Omnibus Essential Fish Habitat Amendment 2

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

Options and alternatives to minimize the effects of fishing on EFH and designate Dedicated Habitat Research Areas

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Prepared by the
New England Fishery Management Council

TABLE OF CONTENTS

TABLES

FIGURES

MAPS

1.0 Introduction

1.1 Goals and objectives of OA2

The purpose of Omnibus Essential Fish Habitat Amendment 2 (OA2) is meet NMFS' published guidelines for implementation of the Magnuson-Stevens Act's EFH provisions. As an omnibus action, this action is intended to minimize adverse effects from fishing on EFH across all Council plans. Deep-sea coral-related goals and objectives were moved to a separate amendment in September 2012. The specific goals and objectives for OA2 are as follows:

GOALS:

1. Redefine, refine or update the identification and description of all EFH for those species of finfish and mollusks managed by the Council, including the consideration of HAPCs;
2. Identify, review and update the major fishing activities (MSA and non-MSA) that may adversely affect the EFH of those species managed by the Council;
3. Identify, review and update the major non-fishing activities that may adversely affect the EFH of those species managed by the Council;
4. Identify and implement mechanisms to protect, conserve, and enhance the EFH of those species managed by the Council to the extent practicable;
5. Define metrics for achieving the requirements to minimize adverse impacts to the extent practicable;
6. Integrate and optimize measures to minimize the adverse impacts to EFH across all Council managed FMPs;
7. Update research and information needs;
8. Review and update prey species information;
9. Enhance groundfish fishery productivity[1]*
10. Maximize societal net benefits from the groundfish stocks while addressing current management needs*

OBJECTIVES:

A. Identify new data sources and assimilate into the process to meet goals (state, federal and other data sources);
B. Implement review of existing HAPCs and consider modified or additional HAPCs (Goal 1);

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[1] Goals and objectives indicated with an * were approved October 2012 by Groundfish Committee, November 2012 by the Council

C. Review EFH designations and refine or redefine where appropriate as improved data and analysis become available (Goal l);
D. Develop analytical tools for designation of EFH, minimization of adverse impacts, and monitoring the effectiveness of measures designed to protect habitat (Goal l, Goal 3 and Goal 5);
E. Modify fishing methods and create incentives to reduce the impacts on habitat associated with fishing (Goal 4);
F. Support restoration and rehabilitation of fish habitat which have already been degraded (by fishing and non-fishing activities) (Goal 4);
G. Support creation and development of fish habitat where appropriate and when increased fishery resources would benefit society (Goal 4);
H. Develop a strategy for prioritizing habitat protection (Goal 4);
I. Develop criteria for establishing and implementing dedicated habitat research areas (Goal 7);
J. Design a system for monitoring and evaluating the benefits of EFH management actions including dedicated habitat research areas (Goal 7);
K. Improved groundfish spawning protection; including protection of localized spawning contingents or sub-populations of stocks* (Goal 9); including:
    - Spawning fidelity
    - Conservation of sub-stocks and spawning components
    - Prevent extirpation
L. Improved protection of critical groundfish habitats (Goal 9)*
M. Improved refuge for critical life history stages (Goal 9)*
N. Improved access to both the use and non-use benefits arising from closed area management across gear types, fisheries, and groups. These benefits may arise from areas designed to address the other three groundfish closed area objectives (Goal 10).*
    - Not a primary reason for closed areas, but a consideration for spatial management
    - May produce benefits to specific fisheries or ocean users

1.2 Document contents

This document includes four sections, plus references:

- **<u>Section 2.0</u>**: Area-specific habitat management alternatives and component options (current as of 03/19/13 Habitat Committee meeting)
- **<u>Section 3.0</u>**: Area-specific dedicated habitat research area options (current as of 03/19/13 Habitat Committee meeting)
- **<u>Section 4.0</u>**: Additional alternatives related to monitoring and frameworkability
- **<u>Section 5.0</u>**: Area-specific habitat management options that have been previously discussed by the Habitat Committee and removed from further consideration

Options to address groundfish productivity goals and objectives are currently under development and are not discussed in this document.

1.3 Definitions

The following definitions are used throughout:

- **Option** refers to a single habitat management area (exisiting, modified, or newly proposed) and a single associated management measure. For example, "Establish the Platts Bank habitat management areas and close them to mobile bottom-tending gear". The intention is to provide some analysis of options on an individual basis. This document summarizes adverse effects minimization options; options designed to achieve groundfish objectives are currently in development.
- **An alternative** is a combination of options that would be discussed and analyzed as a group. For example, the no action alternative would include options to maintain each of the six existing habitat closed areas.
- **A habitat management area (HMA)** is a location where habitat management measures could be implemented. These locations are bounded by specific coordinates that were developed by the Habitat Committee and Plan Development Team between July 2011 and June 2012.
- **Management measures** are the fishing restrictions that could be associated with new or modified habitat management areas. Individual areas generally have two different types of measures that might be selected, specifically a mobile bottom tending gear restriction, where these gear types are prohibited entirely, or a prohibition on all fishing gears. The latter is only proposed for the Ammen Rock habitat management area. This area overlaps completely with the Cashes Ledge HMA and would therefore represent an enhanced protection level for the specific habitat types on the Ammen Rock pinnacle.
- **A dedicated habitat research area (DHRA)** is a location that may or may not overlap with a habitat management area, and is designed to allow for one or more specific research and monitoring objectives to be addressed. DHRAs would be implemented via separate regulations from the HMAs as they may involve different boundaries, restrictions on fishing, and time frames for review of effectiveness.

2.0 Management alternatives to minimize the adverse effects of fishing on Essential Fish Habitat

The Magnuson Stevens Fishery Conservation and Management Act states that fishery management plans must do the following:

"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"*

The Secretarial guidelines define 'adverse' as a combination of effects on habitat that are both 'more than minimal' and 'not temporary' (see EFH final rule for details; a copy is posted at http://www.nefmc.org/habitat/efhfinalrule.pdf). 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.

Habitat management in the region has been area-based for many years. The two existing Habitat Areas of Particular concern were designated in 1999 via Omnibus EFH Amendment 1, and six habitat closure areas were implemented via Amendment 13 to the multispecies FMP.

To foster objective decision making in regards to habitat management across FMPs, the Council's Habitat PDT developed the Swept Area Seabed Impact (SASI) approach to estimating the spatial extent of the adverse effects of fishing gears to benthic habitats. The NEFMC Habitat PDT developed SASI especially for use in OA2. This document assumes that the reader has a basic understanding of the SASI approach to evaluating the impacts of fishing on benthic habitats. A brief summary of the SASI approach is available here: http://www.nefmc.org/habitat/sasi_info/110624_SASI_Summary_v2.pdf. A more detailed explanation of the SASI approach is available here: http://www.nefmc.org/habitat/sasi_info/110121_SASI_Document.pdf. Work on SASI was substantially complete by early 2010, and the primary focus since June 2010 has been the development of habitat management area options.[2]

One important output of the SASI model is spatially specific estimates of habitat vulnerability by gear type. SASI uses a dominant-substrate based definition of habitat, and habitats dominated by larger substrate grain sizes (i.e. gravels) were found to be more vulnerable to accumulating adverse effects from fishing due to extended recovery periods (i.e., not minimal or temporary). The LISA The Local Indicators of Spatial Association (LISA) analyses of these SASI vulnerability results used spatial statistics to identify clusters of vulnerable habitats, specifically showing which of the SASI grid cells had higher or lower than average vulnerability, and whether they were within higher than

[2] Recent meeting summaries may also be of interest and are available at http://www.nefmc.org/habitat/index.html.

average or lower than average vulnerability 'neighborhoods'. These two analyses complemented one another, with the raw SASI results locating the vulnerable habitats and the LISA analysis indicating which are clustered together and best the focus for management. For example, all gravels are vulnerable but it is not practical - or practicable - to manage impacts to all gravel patches due to the complex of gear composition and fishing paterns. However, clusters of vulnerable habitats can be of sufficient size to implement practical spatial management measures.

These clusters were used as a starting point for PDT discussions about which locations to recommend to the Committee as adverse effects minimization habitat management areas.[3] Although clustering of the SASI model vulnerability outputs for all gear types were evaluated using the LISA analysis, the PDT's recommendations were based on the trawl gear SASI outputs. This was because trawl gears represent the bulk of the adverse effects in the region relative to other gears, in large part because their realized area swept is an order of magnitude greater than that for all other gear types. Per unit of area swept, scallop dredge impacts were estimated to be the same as for trawl gears. Fixed gear (longline, gillnet, and trap) impacts were found to be less adverse than mobile gear impacts. This is because geological and biological habitat features were estimated to be less susceptible to damage from fixed gears, and because with more minimal damage, recovery was estimated to occur more quickly. Hydraulic dredge impacts were also evaluated using SASI, but this fishery is spatially very localized, and only operates within certain habitat types. Specifically, areas with larger substrate grain sizes are not fished with hydraulic dredges.

In June 2011, the PDT evaluated the model outputs, underlying data, and other available habitat data to move from a set of cluster outputs to a set of 'vulnerable areas' (see Map 1). These vulnerable areas were based on both model results and the known locations of natural features including banks, ledges, or gravel-dominated hotspots that meet the conceptual definition of vulnerability as used in the model. This list of areas included some areas that were based on the LISA clusters and some that were outside the clusters. Also, some of the coastal LISA cluster areas were not included on the list. The vulnerable areas were presented to the Committee in July 2011. The area boundaries identified by the PDT at this time were not intended to be management area boundaries, rather, the intention was to highlight vulnerable features such as banks and ledges in the Gulf of Maine, and gravel-dominated hotspots on Georges Bank and to the west of Great South Channel. Cox Ledge in Southern New England was also highlighted.

Following the July 2011 Committee meeting, the PDT refined the boundaries of some of these areas (in particular the areas west of the Great South Channel, the gravel-dominated hotspots on and west of Georges Shoal, and the Jeffreys Ledge area) to produce more straightforward boundaries that were intended for adoption as management areas (see

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[3] The PDT also conducted an Equal Area Permutation analysis, which evaluated the performance of the existing habitat closures in terms of whether or not they encompassed high vulnerability habitats. Some of the closures performed well based on this metric, and others relatively poorly.

Map 2). At this time, the PDT also suggested intermediate options between maintaining and eliminating the Nanctucket Lightship and Closed Area II habitat closed areas (again, see Map 2), although the Committee did not adopt these options for further consideration at their August 30 meeting (see Map 3).

In February 2012, the PDT developed some area-based management options for Stellwagen Bank and the surrounding area, as well as two other locations in the inshore/western Gulf of Maine, New Scantum and Gloucester Bank-Lower Stellwagen Bank. The Committee reviewed these options later that month and decided to move forward with the Stellwagen option for the southern part of the WGOM habitat closure. The full range of options as initially proposed is shown on Map 4. Details are provided in the section of this document summarizing previously considered options.

Also at their February 2012 meeting, the Committee asked the PDT to revisit the boundary options for Platts Bank, Fippennies Ledge, and Cox Ledge, to make them more discrete. The Committee reviewed these options in April and June 2012 and accepted them for further analysis at their June meeting in Providence. Also at the June 2012 meeting, the Committee reconsidered a previously rejected option to modify the boundaries of the Jeffreys Bank habitat area. In March 2013, the Committee updated the range of area-based management options for the Great South Channel to include three variations on a single GSC management area (Map 7), moving the four-box option to considered but rejected.

Also in June 2012, the Committee reconsidered the use of gear modifications as a management strategy in various GOM areas, and added ground cable length limit options for all areas except Ammen Rock (Map 6). At their August and December 2012 meetings, and at their March 2013 meeting, the Committee considered PDT and advisory panel advice about whether or move forward with these types of options in OA2. Ultimately, the Committee decided not to move forward with these types of options in OA2, but is exploring enhanced monitoring and data collection to facilitate development of such options in future management actions. Further discussionof gear modification options can be found in section 5.1.1.11.

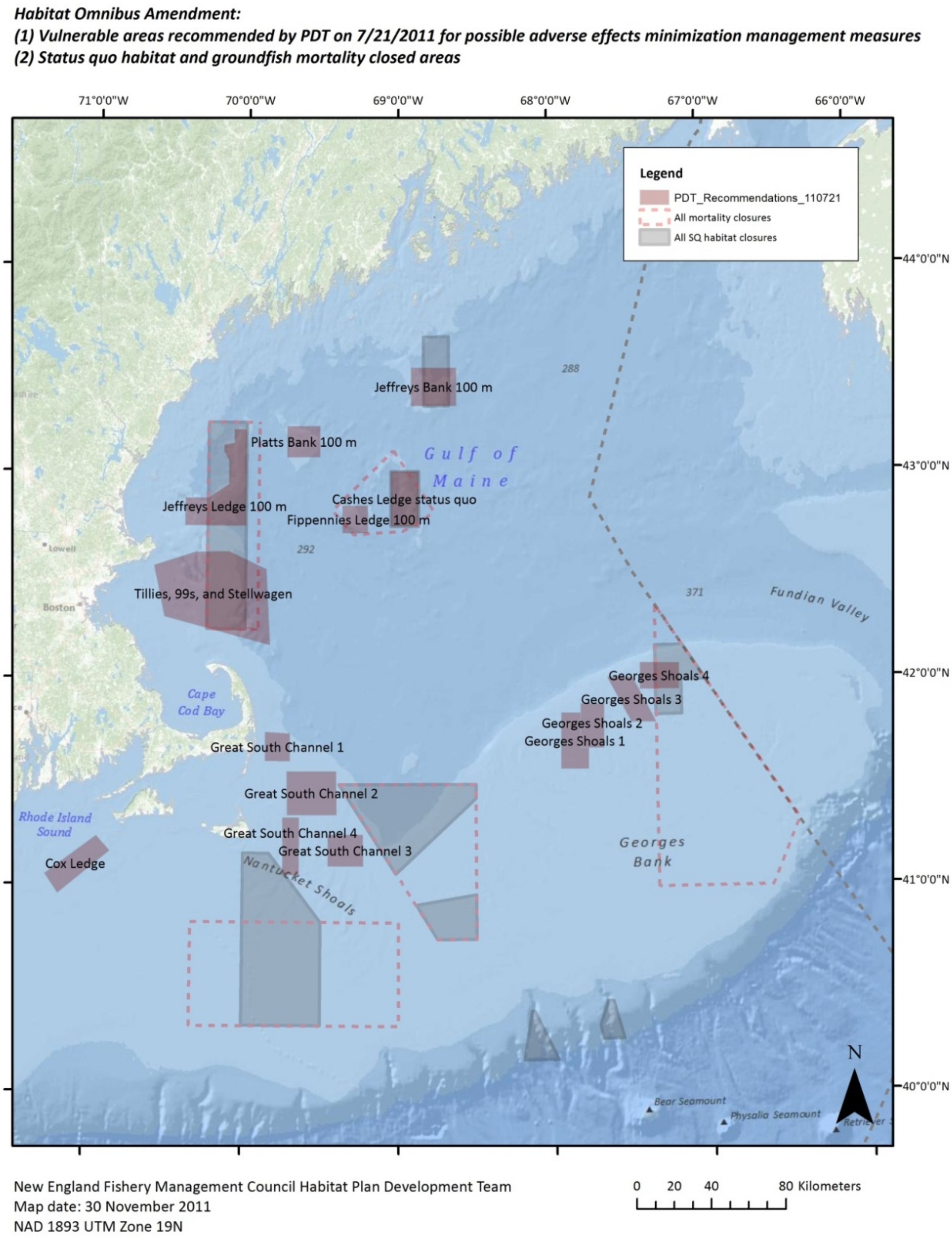
Aside from gear modifications, the Committee has discussed the closure of specified habitat areas to particular types of fishing gear. A mobile bottom tending gear restriction, which includes all types of trawls and dredges, applies to the existing habitat closed areas, and is proposed as an option for most of the new and modified areas:

Another option under consideration is closure to all types of fishing activity. This restriction would include all types of bottom tending gear: bottom trawls, dredges, demersal longlines, sink gillnets, and traps, with the exception of lobster traps, as well as midwater trawl gear and recreational gear. 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’).

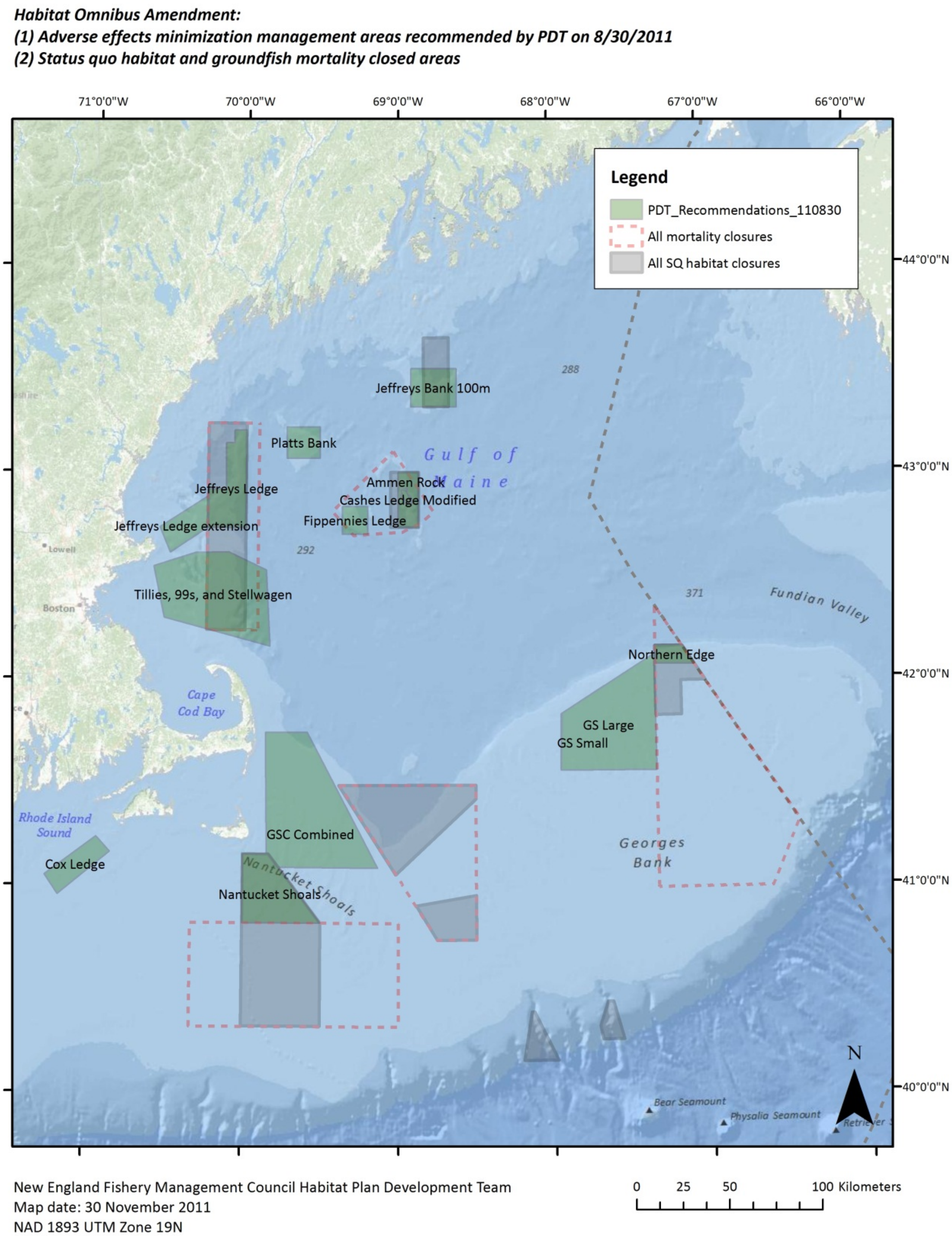
Coordinates for the existing and proposed habitat management areas are listed in

Table 1 (exisiting areas), Table 2 (new or modified areas). Coordinates for existing areas are those listed in regulations; coordinates given for new or modified areas reflect the most recent updates to area boundaries.

