Background on Potential modification to Access Areas in future action

PDT: This is document was originally shared in early 2016. It has been updated with 2016 survey information, but is generally the same information.

Discuss the timing and mechanics of folding new areas into the specs process (ex: CAI).

Consider long-term approach to area-management post OHA2.

The Council identified final recommendations for modifications to habitat management areas over two Council meetings, April 2015 and June 2015. Council staff sent a draft submission document to GARFO on January 14, 2016, and suggested revisions have been made. **Note that these measures have not been approved; a proposed rule is expected in 2017, and a final decision on the amendment will be available 90 days from publication of the amendment.**

A summary of the Council's preferred recommendations can be found at www.nefmc.org, and Figure 1 and Figure 2 are included below with the final recommendations for habitat management areas and seasonal spawning areas.

The Council considered modifying the CA I AA boundary in FW28, but ultimately moved this option to considered and rejected given the delay in a proposed and final rule for the OHA2. The Council plans to revisit the CA I AA measures again in the next available action, pending OHA2 approval.

Figure 1 – Preferred alternative year-round spatial management areas. Seasonal areas not shown.

-- Gear exemption areas hatched. In western Gulf of Maine, shrimp trawls exempt. In Great South Channel and Georges Shoal, clam dredges exempt for one year. On Northern Edge (red area), scallop access fishing exempt, bottom trawling for groundfish exempt west of 67° 20' W.

-- Dedicated Habitat Research Areas are cross-hatched. Stellwagen DHRA (north), Georges Bank DHRA (south)

-- Mortality closures shown with heavy black outline. Current gear restrictions.

-- Largest shaded area is the roller gear restricted area.

-- Other shaded/colored areas are mobile bottom-tending gear closures, with gear exemptions as noted above.

-- Cox Ledge closed to clam dredges, and trawls cannot use ground cables.

-- Ammen Rock closed to all gears except lobster traps.

