



New England Fishery Management Council

50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
E.F. “Terry” Stockwell III, *Chairman* | Thomas A. Nies, *Executive Director*

MEMORANDUM

DATE: April 17, 2015
TO: Council
FROM: Tom Nies, Executive Director
SUBJECT: **Analysis of Two New Georges Bank HMA Options**

The Habitat Committee will offer 20 motions for the full Council to consider for final action at the April 2015 meeting. Most are preferred alternative recommendations, and some include recommendations for modified alternatives.

The Habitat Committee passed two motions on April 9, 2015 related to adding new options in the action for analysis and consideration, as shown in the map below (Figure 1). This memo summarizes additional analyses that have been prepared for this specific issue. It should be emphasized that these are Council staff analyses and were not developed or reviewed by any Council PDTs; there was not sufficient time. *If the Council does not intend to select these measures as part of the preferred alternative, they should not be included in the document since they have not been fully analyzed yet.* It would take a substantial amount of time to include these alternatives in the document as non-selected alternatives.

Motion: Move to add an option to OHA2 for analysis and consideration by the Council, to include the habitat closure area contained in “New_Northern_Edge_1” combined with the “Georges Shoal 2 MBTG” component of Alternative 7. The motion carried 5:2:2 on a show of hands.

Motion: Move to add an option to OHA2 for analysis and consideration by the Council, to include the habitat closure area contained in “New_Northern_Edge_1”, less a four nautical mile alley along the Hague Line, combined with the “Georges Shoal 2 MBTG” component of Alternative 7. The motion carried 4:2:3 on a show of hands.

Staff prepared limited, preliminary analyses of these options to compare them with the range of areas already evaluated in the DEIS. Specifically, the area has been calculated (

Table 1), several maps were prepared overlaying these areas with substrate (Figure 2) and abundance of important groundfish species within the region (Figure 3, Figure 4, Figure 5, Figure 6, and Figure 7), and preliminary estimates of scallop biomass were calculated (Table 2 and Table 3, scallop distributions mapped in Figure 8 and Figure 9) to give a sense of potential impacts on that fishery compared to other options in the DEIS. In general, because the potential new areas are within the range of alternatives in the document already, the overall impacts are also expected to be within the range analyzed.

Figure 1 – Potential areas to include for consideration as habitat management areas on Georges Bank.

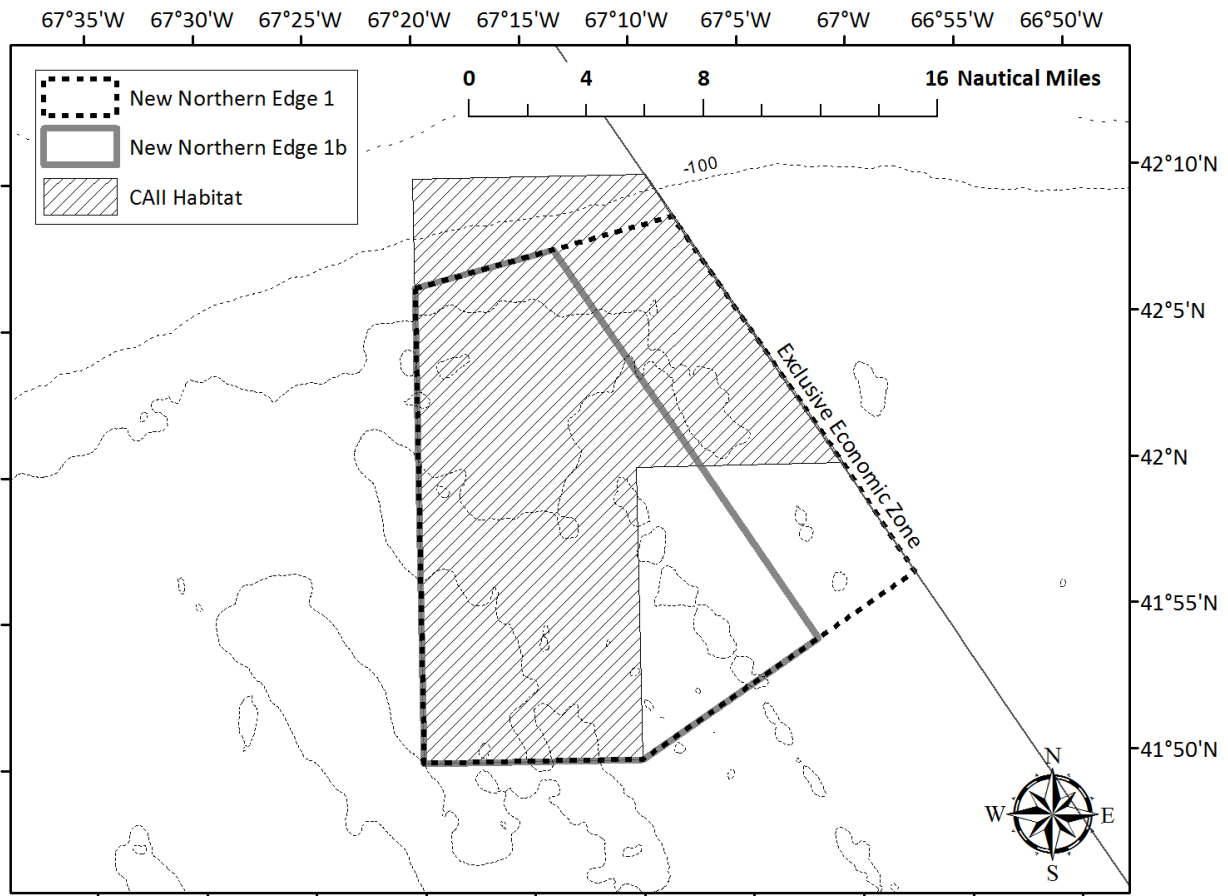


Table 1 compares the size of the new areas with other areas on Georges Bank east of Closed Area I. The dominant substrate types in and around the new areas are shown in Figure 2. It seems that the new northern edge area may contain more complex bottom overall compared to the existing habitat closure in this area because the extension of the southern portion to the Hague Line includes some areas with complex bottom, compared to the northern portion of the existing closure which is primarily granule-pebble and sand.

Table 1 – Size of GB habitat management areas (new ideas shaded)

Area	Size, square nautical miles
Closed Area II Habitat Closure (Alt 1/No Action)	187
Closed Area II (Groundfish Closure, Alt 1/No Action)	2,000
Northern Edge (Alt 3)	139
Georges Shoal 1 MBTG Closure (Alt 5)	270
EFH Expanded 1 (Alt 6a)	336
EFH Expanded 2 (Alt 6b)	234
EFH South MBTG Closure (Alt 7)	81
Georges Shoal 2 MBTG Closure (Alt 7)	299
Northern Georges MBTG Closure (Alt 8)	1,396
New Northern Edge 1	225
New Northern Edge 1b (with 4 nm wide area along Hague line removed)	163

Figure 2 – Existing and new areas overlaid on dominant substrate. Red/brown indicates boulder, brown indicates cobble, green indicates granule-pebble, and beige indicates sand.