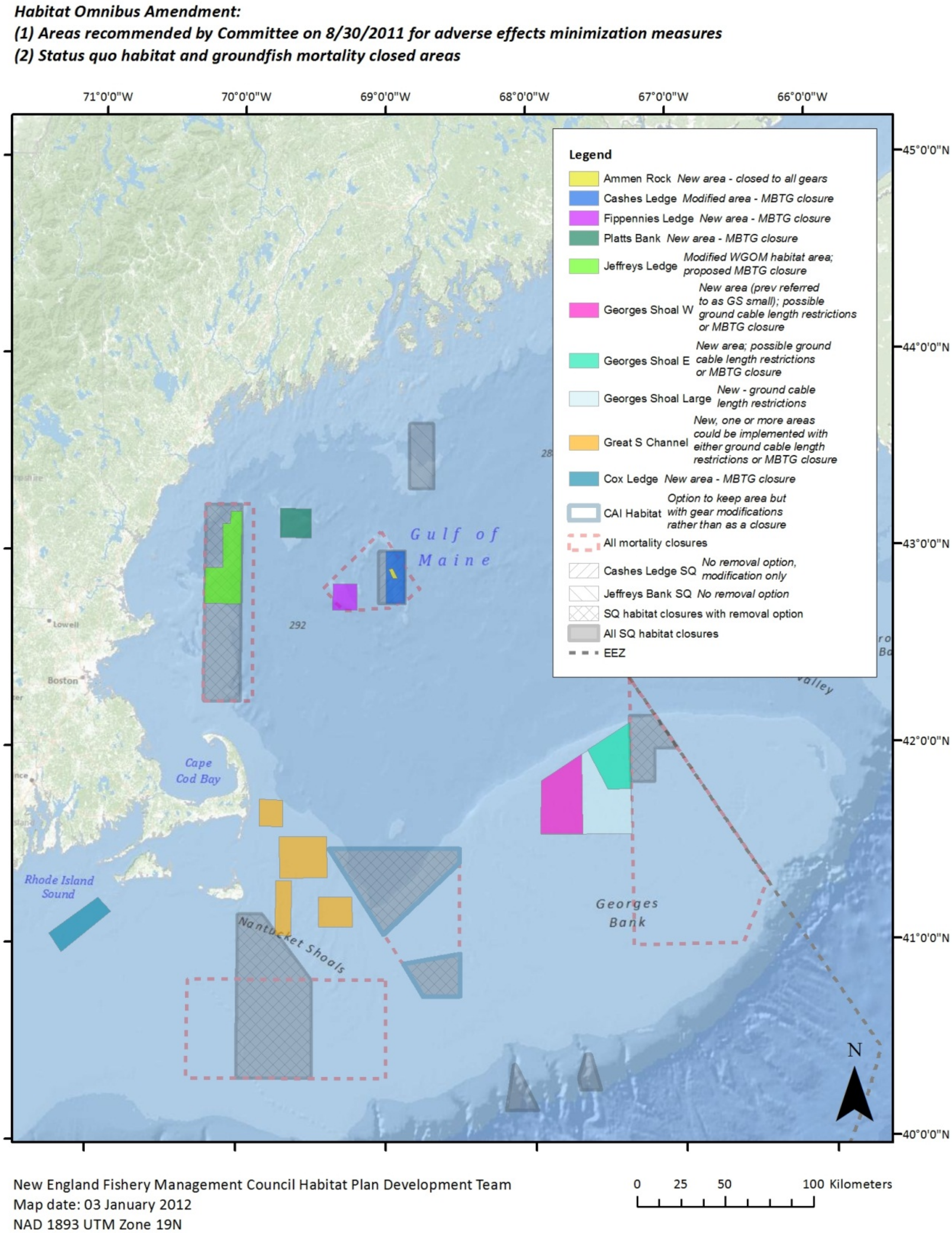
Map 1 – Vulnerable areas recommended by the PDT at the Committee's July 21, 2011 meeting.



Map 2 – Habitat management areas recommended by the PDT at the Committee's August 30, 2011 meeting.

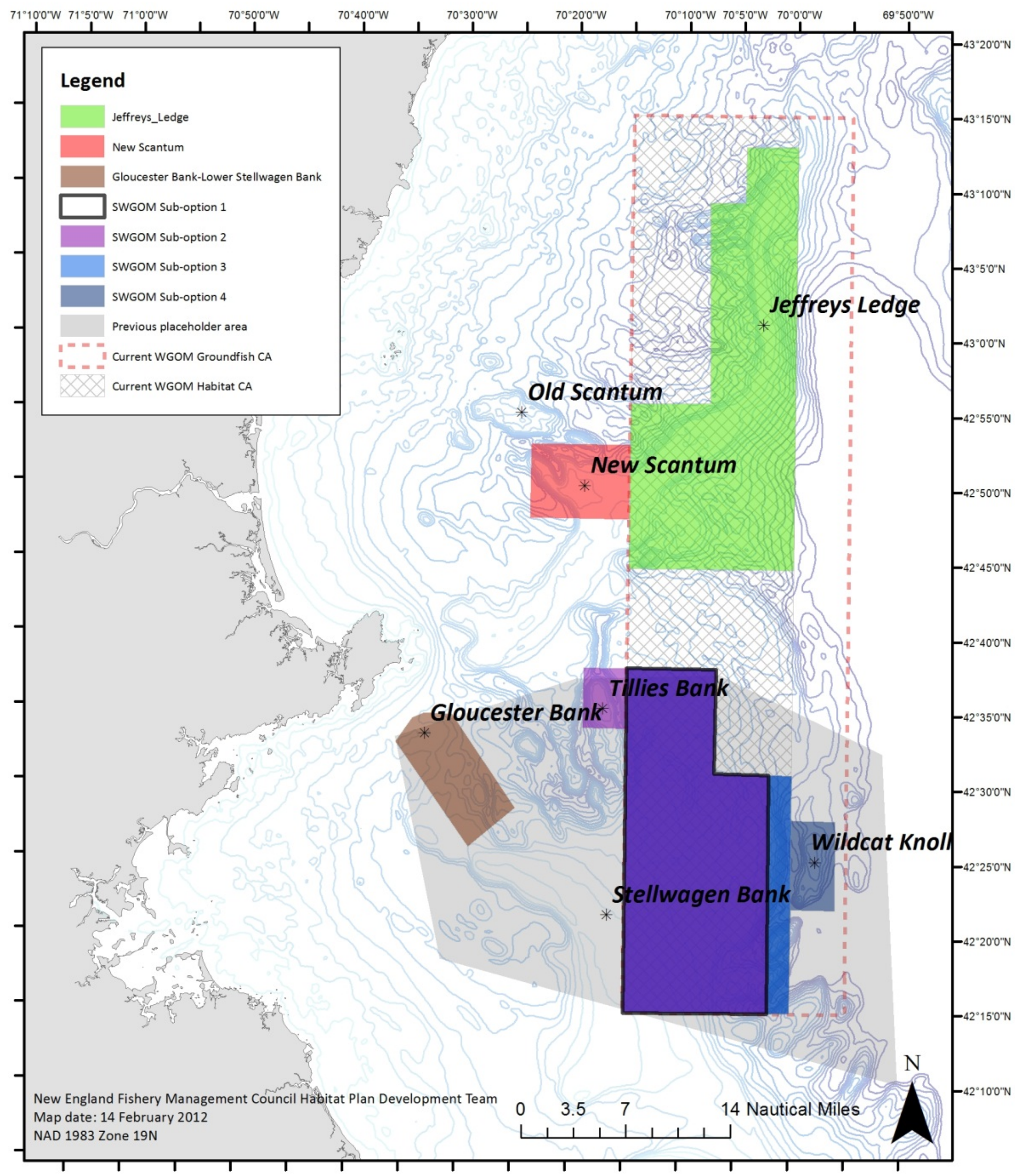


Map 3 – Habitat management areas recommended by the Committee at their August 30, 2011 meeting.

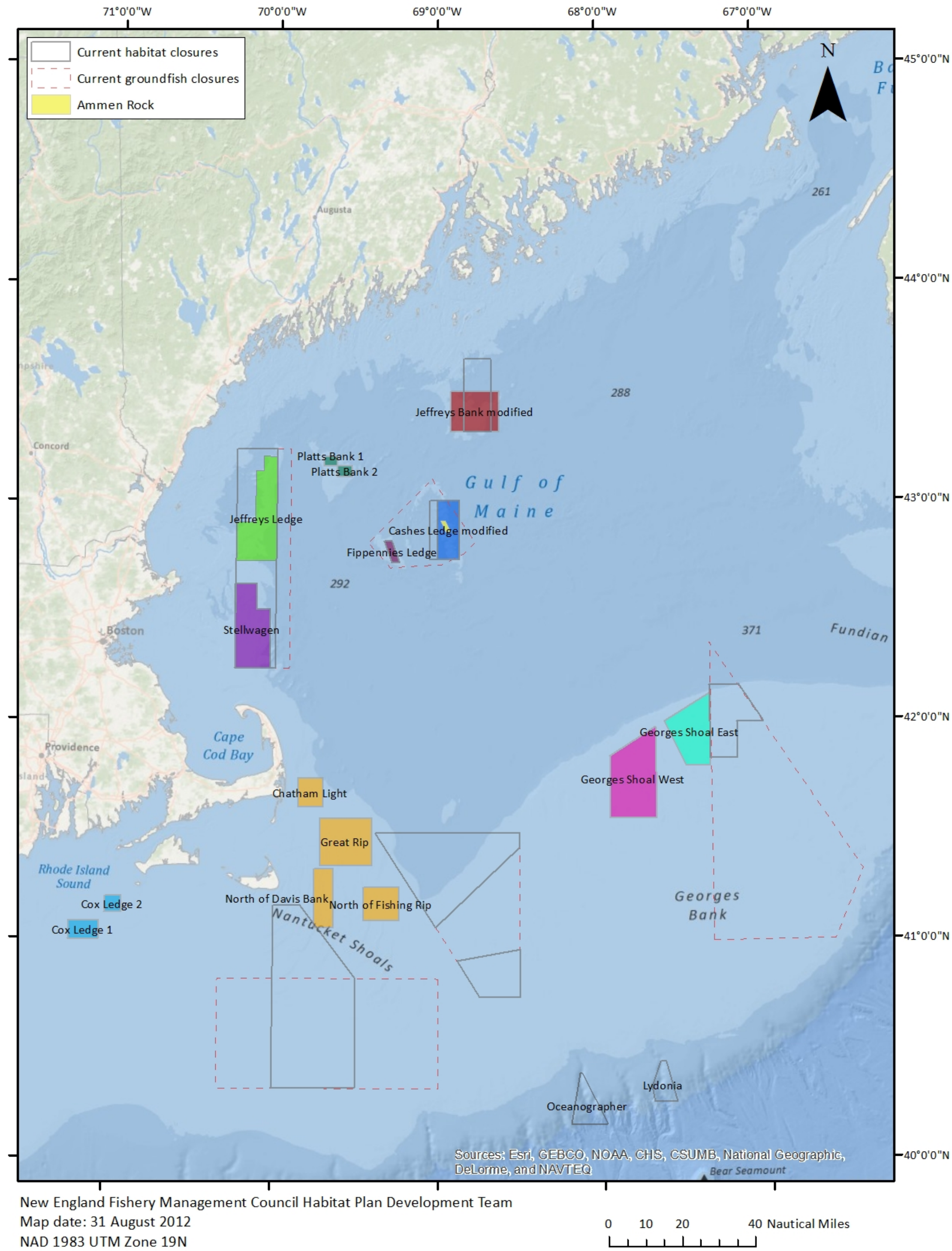


Map 4 – Additional habitat management areas in the western Gulf of Maine recommended by the PDT at their February 7, 2012 meeting.

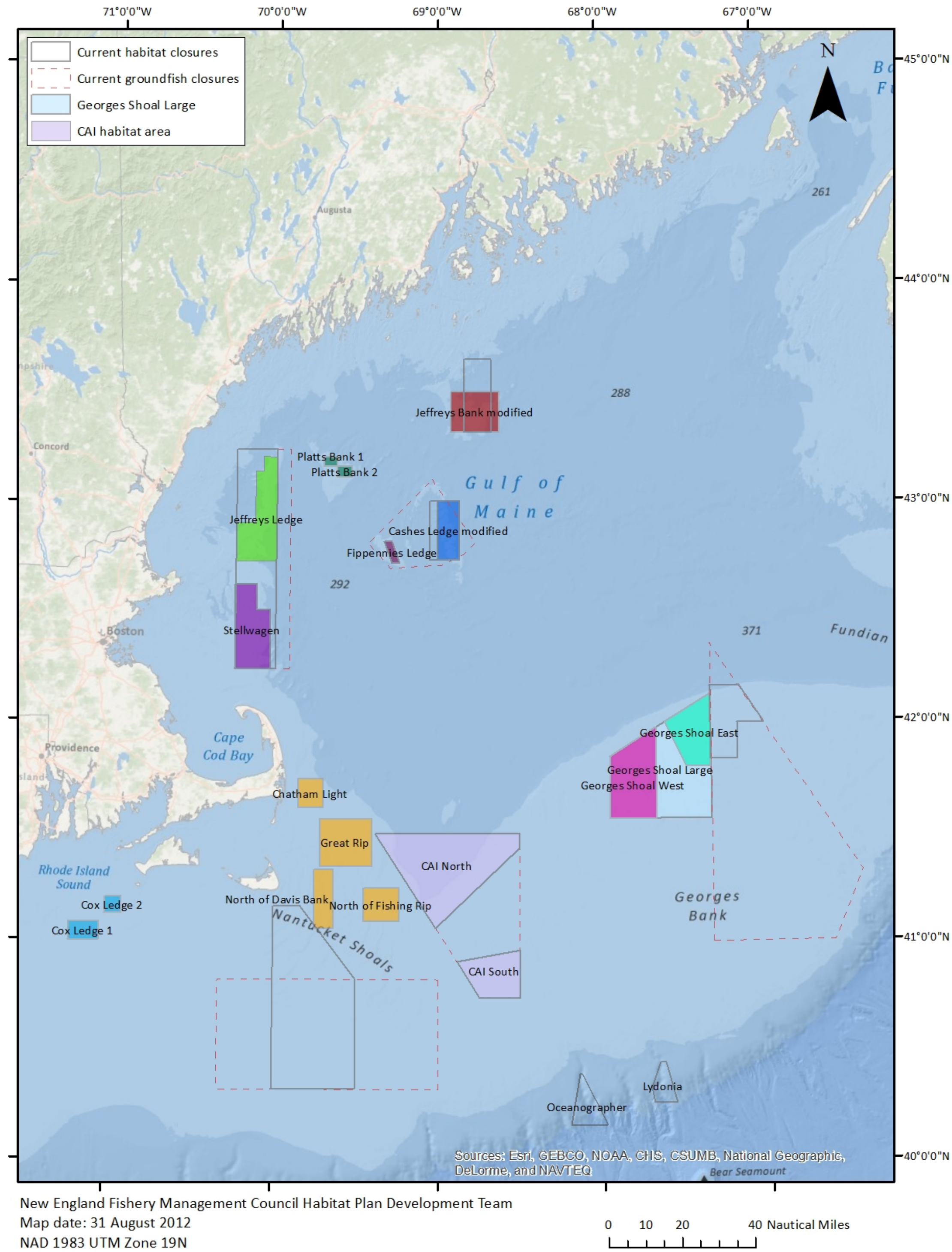
Habitat Omnibus Amendment:
Adverse effects minimization measures for the western Gulf of Maine, including:
(1) Jeffreys Ledge area recommended by Committee on 8/30/2011
(2) Additional areas recommended by PDT on 2/7/2012
(3) Status quo habitat and groundfish mortality closed areas



Map 5 - Habitat management areas recommended by the Committee at their June 8, 2012 meeting for further development as mobile bottom tending gear closures (most areas) or as a closure to all fishing (Ammen Rock only). Ammen Rock is not labled on the map, but is shown in yellow and overlays the Cashes Ledge modified area shown in royal blue.



Map 6 – Habitat management areas recommended by the Committee at their June 8, 2012 meeting for further development as gear modification areas with maximum ground cable length requirements. Differences from the previous map include the addition of Georges Shoal Large and CAI N and S to the list of areas under consideration, and the removal of the Ammen Rock area, which is not under consideration for gear modification measures.



Map 7 – Habitat management areas recommended by the Committee at their March 19, 2012 meeting for further development as mobile bottom tending gear closures (most areas) or as a closure to all fishing (Ammen Rock only). Note that there are three boundary options being analyzed for the Great South Channel. An additional area on the Northern Edge of Georges Bank is also in development.

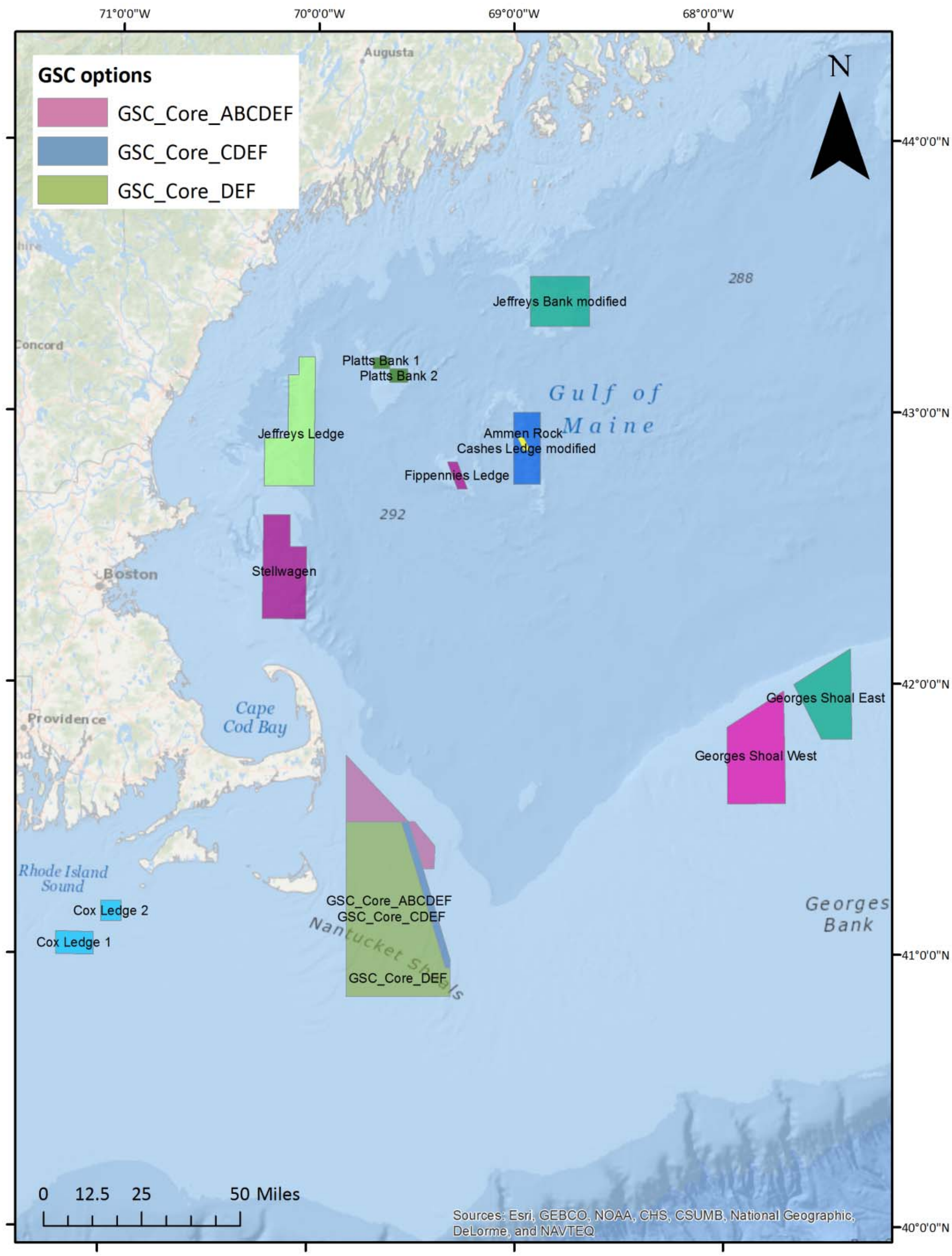


Table 1 – Coordinates for existing habitat areas in degrees, decimal minutes.

Jeffreys Bank Habitat Closure Area

Point	Latitude	Longitude
JB1	43° 40’	-68° 50’
JB2	43° 40’	-68° 40’
JB3	43° 20’	-68° 40’
JB4	43° 20’	-68° 50’

Cashes Ledge Habitat Closure Area

Point	Latitude	Longitude
CLH1	43° 01’	-69° 03’
CLH2	43° 01’	-68° 52’
CLH3	42° 45’	-68° 52’
CLH4	42° 45’	-69° 03’

Western Gulf of Maine Habitat Closure Area

Point	Latitude	Longitude
WGM4	43° 15’	-70° 15’
WGM1	42° 15’	-70° 15’
WGM5	42° 15’	-70° 00’
WGM6	43° 15’	-70° 15’

Closed Area II Habitat Closure Area

Point	Latitude	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	Latitude	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	Latitude	Longitude
CIH3	40° 55’	-68° 53’
CIH4	40° 58’	-68° 30’
CI3	40° 45’	-68° 30’
CI2	40° 45’	-68° 45’

Nantucket Lightship Habitat Closure Area

Point	Latitude	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’

Table 2 – Coordinates for new or modified habitat areas in degrees, decimal minutes.