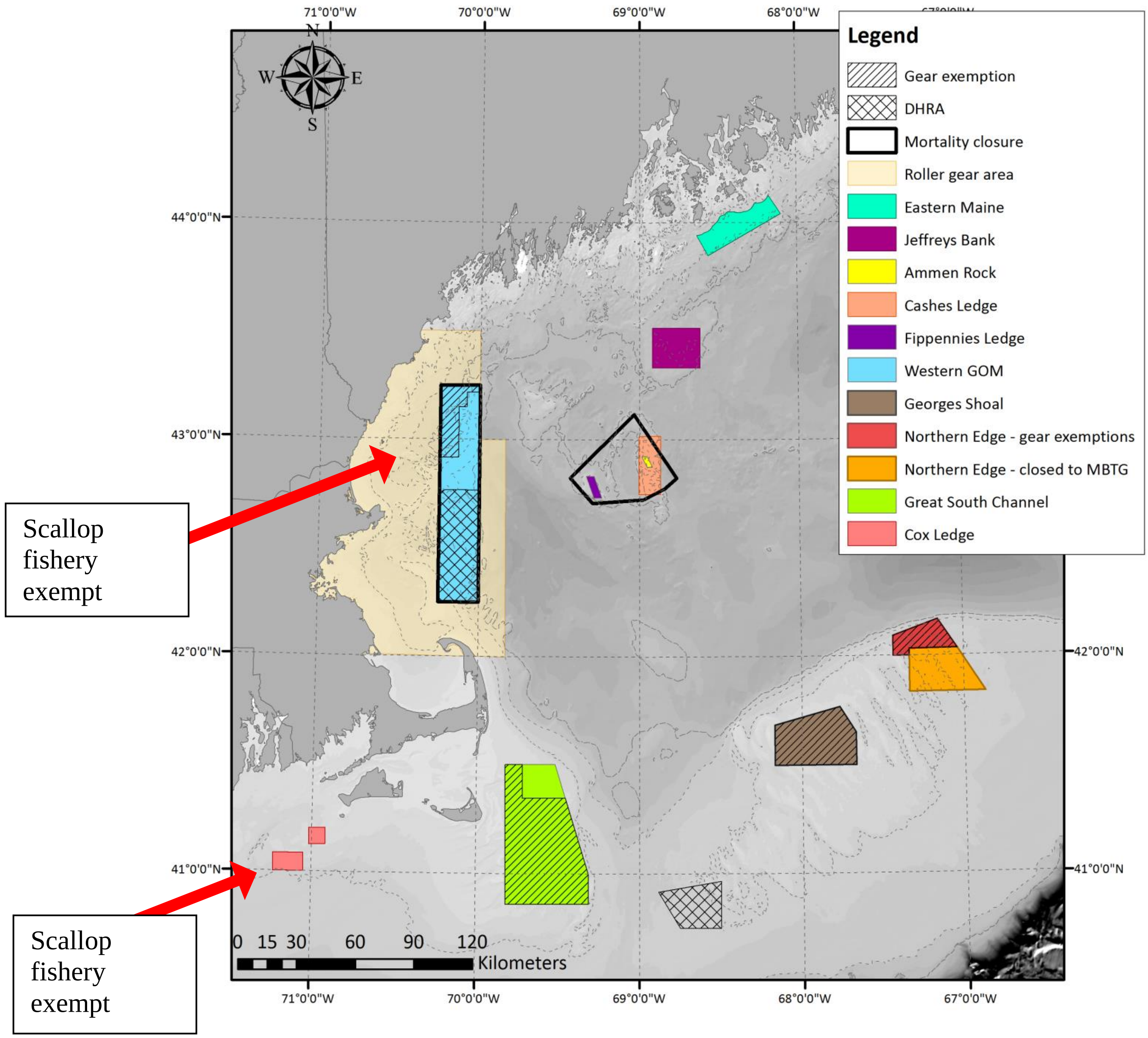
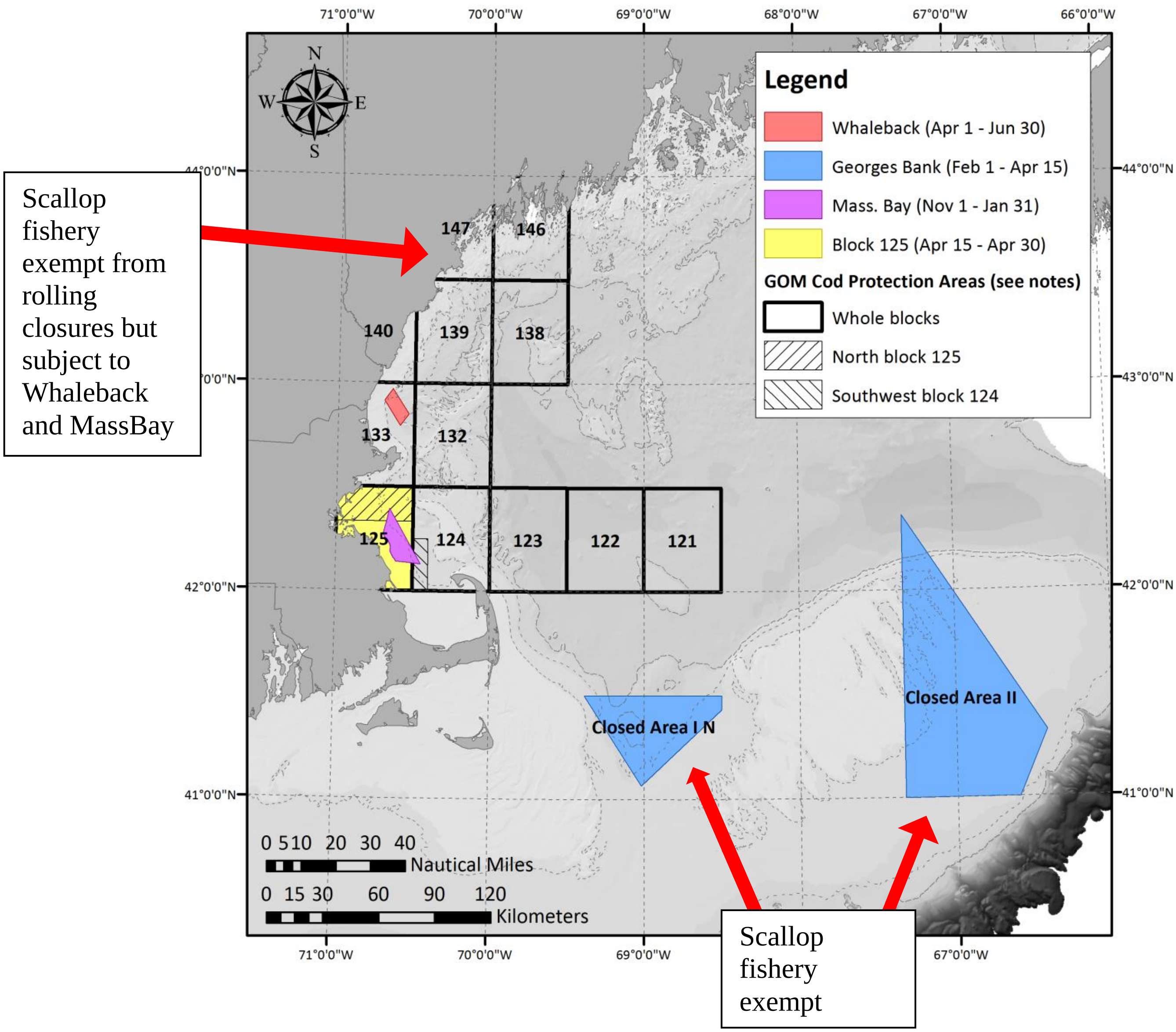


Figure 2 – Preferred alternative seasonal spatial management areas. Year-round areas not shown.