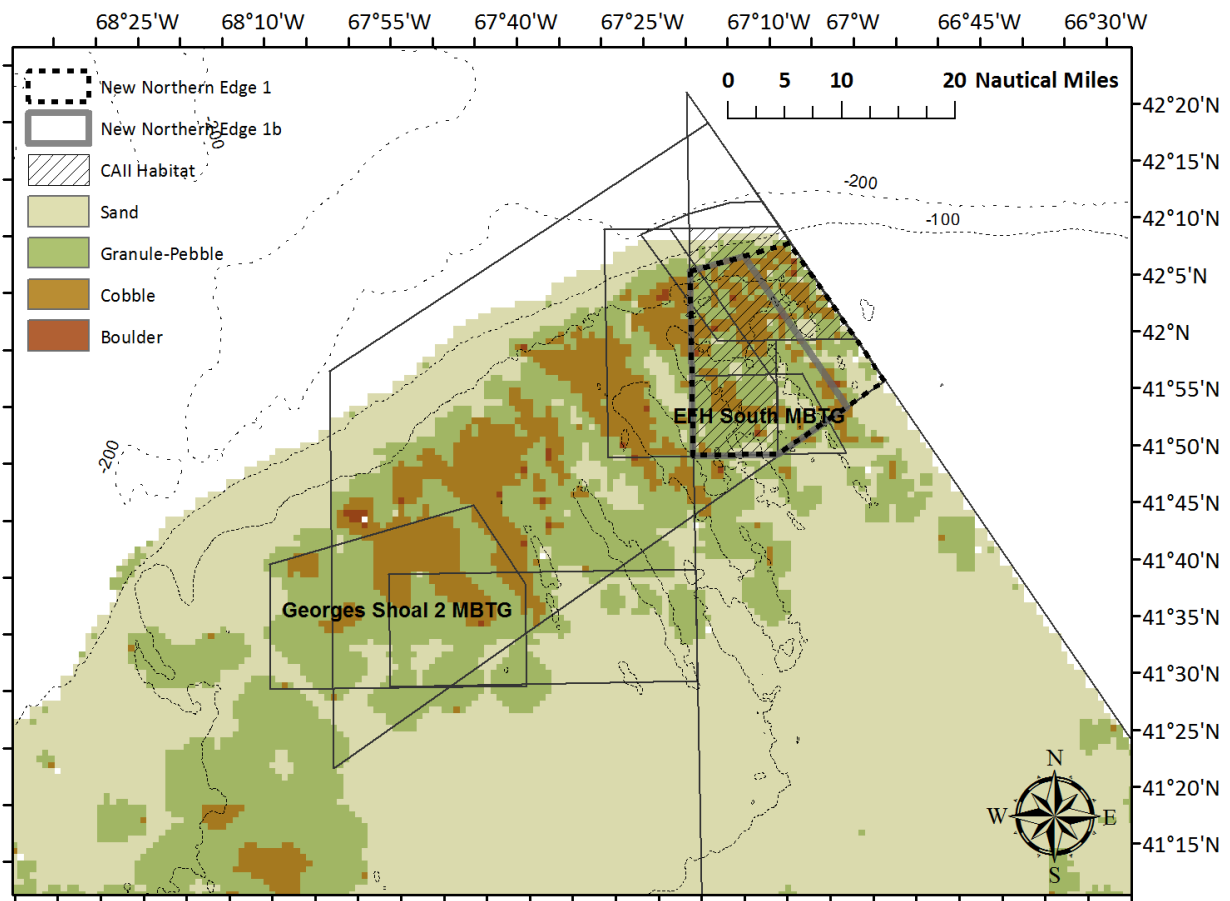


Figure 3 – Cod 35 cm total length or smaller, 2002-2012 survey tows. Zero tows shown as an X.

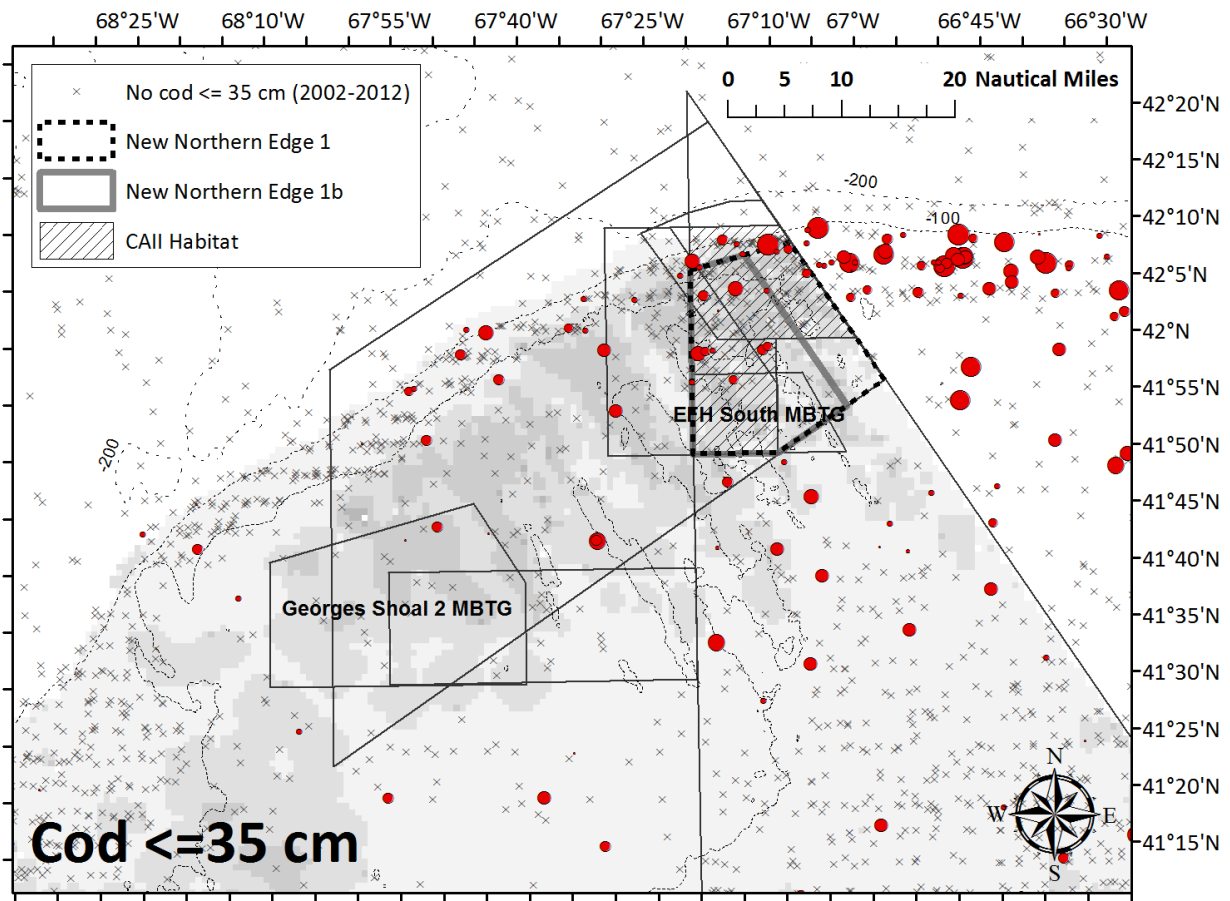


Figure 4 – Haddock 35 cm total length or smaller, 2002-2012 survey tows. Zero tows shown as an X.