Ammen Rock Habitat Management Area

Point	Latitude	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’

Modified Cashes Ledge Habitat Management Area

Point	Latitude	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’

Platts Bank: Habitat Management Area 1

Point	Latitude	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: Habitat Management Area 2

Point	Latitude	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’

Fippennies Ledge Habitat Management Area

Point	Latitude	Longitude
1	42° 50.0’	-69° 17.0’
2	42° 44.0’	-69° 14.0’

Modified Jeffreys Bank Habitat Management Area

Point	Latitude	Longitude
1	43° 31’	-68° 37’
2	43° 20’	-68° 37’

3	42° 44.0’	-69° 18.0’	3	43° 20’	-68° 55’
4	42° 50.0’	-69° 21.0’	4	43° 31’	-68° 55’

<u>Jeffreys Ledge Habitat Management Area</u>

Point	Latitude	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’

<u>Stellwagen Habitat Management Area</u>

Point	Latitude	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’

<u>Georges Shoal (three areas)</u>

Western Georges Shoal Area

Point	Latitude	Longitude
1	41° 58.848’	-67° 40.0’
2	41° 34.0’	-67° 40.0’
3	41° 34.0’	-67° 57.0’
4	41° 51.0’	-67° 57.0’

Eastern Georges Shoal Area

Point	Latitude	Longitude
1	42° 08.0’	-67° 20.0’
2	41° 48.0’	-67° 20.0’
3	41° 48.0’	-67° 29.0’
4	42° 0.23’	-67° 37.0’

Large Georges Shoal Area

Point	Latitude	Longitude
1	42° 08.0’	-67° 20.0’
2	41° 34.0’	-67° 20.0’
3	41° 34.0’	-67° 57.0’
4	41° 51.0’	-67° 57.0’

<u>Cox Ledge Habitat Management Area 1</u>

Point	Latitude	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’

<u>Cox Ledge Habitat Management Area 2</u>

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’

Table 3 – Coordinates for updated Great South Channel Areas (March 2013)

Area name	Vertex	Longitude decimal degrees	Latitude decimal degrees	Longitude degree decimal minute	Latitude degree decimal minute
Core	1	-69.74919585	41.5032389	-69° 44.95'	41° 30.19'
Core	2	-69.55263546	41.50450733	-69° 33.16'	41° 30.27'
Core	3	-69.33288075	40.9666256	-69° 19.97'	40° 58'
Core	4	-69.63572332	40.9648593	-69° 38.14'	40° 57.89'
Core	5	-69.75095231	41.085675	-69° 45.06'	41° 5.14'
Core	1	-69.74919585	41.5032389	-69° 44.95'	41° 30.19'
Add-on A	1	-69.82243352	41.50276656	-69° 49.35'	41° 30.17'
Add-on A	2	-69.82460528	41.74787888	-69° 49.48'	41° 44.87'
Add-on A	3	-69.51628782	41.50505171	-69° 30.98'	41° 30.3'

Area name	Vertex	Longitude decimal degrees	Latitude decimal degrees	Longitude degree decimal minute	Latitude degree decimal minute
Add-on A	4	-69.55263546	41.50450733	-69° 33.16'	41° 30.27'
Add-on A	1	-69.82243352	41.50276656	-69° 49.35'	41° 30.17'
Add-on B	1	-69.51628782	41.50505171	-69° 30.98'	41° 30.3'
Add-on B	2	-69.48757168	41.50587353	-69° 29.25'	41° 30.35'
Add-on B	3	-69.386965	41.41501425	-69° 23.22'	41° 24.9'
Add-on B	4	-69.39108189	41.33002577	-69° 23.46'	41° 19.8'
Add-on B	5	-69.44461965	41.33011702	-69° 26.68'	41° 19.81'
Add-on B	1	-69.51628782	41.50505171	-69° 30.98'	41° 30.3'
Add-on C	1	-69.33288075	40.9666256	-69° 19.97'	40° 58'
Add-on C	2	-69.55263546	41.50450733	-69° 33.16'	41° 30.27'
Add-on C	3	-69.51628782	41.50505171	-69° 30.98'	41° 30.3'
Add-on C	4	-69.30911942	40.99663295	-69° 18.55'	40° 59.8'
Add-on C	5	-69.30897992	40.96674856	-69° 18.54'	40° 58'
Add-on C	1	-69.33288075	40.9666256	-69° 19.97'	40° 58'
Add-on D	1	-69.81653567	40.96391581	-69° 48.99'	40° 57.83'
Add-on D	2	-69.63572332	40.9648593	-69° 38.14'	40° 57.89'
Add-on D	3	-69.30897992	40.96674856	-69° 18.54'	40° 58'
Add-on D	4	-69.30849352	40.86219716	-69° 18.51'	40° 51.73'
Add-on D	5	-69.81492478	40.85933086	-69° 48.9'	40° 51.56'
Add-on D	1	-69.81653567	40.96391581	-69° 48.99'	40° 57.83'
Add-on E	1	-69.81795829	41.0852879	-69° 49.08'	41° 5.12'
Add-on E	2	-69.75095231	41.085675	-69° 45.06'	41° 5.14'
Add-on E	3	-69.63572332	40.9648593	-69° 38.14'	40° 57.89'
Add-on E	4	-69.81653567	40.96391581	-69° 48.99'	40° 57.83'
Add-on E	1	-69.81795829	41.0852879	-69° 49.08'	41° 5.12'
Add-on F	1	-69.82243352	41.50276656	-69° 49.35'	41° 30.17'
Add-on F	2	-69.74919585	41.5032389	-69° 44.95'	41° 30.19'
Add-on F	3	-69.75095231	41.085675	-69° 45.06'	41° 5.14'
Add-on F	4	-69.81795829	41.0852879	-69° 49.08'	41° 5.12'
Add-on F	1	-69.82243352	41.50276656	-69° 49.35'	41° 30.17'

2.1 Alternative 1 – No Action HMAs

The No Action Alternative would maintain the following mobile bottom tending gear habitat closures: Jeffreys Bank, Cashes Ledge, Western Gulf of Maine, Closed Area II, Closed Area I, and Nantucket Lightship. Lydonia Canyon and Oceanographer Canyon EFH closures in the monkfish plan would also be maintained, although they have not been discussed much in an adverse effects minimization context. It may be more useful to reconsider their boundaries in the context of deep-sea coral protection zone designations. The areas are shown on Map 8.

Individual options that are a part of this alternative are as follows:

2.1.1 Maintain existing Jeffreys Bank habitat closed area as a mobile bottom-tending gear closure

This option would maintain the current mobile, bottom tending gear habitat closure in the multispecies and scallop FMPs.

2.1.2 Maintain existing Cashes Ledge habitat closed area as a mobile bottom-tending gear closure

This option would maintain the current mobile bottom tending gear habitat closure on Cashes Ledge in the multispecies and scallop FMPs.

2.1.3 Maintain existing Western Gulf of Maine habitat closed area as a mobile bottom-tending gear closure

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

2.1.4 Maintain existing Closed Area II habitat closed area as a mobile bottom-tending gear closure

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

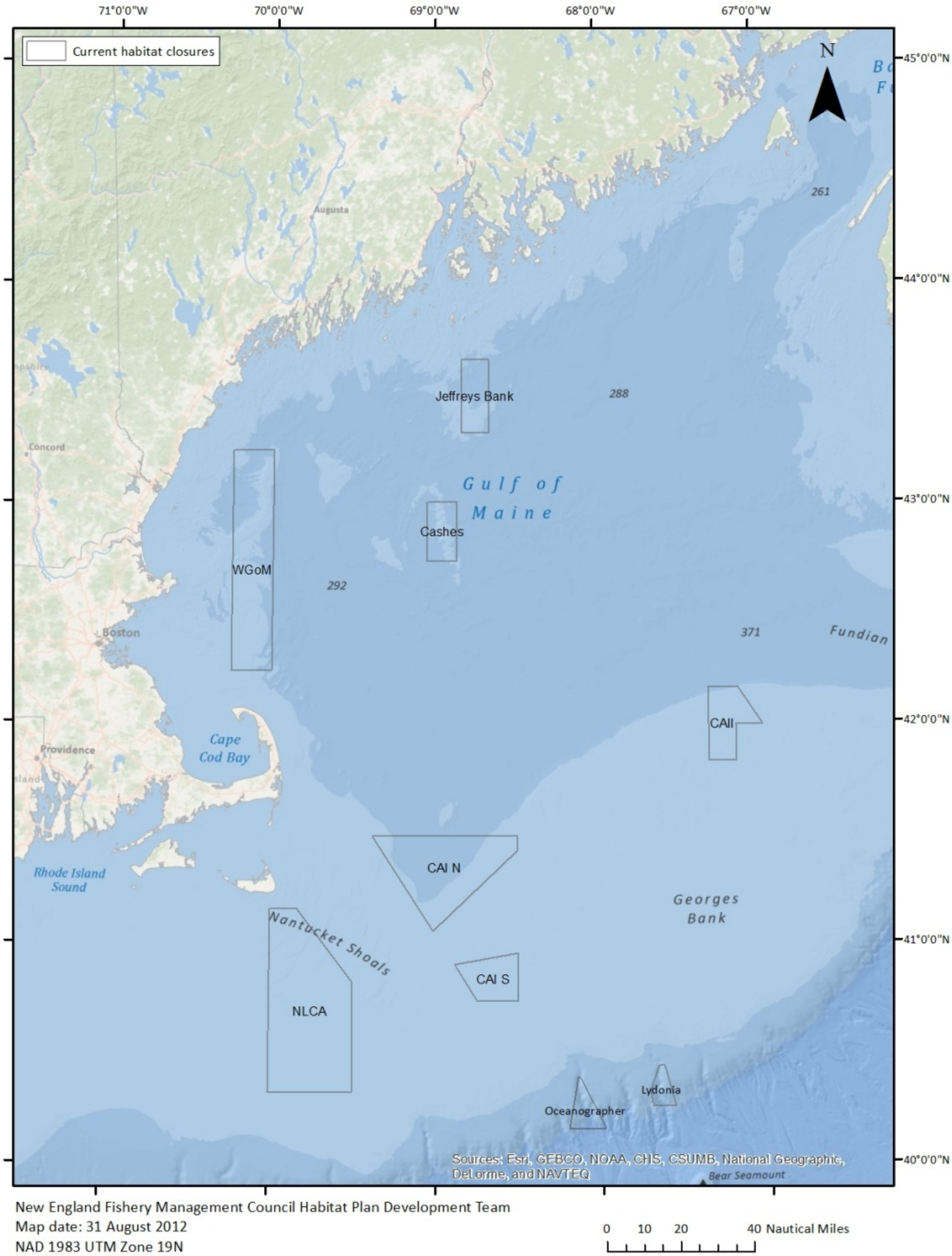
2.1.5 Maintain existing Closed Area I habitat closed areas as mobile bottom-tending gear closures

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

2.1.6 Maintain existing Nantucket Lightship habitat closed area as a mobile bottom-tending gear closure

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

Map 8 – Alternative 1 – No action habitat management areas. The map showns the Lydonia and Oceanographer Canyon areas that are in the monkfish plan and closed to fishing while on a monkfish DAS, but these areas have not received much discussion in the context of OA2.



2.2 Alternative 2 – Remove or modify existing habitat areas and implement new habitat management areas

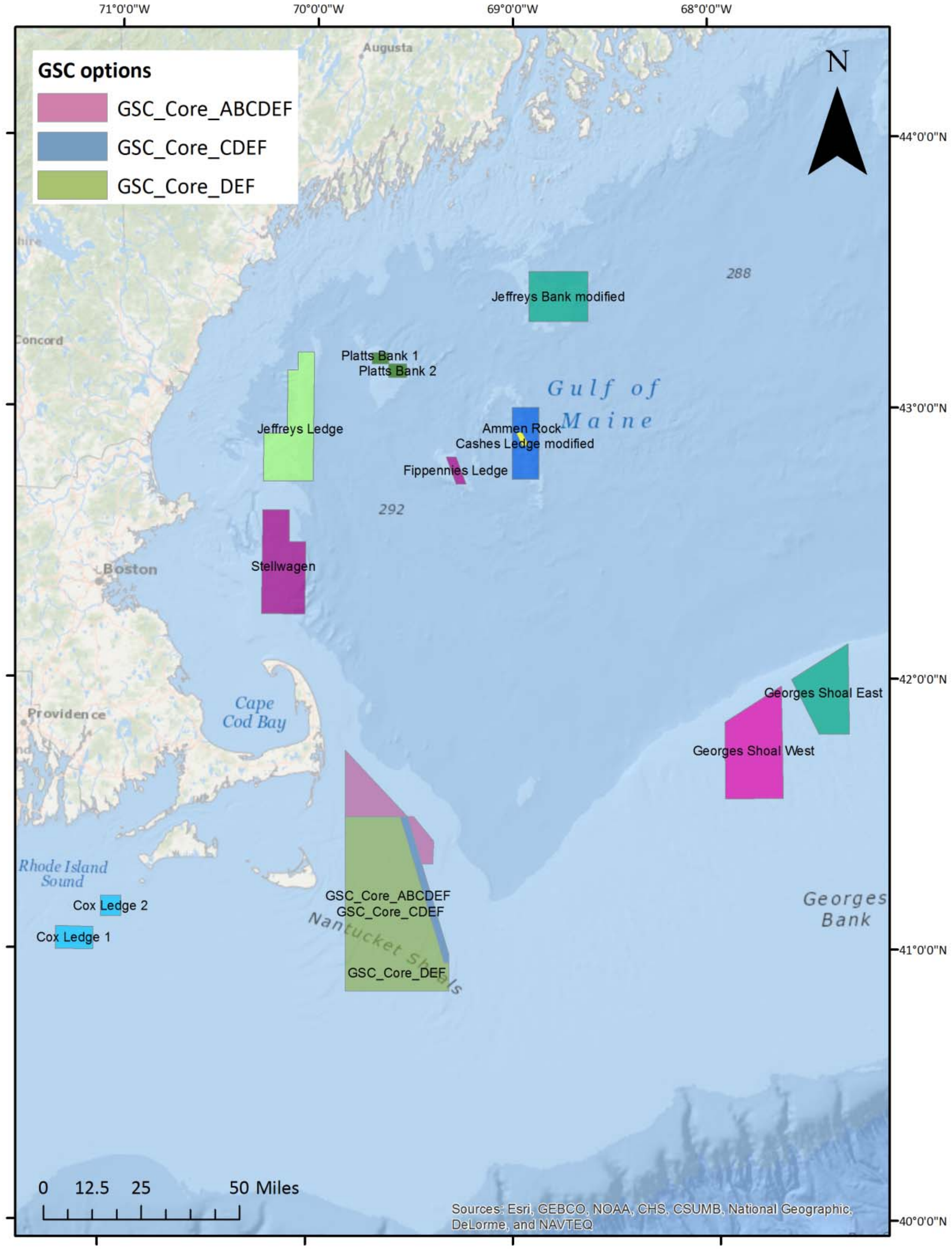
Alternative 2 would eliminate some of the existing habitat closures, modify others to create updated habitat management areas, and create some new habitat management areas (Table 4). The gear closure options included in this alternative are shown on Map 9.

Table 4 – Summary of habitat management options included in Alternative 2. MBTG = mobile bottom tending gear.

Location	Area	Action	Subareas, if applicable	Notes
Jeffreys Bank	Existing Jeffreys Bank	Modify boundaries but keep as a MBTG closure	None	
	Modified Jeffreys Bank		None	Designed to encompass shallower habitats (<100 m)
Cashes Ledge	Existing Cashes Ledge	Modify boundaries but keep as a MBTG closure	None	
	Modified Cashes Ledge		None	Smaller area designed to encompass shallower habitats (<100 m)
	Ammen Rock	Close to all fishing	None	Subset of both the existing and the modified Cashes Ledge habitat areas
Fippennies Ledge	Fippennies Ledge	Create new area, MBTG closure	None	Subset of the existing Cashes Ledge <u>groundfish</u> closed area
Platts Bank	Platts Bank	Create new areas, MBTG closure	Platts Bank 1, Platts Bank 2	Both areas would be implemented under this alternative
Western Gulf of Maine	Existing Western Gulf of Maine habitat closure	Modify boundaries to create Jeffreys Ledge and Stellwagen areas but keep as a MBTG closure	None	Another option would be remove just the northwestern corner of the WGOM area
	Jeffreys Ledge		None	
	Stellwagen		None	
Closed Area II	Existing Closed Area II habitat closure	Remove	None	Would be removed under this alternative
Georges Shoal	Western Georges Shoal	Create new area, MBTG closure	None	Both GS areas would be implemented under this alternative
Georges Shoal	Eastern Georges Shoal	Create new area, MBTG closure	None	
Closed Area I	Existing Closed Area I habitat closure	Remove	North and South	
West of Great South Channel	West of Great South Channel	Create new area, MBTG closure	Three sub-options under consideration	
Nantucket Lightship	Existing Nantucket	Remove	None	

Location	**Area**	**Action**	**Subareas, if applicable**	**Notes**
	Lightship habitat closure			
Cox Ledge	Cox Ledge	Create new areas, MBTG closure	Cox Ledge (1), 19 Fathom Bank (2)	Both subareas would be implemented under this alternative

Map 9 – Alternative 2 – Remove or modify existing habitat areas and implement new habitat management areas.



Individual options that are a part of this alternative are as follows:

2.2.1 Eliminate the existing Western Gulf of Maine habitat area

This option would eliminate the WGOM habitat closed area from the multispecies and scallop FMPs. Other options listed below would designate portions of this area as the Jeffreys Ledge and Stellwagen habitat management areas.

2.2.2 Eliminate the existing Closed Area II habitat closed area

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

2.2.3 Eliminate the existing Closed Area I habitat closed areas

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

2.2.4 Eliminate the existing Nantucket Lightship habitat closed area

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

2.2.5 Adjust the boundaries of the exisiting Jeffreys Bank habitat closed area to create the Jeffreys Bank habitat management area and maintain status as a mobile bottom-tending gear closure

This option would change the boundaries of the current Jeffreys Bank habitat closure, and close the updated area to mobile bottom tending gear. The current 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. Note that the Habitat Committee has not proposed complete removal of the Jeffreys Bank habitat area, only modification.

During June 2011, the PDT developed a list of areas likely to accumulate adverse effects to EFH (i.e. 'vulnerable areas'). Areas were indentified using the generic trawl gear SASI/LISA cluster analysis and other extra-SASI information. The area in and around Jeffreys Bank clustered in the LISA analysis, and Jeffreys Bank contains gravel habitats vulnerable to fishing gear impacts. In July 2011, the PDT recommended that the Committee consider management options to minimize adverse effects in these areas. One of the vulnerable areas discussed was Jeffreys Bank. The PDT recommended modifying the existing Jeffreys Bank habitat closure to better encompass likely hard bottom (i.e. boulder) habitats. Specifically, they recommended area encompassed the portion of the bank shallower than 100 m. While the advisory panel recommended continued consideration of both the current and modified Jeffreys Bank areas, at their July and August meetings, the Committee discussed both areas and recommended keeping the current closure and moving the modified area to the list of considered but rejected options. In June 2012, the Committee reconsidered and adopted this option for further analysis. See Map 10.

2.2.6 Adjust the boundaries of the Cashes Ledge habitat closed area to create the Cashes Ledge habitat management area and maintain status as a mobile bottom-tending gear closure

This option would changes the boundaries of the current Cashes Ledge habitat closure, moving the western boundary to 69° W longitude. The area would remain closed to mobile bottom tending gear. The PDT recommended keeping the current Cashes Ledge habitat closed area at the July 21, 2011 Committee meeting. The PDT then recommended at the August 30, 2011 Committee meeting to modify the Cashes Ledge habitat closed area western boundary by moving it to 69° W longitude. This recommendation was based on feedback from industry members who attended the August 15, 2011 PDT meeting. The PDT discussed that 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 PDT discussed that these are the most important habitats types on Cashes Ledge to protect from the adverse effects of fishing. The Committee agreed to include the modified area as an option for Cashes Ledge. As above for Jeffreys Bank, the Committee has not proposed complete removal of the Cashes Ledge habitat area, only modification. See Map 11.

2.2.7 Adjust the boundaries of the WGOM habitat closed area to create the Jeffreys Ledge habitat management area, and maintain status as a mobile bottom-tending gear closure

This option would adjust the boundaries of the current WGOM habitat closed area to create a habitat management area on Jeffreys Ledge, and then maintain that area as a mobile bottom tending gear closure. See Map 13.

2.2.8 Adjust the boundaries of the WGOM habitat closed area to create the Stellwagen habitat management area, and maintain status as a mobile bottom-tending gear closure

This option would adjust the boundaries of the current WGOM habitat closed area to create a habitat management area focused on the eastern portion of Stellwagen Bank, and then maintain that area as a mobile bottom tending gear closure. The eastern boundary extends only to the edge of the multibeam sampling area discussed below, not to the current habitat closure boundary, because the existence of vulnerable habitat types is best documented in the areas sampled with multibeam.

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). 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. 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. See Map 13.

2.2.9 Adjust boundaries of the WGOM habitat area to remove only the northwest corner, and maintain the remaining portion as a mobile bottom-tending gear closure

This option would adjust the boundaries of the existing WGOM habitat closed area to remove the northwestern portion (the same area eliminated by the creation of the Jeffreys Ledge HMA). This portion of the WGOM closure is deeper and dominated by mud substrates, in comparision with the sand and gravel substrates on Jeffreys Ledge and on and east of Stellwagen Bank. Prior to implementation of the WGOM habitat closure, which restricts mobile bottom tending gear, including shrimp trawls, seasonal shrimp fishing occurred in this location. **This option is an alternative to the Jeffreys Ledge and Stellwagen areas described above as it completely contains both of the HMAs.**

2.2.10 Establish the Ammen Rock Habitat Management Area and close it to all fishing gear types

This option would establish the Ammen Rock Habitat Management Area and close it to all types of fishing gear that can be managed by the Council. At the August 2011 Committee meeting, the PDT recommended additional restrictions on Ammen Rock, within Cashes Ledge. The Committee agreed to consider additional restrictions on Ammen Rock. See Map 11.

2.2.11 Establish the Fippennies Ledge habitat management area and close it to mobile bottom-tending gear

This option would establish a new habitat management area on Fippennies Ledge, and close the area to mobile bottom tending gear. Note that this area is currently closed to this gear type, but that this is due to its status as a part of the Cashes Ledge groundfish mortality closure, not because of any habitat management designation. At the July 2011 Committee meeting, the PDT recommended establishing a habitat management area on Fippennies Ledge. The Committee agreed to consider Fippennies Ledge as an option for minimizing adverse impacts from fishing by instructing the PDT to consider gear restrictions, including no gear restrictions, in this area. In June 2012, the Committee modified a larger potential management area based on encompassing the entirety of the ledge to the 100m contour to focus on the core shallow portions of the bank. The objective was to protect a representative array of substrate and habitat types while allowing fishing activity along the edges of the ledge. See Map 11.