GOM COD PROTECTION CLOSURES Closed to commercial gears with various exemptions	**SPAWNING AREAS**
Nov-Jan: 125 and 124 (southwest corner of 124 only) Feb: None Mar: 121, 122, and 123 (all areas common pool only) April: None** May: 125 (northern part only), 132, 133, 138, 139, 140 June: 125 (northern part only), 132, 139, 140, 146, 147 July-September: None October: 124 and 125 (both areas common pool only)	-- Whaleback and Massachusetts Bay Cod Spawning Protection Areas have the same gear restrictions, i.e. closed to commercial and recreational gears with various exemptions -- Georges Bank areas closed to various commerical and recreational gears capable of catching groundfish, with various exemptions, including scallop dredges ** Block 125 in April is not part of Cod Protection Closures, but was added by Council in June as a spawning area from April 15 - April 30



Draft Objectives for scallop action to modify access area boundaries

What should the objectives be for potentially modifying access area boundaries?

> Same as area rotation guidelines for scallop access areas, or different since areas have been closed already for other purposes (GF and habitat)?

Should access approach be different that used in previous openings?

Should a phased approach be considered (EX: AA trips initially, then open areas?)

Data needs

Brainstorm a wish list of data sets we would like to have for this action

Initial brainstorming about boundaries

- Closed Area I – Council developed a boundary in FW28 (Considered and Rejected)
- Nantucket Lightship
- Closed Area II South
- Closed Area II North

From FW28 - Modification to Closed Area I Access Area Boundary

The Closed Area I Access Area boundary would have been modified, consistent with recent modifications to groundfish closed areas and habitat closures through the OHA2 (TBD, pending final rule). Alternative 2 would have expanded the boundary of existing Closed Area I access area to include a “sliver” of biomass just to the north of existing northern boundary (Figure 4), while Alternative 3 would have expanded the Closed Area I access area to include the entire Closed Area I Habitat Management Area to the north (Figure 5). Modifications to the Closed Area I Access Area boundary are contingent upon the final rule of Omnibus Habitat Amendment 2.

Rationale for rejection: The Committee’s stated intent is to address this issue in the next available Council action. Both the Scallop Advisors and Committee identified expanding the CA I AA to include the entire CA I N HMA as preferred. The Committee voted to move this measure to considered and rejected at its November meeting because it felt that there continues to be uncertainty with when the OHA2 final rule will publish, and there is a possibility that NMFS may not approve the change to the HMA that this measure is predicated upon.

Figure 3 - Current Closed Area I Access Area Configuration

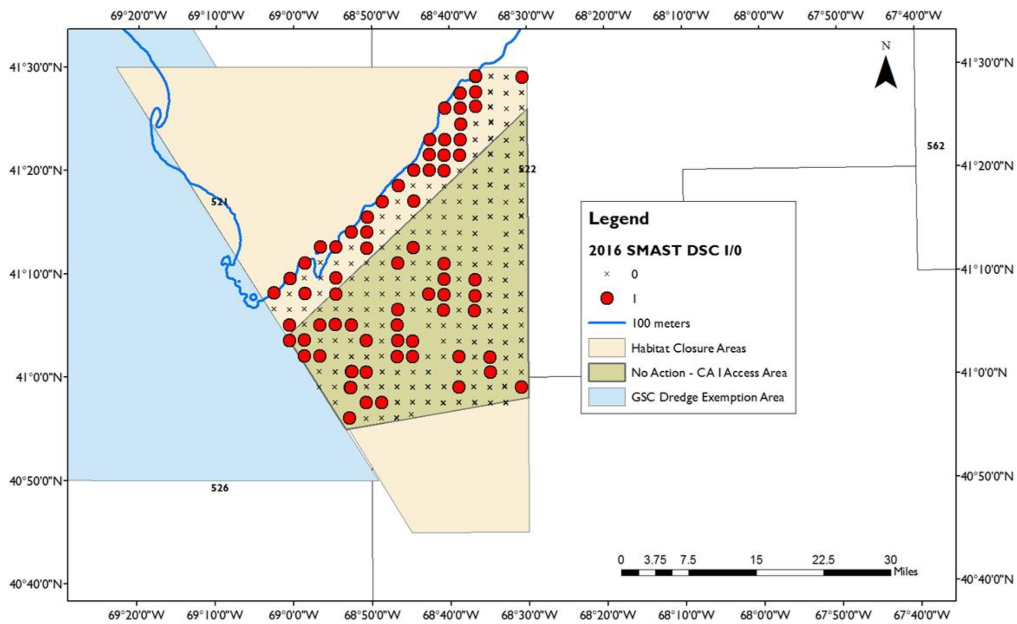


Figure 4 - Configuration of Alternative 2, Expansion of CA I AA (shown in green).