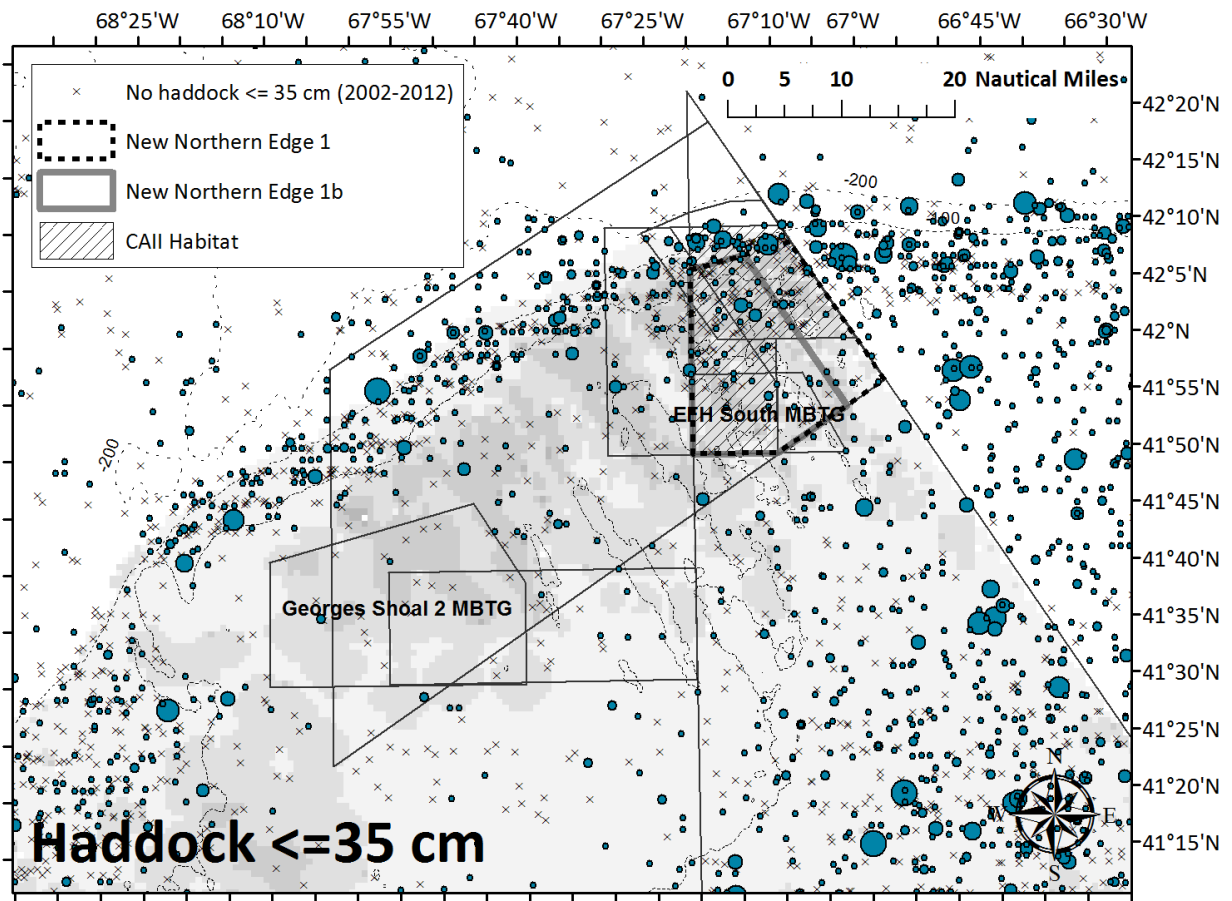


Figure 5 – Yellowtail 15 cm total length or smaller, 2002-2012 survey tows. Zero tows shown as an X.

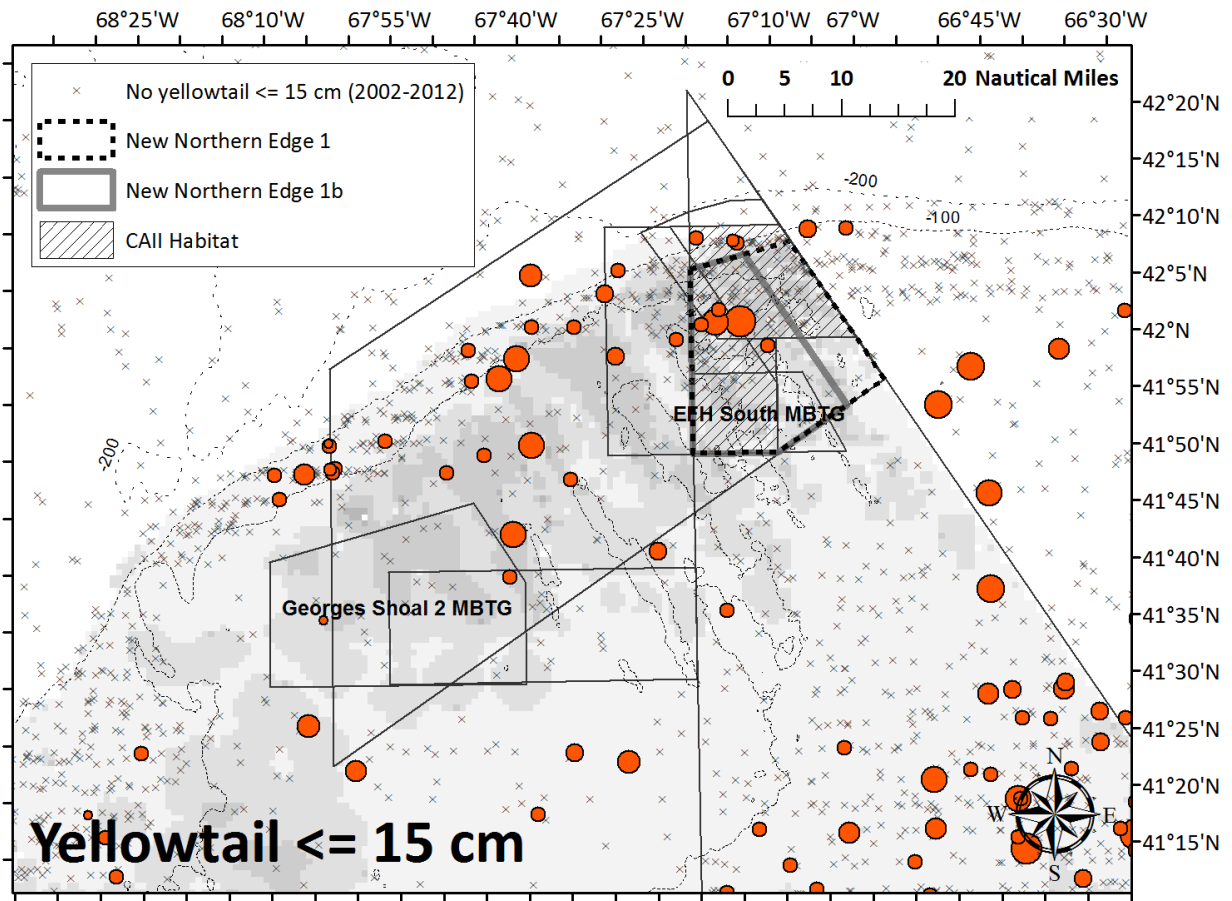


Figure 6 – Windowpane 15 cm total length or smaller, 2002-2012 survey tows. Zero tows shown as an X.