2.2.12 Establish the Platts Bank habitat management areas and close them to mobile bottom-tending gear

This option would establish a new habitat management area on Platts Bank consisting of two sub-areas, and close it to mobile bottom-tending gear. At the July 2011 Committee meeting, the PDT recommended establishing a habitat management area on Platts Bank.

The Committee agreed to consider Platts Bank as an option for minimizing adverse impacts from fishing. In June 2012, the Committee modified a larger potential management area based on encompassing the entirety of the bank to the 100m contour to focus on two shallow portions of the bank. The objective was to protect a representative array of substrate and habitat types while allowing fishing activity along the edges of the bank. See Map 12.

2.2.13 Establish the Eastern Georges Shoal habitat management area and close it to mobile bottom-tending gears

This option would create a habitat management area on and immediately west of Georges Shoal, encompassing portions of the two easternmost vulnerable areas presented to the Committee in on July 21, 2011, and close the area to mobile bottom-tending gears. See Map 14.

2.2.14 Establish the Western Georges Shoal habitat management area and close it to mobile bottom-tending gears

This option would create a habitat management area west of Georges Shoal and close the area to mobile bottom-tending gears. See Map 14.

2.2.15 Habitat area in the Northern Edge region (under development)

An additional habitat area that balances protection of cobble/boulder seabed, scallop fishery access, and groundfish fishery access is under development by the PDT at the request of the Committee. See the Committee meeting summary from March 19, 2013 for a detailed discussion of this issue.

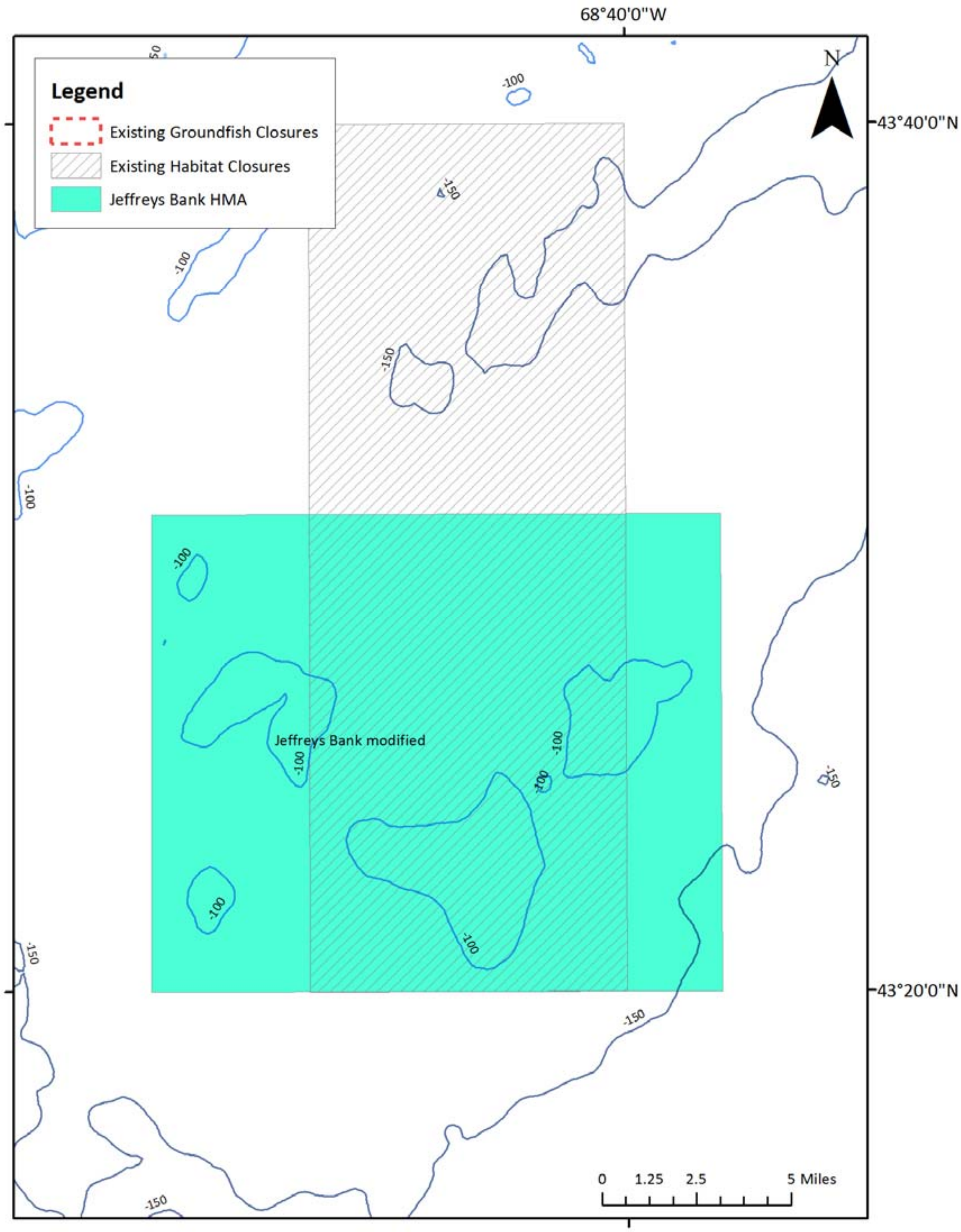
2.2.16 Establish a single habitat management area west of the Great South Channel and close it to mobile bottom tending gear

This option would create a single habitat management area in the Great South Channel region and close the area to mobile bottom-tending gears. There are three possible boundaries for this area, based on a core, central area and six surrounding add-ons. The sub-options include the core area plus all six add-ons, the core area plus add-ons C, D, E, and F, and the core area plus add-ons D, E, and F. See Map 15.

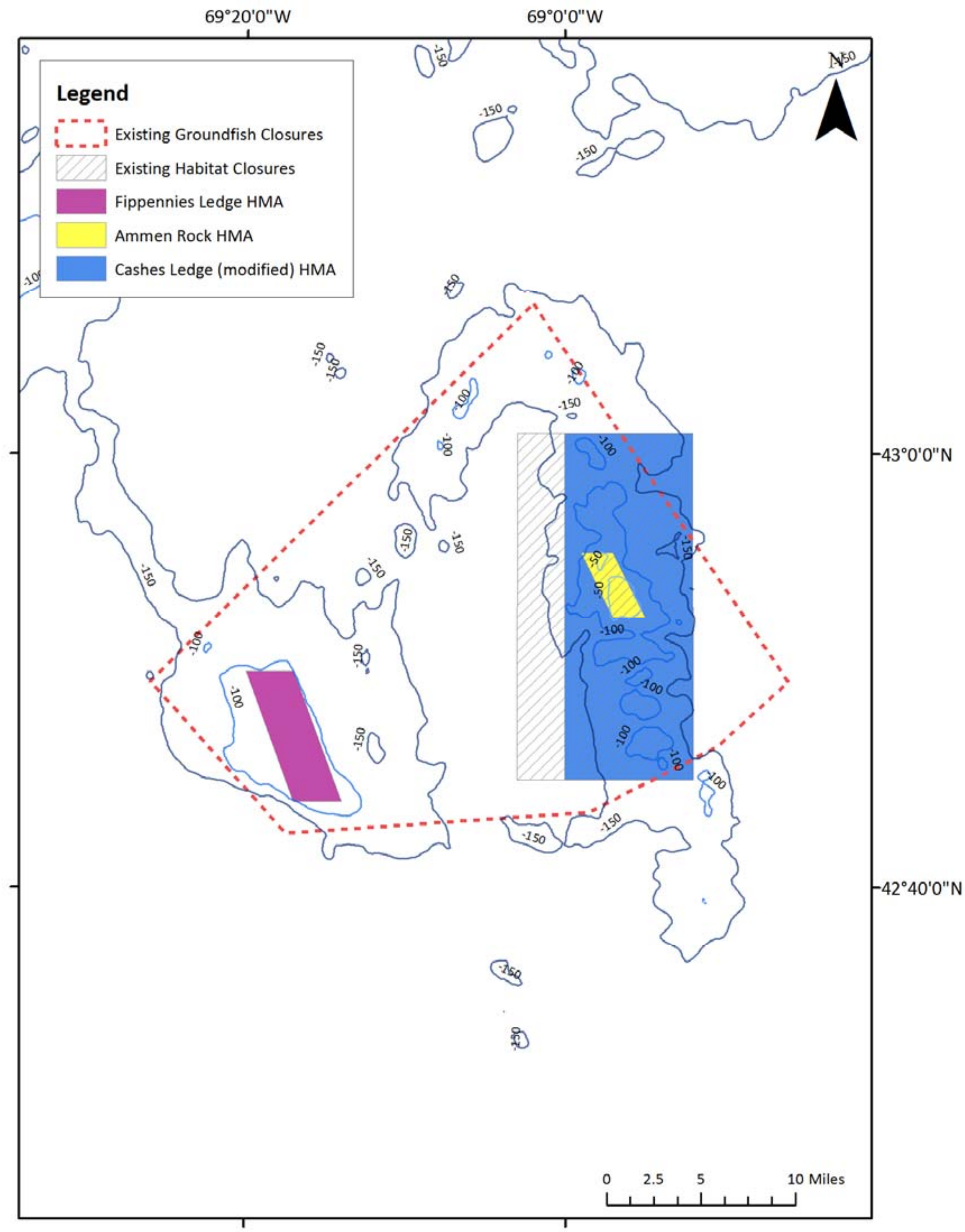
2.2.17 Establish two management areas on and around Cox Ledge and close them to mobile bottom-tending gear

This option would establish two habitat management areas, Cox Ledge 1 (Cox Ledge) and Cox Ledge 2 (19 Fathom Bank), and close the areas to mobile bottom-tending gear. See Map 16.

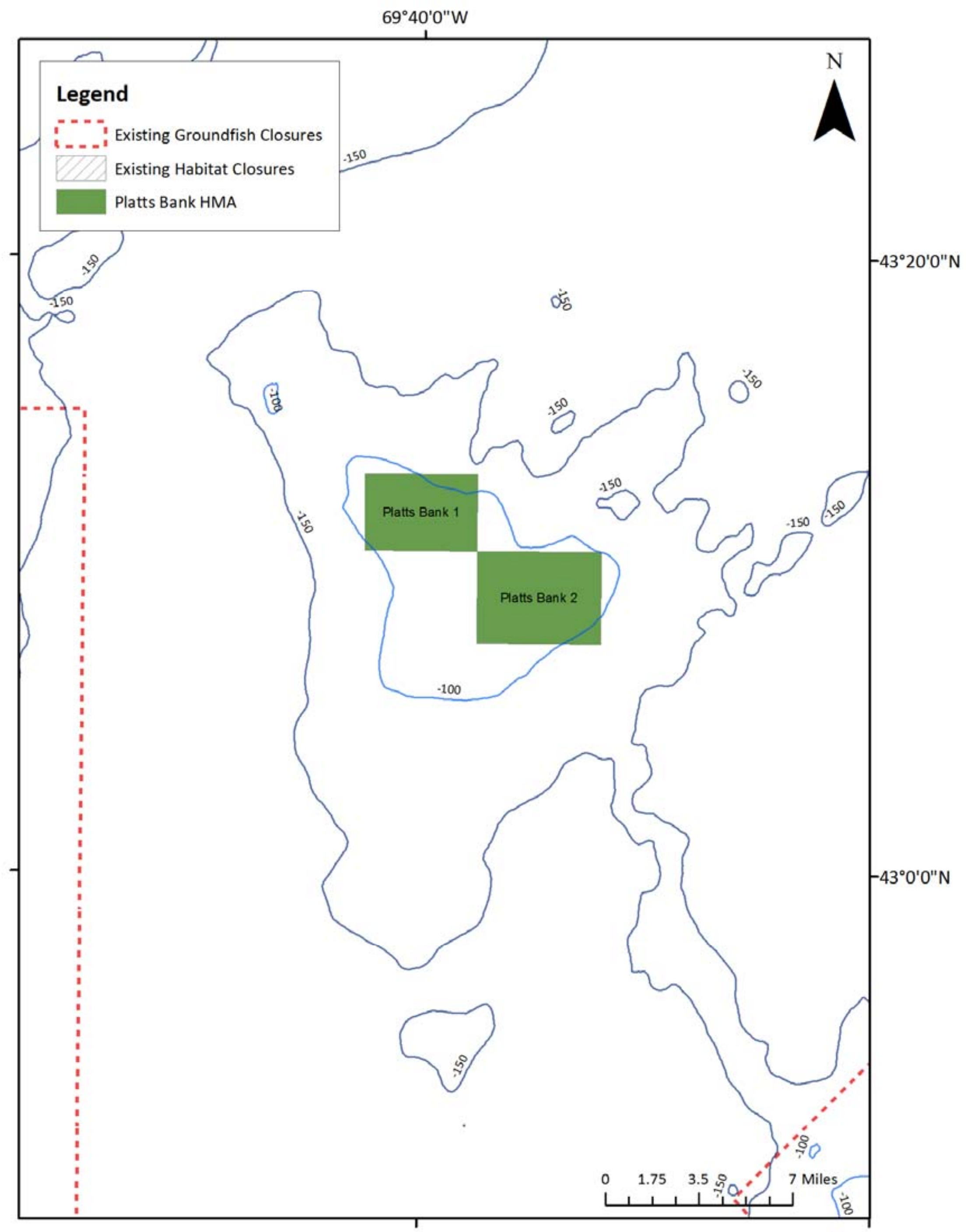
Map 10 – Jeffreys Bank habitat management areas – current and modified (green).



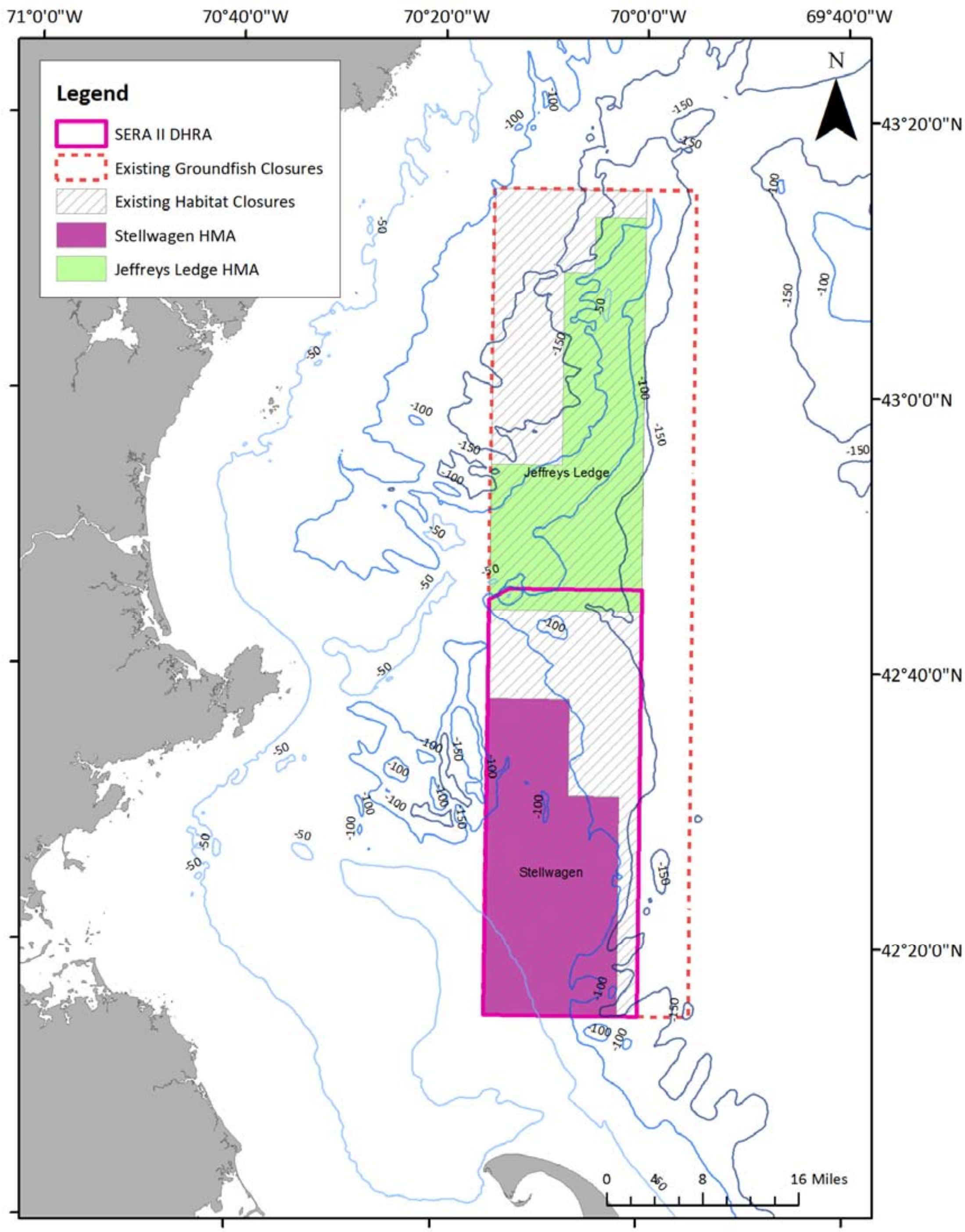
Map 11 – Cashes Ledge modified (blue) and Fippennies Ledge (purple) habitat management areas. Exisiting habitat and groundfish closures are also shown. The Ammen Rock area (yellow) is proposed as a closure to all types of fishing activity. Depth contours are in meters.



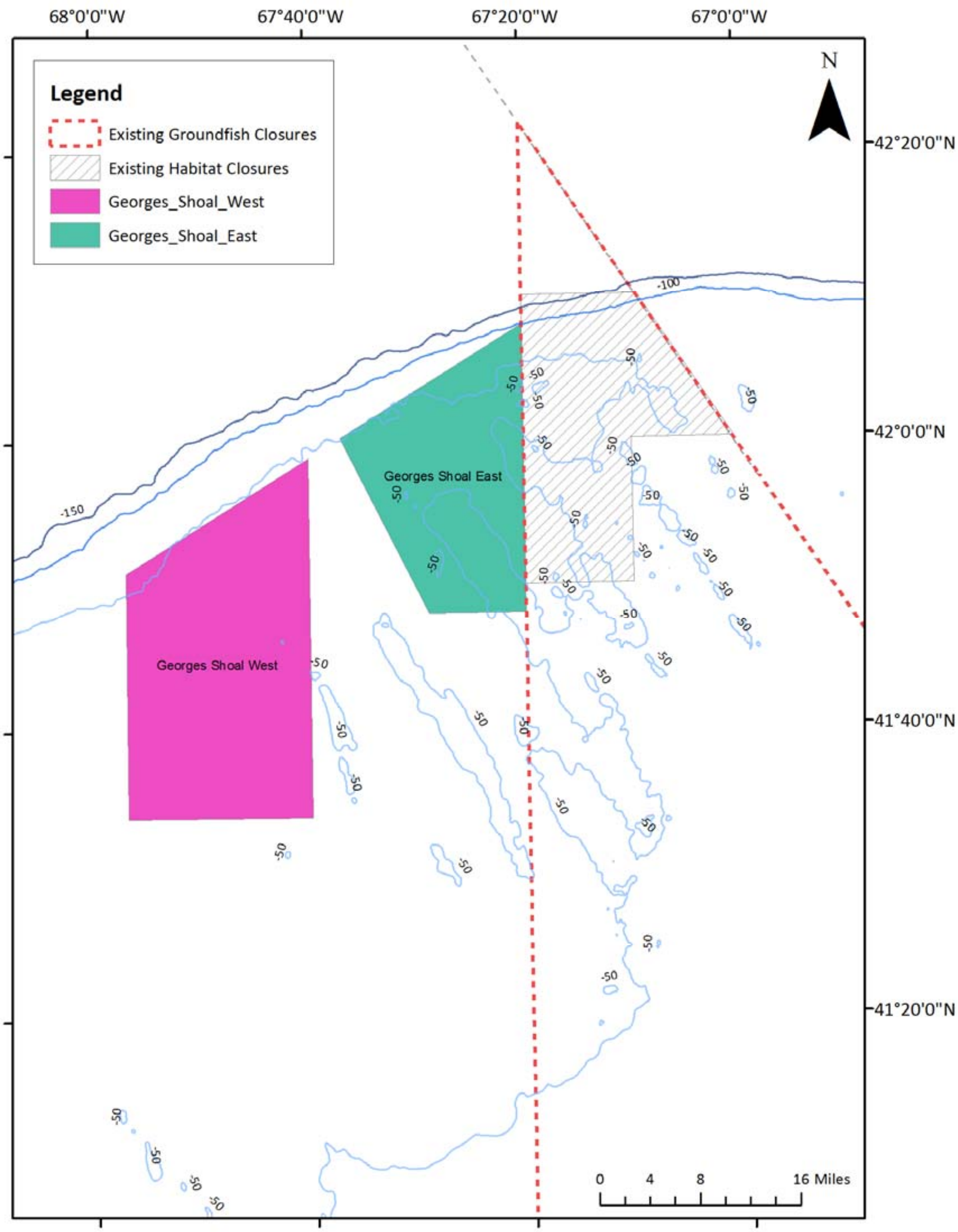
Map 12 – Platts Bank habitat management areas are shown in dark green. Edges of adjacent groundfish closures are also shown. Depth contours are in meters.



