All variables represent annual estimates derived from federal VTRs. 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. Note that the small area is a subset of the large area.

Area	Vessel Size	Mean Revenue	Median Revenue	SD Revenue	Max Revenue	Min Revenue	Individ.	Trips
Bigelow Large	L/U	176,087	155,447	37,396	-	-	4	87
Bigelow Large	M	524,001	457,520	210,129	759,329	355,154	19	470
Bigelow Large	S	847,795	969,194	298,789	1,066,776	507,414	59	1,128
Bigelow Large	***Total***	***1,547,883***	***1,582,161***	***546,314***	***1,826,105***	***862,568***	***82***	***1,685***
Bigelow Small	OTHER	144,517	144,517	79,146	200,482	88,552	11	278
Bigelow Small	S	205,282	205,282	117,275	288,207	122,356	30	518
Bigelow Small	***Total***	***349,799***	***349,799***	***196,421***	***488,689***	***210,908***	***41***	***796***

Thus, WGOM Alternatives 3, 4, or 5 with Options 1 or 2 could have a negative impact on the shrimp fishery, Alternative 5 less so than Alternatives 3 or 4. Shrimp traps could continue to be used in the area, although the bulk of the fishery is prosecuted using trawls. Other than alternatives that include the Large or Small Bigelow Bight areas and would close them to trawl gears, the alternatives in this amendment would result in relatively little displacement of future shrimp fishing effort, assuming that effort in the future has a similar spatial distribution to that observed in recent years. It is possible that some of this effort could be displaced into more offshore grounds if these alternatives are adopted, because deeper mud habitats west of Jeffreys Ledge would be open to shrimp trawls under these alternatives, as well as under Alternative 2 and Alternative 6. There has been shrimp fishing in these areas historically, although this only occurs when the season is long enough that the shrimp move back from their spawning grounds into offshore waters. As shown in the table above, smaller vessels (<50 ft) constitute the bulk of the revenue in the Bigelow Bight areas, and they may be less able to fish further offshore.

4.5.13.2.2 Spawning management alternatives

As currently written, shrimp trawls would be exempted from the Gulf of Maine spawning management areas, so the no action and action alternatives are not expected to impact this fishery. There is no shrimp fishery in the Georges Bank/Southern New England region so those alternatives would have no impact on the shrimp fishery.

4.5.13.2.3 Dedicated Habitat Research Area alternatives

Shrimp trawl vessels would be excluded from the Alternative 2 (Eastern Maine DHRA) and Alternative 3 (Stellwagen DHRA) research areas because they are a mobile bottom tending gear. The Eastern Maine DHRA is currently open to shrimp trawls and there appears to be little overlap with this gear type, so neutral to slight negative impacts are expected if this area is implemented as a DHRA. The Stellwagen DHRA is currently closed, so it is difficult to infer the potential for different types of fishing activities, but it is generally south and east of where shrimp fishing typically occurs. The types of information expected to be generated by research in these areas is not expected to have a direct benefit on management of the shrimp fishery.

4.5.13.2.4 Framework and monitoring alternatives

The process by which spatial management measures are evaluated and updated is not expected to have a direct impact on the fishery. The direct impacts of any future changes on the shrimp fishery would be evaluated in future framework or amendment analyses.

4.5.14 American lobster

4.5.14.1 *Biological impacts*

4.5.14.1.1 Background information

The American lobster fishery occurs from Maine to Cape Hatteras, North Carolina. There are seven Lobster Conservation Management Areas (Areas), Areas 1, 2, 3, 4, 5, and Outer Cape Cod Area. The American lobster resource and fishery are cooperatively managed by the states (0-3 nautical miles) and the National Marine Fisheries Service (3-200 nautical miles) under the framework of the Atlantic States Marine Fisheries Commission (ASMFC). There are three distinct lobster stock areas, the Gulf of Maine (GOM) lobster stock, the Georges Bank (GB) lobster stock, and the Southern New England (SNE) lobster stock. This action is relevant to the GOM and GB stocks.

The assessment of all US stocks is currently being updated, but based the 2009 lobster stock assessment, the GOM and GB lobster stocks are not depleted and overfishing is not occurring. The 2009 lobster stock assessment states that the GB stock was at record high abundance. The exemption being that statistical area 514 is currently experiencing historically low stock abundance and declines in lobster recruitment. In addition, it has been determined that the statistical are 514 is experiencing high levels of exploitation. The SNE lobster stock is depleted mainly due to recruitment failure, but the stock is not experiencing overfishing.