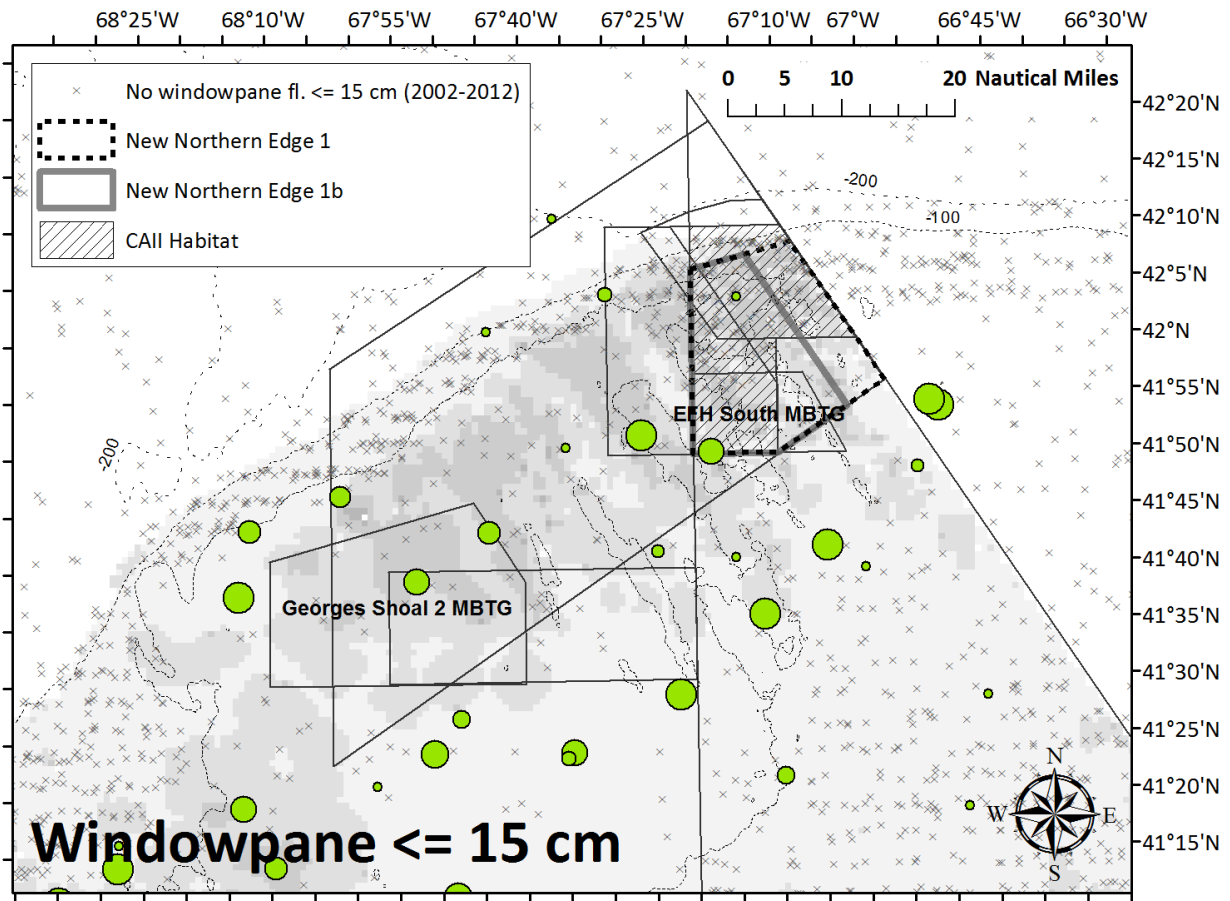


Figure 7 – Red hake 25 cm total length or smaller, 2002-2012 survey tows. Zero tows shown as an X.

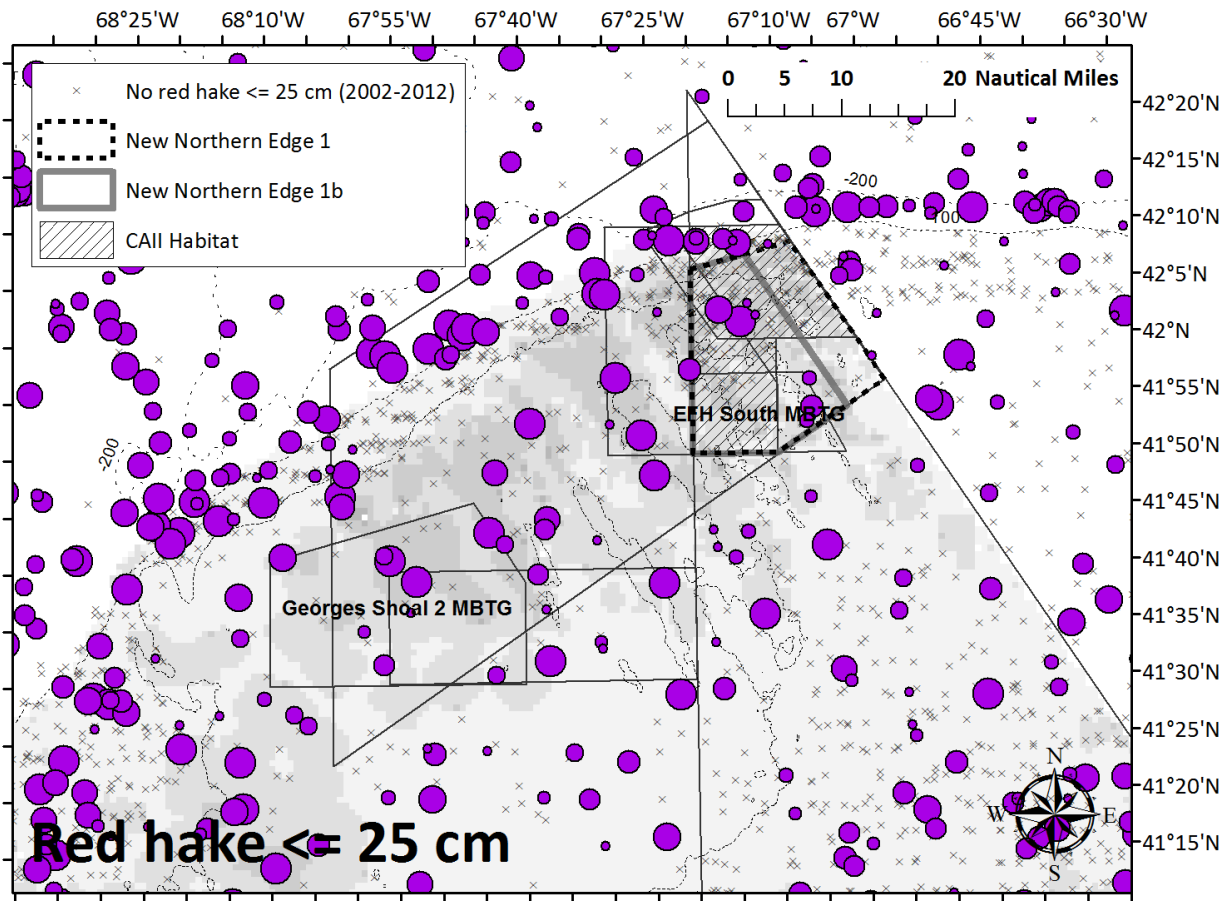


Figure 8 – Scallop weight per tow, scallop dredge surveys 2002 and later. Zero tows shown with an X.