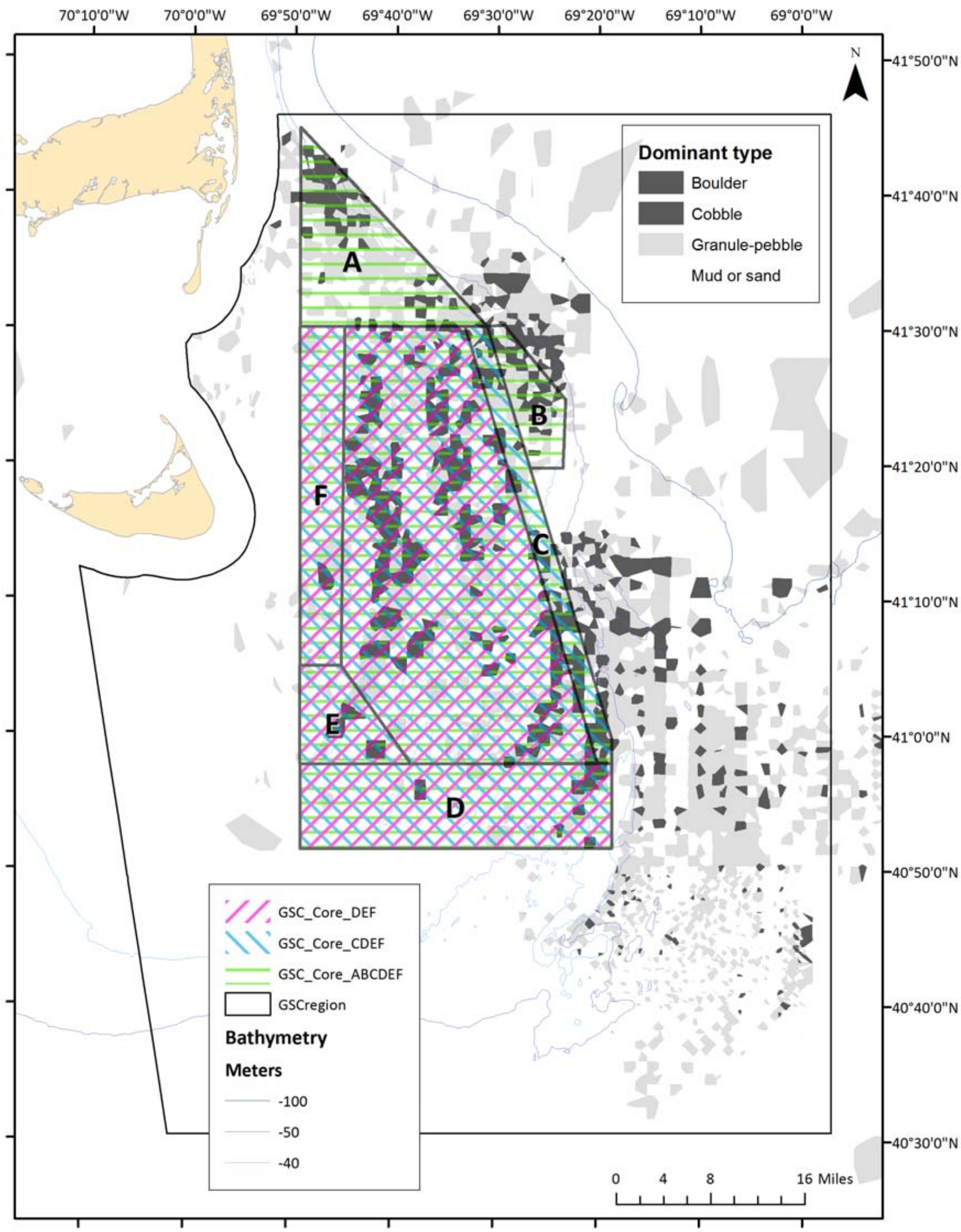
Map 13 – Jeffreys Ledge and Stellwagen habitat management areas shown in light green and solid purple. The current WGOM habitat and groundfish areas are also shown, in addition to the proposed DHRA SERA II. Depth contours are in meters.



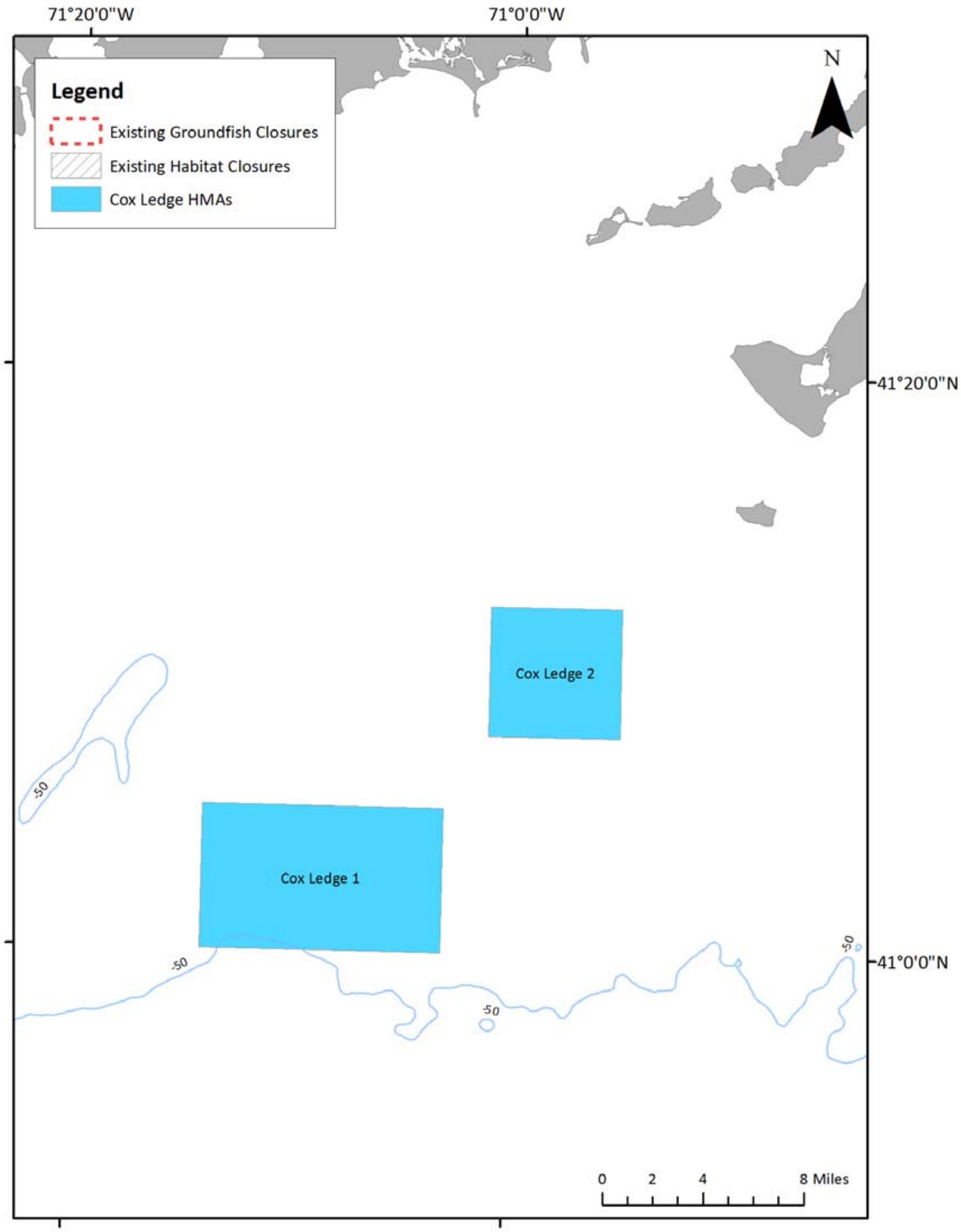
Map 14 – Georges Shoal habitat management areas – eastern area in green, western area in magenta. The northern portion of the exisiting CAII groundfish area and the existing CAII habitat area are also shown. Depth contours are in meters.



Map 15 – Habitat management areas options west of the Great South Channel. The core and add-ons are outlined in black and labeled. The hatching indicates the areas that are combined to form the Core+DEF (pink), Core+CDEF (blue), and Core+ABCDEF (green). The boundaries were drawn to encompass cobble and boulder habitat types, shown in dark grey.



Map 16 – Cox Ledge habitat management areas are shown in turquoise.



2.3 Alternative 3 – To be determined; a subset of Alternative 2 options

This alternative would consist of a subset of the options from Alternative 2. The options to be included would be decided upon following initial analysis and public hearings. Final analysis of this alternative including a cumulative effects analysis of the combined options would occur after the alternative is drafted.

3.0 Management alternatives to designate Dedicated Habitat Research Areas

The Habitat PDT has been tasked with evaluating how to redesign habitat closures in the Northwest Atlantic to minimize adverse effects to essential fish habitat (EFH) to the extent practicable as part of EFH Omnibus Amendment 2. To date, existing knowledge from the region as well as from across the world has been used to develop general ecological assumptions about designating EFH as well as produce specific management measures to minimize adverse effects.

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

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

This section of the document:

- **Outlines a research agenda for DHRAs**
- **Discusses DHRA design and implementation issues**
- **Recommends specific DHRA alternatives**

3.1 Research agenda

The PDT has identified and the Habitat Comittee has approved 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 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 includng spatial complexity, functional groups, community state, and recovery rates and dynamics?

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

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

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

- How accurate are the susceptibility and recovery scores for biological and geological components derived in the SASI model?
- How accurate are the assumptions in SASI model about the cumulative impacts of each gear type (e.g. multiple passes)?

- Has SASI correctly identified the most vulnerable habitats?
- Are the differences in magnitude of impact among gear types correct?
- Have we significantly over- or under-estimated the impacts of particular gear types?

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

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

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

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

<u>Habitat Recovery</u>

What recovery models (e.g., sucessional 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, v.s. habitats that have experienced some recovery, but look different ecologically than they did prior to disturbance. Habitats that have recovered to a different state than they were in originally may nonetheless provide similar functional value for managed and ecosystem component species.

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

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

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

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

<u>Natural Disturbance</u>

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

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

<u>Productivity</u>

How does the productivity of managed species (and prey species) vary across habitat types nested within the range of oceanographic and regional settings? And how does

this productivity change when habitats are impacted by fishing gear? Do durable mobile bottom tending gear closures increase fish production? Why are highly productive areas (e.g. Stellwagen Bank) so productive?

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

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

3.2 Research area design and implementation

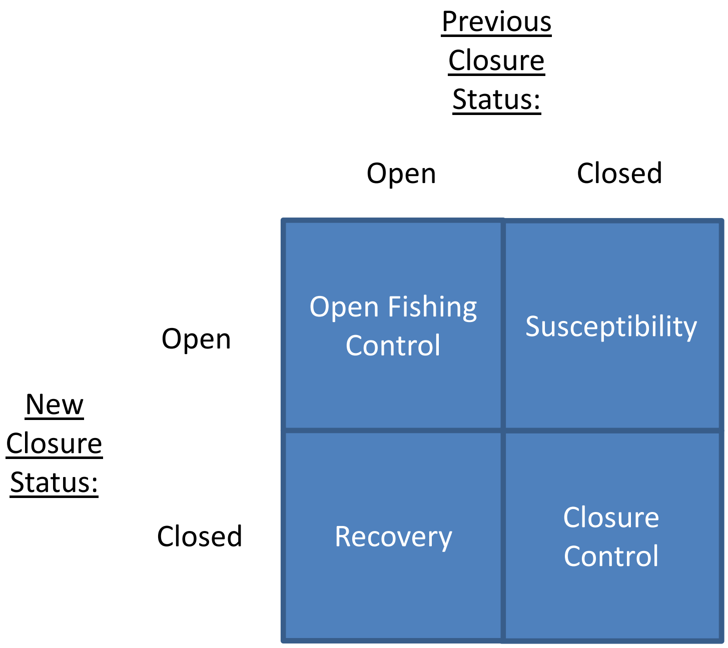
Dedicated Habitat Research Areas would be a new type of management area designation for the Council, so there are a number of design and implementation elements to think through.

3.2.1 Area design

A particular habitat research area will contain a mix of control and treatment sub-areas as appropriate to address specific research questions. The size and shape of each sub-area will depend on the spatial arrangement of habitat types, energy regimes, and locations that are appropriate for different types of fishing activities. Overall size will depend on decisions regarding DHRA design and goals. Assessing the effects of habitat impacts on fish productivity will require larger areas because of movement patterns of fishes (as compared to evaluations of how fishing effects seafloor habitats alone). The size of DHRA treatments for gear impact studies will depend on how many gear types and replicates need to be nested within each. Note that recovery is in part affected by the size of the impacted area and how it is nested within unimpacted habitat.

A **before-after control-impact (BACI)** design was recommended as the ideal. This type of design requires an area that is currently closed for the before treatments, as well as an area that would be newly designated for management for the after treatments (Figure 1). Sequential closing of parts of the open to closed ‘recovery’ area could address temporal effects on recovery trajectories. In practice, none of the three DHRAs identified conform to this design.

Figure 1 – Before After Control Impact design.

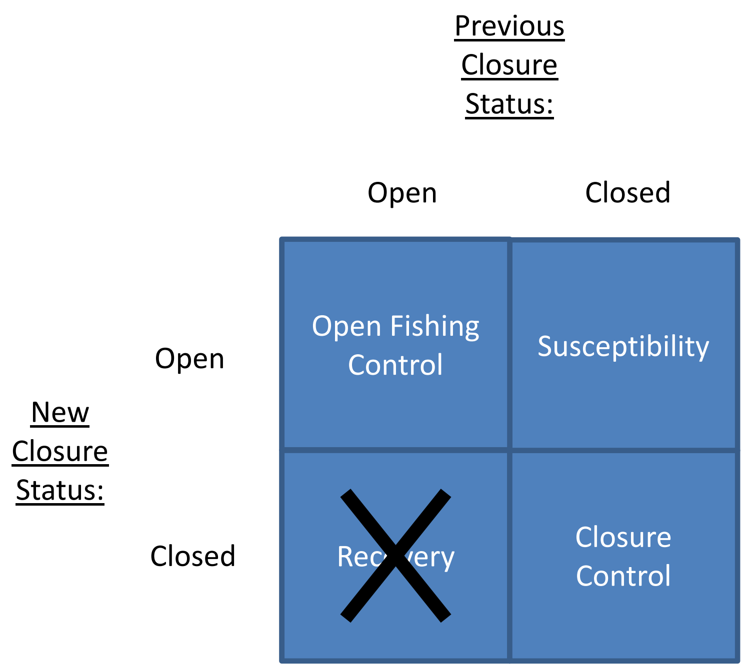


A BACI design could produce results that:

- 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.

A control-impact design has more limited utility, but was recommended in cases where an existing closed area is to remain closed, and there is no desire to manage fishing or research activities outside of the existing area. Alternatively, this could apply to an area where currently there is no management for habitat purposes to constitute a 'before' treatment. This design would include a closed/closed closure control treatment and a closed/open susceptibility treatment. Areas that are currently open would not be affected.

Figure 2 – Control impact design



A control-impact design will:

- 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).

The three DHRAs suggested in the sections that follow would be CI designs. The PDT recommends that the Council not specify treatment distributions within a particular DHRA at the time of DHRA designation, but rather, that the location of study sites and treatments should be determined by researchers using the DHRA. The Northeast Regional Office, and Stellwagen Bank National Marine Sanctuary (SBNMS) in the case of the SERA II area, would assist with oversight and coordination.

3.2.2 Fishing impact treatments

Another consideration related to DHRA design is how fishing impacts treatments will be implemented. There are at least three approaches that could be taken:

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, or
3. open fishery access in research areas.

The Committee recommended research fishing within a general closure, and the PDT concurs with this recommendation. Specifically, fishing effort would be contracted or arranged specifically by project scientists to occur in particular areas using specific gears.

Potential benefits of this approach include the ability to ensure that effort occurs in the locations desired and at the magnitude desired. Lower administrative costs at the front end because specification of levels of fishing activity is left to the researchers, would require some specifications as to where particular treatments and types of fishing could occur in advance, given that different scientists might be involved in various projects in a single area. This condition requires researchers to invest the greatest amount of resources in designing the fishing impact.

Potential costs are 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.

3.2.3 Fishing restrictions

Two of the suggested DHRAs (SERA II and Closed Area 1) overlap with existing habitat and groundfish closures, and the third does not. It is likely that at least some types of fishing restrictions would be necessary in order for the area to function as a DHRA, and it would make sense to implement such fishing restrictions via the regulations associated with the DHRA designation, even if there is continued overlap with a habitat or groundfish management area at the conclusion of the OA2 process. The most likely type of fishing restrictions that would facilitate an area's use as a DHRA would be mobile bottom tending gear restrictions. However, restrictions on other types of gear might be necessary to achieve a true reference area in the DHRA if fish removals or seabed impacts are of concern, or if the use of other gear types would interfere with ongoing research activities/treatment area.

In general, a Letter of Acknowledgement is used when research that is already exempted from Magnuson (i.e., scientific research on a scientific research vessel) is being conducted. Currently, the Regional Office suggests (but cannot require) that a researcher get a Letter of Acknowledgement, particularly if they are using a commercial fishing vessel as the research platform, for enforcement purposes.

A letter of authorization is used when a vessel is being granted access to an area or program that is specifically allowed for in the regulations, e.g., a special access program or an exempted gear fishery. This would likely not apply to DHRAs.

3.2.4 Oversight and coordination

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 via the Research Steering Committee for the two DHRAs apart from SERA II. NERO and SBNMS, in the case of the SERA II DHRA, will be involved jointly with coordination and oversight to determine where research treatment sites are located and to assure there are no conflicts that would bias results. Details on permitting and management of the SERA II DHRA will be determined in consultation between NMFS/NERO and NOS/ONMS prior to implementation. The Council may wish to request that researchers obtain letters of acknowledgement before conducting research in a DHRA.

3.2.5 DHRA reevaluation/sunset provisions

At their December 2012 meeting, the Committee recommended that a DHRA be removed after three years if no research has been initiated. Previously, the PDT had recommended a review after a minimum of 5 years to assess progress towards meeting general and site-specific goals, revision of goals based on lessons learned, adverse impacts to the fishery, and future status of the DHRA.

Removal would be accomplished via rulemaking or some kind of notice, and would be coordinated by the Northeast Regional Office. In order to avoid the need for a plan amendment to accomplish DHRA removal, should it become necessary, the Council will need to specify in the Omnibus Amendment the criteria that should be used by NMFS to evaluate whether research has been initiated and ongoing. The PDT is drafting a list of criteria that could be included in the amendment. These criteria could include:

1. 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.

2. Documentation of pending or approved proposals or funding requests (including ship time requests) with objectives focused on DHRA topics.

A clear and unambiguous procedure will need to be developed in order to make this assessment possible and clear to those involved in research such that review materials are submitted on time. The procedure should not become a post hoc assessment of research value based on choice of topic, but simply link research to the priority topics described above.

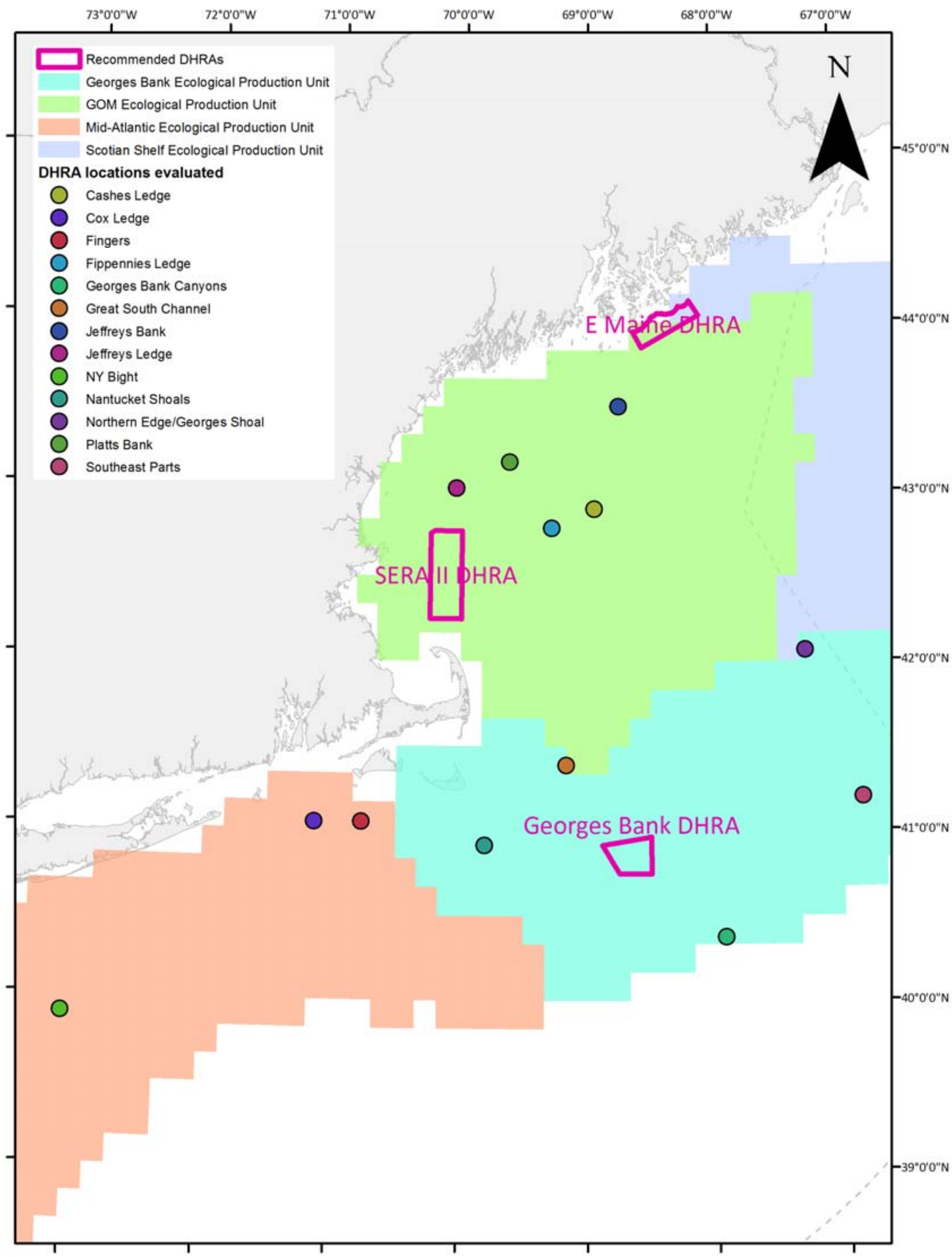
3.3 Specific DHRAs alternatives under consideration

The PDT proposed a regional approach to DHRA designation that would ideally involve multiple areas per region to provide for replication and strengthen the conclusions drawn from the work. The four regions of interest are the "Ecological Production Units" identified by the Northeast Fishery Science Center's Ecosystem Assessment Program, specifically the Eastern Gulf of Maine/Scotian Shelf, Gulf of Maine, Georges Bank/Southern New England, and Southern New England/Mid-Atlantic Bight.