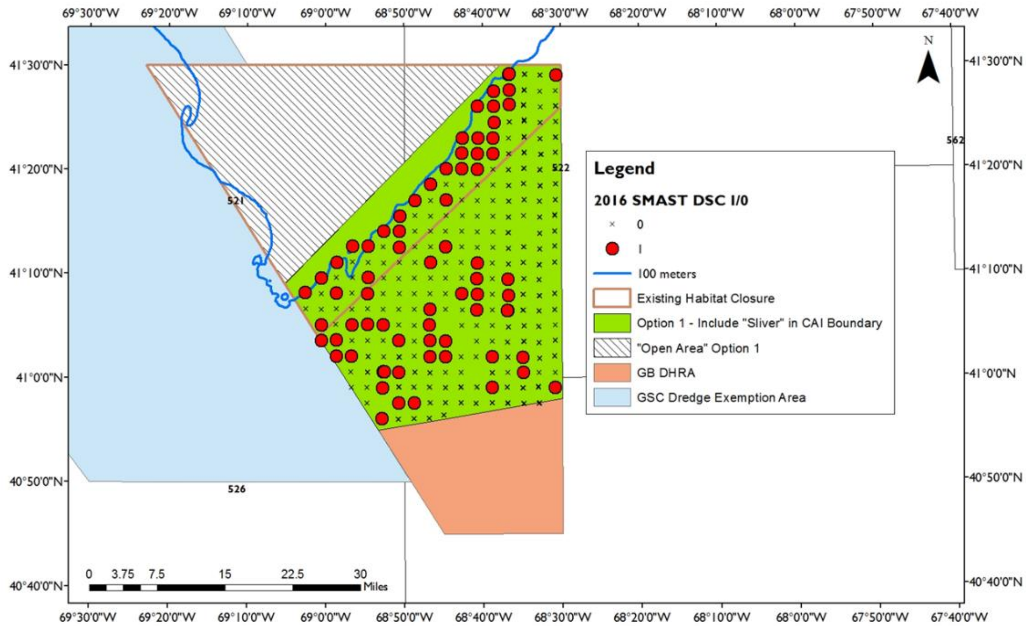
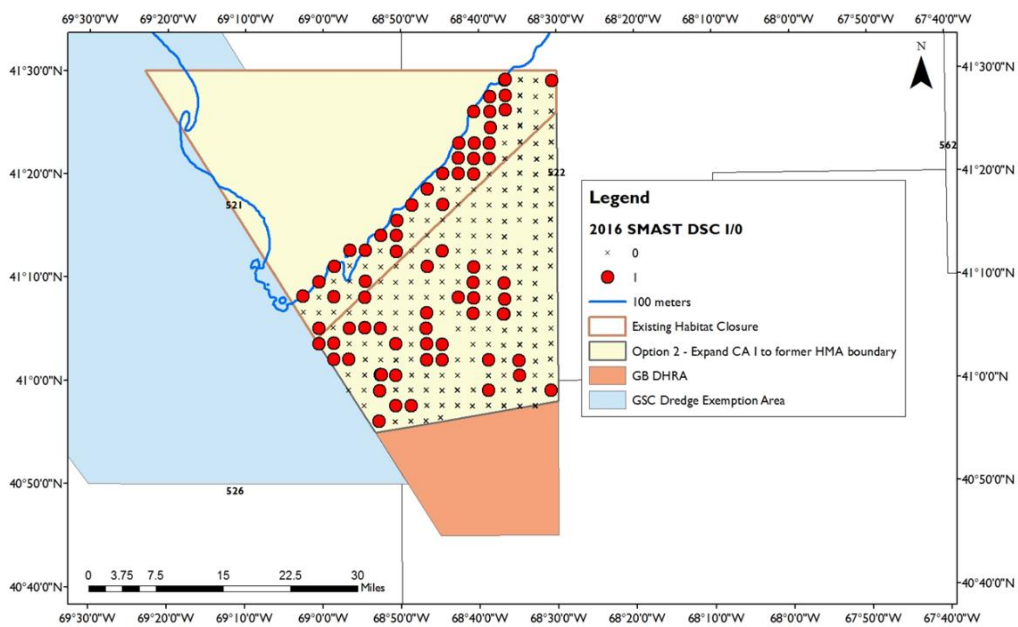