Over the period 1981-2007 the GB stock averaged 5% of the US fishery, although landings from this stock have increased in recent years to over 2,000 mt annually. The GB fishery is prosecuted by fishermen from Rhode Island, Massachusetts, Connecticut, and New Hampshire. Trap hauls would be the most useful effort metric (ASMFC 2009) but catch and effort data is not available for all states. According to tabulations of trap hauls by stock area and state in the assessment through 2007, vessels from Massachusetts contribute about three times more trap hauls than those from New Hampshire. Massachusetts vessels tend to fish the northern and eastern side of GB, and landings from these areas (Statistical Areas 521, 522, 561, 562) have increased recently. The 2007 stock assessment notes that effort on GB is not well characterized due to a lack of both mandatory reporting and appropriate resolution in the reporting system. Based on Massachusetts data, the number of traps fished has remained stable around a mean value of 43,000.

Over the same timeframe (1981-2007), the GOM stock averaged 76% of the US fishery, increasing to 87% from 2002-2007. SNE constitutes the remainder of the fishery and landings have declined recently in response to stock conditions.

The majority of lobsters (about 98%) are taken with traps, but lobsters are also taken as bycatch by Federal lobster permit holders who primarily use bottom otter trawl, gillnet, and scallop dredge. Information on commercial discards and bycatch is incomplete because Federal lobster permit holders with only a Federal lobster permit are not required to report their harvest to the Federal government, and limited sea sampling in the offshore fishery has resulted in minimal fishery-dependent information in this portion of the fishery. Regulatory discards include under and oversized animals, v-notched females, and egg-bearing females. Incidental catch limits for non-directed trips (e.g. groundfish trawl trips) may also lead to discards. There are no discard mortality studies from GB. A comparative study in Long Island Sound (Smith and Howell 1987) investigated trap vs. trawl mortality during different seasons, to quantify lobsters with minor or major external damage.

The results of the study discussed immediate mortality rates caused by trawl-induced physical injury to lobsters, and delayed mortality rates for lobsters with or without physical damage. Immediate mortality rates were low for both trap and trawl gears across all lobsters, including egg bearing females, which have not yet molted and still have hard shells. Immediate mortality rates of trawl-caught lobsters ranged from 0-2.2% depending on the month. Major damage rates were also relatively low at 0-11.8% depending on the month. Delayed mortality, measured by holding fishery caught lobsters in a laboratory setting, was relatively high for lobsters that sustained major damage (42.4-100%, depending on the month), or for lobsters that were newly molted and had soft shells (33%). Undamaged trawl caught lobsters and trap caught lobsters showed little delayed mortality. These results suggest that the fraction of the catch that sustains immediate major damage or is soft-shell can be used to predict delayed mortality rate in lobsters caught by trawl gear. In addition, undamaged lobsters with long laboratory exposures to freezing temperatures (-9.5° C) also sustained high mortality rates (none at 30 minutes, but 70% at 60 minutes and 100% at 120 minutes). While the authors note that the laboratory conditions may have resulted in greater exposure for each lobster as compared to catch piled on the deck of a vessel where some lobsters were insulated from the cold, this result indicates that long exposures during sorting would cause incidental mortality.

Another study (Jamieson and Campbell 1985) examined incidental catch and damage rates in lobster caught in the Gulf of St. Lawrence scallop dredge fishery. Researchers observed that spatial shifts in the distribution of lobsters affected the overlap of lobsters within the scallop fishery in this region. Overall, the study concluded that the scallop fishery did not have substantial negative impacts on the lobster resource since few lobsters occurred on the fishing grounds during the months in which the scallop fishery was most heavily prosecuted. It was not clear whether scallop fishing activity was driving lobsters off the fishing grounds, or if the lobsters were moving off the grounds during that time for other reasons. Lobster catch rates in three types of dredges were compared; one of their dredge types, the Gulf sweep chain dredge, was noted as being most similar to the offshore dredge. Catches of lobsters in unlined Gulf sweep chain dredges were low – 0.07 lobsters per meter per minute – but were higher for lined dredges, and in hoods and covers attached to the dredges. This indicated that some lobsters escaped through the rings and others swam over the dredge.

Recent sex ratios in commercial and survey catches on GB have indicated a heavily skewed number of female lobsters. The reason for this is not clear but may relate to increased conservation of egg-bearing females (which cannot be landed as a conservation measure) and the influence this conservation has over time on population structure. It is also not clear if the population is experiencing sperm limitation. The reproductive patterns for larger lobsters are not very well known. Large females may molt and extrude eggs in alternate years, and many factors appear to influence molt rate/intermolt interval. As indicated by the Smith and Howell study, incidental mortality rates on these females would be affected to the extent that these females are post-molt and therefore softshell during times when other fisheries are being heavily prosecuted in the area, and during the times when there are more lobsters in the area in general (similar to Gulf of St. Lawrence observations).