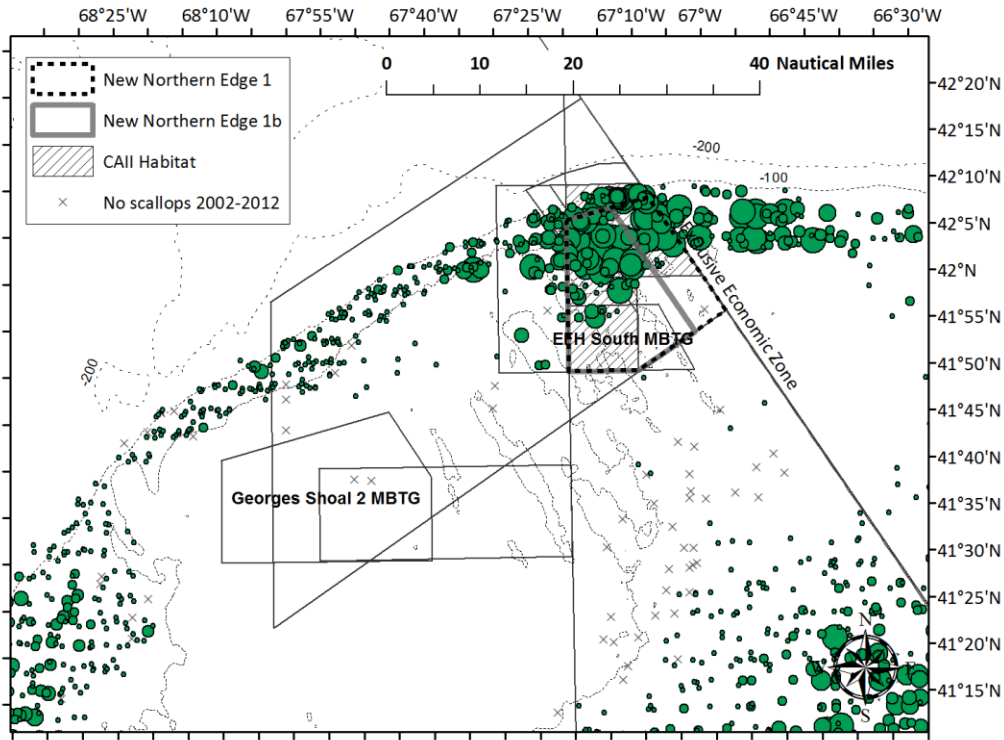
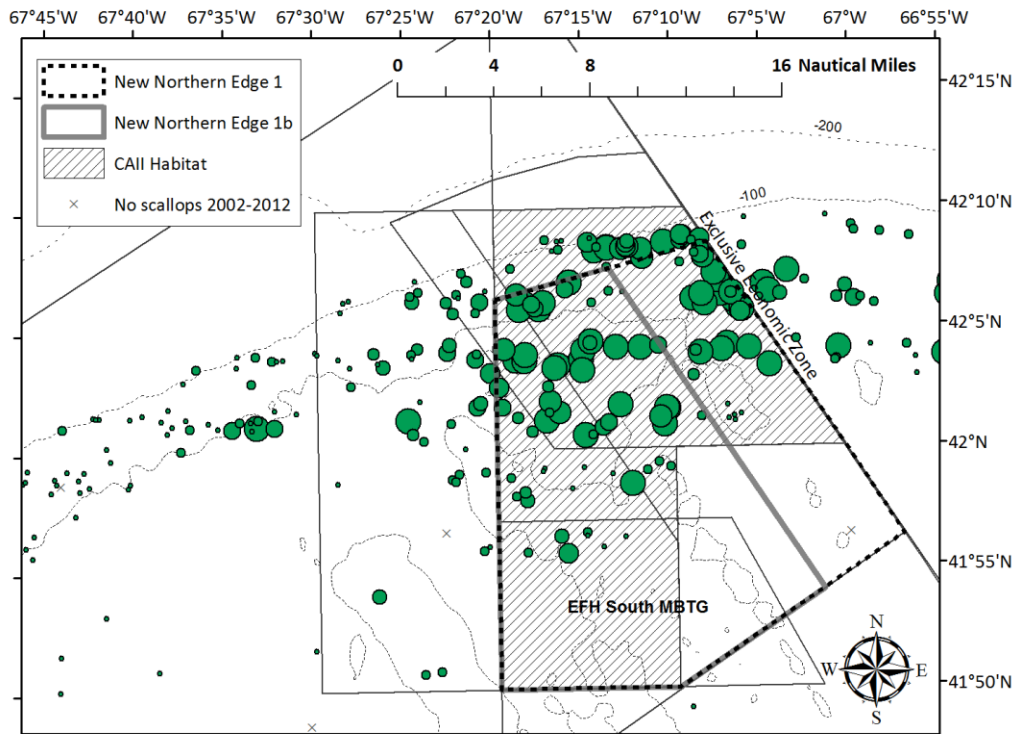


Figure 9 – Scallop weight per tow, scallop dredge surveys 2002 and later, zoomed in on northern edge region. Zero tows shown with an X.



Potential impacts on the groundfish resource and fishery

Both ideas (New Northern Edge 1 and New Northern Edge 1b) expand the area covered by the Closed Area II Habitat Closure south east while contracting the northern boundary (

Table 1 and Figure 1). Northern Edge 1b would create an additional 4 NM open corridor along the US/CA boarder (i.e., Hague Line).

Groundfish resource

A preliminary examination of abundance of several juvenile groundfish species, from the NEFSC bottom-trawl surveys (2002-2012), indicates that relative to the Closed Area II Habitat Closure:

- For cod (total length less than or equal to 35 cm) (Figure 3):
 - New Northern Edge 1 would result in decreased protection on the northern edge
 - New Northern Edge 1b would further reduce protection when compared to New Northern Edge 1 on the northern edge and in the northern part of the open corridor
- For haddock (less than or equal to 35 cm) (Figure 4):
 - New Northern Edge 1 would result in some increased protection in the southeast corner but at the loss of the northern edge which would include relatively more abundant juvenile haddock
 - New Northern Edge 1b would result in some increased protection in the southeast corner but at the loss of the northern edge which would include relatively more abundant smaller haddock and loss of protection in the corridor along the Hague line
- For yellowtail flounder (total length less than or equal to 15 cm) (Figure 5):
 - New Northern Edge 1 would result in decreased protection on the northern edge
 - New Northern Edge 1b would result in similar decreased protection on the northern edge relative to New Northern Edge 1
- For windowpane flounder (total length less than or equal to 15 cm) (Figure 6):
 - New Northern Edge 1 would result in no change
 - New Northern Edge 1b would result in no change as well
- For red hake (total length less than or equal to 25 cm) (Figure 7):
 - New Northern Edge 1 would result in some increased protection in the southeast corner but at the loss of the northern edge which would include relatively more abundant smaller red hake
 - New Northern Edge 1b would result in some increased protection in the southeast corner but at the loss of the northern edge which would include relatively more abundant smaller red hake additional decreased protection, especially in the area along the Hague line

These findings are corroborated by information in the DEIS (see OHA2 DEIS - Volume 3) such that the impact of contracting the northern boundary of the Closed Area II Habitat Closure would result in a loss of protection for groundfish combined hotspots in the fall for age 0/1 (Map 65) and a loss of protection for sub-legal sizes cod and haddock for age 0/1 and 2+ (Map 66 and Map 67).