An initial list of potential DHRA locations was identified in the Gulf of Maine. Most of these coincide with existing and/or proposed management areas. These included habitat management areas to minimize the adverse effects of fishing on EFH within Jeffreys Bank, Cashes Ledge, Fippennies Ledge, Platts Bank, Jeffreys Ledge, and Stellwagen Bank. Another area of potential interest as a DHRA is Jordan Basin, where four locations have been identified as potential deep-sea coral zones. Wilkinson Basin was also identified as an area of interest, although there are no habitat management areas proposed for that location. Multiple potential DHRAs were also identified in the Georges Bank/Southern New England area. These included areas that coincide with existing habitat and/or groundfish closed areas (Northern Edge/Georges Shoal, Southeast Parts, Great South Channel, Nantucket Shoals) as well as the Georges Bank submarine canyons. A research area near Closed Area I was suggested by a habitat advisor. Finally, the PDT identified areas in the Southern New England/Mid-Atlantic Bight region that might be appropriate as DHRAs. These areas include two nearby sites, the Fingers and Cox Ledge, as well as the New York Bight region.

The regions and individual areas are depicted on Map 17. The Committee and PDT discussed building DHRA designations on existing and proposed habitat management areas, and many of the areas below are consistent with that approach. **Ultimately, the Committee recommended three areas, one at the boundary of the Scotian Shelf/Gulf of Maine regions (Eastern Maine DHRA), one in the Gulf of Maine (SERA II DHRA), and one on Georges Bank (Georges Bank DHRA).**

Map 17 – Regional framework for DHRA designation, with ecological production units shaded as shown in the legend. The full list of DHRAs explored by the PDT and Committee are indicated with a black marker and labeled in italics. The three recommended areas are outlined in purple. From north to south, these are the Eastern Maine DHRA, SERA II DHRA, and Georges Bank DHRA.



3.3.1 Sanctuary Ecological Research Area II (Stellwagen Bank DHRA)

Stellwagen Bank is a relatively shallow feature near the Massachusetts coast, with minimum depths of approximately 20 m. Depth increases across the bank to the northwest, with an average depth of 35 m. In some locations, the bank edges are very steep, in other areas the slope is shallower. The top of the bank contains large swaths of granule-pebble habitat, with areas of sand, cobble, and boulder ridges. North of the bank is an area with very complex topography with steep topographic highs and water depths to as deep as 170 m. This area consists of boulder ridges and rock outcrops interspersed with deep mud-dominated habitats. Another topographically complex area lies to the east of the bank. Similar areas of boulder ridges and rock outcrops interspersed with deep muds are expected, but the substrates in this area have not well mapped as compared to areas to the west. As expected based on the range of depths, Stellwagen Bank contains a mix of both high and low energy habitats.

3.3.1.1 Baseline data and results of existing research related to the area

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. 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 (Auster et al. 1996, 1998, 2001, 2003a, 2003b, 2006, 2011; Auster 2002; Auster and Langton 1999, Auster and Lindholm 2005; Cook and Auster 2006; Grannis 2005, Kaufmann 200X, Kropp et al. 2000, Kuo et al. 2010, Lindholm et al. 1999, 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 for juvenile fishes or principal prey may be of particular importance 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, in prep) 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 groundfish closure (WGOM). 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 WGOM 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 WGOM). 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. Of note is a study that indicates fish feed on different prey inside versus outside the WGOM (Kaufman 2007), although the population level consequences of such patterns of remains to be determined.

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 (limited stations inside WGOM, see Stokesbury 2002 for methods) 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.

3.3.1.2 Specific goals and objectives for SERA II research

The Sanctuary Ecological Research Area II (SERA II) DHRA would represent a control-impact style design as it lies completely within the existing WGOM habitat closed area. This is consistent with a Habitat Committee recommendation to constrain the boundaries of a research area in this location to the boundaries of existing or proposed habitat management areas. The specific area boundaries identified for SERA II (Map 18) were recommended by an independent ad-hoc working group of fishermen and scientists that are involved with both SBNMS and the Council Habitat Omnibus process. An initial SERA proposal was developed by SBNMS but not considered by the NEFMC (SERA draft proposal at http://stellwagen.noaa.gov), although the research objectives were viewed as synergistic with NEFMC research needs. Here the SERA II option simultaneously addresses the research objectives of the NEFMC DHRA initiative and SBNMS (Table 5). This synergy of research needs presents a unique collaborative opportunity between the Council, NEFSC and the SBNMS in regards to research coordination, support and application of results.

Table 5 – Concordance of general research questions between the DHRA process and original SERA proposal

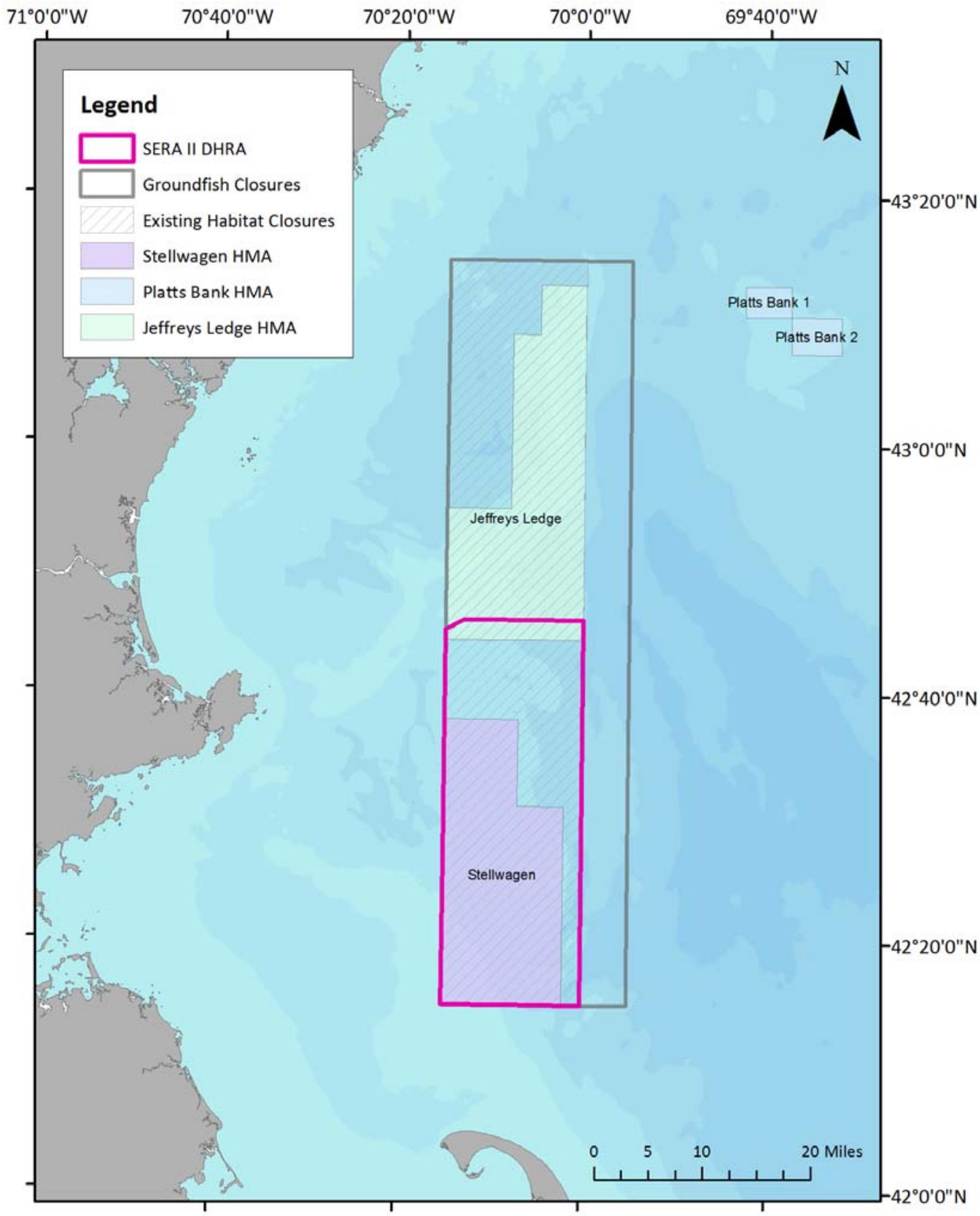
	NEFMC DHRA	SBNMS SERA
Impacts	How do different types of bottom tending fishing gear (e.g., trawl nets, dredges, hook and line, traps, gillnets, longlines) affect the susceptibility and recovery of physical and biological characteristics of seabed habitat, and how do these impacts collectively influence key elements of habitat including spatial complexity, functional groups, community state, and recovery rates and dynamics? 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?	How does variation in the direct impacts of fishing (e.g., using nets and dredges vs. hook and line vs. fixed fishing gear) affect elements of biodiversity (species richness, size, abundance, functional groups, community state, recovery dynamics, etc.) across taxonomic levels of diversity (including microbes, invertebrates, fish, seabirds and marine mammals)? What strategies can mitigate for particular types of human impacts (e.g., live-release of species of concern such as cusk and wolffish in order to reduce fishing mortality, use of fixed versus mobile fishing gear to reduce mortality of vulnerable invertebrate species)?
Recovery	What recovery models (e.g., sucessional 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? 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? 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	Do communities across disturbance regimes exhibit predictable shifts in state, or are changes stochastic, especially as species distributions shift under climate change? How do the drivers of change in marine communities (e.g. physical forcing, competition, predation) vary across habitats and disturbance regimes? What are patterns of connectivity between habitats and how are these influenced by variation in disturbance regimes? How do variations in drivers of change influence diversity, recovery, and ecological resilience? What are the relationships between disturbance regime and persistence of rare species?

	habitat is no longer capable of recovering?	
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?	What are the spatial patterns of diversity and do they vary in phase with increasing levels of disturbance (i.e., both natural and human-caused)? What is the relationship between biodiversity (e.g., species diversity, trophic diversity) and ecological resilience?
Productivity	How does the productivity of managed species (and prey species) vary across habitat types nested within the range of oceanographic and regional settings? And how does this productivity change when habitats are impacted by fishing gear? Do durable mobile bottom tending gear closures increase fish production? Why are highly productive areas (e.g. Stellwagen Bank) so productive?	Do changes in community state alter the provision of ecosystem goods and services from specific habitat types? What are the differences in primary (benthic microalgae) and secondary production across habitats and disturbance regimes (e.g., reference compared to fished areas)?

3.3.1.3 Necessary fishing restrictions

DHRAs should be designed as stand-alone management areas, with implementing regulations that include any restrictions on fishing necessary to meet the research objective of the DHRA. As the SERA II area lies entirely within existing habitat and groundfish management areas, the use of mobile bottom-tending gears and the use of most gears capable of catching groundfish, with the exception of recreational gears, is prohibited. Although the benefits associated with addition restrictions on recreational or midwater gears have been discussed, this issue of which gears to restrict in this or any other DHRAs has not received any significant discussion by the Habitat Committee to date. More work is needed on this issue.

Map 18 – SERA II DHRA



3.3.2 Georges Bank DHRA

The Georges Bank DRHA was suggested by the scallop industry and approved by the Committee for further analysis in December 2012.The DHRA would be a control-impact area design, and would focus primarily on scallop productivity research. The southern part of the existing CAI habitat closed area is suggested as the boundaries for this DHRA (Map 19).

3.3.2.1 Baseline data and existing research related to the area

ideo survey data with substrate, scallop, and epifaunal information are available. A specific survey was conducted in 2011 with 60 randomly distributed stations inside the CAI access area, and 60 stations outside. A 2013 scallop RSA project will examine scallop productivity in relation to habitat via seeding experiments.

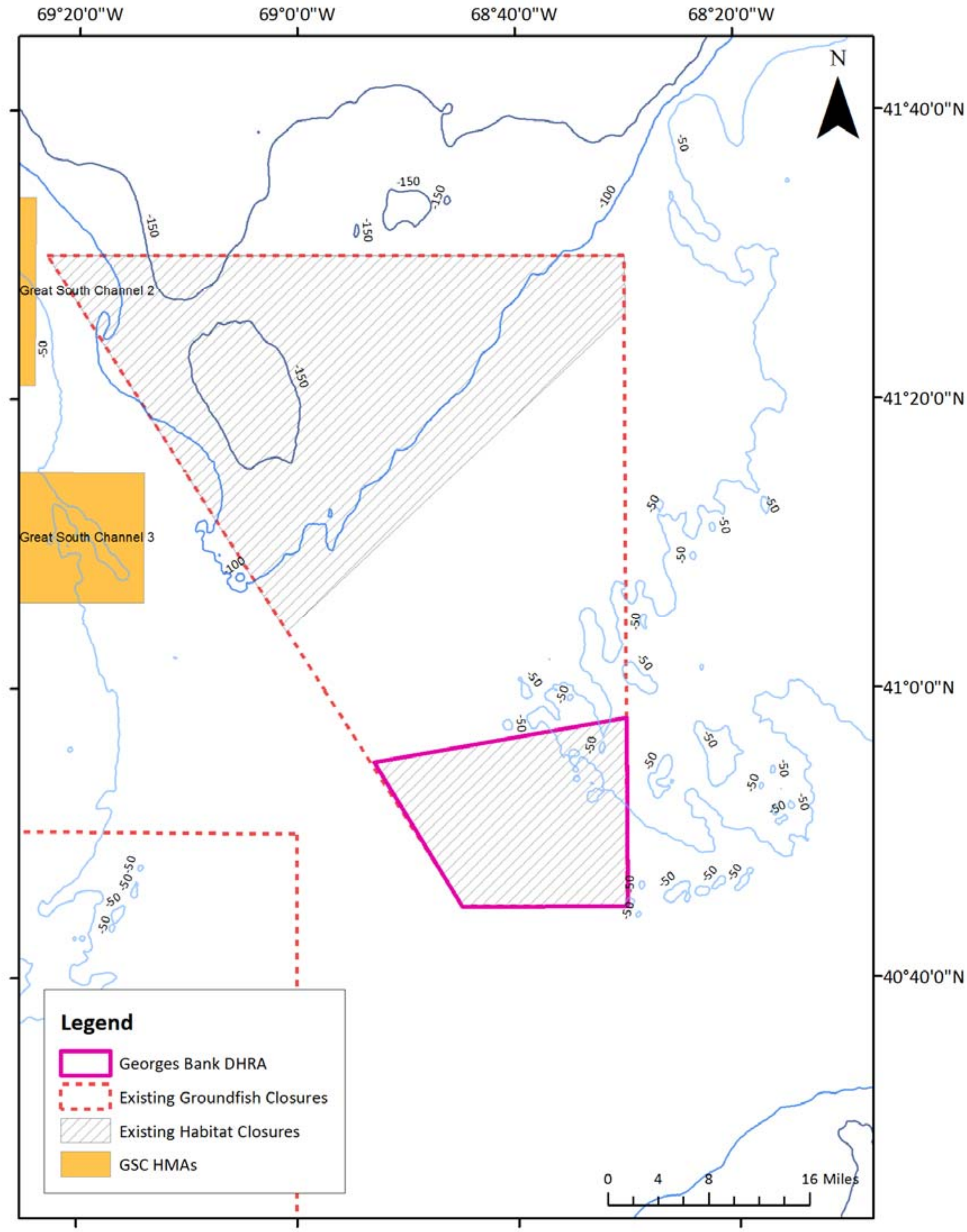
3.3.2.2 Specific goals and objectives for Georges Bank DHRA research

A major goal for this area is to increase understanding of sea scallop productivity as related to habitat variables. More specific objectives to be determined.

3.3.2.3 Necessary fishing restrictions

To ensure that scallop seeding experiments are not disturbed, the area would need to be protected from mobile gear fishing impacts, at a minimum.

Map 19 – Georges Bank DHRA.



3.3.3 Eastern Maine DHRA

Through the Penobscot East Resource Center, a subset of industry members in eastern Maine expressed interest in some a management area to improve groundfish productivity off the Maine Coast. Their request specifically referenced the Swept Area Seabed Impact model trawl LISA cluster that extends from offshore of Mt. Desert Island southeast down the coast to Isle au Haut Bay. At their December 2012 meeting, the Committee asked the PDT to develop an option for a DHRA within the boundaries of the northeastern most LISA cluster. The intent of the motion was to have the PDT design a research area based on this cluster, in collaboration with PERC. PERC has also presented their proposal for a groundfish-related management area in eastern Maine to the Groundfish Committee.

3.3.3.1 Area design

The PDT discussed boundaries for this area during their March 6, 2013 meeting, and the Committee reviewed the recommendations on March 19. The boundaries as modified by the Committee are shown on Map 20.

3.3.3.2 Baseline data and existing research related to the area

The area overlaps with longline sentinel fishery stations. The area contains and is offshore of locations documented as historical cod and/or haddock spawning grounds.

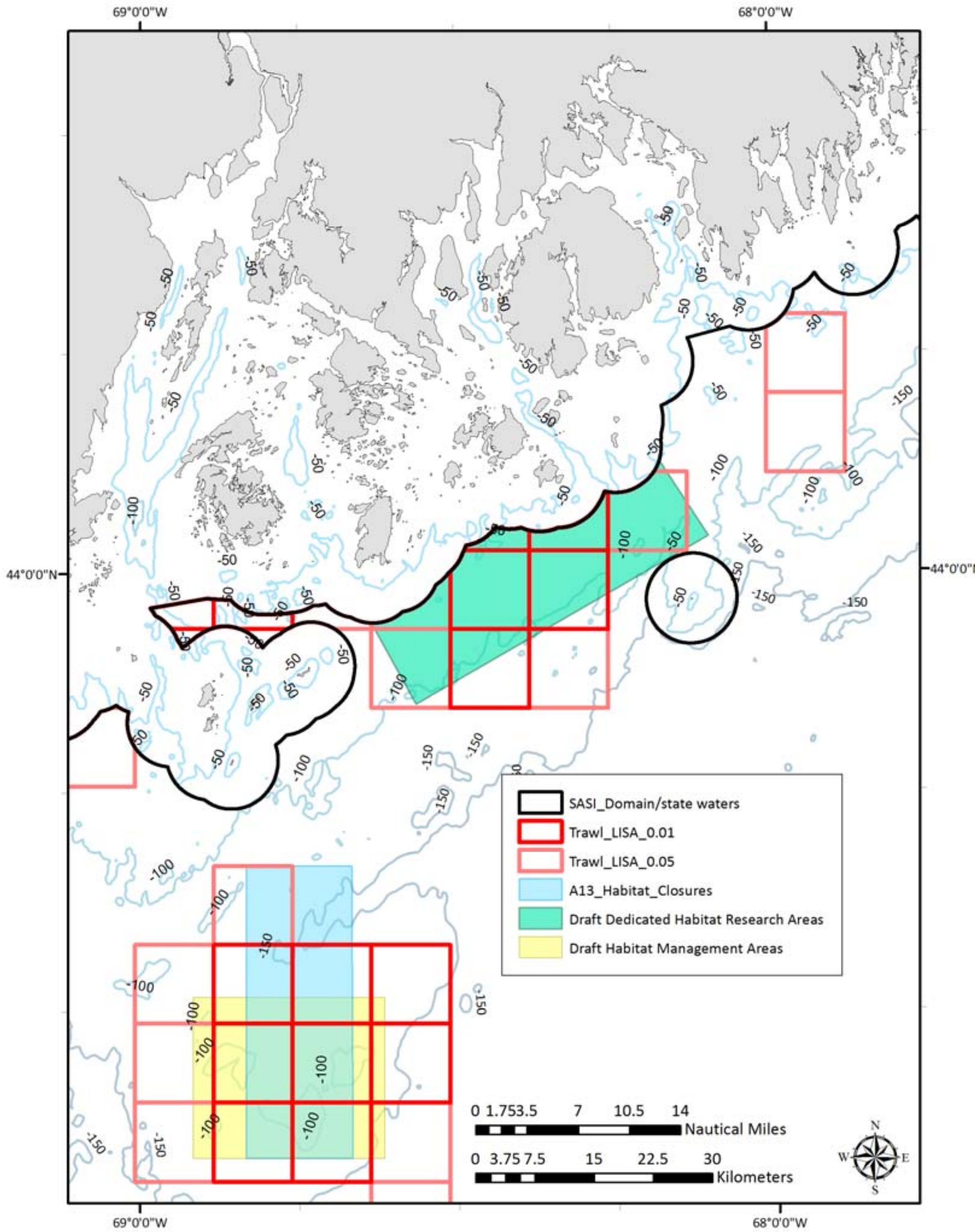
3.3.3.3 Specific goals and objectives for Eastern Maine DHRA research

The general goal for research within this area would be to evaluate distributions of groundfish in relation to habitat attributes. More specific objectives to be determined.