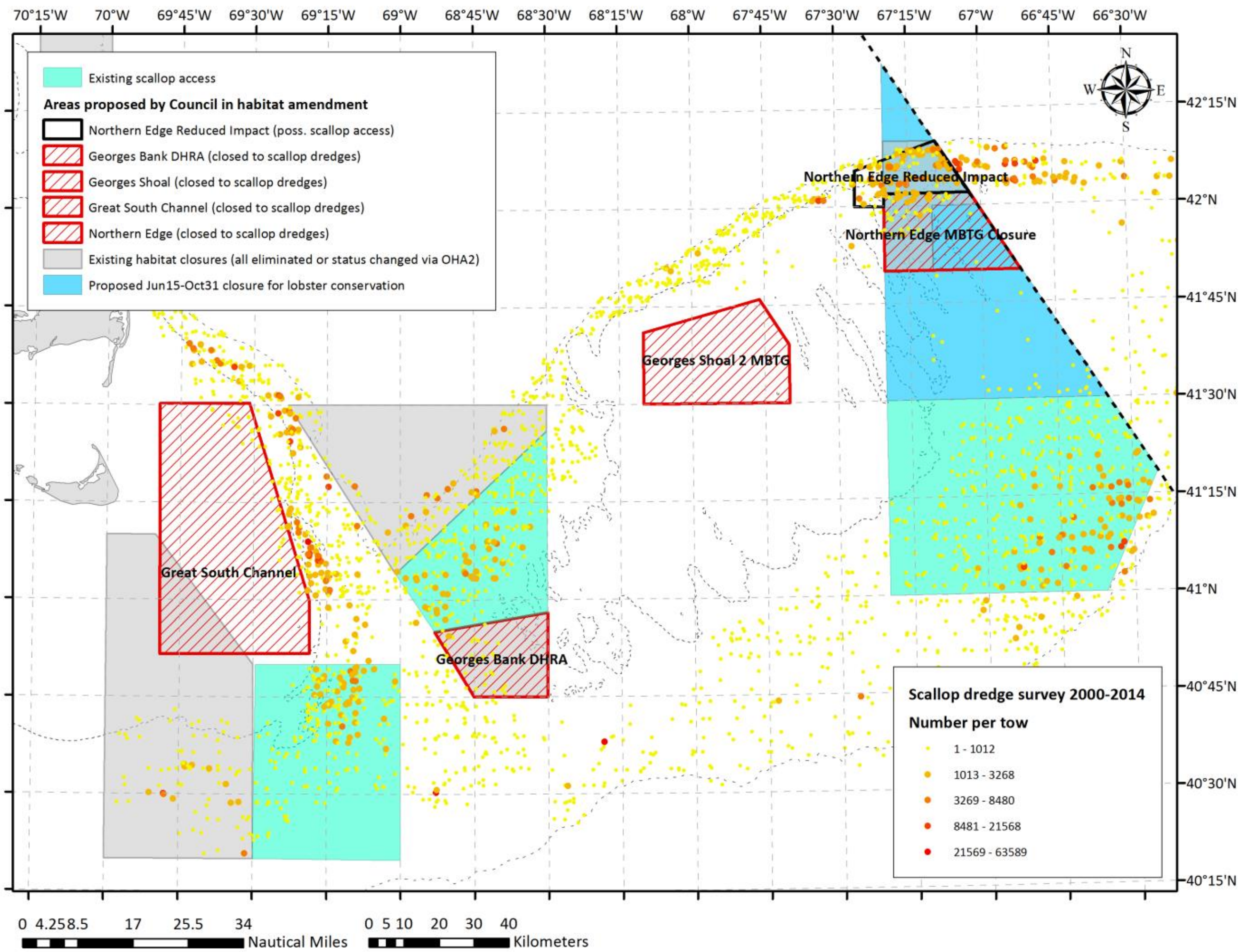