Overall, based on the preliminary analysis of the species examined, New Northern Edge 1 and New Northern Edge 1b would decrease protection for juvenile groundfish species relative to the Closed Area II Habitat Closure, resulting in some negative impacts, in particular for cod and haddock on Georges Bank.

Groundfish fishery

Currently, access to the Georges Bank haddock stock is limited by catches of other species (i.e., cod), spatial management closures (Closed Area I and II), and special access restrictions. Fishing with a haddock separator trawl (to reduce cod catches) is required when fishing under special access. Furthermore, the Georges Bank haddock stock is not overfished and overfishing is not occurring. However, special access for haddock to date has not included the portion contained within the Closed Area II Habitat Closure.

The commercial groundfish fishery is underutilizing its Georges Bank haddock quota. For example in FY 2013 in the Eastern Georges Bank management area, the commercial fishery caught 15.4% of its haddock quota and 36.2% of its cod quota (GARFO groundfish fishery catch report, dated October 30, 2014). By gaining additional access, the commercial groundfish fishery would be able to fish for Georges Bank haddock, especially the portion of the stock under an agreement with the US and Canada (i.e., Eastern Georges Bank haddock). New Northern Edge 1 and New Northern Edge 1b would provide positive economic benefits for the commercial groundfish fishery relative to the Closed Area II Habitat Closure, while New Northern Edge 1b would provide for greater positive economic benefits than New Northern Edge 1.

The social impacts of allowing fishing in an area previously closed to fishing would generally be positive, as it would allow more flexibility to harvest ACE; it would more directly benefit those vessels that could logistically and safely access the area in question.

Furthermore, reducing catches of cod by using a haddock separator trawl within open areas may also provide short-term and long-term positive economic benefits to the cod resource and the groundfish fishery.

Overall, based a preliminary qualitative analysis, New Northern Edge 1 and New Northern Edge 1b would result in positive economic and social impacts for the commercial groundfish fishery, and in particular for the portion of the industry that fishes in the Eastern Georges Bank management area for haddock.

Potential impacts on the scallop resource and fishery

Background

A brief review of the scallop management program may help with the interpretation of the analyses of the potential impacts of Habitat Management Areas (HMAs) on the scallop resource and the scallop fishery.

The expected long-term yield from the scallop fishery is about 25,000 mt annually, based on fishing at F_{MSY} . In any given year, part of the scallop biomass can be fished from areas that are open, and part of the biomass is in areas that are not open and cannot be fished. The areas that are open may be fished under DAS or as part of an open scallop access area. The areas that are not open may be closed either because they are a scallop access area where scallops are being allowed to grow for a future harvest, or because they are closed for other reasons, such as an HMA.

The scallop overfishing definition is based on an overall fishing mortality (F) for the entire resource in all areas. In effect, this averages the F in open and closed areas. If part of the biomass is in a closed area that is not subject to fishing mortality, then the F in open areas can be higher

before the overall F exceeds F_{MSY} and overfishing occurs, or until open area limits are reached (which are set below F_{MSY} to prevent localized overfishing). In the FMP, measures are designed to achieve an F that is lower than F_{MSY} in order to account for scientific and management uncertainty.

Yield that cannot be harvested from a closed area can be partly recovered from an open area. There are limits to how much can be recovered for several reasons. Scallop densities are not uniform and some areas produce more scallops than others. In addition, the FMP constrains the F in open areas in order to minimize localized depletion. If all areas were uniformly productive and only scallop yield was the concern, in theory a closure could be designed where the yield lost from the closure exactly equals the yield gained by fishing at the constrained F in the open areas. This is clearly not the case – there are large differences in the productivity of different areas. The more productive an area is, the more difficult it is to replace the yield lost from closing that area by fishing in open areas.

Two types of analyses are presented in the DEIS that describe the likely impacts of different HMA measures. The first analysis compares the productivity, in terms of biomass and potential yield, from within different HMA alternatives (Table 140 in DEIS; Table 2 and Table 3 below). This gives a relative sense of the impacts of each individual alternative. Because scallop recruitment is highly variable, these estimates are shown for both median and mean recruitment. Strictly speaking, closing one of these HMAs does not result in a loss in yield equal to the yield potential from that area. This is because the management program would adjust the F in open areas to partly recover the lost yield. As mentioned previously, and while the exact impacts depend on the total areas closed, it is not likely that the yield from a highly productive area can be completely recovered by fishing in open areas.

With this first analysis, there is a difference between short-term and long-term yields. If a proposed HMA is currently closed, scallop biomass may have built up that will allow for increased yield from that area in the short term after opening.

The second analysis more accurately captures the impacts of HMA alternatives (page 650 et seq. of the DEIS). Using the same model and constraints used to develop scallop specifications, catches are projected from open and closed areas. This model varies F in open and closed areas. While this is a more accurate representation of what may occur, it is a time-consuming analysis and resource limitations prevent it from being run for the dozens of possible combinations of HMAs. The three examples in the DEIS were used to capture the range of impacts from a range of alternatives.

This second analysis provides information on landings that can be used to evaluate economic impacts. Vessel revenues are not the sole measure of economic impact, and the analysis takes this into account. It also considers the effect of yield on prices. Table 158 and 160 of the DEIS summarize the present value of total economic benefits net of no action for the period 2015 through 2037, using two different discount rates.

The analyses in the DEIS are based on data through 2013. While recent surveys suggest large sets of scallops in some areas, those data have not yet been incorporated into the catch estimates.

Preliminary analysis of impacts

For the new northern edge options, staff completed an estimate of 2013 biomass and short term yield estimates. There was not sufficient time to complete the long term yield estimates (based on mean and median biomass from all years the federal survey has been conducted). However, since both these options are completely within areas that have been closed to fishing for a long time (20+ years) the long-term and short-term yield estimates should be roughly proportional to biomass. Therefore, as a placeholder, the ratio of biomass in these areas to biomass in all of CAII north has been applied to the long-term yield values for CAII north to get an approximate estimate of long-term yield. These approximations are in italics in Table 2 on the next page and would be updated with more precise estimates based on historical survey data if one of these options is included in the DEIS.

Table 140 has been reproduced below as Table **2Error! Reference source not found.** with updated information for the new northern edge options, as well as an updated estimate for Alternative 8. As explained in the Scallop PDT memo from April 9, the 2013 estimate of biomass for habitat Alternative 8 on GB was very high in Table 140 of the DEIS. The original Alternative 8 biomass estimate only used 2013 survey tows, instead of the method that was used for calculating 2013 biomass for the other areas (average of 2008-2013). That has now been corrected so the method used for estimating current biomass is consistent across all areas. The estimate for 2013 biomass for Alternative 8 went from 16,448 mt to about 13,000 mt. Therefore, the short-term yield estimate from the area also declines since the total biomass and total exploitable biomass is lower. Overall, the 2013 biomass value based on the last six years instead of one single year is more stable and likely more reliable. These analyses will be corrected in the FEIS. Table 3 has been included to provide the proportion of long term yield in each area compared to total long-term yield (25,000 mt).

Table 2 – Long-term and short-term yield potential from current EFH closed areas and several new areas under consideration (2 new northern edge options in green, current closures in peach).