4.5.14.1.2 Impacts of management alternatives

Omnibus Essential Fish Habitat Draft Amendment 2 proposes to alter fishing privileges in specific Habitat Management Areas (HMAs), Spawning Management Areas (SMAs), and Dedicated Habitat Research Areas (DHRAs). Changes to areas in and around Closed Area II are as of particular concern to the American lobster fishery.

Some of the habitat management alternatives would result in maintenance of existing areas or portions of them as mobile bottom-tending gear closures. Others would result in reopening of existing areas to mobile bottom-tending gears, or closure of new areas to mobile bottom-tending gears. Biological concerns center on how alternatives that increase access for mobile bottom-tending gear fishing might change the rate of incidental mortality of lobsters in non-trap gears. As discussed above, fishing mortality rates are relatively high for lobsters that have recently molted and have soft shells, and for hard shelled lobsters that suffer major damage. The magnitude of the interaction between lobsters and mobile bottom-tending gears could increase if the number of lobsters increases on a seasonal basis, or if the rate of mobile bottom-tending gear use is high in an area. The fraction of recently molted lobsters will influence the incidental mortality rate. Whether or not any increase in incidental mortality constitutes a significant impact on the stock depends on the magnitude of incidental mortality relative to stock size.

In the GOM, the lobster population is concentrated relatively inshore (see distribution map in the Affected Environment section). In general, the habitat management alternatives might impose additional restrictions on mobile bottom-tending gears inshore, but would not increase their use.

Therefore, incidental mortality increases are of limited concern in this region, and the habitat management alternatives there would likely have a neutral to slightly positive impact on the resource.

On GB, lobsters are concentrated along the edges of the bank and in the eastern part of the bank on either size of the EEZ. The GB sub-region habitat management alternatives other than Alternative 1/No Action would remove CAI and CAII from a habitat protection perspective. Closed Area II is under consideration to be opened to mobile gear fishing. Currently, specific areas within the closure have been closed to mobile gear, with minor exceptions that include Special Access Permits. Closed Area II is located within Area 3 and is fished year-round by some or all of its 137 lobster trap permit holders that have access to these fishing grounds. If an action alternative is also selected for spawning, CAI and CAII would be closed seasonally only (February, March, and April). Some parts of eastern GB might still be off limits to mobile bottom tending gears depending on the alternative and option selected (GB habitat alternatives 3, 4, 5, and 6). The question is how abundant lobsters are in these reopened areas between May and January, and when and at what rate soft-shell lobsters are present. Based on data provided by ASMFC, lobster fishing effort peaks from July to October, and discard rates appear to be highest in August and September. Discards would be due to lobsters being undersized, oversized, egg bearing females, or v-notched females.

ASMFC provided the Council with lobster bycatch data collected by the Atlantic Offshore Lobstermen's Association from two vessels. These data indicate that about half the lobsters sampled in July-September are egg bearing females, and about 80% of lobsters sampled October-December are egg bearing females, which would help explain the high discard rates. It is not clear from the data provided whether lobsters are more abundant on Eastern GB during July-October, or if that is simply the preferred season for lobster fishing. Because most of these lobsters are ovigerous, they have not yet molted, so there should not be an increase in incidental mortality on most of the animals as a result of their soft-shell status. Nonetheless, injury-related delayed incidental mortality on these females may be of concern. This concern is tempered by the fact that the GB stock status is at record high abundance as of the last assessment, with large numbers of female lobsters in the population. Overall, the GB habitat and spawning action alternatives that increase mobile bottom-tending gear access to currently closed areas, particularly CAII, may have a small negative impact on the lobster resource.

4.5.14.2 *Fishery impacts*

Lobster trapping, which comprises the vast majority of lobster fishing effort, would not be restricted under any of the management alternatives in this amendment, so there would not be any direct impacts through displacement of lobster trapping effort. Any positive or negative impacts on the lobster fishery would be indirect, and will relate to increases or decreases in the use of other gears on lobster fishing grounds.

One of the main concerns with opening CAII to mobile gear is that gear conflicts may arise between fixed lobster gear vessels and mobile gear vessels. The lobster industry, specifically in Area 3, and the Atlantic States Marine Fisheries Commission are aware of this potential for increased gear conflict. Therefore, the Commission has addressed the issue by adopting Addendum XX to Amendment 3 of the Interstate Fishery Management Plan for American lobster. Addendum XX formalized a previous agreement between the groundfish sector industry and the offshore Area 3 lobster industry. Within the document, specific measures are outlined to establish different seasons for lobster fishing within Closed Area II, and different seasons for mobile gear fishing. Because this agreement was established between both fishing industries directly affected by the re-opening of the closed area, the potential for negative implications has been greatly reduced, while allowing for the lobster industry to continue fishing in the area without mobile gear during specified time frames.