Figure 5 - Configuration of Alternative 3 (formerly Option 2), expansion of the CA I AA.



Scallop Distribution

Map 1 - Areas proposed by Council in OHA2 and NEFSC scallop dredge survey 2000-2014 (numbers per tow)



There is also GB biomass information from SMAST drop camera data for 2003-2012, and 2014-2015. SMAST also surveyed CAI AA and the NLS AA in 2016. The 2015 broadscale is below as an example and staff has other years as well.

Map 2 – 2015 SMAST drop camera survey.

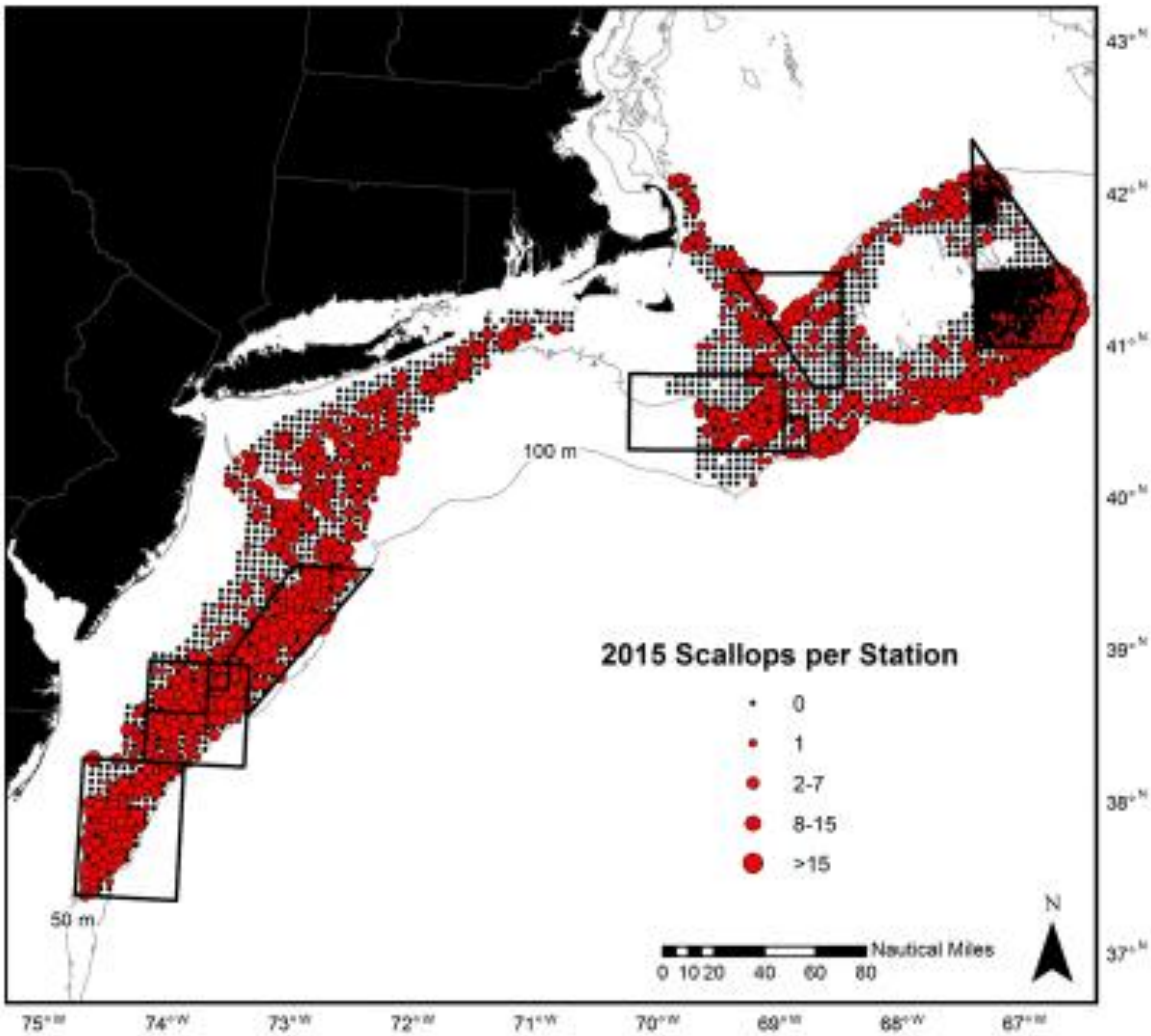


Figure 6 - 2016 dredge surveys of Georges Bank, including VIMS and federal NEFSC dredge survey.

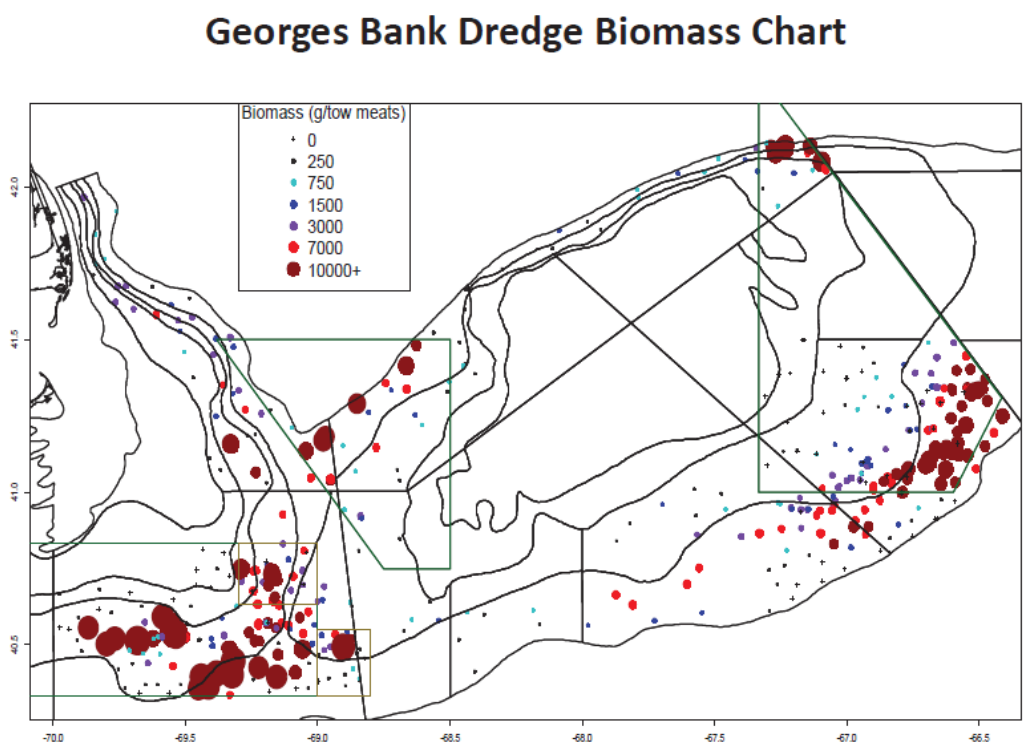


Figure 7 - 2016 SMAST NLS Survey Locations, including Large Camera data.