3.3.3.4 Necessary fishing restrictions

To be determined.

Map 20 –Eastern Maine DHRA



4.0 Management alternatives related to monitoring and frameworkability

4.1 Develop a data collection program related to gear modifications

Through discussions of potential gear modification management options, the Habitat Committee and others have reached a consensus that existing data on gear configuration are inadequate for developing these types of measures. The Committee, PDT, and AP have discussed various data elements that would be useful for both development of gear modification alternatives, and for more accurate implementation of the SASI model. At their March 19 meeting, the Committee requested help from the Groundfish AP in creating a list of essential gear characteristics, for example:

- Door – make, weighted or not, how much weight;
- Ground cables – length, diameter, chain, wire, cookie, or rope;
- Sweep – chain, disk, or rockhopper, diameter of biggest part.

It is not yet clear how these data would be collected or stored. Options could include self-reported data collection during permitting, revisions to the data collected by the observer program, or a periodic census of gear use conducted by industry members/gear technologists. However, the Committee agreed that whatever approach is taken it would be important to characterize spatial variation in gear usage. The Committee acknowledged that many boats with multiple nets each with multiple rigging will result in a very large dataset if extremely detailed data are collected, but the list of basic components should be easy to develop.

4.2 Make gear modification measures in habitat management areas a frameworkable action

At their December 2012 meeting, the Committee recommended an alternative that would specify that gear modification options within habitat management areas could be implemented via framework action vs. requiring a full FMP amendment.

5.0 Previously considered options

5.1 Considered and rejected options to minimize the adverse effects of fishing on EFH

5.1.1 Considered and rejected Habitat Management Areas

5.1.1.1 Allow shrimp vessels in existing WGOM habitat closed area

This option was proposed via a Committee motion made in January 2011. The PDT discussed the issue of shrimp trawling in the WGOM habitat closed area during June 2011, and recommended modifying the closure to focus more on Jeffreys Ledge, thereby removing the northwestern part of the closure. This northwestern corner includes deeper mud shrimp habitats, so adopting the Jeffreys Ledge option would create flexibility for the shrimp fishery without having to exempt shrimp trawls entirely from any habitat closure in that area. Based on a Committee motion in July 2011, an option was added to that would keep the WGOM closure intact, with the exception of the northwest corner, which would be eliminated.

5.1.1.2 Adjust the boundaries of the existing Closed Area II habitat closed area

There is currently a status quo option and a removal option for the CAII habitat closed area. In August 2011 the PDT discussed an intermediate option that would have modified the current CAII habitat closed area by shifting the southern boundary north. This area, referred to as the Northern Edge habitat area, was recommended by the PDT at the August 30, 2011 Committee meeting as a closure to all fishing gear. The Committee did not recommend the area for further analysis.

5.1.1.3 Adjust the boundaries of the existing Nantucket Lightship habitat closed area

Similar to the above option in CAII, this option would have adjusted the boundaries of the current NLCA habitat closed area to form the Nantucket Shoals habitat area, and kept the area closed to mobile bottom tending gear. Specifically, the Nantucket Shoals area would be the portion of the NLCA habitat area that lies outside the NLCA groundfish closure. The PDT recommended this option in August 2011, but the Committee did not recommend the area for further analysis.

5.1.1.4 Establish a single large habitat management area in the Great South Channel (August 2011 version of area)

The Great South Channel is one of the areas where grid cells highly vulnerable to trawl gear clustered in the SASI LISA analysis. This area contains a relatively large amount of gravel seabed, which is vulnerable to the adverse effects of fishing. Vulnerable habitat areas were identified in the Great South Channel based on the locations of gravel-dominated hotspots as identified by Harris and Stokesbury 2010, which analyzed the distribution of sediments on Georges Bank based on video survey data. These areas are currently open to fishing. This option would have defined a single large area that encompassed all of the gravel-dominated hotspots, and either made the area a trawl ground cable modified area, or closed it to mobile bottom tending gear. At their August 2011 meeting, the Committee did not recommend this area for further analysis, and recommended instead some combination of the smaller GSC areas. In December 2012 the Committee revisted this issue and asked the PDT to develop a single HMA for the GSC that has similar conservation value to the four individual areas.

5.1.1.5 Extend the boundaries of the Jeffreys Ledge habitat management area to the west

This option would have extended the Jeffreys Ledge area further west (Map 4). Similar habitat types are found on the portion of the ledge within the exisiting WGOM habitat closure and outside the existing closure to the southwest towards Cape Ann, Massachusetts. The Committee did not recommend further consideration of this option during their August 2011 meeting.

5.1.1.6 Establish a habitat management area on Stellwagen that includes Tillies Bank

This option would have included all of the area covered by the Stellwagen HMA, plus an extension to encompass Tillies Bank (Map 4). Tillies Bank is a relatively small area, approximately 3 miles long north to south and 1.5 miles wide east to west, that lies outside the current WGOM habitat closed area. Tillies Bank is densely covered by boulder ridges and has high intensity multibeam backscatter values, which indicates the presence of habitat types that have relatively high susceptibility to fishing gear impacts.

5.1.1.7 Establish a habitat management area on Stellwagen that includes an extension to the east

This option would have included all of the area covered by the Stellwagen HMA, plus an extension to the eastern boundary of the current WGOM habitat closed area (Map 4). The additional area represents the eastern edge of Stellwagen Bank, and slopes relatively steeply from west to east. Substrates in the additional area are not particularly well sampled relative to the top of Stellwagen Bank, but based on the data assembled for the SASI substrate model, in the northern part of this extension, there appears to be a transition from sand and gravel in the shallower areas to mud in the deeper waters. The southern part of this extension contains a small unmapped bank and part of a partially mapped bank, both of which are highly likely to contain boulder ridge habitats.

5.1.1.8 Establish a habitat management area on Stellwagen that includes an extension to the east in addition to Wildcat Knoll

This option would have included all of the area covered by the Stellwagen HMA, plus the eastern extension, plus an extension to cover Wildcat Knoll (Map 4). Wildcat Knoll is roughly similar in size to Tillies Bank, at about 5 miles long north to south and 2.5 miles wide east to west. It lies outside the WGOM habitat closure but inside the WGOM groundfish closure, so it is currently not fished by gear capable of catching groundfish. Although not included in the multibeam area or well characterized in the SASI sediment model, Wildcat Knoll is known to contain boulder ridge habitats that are similar to those found on Tilles and Stellwagen Banks (P. Auster, personal communication). These features also occur on the other small banks that lie southwest of Wildcat Knoll.

5.1.1.9 Extend the Jeffreys Ledge habitat management area boundary to include New Scantum

New Scantum is a peninsula-shaped extension of Jeffreys Ledge that lies immediately to the west of the WGOM habitat closure (Map 4). New habitat data for the area were collected during a recent August 2011 cruise aboard the EPA's R/V Bold. The data were collected and processed using the same techniques as the SMAST video survey. An updated substrate coverage was created by aggregating data from the previous SASI substrate model (SMAST video, usSEABED grab samples) with the new data and constructing a new grid using the same Voronoi tessellation techniques employed during SASI model development. The previous SASI substrate coverage showed an area dominated by ganule-pebble and sand, but the new coverage indicates that the area contains the full range of substrate types: mud, sand, granule-pebble, cobble, and boulder.

This updated substrate map is consistent with the previously available substrate map for the northern portion of Jeffreys Ledge, and is also consistent with the multibeam map and associated boulder ridge data for the southern part of Jeffreys Ledge that extends further west towards Cape Ann, Massachusetts. As noted above, 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. Thus, the area was recommended as a habitat management area designed to minimize the adverse effects of fishing on EFH.

5.1.1.10 Establish a habitat management area on Gloucester Bank-Lower Stellwagen Bank

Gloucester Bank lies just offshore of the 3nm state-federal boundary, southeast of Cape Ann, Massachusetts. The bank and associated similar banks extend southeastward to Lower Stellwagen Bank and are very densely covered by boulder ridge habitats. Between the shallower hard-bottom habitats with boulder ridges there are deeper muddy areas. 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. Thus, the area was recommended as a habitat management area designed to minimize the adverse effects of fishing on EFH.

5.1.1.11 Establish four habitat management areas west of the Great South Channel and close them to mobile bottom tending gears

This option would have created habitat management areas in one or more of the four sub-areas west of the Great South Channel, closing the area(s) to mobile bottom tending gear. See Map 5Map 15**.** The Habitat Committee decided subsequently that a single area option for this region was preferable (see section 2.2.15).

5.1.2 Considered and rejected gear modification options

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.

An overall reduction in fishing as a means to minimize area swept and thus adverse effects on EFH is likely not practicable. Managing fisheries to generate high CPUE is not particularly straightforward, and designing such programs goes well beyond the scope of the Omnibus EFH Amendment 2 (OA2), as many factors interact to produce the spatial patterns of fishing and associated catch rates that we observe. This leaves management options to reduce gear contact with the seabed. This could take the form of wholesale gear substitutions (e.g. requiring longlines instead of trawls, etc.), or gear modifications (e.g. raised footrope trawls, semi-pelagic trawl doors, etc.)

OA2 considered one specific gear modification strategy: setting maximum ground cable lengths for trawl gear within specified habitat management areas. Limiting ground cable length would be expected to reduce the linear effective width of the gear and thereby the area swept and associated seabed impacts. However, this ignores effects on catchability of the target species. If capping ground cable length reduces catchability, this could lead to longer tows. In order to predict how the amount and distribution of area swept might change, the relationship between ground cable length, catchability, and other factors needs to be better understood. If such relationships cannot be determined empirically, assumptions will need to be made so that impacts to both habitat and managed species can be predicted.

Ground cables are defined as wire ropes extending along the seabed between the trawl doors and the bridles or net; for the purpose of herding fish and increasing the area of seabed fished (swept) by the trawl gear. Ground cable diameter can be increased be passing the wires through rubber disks (cookies) or rollers; this modification is designed to assist passage of the ground cables over the seabed.

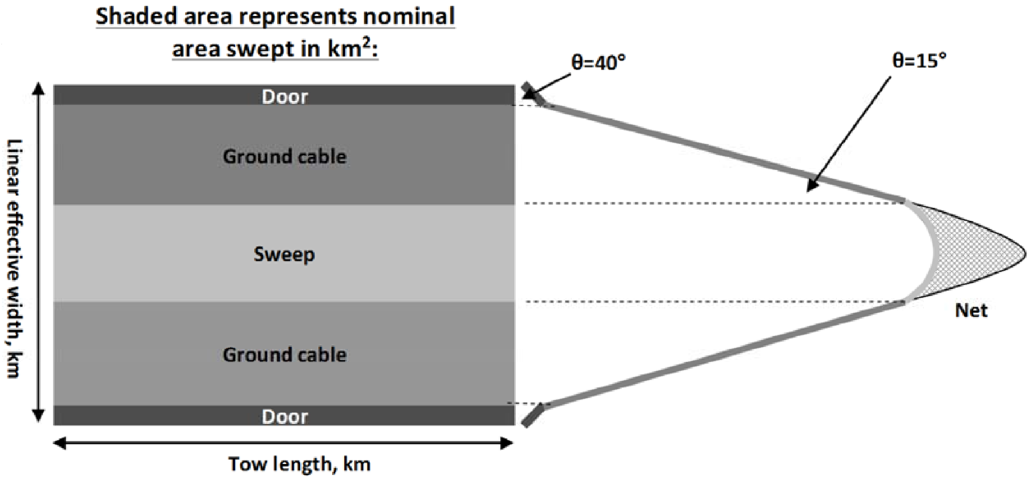
Ground cables are typically constructed from steel wire rope (twisted), often with small diameter rubber disks (cookies) compressed together along the entire cable length. There are some reports that a few fishermen use chain as an alternative to wire rope. Cable diameter ranges from $^{9}/_{16}$ inch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

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

In comparison with the sweep and the doors, ground cables are the longest element of bottom trawl gear and thus they contribute the greatest proportion of area swept for a given fishing event (Figure 3 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.

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 relatively simple to estimate the reductions in linear effective gear width that could result from shortened cable lengths, and to then use these reduced area swept estimates in the SASI model to estimate changes in adverse effects within the location of the gear restrictions. However, in order to understand if there is a **net benefit** for use of these types of gear modifications to minimize total area swept, other information would need to be incorporated into the analysis, such as:

- **What is the cable length/catchability trade-off for target species?**
  - If catchability is reduced with shortened cables, how does tow length/duration increase to compensate? Would gear modifications lead to a net increase or decrease in area swept, and thus EFH adverse effects, within restricted areas because of the trade-off between CPUE and ground cable length?
  - 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 gear restrictions are implemented?**
  - What degree of reduction in catchability will lead a vessel to simply fish elsewhere, rather than within the restricted ground cable area? Will

  - shortened cable lengths actually reduce the use of trawl gear in those habitats we are targeting for conservation?
  - Can target species within the ground cable area be targeted using other gear types instead?

- **Are frequent changes in cable length practical?**
  - Are there ground cable length reductions that have relatively insignificant effects on catchability, such that fishermen use these nets in all fishing areas?
  - Is having multiple ground cable length limits in multiple areas too complicated?
  - How many nets are fishermen willing to carry?
  - What is the effect of area size on the practicability of ground cable length limit measures?

- **What is the specific objective of ground cable modification measures, and how does that influence the recommended cable length by area?**
  - Require a ground cable that is so short such that there is a strong disincentive to use trawl gear in the area at all?
  - Require a ground cable that is moderately short such that there is a strong disincentive to fish in the area, unless the target species is highly abundant?
  - Require a ground cable length that eliminates use of 'unnecessarily long' ground cables but has little impact on catchability and thus on fishing behavior?

Looking more holistically at fishing across a full suite of managed and unmanaged areas, reductions in either the amount of fishing effort or the catch rates inside a ground cable area could lead to increased fishing effort in other locations. The size and direction of changes in adverse effect estimates can be calculated using applications of the SASI model, but only if effort allocation is well understood. However, the effect of ground cable modifications on species catchability, limitations across the gradient of habitat complexity, and thus fishermen profits and effort allocation, is not well understood. Any gear modification impact analysis, including its general effectiveness in terms of adverse effect mitigation, will necessitate assumptions regarding the relationship between catchability and ground cable length, and there is little data known for our region on which to base these assumptions.

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

Steps in impacts analysis:

1. Calculate reduction in linear effective width associated with reduced ground cable length. *Assumptions – everyone uses maximum length? Angle/geometry is the same before/after change?*
2. Estimate catchability and use this value to predict changes in tow length (time and distance). *Assumptions – catchability changes – should this vary by species and area?*
3. Estimate how effort will be redistributed:
    a. *Assumptions: For areas that are currently open, will all trips still occur but with the changes outlined in steps 1 and 2? Or will some effort be displaced to other areas? Are these other areas lower vulnerability?*
    b. *Assumptions: For areas that are not currently open, but become gear modification areas, how much effort will occur there? Will this effort be redistributed from somewhere else? Is the somewhere else lower vulnerability?*
4. Compare resulting area swept and realized adverse effects with and without gear modifications
5. Determine whether the difference is "significant" and how to communicate the degree of uncertainty in the results

In the context of minimizing adverse effects, gear modification requirements were first considered by the Habitat Committee at their June 2010 meeting, within the LISA clusters in the Gulf of Maine (GOM), on Georges Bank (GB), and in Southern New England (SNE). The Committee reiterated their desire for analysis of both ground cable and roller gear restrictions in GOM clusters 1, 3, and 4 at their October 2010 meeting. At their October 2010 meeting, the Committee agreed to provide some recommendations to the PDT about an appropriate range of options for ground cable lengths, but at the current time, specific length options need further development by the PDT and Committee.

During their June 2011 meeting, the PDT reviewed the LISA cluster results and other non-SASI information, and recommended a range of vulnerable areas to the Committee as candidate areas for adverse effects minimization measures. At their July 2011 meeting, the Committee recommended analyzing mobile bottom tending gear closures and ground cable restrictions in potential management areas designed to encompass gravel hotspots identified by the PDT on and west of Georges Shoal. Also at that meeting, they recommended analysis of ground cable length restrictions in lieu of the current mobile bottom tending gear closure in the existing Closed Area I habitat areas. Specifically, the ground cable options would set a maximum total ground cable length for trawl vessels operating in a particular spatial area.

At their August 2011 meeting, the PDT recommended ground cable length restrictions only in a large area on Georges Shoal and in a large area combining four separate gravel hotspots west of the Great South Channel. At their August 2011 meeting, the Committee recommended analyzing ground cable restrictions for three areas on and west of Georges Shoal (Georges Shoal Large, as recommended by the PDT for this purpose, Georges Shoal East area developed at the meeting, and a Georges Shoal West area combining the two westernmost gravel hotspots). The Committee also recommended ground cable restrictions be analyzed for the four Great South Channel areas individually, and a single Cox Ledge area, and reiterated their support for the analysis of the existing CAI habitat areas as ground cable modification areas.

At their June 2012 meeting, the Habitat Committee added a ground cable length limit option for all of the GOM areas, with the exception of the Ammen Rock subsection of the Cashes Ledge area. These include the new and modified areas on Jeffreys Bank, Cashes Ledge, Fippennies Ledge, Platts Bank, Jeffreys Ledge, and Stellwagen, and the existing WGOM, Jeffreys Bank, and Cashes Ledge habitat closures.

At their August 2012 meeting, the PDT discussed that given the many assumptions necessary when analyzing ground cable modifications, the results of the analysis may ultimately be inconclusive in terms of whether such options will actually reduce the adverse effects of fishing on EFH. They recommended that the Committee consider removing the options from consideration. At their meeting later in the month, the Committee discussed the issue and decided to ask the Advisory Panel to work with the PDT to determine whether to recommend continued development of such options, and if so, to identify an appropriate maximum ground cable length for each area.

The PDT and Advisory Panel met in October 2012 to discuss this issue and a series of specific options were recommended to the Committee in December 2012. Most of these were developed by the AP. For other areas, no options were developed by the AP. With the exception of enhanced data collection related to gear modifications, and consideration of scallop dredge modifications in the context of the Great South Channel areas, the Committee did not move any of the recommended options forward for analysis. During their March 2013 meetings, the Habitat PDT and Committee discussed the potential for scallop dredge gear modifications to minimize habitat impacts, but no specific options were developed.

5.1.2.1 Roller gear and ground cable restrictions in clusters 1, 3, and 4

Gear restrictions for areas in the GOM were discussed in June 2010 and again in October 2010. The PDT analyzed data associated with each of the clusters and did not recommend any further development of management measures for clusters 1 and 4 (south of Mount Desert Island Cluster, Cape Neddick Cluster). The PDT recommended focusing management efforts just on the central, shallower portion of cluster 3 that covers Platts Bank. However, the PDT did not recommend gear restrictions in this area, but instead recommended a mobile bottom-tending gear closure.

5.1.2.2 Maintain the existing Jeffreys Bank habitat closed area boundary but change management measures to require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.3 Adjust the boundaries of the Jeffreys Bank habitat closed area to create the Jeffreys Bank habitat management area and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.4 Maintain the existing Cashes Ledge habitat closed area boundary but change management measures to require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.5 Adjust the boundaries of the Cashes Ledge habitat closed area to create the Cashes Ledge habitat management area and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.6 Establish the Fippennies Ledge habitat management area and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.7 Establish Platts Bank habitat management areas and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.8 Adjust the boundaries of the WGOM habitat closed area to create the Jeffreys Ledge habitat management area, and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.9 Adjust the boundaries of the WGOM habitat closed area to create the Stellwagen habitat management area, and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.10 Maintain the existing CAI habitat closed area boundaries but change management measures to require shortened ground cables on bottom trawls

The current Closed Area I habitat closed area was added to the list of areas under consideration as gear modification areas in August 2011. The AP did not recommend a gear modification option for this area.

5.1.2.11 Establish two management areas on Cox Ledge and require shortened ground cables on bottom trawls

Added as an option by the Committee in June 2012. The AP did not recommend a gear modification option for this area.

5.1.2.12 Establish the East and West Georges Shoal habitat management areas and require shortened ground cables on bottom trawls

Georges Shoal West encompasses most of the shoal itself, and other shoal areas to the west. Georges Shoal east is north and east of Georges Shoal, with the eastern boundary of the area running along the existing CAII boundary. All three areas were added to the list of areas under consideration as gear modification areas in August 2011. The AP did not recommend a gear modification option for this area, but focused on the Georges Shoal Large HMA instead (see below).

5.1.2.13 Establish the Georges Shoal Large Habitat Management Area and limit ground cables to 45 fathoms

The Georges Shoal Large Habitat Management Area (Map 21) is currently open to fishing with trawl gears. It lies west of the existing Closed Area II habitat and groundfish closed areas and covers an area of 934 mi^2 (2,420 km^2, 70 nm^2). Smaller subsets of this larger area were defined as the Georges Shoal East and West HMAs. The large area was only proposed as a candidate for gear modifications to trawl ground cables.