Sub-region	Area	Status	Long-term yield (mean)	Long-term yield (median)	Biomass 2013	Short-term yield
GB	CAII North (all area north of scallop access area within CAII closure)	Current	1,254	536	8,630	2,589
GB	CAI-N Habitat Closure (Alt 1)	Current	601	42	4,841	1,452
GB	CAI-S Habitat Closure (Alt 1)	Current	29	11	1,658	497
GB	Northern Edge HMA (Alts 3 and 4)	Proposed	1,214	502	7,433	2,230
GB	EFH Extended 1 HMA (Alt 6A)	Proposed	1,858	800	11,519	3,456
GB	EFH Extended 2 HMA (Alt 6B)	Proposed	825	324	4,493	1,348
GB	Georges Shoal 2 MBTG HMA (Alt 7)	Proposed	2	0	3	1
GB	EFH South MBTG HMA (Alt 7)	Proposed	23	10	440	139
GB	Northern Georges MBTG HMA (Alt 8)	Proposed	2,829	1,211	16,448 13,654	5,200 4,317

Sub-region	Area	Status	Long-term yield (mean)	Long-term yield (median)	Biomass 2013	Short-term yield
GB	EFH "New Northern Edge 1" HMA	Habitat Cmte motion	<i>1,053</i>	<i>450</i>	7,238	<i>2,174</i>
GB	EFH "New Northern Edge 1 with 4 nm alley" HMA	Habitat Cmte motion	<i>577</i>	<i>247</i>	3,977	<i>1,191</i>
GSC-SNE	Nantucket Lightship Habitat Closure (Alt 1)	Current	552	3	93	28
GSC-SNE	Great South Channel East HMA (Alt 3)	Proposed	4,034	1,101	4,460	1,338
GSC-SNE	Great South Channel HMA (Alt 4)	Proposed	313	64	100	30

Notes:

- Long-term yield estimates calculated by multiplying the recruitment in each area by the maximum yield per recruit. Recruitment is based on all NEFSC dredge data from all years (1979-2013)
- Biomass 2013 is NOT the biomass estimate of all 2013 surveys combined (NEFSC, VIMS, SMAST, Habcam) as it is in scallop frameworks. For this analysis only dredge data were used because it was not practical to subdivide all scallop surveys into all these various areas. Since using one year is not very reliable, the PDT used an average biomass from all NEFSC dredge tows between 2008-2013 (and for alternatives that include the northern edge VIMS dredge tows from 2012 and 2013 were used as well).
- Short-term yield estimates are calculated by applying Fmsy to the exploitable portion of biomass and accounting for depletion effects.
- There was not time to calculate the long term yields for the new northern edge options. An estimate has been inferred based on the ratio of 2013 biomass in those areas to 2013 biomass in all of CA2north. For the "New northern edge 1" the ratio is 0.84 and for "New northern edge with 4nm alley" the ratio is 0.46, or almost half of CAII North. *Placeholder estimates have been included in italics.*

Table 3 – Proportion of total long-term yield (mean and median) contained in each alternative as well as the proportion of total short-term biomass and short-term yield

Sub-region	Area	Proportion of total potential Long-term yield (mean)	Proportion of total potential Long-term yield (median)	Proportion of total short-term biomass (2013)	Proportion of total short-term potential yield
GB	CAII North (all area north of scallop access area within CAII closure)	5.0%	2.1%	7.6%	10.4%
GB	CAI-N Habitat Closure (Alt 1)	2.4%	0.2%	4.3%	5.8%
GB	CAI-S Habitat Closure (Alt 1)	0.1%	0.0%	1.5%	2.0%
GB	Northern Edge HMA (Alts 3 and 4)	4.9%	2.0%	6.6%	8.9%
GB	EFH Extended 1 HMA (Alt 6A)	7.4%	3.2%	10.2%	13.8%
GB	EFH Error! Bookmark not defined. Extended 2 HMA (Alt 6B)	3.3%	1.3%	4.0%	5.4%
GB	Georges Shoal 2 MBTG HMA (Alt 7)	0.0%	0.0%	0.0%	0.0%
GB	EFH South MBTG HMA (Alt 7)	0.1%	0.0%	0.4%	0.6%

Sub-region	Area	Proportion of total potential Long-term yield (mean)	Proportion of total potential Long-term yield (median)	Proportion of total short-term biomass (2013)	Proportion of total short-term potential yield
GB	Northern Georges MBTG HMA (Alt 8)	11.3%	4.8%	12.1%	17.3%
GB	EFH "New Northern Edge 1" HMA	4.2%	1.8%	6.4%	8.7%
GB	EFH "New Northern Edge 1 with 4 nm alley" HMA	2.3%	1.0%	3.5%	4.8%
GSC-SNE	Nantucket Lightship Habitat Closure (Alt 1)	2.2%	0.0%	0.1%	0.1%
GSC-SNE	Great South Channel East HMA (Alt 3)	16.1%	4.4%	3.9%	5.4%
GSC-SNE	Great South Channel HMA (Alt 4)	1.3%	0.3%	0.1%	0.1%

Notes:

- Proportion of long-term yield estimates based on total yield of 25,000 mt or 55 million pounds.
- Total short-term 2013 biomass based on estimate used for total scallop biomass in Scallop FW25 (113,242 mt). If use just the dredge estimate the proportions would increase slightly because the total biomass estimate from dredge only in 2013 was 105,923 mt. The mean of total biomass for 2008-2013 is not available.
- Total short term yield is assumed to be 25,000 mt or 55 million pounds; equal to the long-term total yield estimate. Proportions of total short-term yield higher than long-term because the current estimates of yield in many of these areas are higher than the long-term estimates because many of the areas have been closed.

Summary

1. The estimated long-term yield from the entire scallop resource from all open and closed areas on Georges Bank and the Mid-Atlantic combined is about 25,000 mt per year.
2. If there were no closures and fishing mortality was set at F_{MSY} , the annual scallop catch from each of these areas would likely be somewhere between the mean and median long term yield estimates. However, in reality all of these areas would not be open to the fishery in the same year, and they would not all be fished at F_{MSY} every year due to the fact that total fishing mortality is set lower than F_{MSY} . Yield from these areas would be impacted by other aspects of area rotation such as whether there are other access area closures or opening in the Mid-Atlantic.
3. There is quite a difference between the mean and median long-term yield estimates in Table 2. The scallop dredge survey is a random stratified design and in some years there are very few tows in these small areas and a large tow in one year could greatly impact the mean. Also, these estimates are based on all years the NEFSC dredge survey has been conducted (1979-2013) and for many years scallop biomass was very low in all areas. If earlier years were removed from the time series these estimates would likely increase since scallop biomass overall is much higher now than it was in the 1980s and 1990s.
4. The most straight forward way to compare one area to another in terms of the potential impacts of habitat closed areas that are likely to be in place for a relatively long time is to consider the long-term mean and median yield estimates. A value somewhere between the two estimates can be compared to the total estimated annual scallop yield of 25,000 mt, or 55 million pounds.