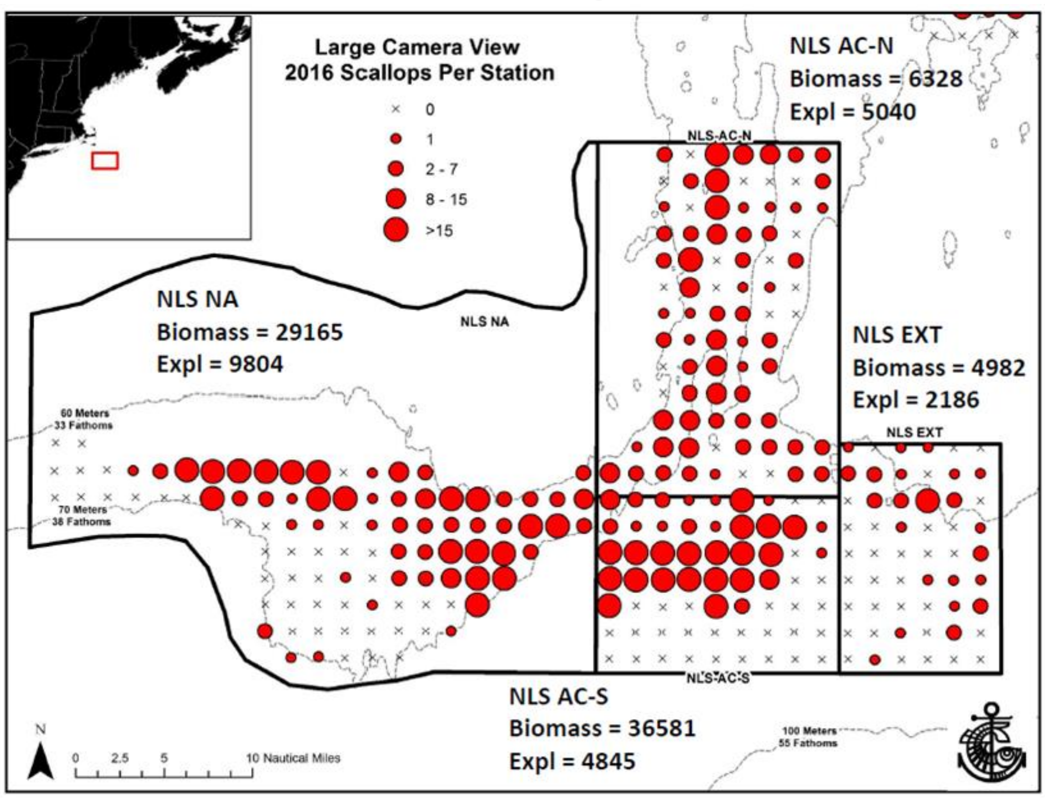
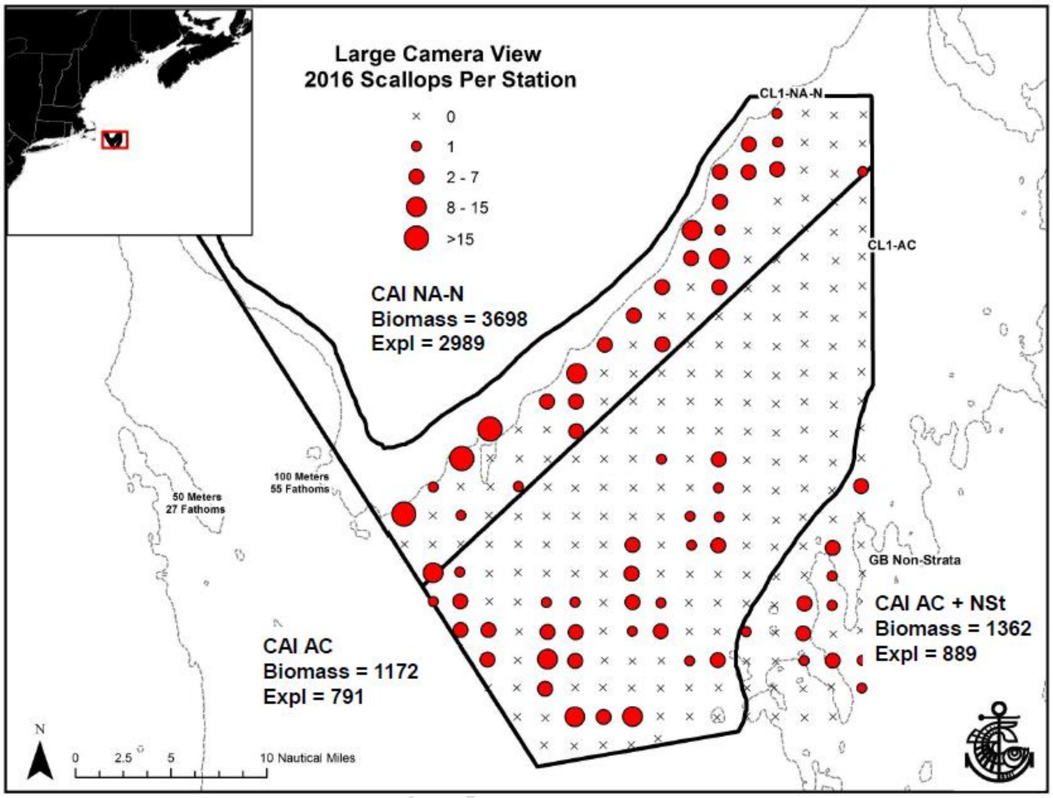