The advisory panel suggested the following management option:

- **Configuration:** A maximum ground cable length cap for this area of 45 fathoms per side, along with a requirement that the ground cables be equipped with elevating disks 20 cm in diameter spaced at 5 fathom intervals.

- **Data collection and implementation schedule:** A data collection program would go into effect in year 1, and the gear modification would go into effect in year 2, with an evaluation of the program occurring after year 3.

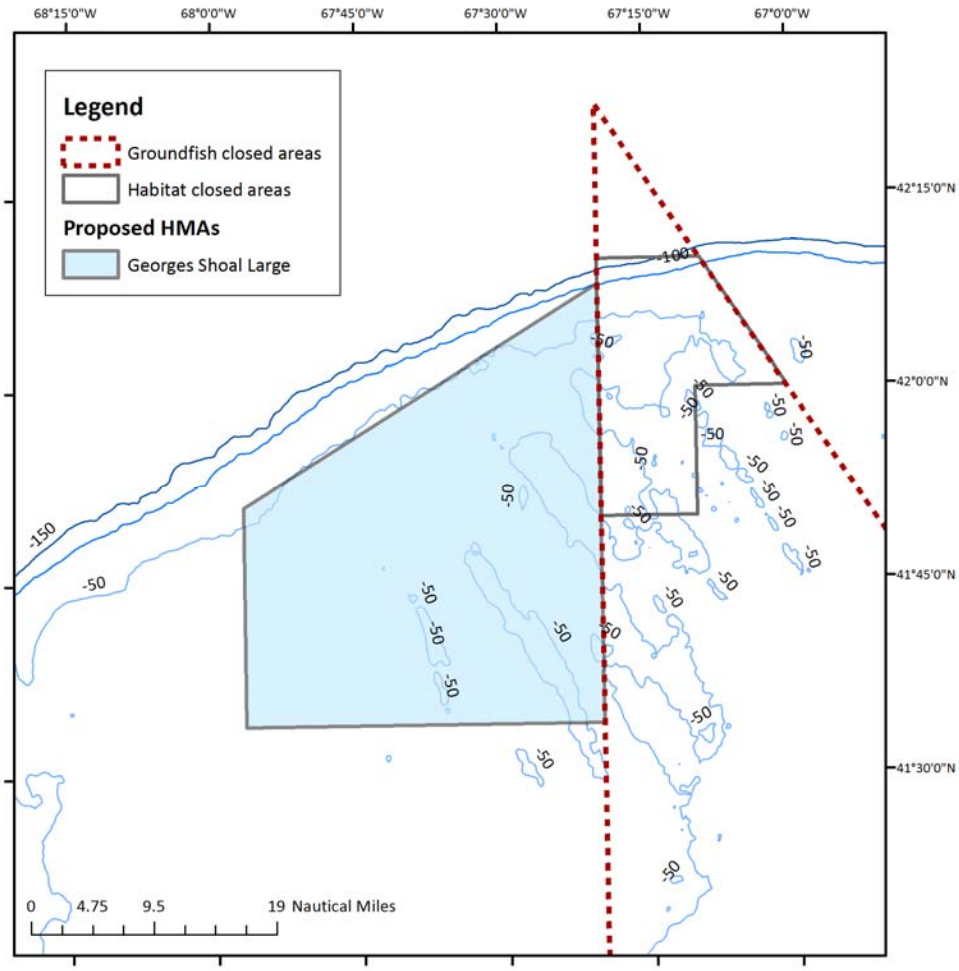
After the joint meeting the PDT had some further discussion of this issue and made the following recommendations:

- **Configuration:** The cap should be on the combined length of ground cables and lower bridles, rather than on the ground cables only. It may be appropriate to increase the cap from 45 fathoms to accommodate the Advisory Panel's original intent. At the AP/PDT meeting, one audience member cited typical bridle lengths of 10-20 fathoms.

- **Data collection:** The PDT discussed gear elements that would need to be measured in order to develop and evaluate these types of regulations. See Appendix I for details.

Neither of these options was approved by the Committee for futher analysis at their December 4 meeting.

Map 21 – Georges Shoal Large habitat management area in light blue. The northern portion of the existing CAII groundfish area is shown in dotted red outline, and the existing CAII habitat area is shown in grey outline. Depth contours are in meters.



5.1.2.14 West of the Great South Channel (4 subareas)

The four Habitat Management Areas proposed west of the Great South Channel (Map 15) are currently open to fishing with trawl gears. The advisory panel suggested the following management option:

- **<u>Ground cable length cap (AP option):</u>** In the four Great South Channel areas, ground cable lengths would be capped at 95% (approximately) of the current maximum length. The objective here was to more or less cap ground cable lengths at their current baseline. The idea is to manage adverse effects by not allowing them to increase.

Based on a data set of ground cable lengths used during observed trips, this would result in a ground cable length cap of 70 fathoms (all observations, n=1010), or 50 fathoms (outliers removed, n=931 fathoms). Outliers were identified using boxplots, and were defined as those observations that are more than 1.5 times the interquartile range from the box edge. In this example, the interquartile range is 20 (1^{st} quartile 10 fathoms, 3^{rd} quartile 30 fathoms), so the outliers are those values greater than 60 fathoms (30 + (20 x 1.5)).

During a November 2 conference call, the PDT discussed this issue further. The PDT felt that it would make sense to develop a recommendation for these four areas that is consistent with the one developed for the Georges Shoal Large area. Similar to the Georges Shoal recommendation, the cap should be on the combined length of ground cables and lower bridles, rather than on the ground cables only. The total recommended length would be shorter, because observer data indicate that shorter ground cables are used in these locations as compared to the Georges Shoal Large area. Below is the PDT recommendation:

- **<u>Ground cable length cap (PDT option):</u>** In the four Great South Channel areas, ground cable lengths would be capped at 25 fathoms plus an appropriate allowance for the bridle length per side, along with a requirement that the ground cables be equipped with elevating disks 20 cm in diameter spaced at 5 fathom intervals.[4]

- **<u>Data collection and implementation schedule:</u>** A data collection program would go into effect in year 1, and the gear modification would go into effect in year 2, with an evaluation of the program occurring after year 3. See Appendix I for details.

For Georges Shoal, the ground cable length selected (45 fathoms) was greater than the median and mean values, but less than the 75^{th} percentile value by 5 fathoms. This same method was applied to the Great South Channel data, resulting in a ground cable cap of 25 fathoms.

Neither of these options was approved by the Committee for futher analysis at their December 4 meeting.

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[4] Again, it is not clear what size ground gear is currently used on ground cables, or how disks of this size spaced widely would operate differently from bare wire or cookie-covered ground cables.

5.2 Considered and rejected DHRA options

5.2.1 DHRA options initially considered by ultimately not recommended by the PDT

5.2.1.1 Fippennies Ledge

The top of Fippennies Ledge is relatively flat, with depths ranging from 60-80 m. The sediment data layer used for SASI indicates that the flat ledge top contains sand, granule-pebble, cobble, and boulder dominated areas. The edges are sand dominated, and the deep areas around the ledge are sand and mud dominated. Langton and Robinson (1990) evaluated scallop beds on the ledge using photographic transects and noted dominance of sabellid worms, burrowing cerianthid anemones, and sea scallops. The area was video surveyed by SMAST in 2009 (Stokesbury et al 2010) and again in 2010, primarily to document scallop distribution, size, and abundance. Their survey also includes information not discussed in the publication, such as substrate grain size and fish and epifaunal invertebrate presence and abundance.

The PDT discussed Fippennies as a DHRA but ultimately did not recommend it to the Committee. Fippennies Ledge and the proposed habitat management area associated with it are relatively small in size. The Committee's objective is to base DHRA designations on HMA boundaries. Since the proposed HMA is approximately 17 mi^2, the control and impact treatments associated with a research area would likely impact much of the HMA, which runs counter to the objective of minimizing adverse effects within the HMA boundaries.

5.2.1.2 Platts Bank

Like Fippennies Ledge, the top of Platts Bank has depths ranging from less than 60 m to approximately 80 m. A full range of grain sizes from mud to boulder have been documented on and around Platts Bank, but the area is not particulary well mapped. The area was video surveyed by SMAST in 2009 (Stokesbury et al 2010) and again in 2010, primarily to document scallop distribution, size, and abundance. Their survey also includes information not discussed in the publication, such as substrate grain size and fish and epifaunal invertebrate presence and abundance.

The PDT discussed Platts Bank as a potential DHRA but did not recommend it to the Committee. The Committee's objective is to base DHRA designations on HMA boundaries. Since the proposed HMAs are approximately 12 mi^2 and 16 mi^2, the control and impact treatments associated with a research area would likely impact much of the HMA, which runs counter to the objective of minimizing adverse effects within the HMA boundaries. Also, since Platts Bank is currently open to all types of fishing, there is not the possibility for a currently closed and reopened to fishing disturbance treatment, or a closed-closed reference area.

5.2.1.3 Wilkinson Basin

The muddy basins in the GOM have depths exceeding 200 m and are uniformly low energy. One of the major ones is Wilkinson Basin, which lies between Jeffreys Ledge, Stellwagen Bank, Platts Bank, and Fippennies Ledge. The topography is generally flat, and is dominated by mud with scattered areas of hard substrate. The PDT discussed this area as a DHRA but ultimately did not recommend it as there is no nexus to current or proposed management areas.

5.2.1.4 Jordan Basin

Jordan Basin lies east of Jeffreys Bank and straddles the Hague Line. Like Wilkinson Basin, the topography is generally flat, and is dominated by mud with scattered areas of hard substrate. Research in Jordan Basin has included ROV work looking at distribution of corals and associated species. The PDT discussed this area as a DHRA but ultimately did not recommend it because there are no current management areas in this location, and the four proposed coral zones in Jordan Bain are relatively small in size and would probably not be suitable as research areas designed to evaluate fishing impacts.

5.2.1.5 Southeast Parts of Georges Bank

On the southeastern part of Georges Bank, the substrate is almost uniformly sand dominated, with occasional areas of mud or granule-pebble. Depth decreases gradually from about 40 m near the center of the bank to about 90 m at the margin. Most of the area is high energy/mobile sand except for the areas deeper than approximately 60m (routine disturbance) - 80 m (storm generated disturbance). Starting at around 100 m, the bank drops off very steeply and is cut by numerous canyons.

Video survey data include substrate, benthic invertebrate presence (abundance for some taxa), and fish presence and abundance (Stokesbury 2002, Stokesbury et al. 2004). These data were collected at 5.5 km grid resolution throughout the southeast parts. This area has also been mapped using a still camera transect survey, HabCam (Howland et al. 2006). Transect coverage varies. The area was surveyed during a June 1999 cruise before it was reopened to scalloping. Lindholm et al. (2004) investigated the distribution and abundance of microhabitat features in portions of the southeast parts open to fishing and closed to fishing. Link et al. (2005) investigated differences in the distribution and abundance of fish and benthic fauna between open and closed fishing areas.

The PDT discussed this area as a possible DHRA but did not recommend it because it has been fished since 1999 by scallop dredge vessels as part of a rotational access program.

5.2.1.6 Nantucket Shoals

Nantucket Shoals is a high energy sand area with some areas of gravel substrate. Depth ranges from less than 10 m to 40 m. The topography is fairly flat, except along the edges of the many small sand ridge bedforms, where it is locally somewhat steep (0.75-2.39 degrees). Video survey data include substrate, benthic invertebrate presence (abundance for some taxa), and fish presence and abundance (Stokesbury 2002, Stokesbury et al. 2004). This survey covers the southeastern portion of the area at a 5.5 km grid resolution. Other substrate data come from the usSEABED database. Given the lack of video data in part of the area, combined with the fact that most of the sampling technologies used for the usSEABED data were not capable of sampling gravel, it is likely that coarse substrates in the area are under-represented on SASI maps. The PDT discussed this area as a possible DHRA but did not recommend it because it appeared unlikely to continue as a habitat management area.

5.2.1.7 Georges Bank canyons

The Georges Bank canyons lie along the southern margin of the bank, with their heads beginning at around 100 m. They incise the continental slope and empty onto the abyssal plain at depths below 2000 m. The canyon walls can be locally very steep, over 30 degrees in some areas. Substrates consist of rock outcrops and occasional glacial erratics draped with soft sediments. Some of the canyons are relatively well studied, and some have received little scientific attention.

Currently, there are closures in parts of Lydonia and Oceanographer Canyons under the monkfish and tilefish FMPs. Species and gear types of particular interest include deep-sea corals, lobsters, squid, deep-sea red crab, and tilefish (in consolidated mud habitats between 100-300 m). While the canyons are not rescommended as research areas in this context (for fishing impact studies), new work to evaluate coral distributions and map the canyons is ongoing.

5.2.1.8 Fingers

The Fingers is located in Southern New England, and has depths of 40-50 m, relatively flat, high energy, sandy. Existing baseline data and previous studies include usSEABED substrate data, and studies by Auster et al. (1991, 1995, 1997). This DHRA was discussed by the PDT but not recommended for futher development, because there is no nexus to proposed or current management areas.

5.2.1.9 Cox Ledge

Cox Ledge is 40-50 m deep, relatively flat, and high energy. The area contains a mix of granule-pebble, cobble, and boulder-dominated areas, surrounded by sand. Existing baseline data and previous studies include substrate maps from SMAST, and usSEABED; although the area is sparsely sampled. This DHRA was discussed by the PDT but not recommended for futher development, because the proposed HMAs on Cox Ledge and 19 Fathom Bank are approximately 27 mi^2 and 55 mi^2, the control and impact treatments associated with a research area would likely impact much of the HMA, which runs counter to the objective of minimizing adverse effects within the HMA boundaries. 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.

5.2.1.10 New York Bight

The New York Bight is sandy, with flat topography, and mix of high energy closer to shore, low energy in deeper waters below 60 m offshore. Existing baseline data and previous studies include Steves et al. 2000, Sullivan et al. 2006. 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.

5.2.2 DHRA options recommended by the PDT but not approved by the Committee for futher analysis

5.2.2.1 Jeffreys Bank

Jeffreys Bank is a mud-draped gravel bank with areas of large boulders (Auster et al 1996; full range of grain sizes documented in SMAST video survey). The shallowest areas reach minimum depths of 80 m, while adjacent deepwater mud habitats reach depths of 150 m. Auster et al. (1996) collected video data from Jeffreys Bank in 1987, and then again in 1993. The 1987 footage documented mobile and immobile invertebrates including pycnogonids, bryozoans, hydroids, anemones, corals, sponges, crinoids, tunicates, crustaceans, snails, and sea scallops. The 1993 footage indicated a loss of mud veneer and reduced epifaunal abudance. The authors hypothesized that fishing impacts accounted for the change over time. Stokesbury et al. (2010) conducted a centric, systematic quadrat video and still camera survey of the area in 2009 as part of an overall evaluation of scallop populations on offshore banks and ledges in the Gulf of Maine. Although not presented in the 2010 paper, their data for this area include substrate grain size and fish and epifaunal invertebrate presence and abundance.

A BACI design was recommended for this location. Portions of Jeffreys Bank and the adjacent deeper water habitats to the north have been closed to mobile bottom tending gear fishing since Multispecies Amendment 13 was implemented in 2004. A modification of this area has been proposed that would trend more east-west and overlap with the shallower habitat features in the vicinity, which contain or would be expected to contain higher proportions of hard substrates that are more vulnerable to fishing gear impacts. The closed-closed and closed-impact treatment areas would be accommodated in the area of overlap between the existing and modified habitat management areas. The open-closed treatment would be accommodated in an area that is currently unregulated but would be part of the modified habitat management area. The open-open reference area would be entirely outside both the existing and proposed habitat management areas.

5.2.2.2 Cashes Ledge

Cashes Ledge reaches depths of less than 20 m at the shallowest point. The ledge drops off at about 100 m, and adjacent deepwater habitats have depths of up to 200 m. The ledge contains a full range of substrate grain sizes, ranging from mud to boulder. Areas less than 20 m have dense coverage of Laminaria kelp, while areas between 20-40 m have a loose canopy of shotgun kelp. Bedrock and boulder habitats without kelp coverage are found at depths of 40-70 m. Waters 70-100 m and deeper are dominated by mud and sand. Multiple authors (Vadas and Steneck 1988, Grabowski 2009, McGonigle et al 2011) have studied the kelp distributions on Cashes Ledge. The offshore kelp beds on Cashes, which are a unique feature in the Gulf of Maine, are able to exist because the relatively shallow minimum depths are within the photic zone. SMAST video surveyed the area in 2009 (Stokesbury et al 2010) and again in 2010, primarily to document scallop distribution, size, and abundance. Although not presented in the 2010 paper, their data for this area include substrate grain size and fish and epifaunal invertebrate presence and abundance.

Two alternative DHRA designs were suggested for Cashes Ledge, a BACI design and a CI design. The sub-areas associated with these designs followed from the boundaries of the current groundfish closure designation, the current habitat closure designation, and the proposed modification to the habitat designation. The area design was intended to incorporate shallow to deep transition areas.

5.2.2.3 Jeffreys Ledge

The central and northern parts of Jeffreys Ledge run north-south, and the ledge is relatively narrow. The top of Jeffreys has depths less than 60 m, in some cases less than 50 m. The topography is steepest between 70-100 m, particulary on the western side of the ledge, and flattens out somewhat around 100-110 m. The southern/western part of the ledge extending to New Scantum is wider, again with minimum depths of less than 50 m, and steeply sloping edges between 70-100. There are areas to the northwest of New Scantum with very complex topography. The ledge itself contains sand, granule-pebble, cobble, and boulder-dominated areas. Mud is present in deeper waters where the topography levels off.

Langton and Robinson (1990) evaluated scallop beds on the ledge using photographic transects and noted dominance of sabellid worms, burrowing cerianthid anemones, and sea scallops. The area was video surveyed by SMAST in 2009 (Stokesbury et al 2010) and again in 2010, primarily to document scallop distribution, size, and abundance. Their survey also included information not discussed in the publication, such as substrate grain size and fish and epifaunal invertebrate presence and abundance. Malik and Mayer (2007) mapped the southern part of Jeffreys Ledge using multibeam with video groundtruthing. Other studies – Grizzle et al 2008, Smith et al. 2007, Knight et al 2005, Runge et al 2010, Meyers and Byers 2011.

A control-impact style DHRA was recommended on Jeffreys Ledge. This was consistent with the Habitat Committee's recommendation to constrain a research area in this location to be within existing/proposed habitat management areas.

5.2.2.4 Great South Channel and adjacent shoals

The Great South Channel is a deep channel that divides the relatively shallow waters of Georges Bank from the shoal areas to the west, including Nantucket Shoals, Davis Bank, Middle Rip, Fishing Rip, Phelps Bank, and Asia Rip. The northern edge of the channel represents the southern extent of the Gulf of Maine region. Maximum depths in the channel are roughly 80 m. The area is uniformly high energy. Substrates in the region range from sand to boulder, with long north-south gravel features in the channel itself and on the shoal areas to the west. The many smaller features that comprise these large features trend east to west and result from the dominant current flow in the area, which runs north to south. Some of the smaller bedforms are composed mainly of sand, and appear to be transient, while others are more coarse-grained and static.

Video survey data include substrate, benthic invertebrate presence (abundance for some taxa), and fish presence and abundance (Stokesbury 2002, Stokesbury et al. 2004). This survey covers the entire area at a grid resolution of 1.5 km to 5.5 km, depending on the location. USGS conducted a multibeam echo sounder survey of the area in 1998 and produced a series of maps depicting topography and backscatter intensity (Valentine et al. 2002). This area has also been mapped using a still camera transect survey, HabCam (Howland et al. 2006). Transect coverage varies.

A control-impact style DHRA was recommended in the northwest corner of the Great Rip area.

5.2.2.5 Northern Edge/Georges Shoal

The top of the eastern Georges Bank is relatively flat and high energy. The substrate consists of long gravel formations interspersed with sand ridges. The gravel areas are dominated mainly by granule-pebble and cobble grain sizes, with occasional boulder-dominated areas. Along the edges of the bank, starting between 70 and 80 m, depth increases relatively rapidly. The energy regime shifts from high to low, and the substrate changes from gravel to sand-dominated. At around 170 m, the slope begins to flatten out again and the energy regime is uniformly low. The substrate distribution here is mainly sand-dominated, with some ares of mud.

Substrate data are sparse in the deeper waters, but the top of the bank and the transition towards deeper depths is well mapped. Video survey data include substrate, benthic invertebrate presence (abundance for some taxa), and fish presence and abundance (Stokesbury 2002, Stokesbury et al. 2004, Stokesbury et al. 2009). These data were collected at 1.5 km grid resolution throughout this area, except for on the westernmost part of Georges Shoals (5.5 km grid). Harris and Stokesbury (2010) analyzed the distribution of gravel substrates in the video data. This area has also been mapped using a still camera transect survey, HabCam (Howland et al. 2006), with the most recent survey during summer 2012. Other research has focused on the distribution of benthic fauna and recovery rates following the cessation of mobile gear fishing disturbance (Collie et al. 1997, 2000, 2005, 2009; Asch and Collie 2007).

A Before-After-Control-Impact area was recommended by the PDT for this area. **At their December 4 meeting, the Committee concluded that the PDT may continue development of a research area in this region and present a more detailed proposal at the next meeting, but was not willing to make a motion directing the PDT to do so. A committee member requested that the proposal include area boundaries and a review of Advisory Panel concerns.**

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