5. As noted above, Table 3 provides the proportion of long term yield in each area compared to total long-term yield (25,000 mt). For example, all No Action EFH closures combined (CAII north, CAI north, CAI south, and NL Habitat) are currently closed to the scallop fishery. The long-term median yield from all these areas combined is 592 mt and the long-term mean yield is 2,436 mt. Therefore, the annual impact of these closures on scallop landings is somewhere between 592 mt (1.3 million pounds) and 2,436 mt (5.4 million pounds), or 2-10% of the total potential yield, assuming all areas are fished at F_{MSY} every year.
6. Taking just the northern edge area separately, the current EFH closed area in CA2 has an annual long-term yield estimate of 536-1,254 mt, 2-5% of the total potential yield depending on whether the median or mean is used. Overall, some of the other alternatives under consideration for this area have lower long-term yield estimates (#6B, #7 and both of the new northern edge options), some have higher (#6a, and #8), and some are very similar (#3 and #4). The new northern edge options with the 4nm alley seems to have about half the scallop yield potential as the new northern edge option without the alley; this means that more scallops would be available to the fishery with this option. The new northern edge option provides about 80-200 mt more yield potential per year compared to No Action (or 175,000 - 440,000 pounds), assuming the area is fished at F_{MSY} .
7. In every case, the short term yield estimates are higher than the long-term yield estimates because most alternatives include areas that have been closed to the fishery, so there would be short-term gains by providing access in those areas.
8. Section 4.6.4.2.1.2 (page 650) in the DEIS goes into much more detail about the potential short and long term economic impacts of the various alternatives in terms of how differences in landings could impact revenues and total net economic impacts. If areas open that have been closed, positive economic impacts are expected. Tables 157 through 160 evaluate the present value of total economic benefits for three different scenarios: Run 1 is the No Action habitat closures, Run 2 is no habitat closures, and Run 3 combines two new habitat closures under consideration (Alt#3 on GB and Alt#4 in the Channel). These runs characterize the range of impacts that can be expected from various HMA alternatives. The run with no habitat closures estimates over \$50 million total economic benefits in the short term (FY 2015) compared to No Action, and the run with the Northern Edge/GSC closures increases total economic benefits by almost \$70 million in compared to No Action 2015 (see Table 158). However, the estimated impacts for the medium term provide additional insight given that the OHA2 is not implemented yet. The period from 2015-2018 includes the impacts of habitat alternatives with various changes in scallop management such as opening of some access areas. The results show that in the medium-term from 2015 to 2018 the cumulative economic benefits for Run 3 with Northern Edge/GSC closures (\$148 million net of No Action) is higher than the cumulative economic benefits under Run 2 with no habitat closures (\$52 million net of No Action) as the total economic benefits for Run 2 decline in 2016-2018 compared to No Action values. In the long-term the estimate of total economic benefits from Run 2 is over \$700 million over 23 year (2015-2037), or about \$32 million dollars a year compared to No Action, using a 3% discount rate. To put this in perspective, \$32 million dollars is about 6% of the total new revenues projected for Run 2 in 2015 (\$492 million dollars). In addition, over the long-term, this run provides an additional \$264 million in benefits compared to run 3 (\$12 million per year, or 2.4 percent of the Run 2 benefits for FY 2015).

9. Run 3 includes different habitat closures than the No Action closures. At first there are higher economic benefits for this run compared to No Action (almost \$70 million in year 1) because areas reopen that have been closed. This run is even higher than Run 2 with no closures (\$11 million higher) because if some of the resource is experiencing zero fishing mortality other areas can be fished harder so long as the overall fishing mortality is still below allowable levels. Similarly, the cumulative economic benefits for the run with the Northern Edge/GSC closures exceed the benefits for the run with no habitat closures by \$96 million in the medium term during 2015-2018 using a 3% discount rate. In the long-term, the economic benefits of Run 3 are not as high as Run 2 (no closures). Over the same 23 year projection the total net economic benefits of Run 3 is \$458 million dollars higher than No Action, or \$20 million dollars a year, but is \$264 million less than Run 2. The present value of total economic benefits is illustrated in Figure 10 and Figure 11.
10. In summary, the proportion of potential long and short-term scallop yield in each area is one way to evaluate the potential impacts of these alternatives (Table 3). For example, the new northern edge option is estimated to contain about 1.8% - 4.2% of the total long-term yield if fished at Fmsy, and about 8.7% of the current potential yield.
11. It is difficult to estimate the impacts on future scallop landings and revenue far into the future because it is possible that if this action greatly modifies long-term closed areas the principles currently used to set scallop specifications may be adjusted. For example, if more areas are closed in HMAs, the current limits set for open areas may be higher and vice versa. These issues would need to be carefully considered and evaluated in future scallop actions that set fishery allocations.

Figure 10 – Scallop fishery present value of total economic benefits for three SAMs runs. Values are millions of dollars, 3 percent discount rate. Data from OHA2 DEIS Table 157.

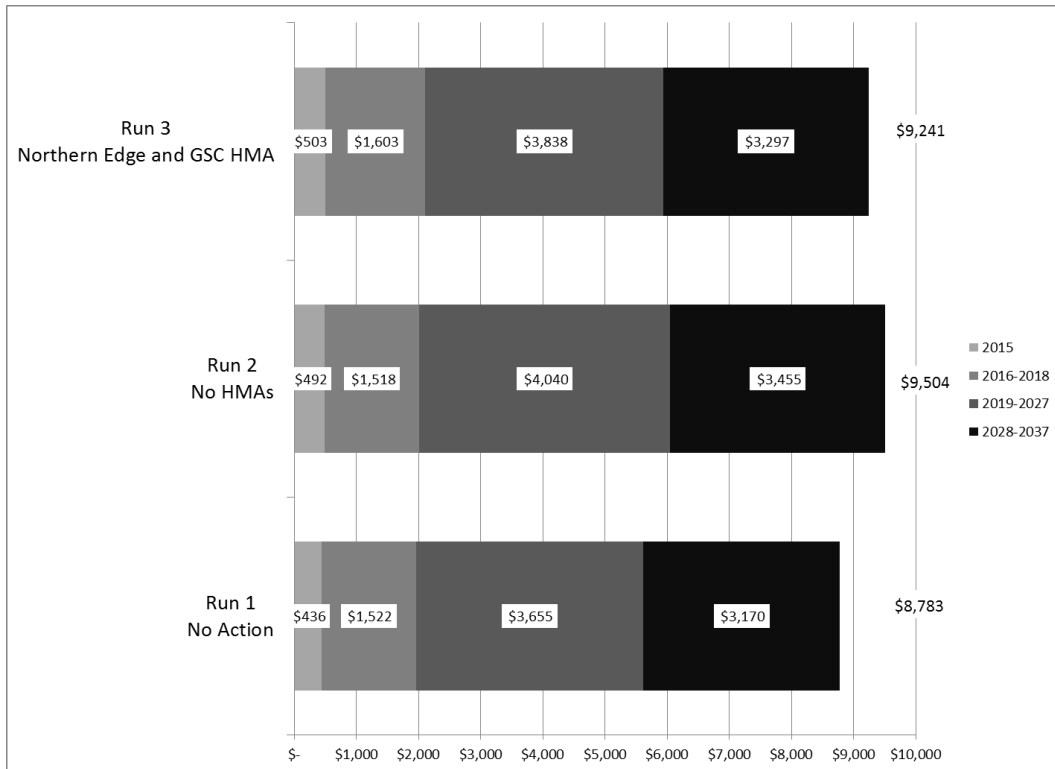


Figure 11 - Scallop fishery present value of total economic benefits for three SAMs runs. Values are millions of dollars, net of No Action, 3 percent discount rate. Data from OHA2 DEIS Table 158. Note scale is different than previous figure.