Figure 8 - 2016 SMAST CA I Survey stations, with Large Camera Data.



Impacts on recruitment and larval production

Georges Bank is somewhat unique because it is a mixed larval pool and scallop recruitment on Georges Bank is cyclical. There has been research on transport of scallop larvae on Georges Bank and the potential benefit of closed areas as population replenishment sources[1]; however, the survival after settlement in open areas is still uncertain and variable. **For sessile species like scallops, permanently closed areas can enhance fishery yields only if recruitment outside the closures increases to a level that more than compensates for the loss of yields from within the closures** (Hilborn et al., 2004). Some work has been done in this region on the

[1] The Scallop PDT reviewed several papers on scallop larval transport (Davies et al 2015, Davies et al 2014, Gilbert et al 2010, Tian et al 2009). There are three main scallop aggregations on GB: northeast peak (NEP), southern flank (SF), and Great South Channel (GSC). The NEP contains the highest abundance of adult scallops and acts as a significant larval source for other aggregations. The GSC is the most retentive, and the NEP and SF are not retentive and rely on larvae from other aggregations. Dispersal and connectivity are driven by physical processes such as tidal mixing, along shelf currents, and wind; as well as biological processes such as growth, mortality and behavior (Tremblay et al 1994, Tian et al 2009, and Gilbert 2010). There can be great variation in all of these parameters. Davies et al 2015 concluded that the closed areas on Georges Bank have increased the overall abundance and decreased the spatial variability of larvae produced in both Canadian and US waters, and model simulations indicate that the increases were sufficient to affect larval settlement on the bank. However, it is still not clear whether these increases in larval production translate into increased recruitment to the fishery.

subject of evaluating whether closed areas have contributed to increased biomass and recruitment success, but the results are not black and white.

Hart and Rago 2006 evaluated whether the closures on Georges Bank impacted recruitment on Georges Bank overall. They found that **mean recruitment on Georges Bank did increase after the closures, but it was not significant. However, strong recruitment was observed downstream of the Hudson Canyon rotational access area.** Their analysis used all federal scallop survey data from 1979 through 2005. During the years after the Georges Bank closures (1994), mean recruitment did not significantly increase; and mean recruitment was similar inside and outside of closed areas suggesting that dredging did not have a significant effect on settlement success; i.e., the area effect was not significant. **However, in more recent years (after 2005) there have been very high recruitment levels on Georges Bank, especially in 2014 and 2015. It is possible that with more data points the increase in mean recruitment on Georges Bank may now be significant, but the analyses done for the 2006 paper have not been updated.**

A modeling study by **Hart (2006)** focused on whether marine reserves increase fishery yields, specifically highly productive and fecund sea scallops on Georges Bank versus canary rockfish, a long-lived, low productivity species prone to recruitment overfishing. Models were developed to identify yield as a function of fishing mortality and closure fraction for the two species. The results suggest that closed areas can increase overall yield, but only when spawning stock biomass is low, fishing mortalities are greater than F_{MSY}, and with low closure fractions. Currently on GB the spawning stock biomass of scallops is relatively high and fishing mortality is below F_{MSY}; therefore, the potential benefits of area closures to increase total scallop yield may be limited. Furthermore, the PDT discussed that above a certain point, additional biomass may not contribute additional recruitment success. As noted above, Georges Bank in particular is a mixed larval pool increasing movement of larvae around the Bank, which could lead to saturation at lower biomass levels.

Hart et al. 2013 concluded that there is no evidence that recruitment of sea scallops increased outside of closed areas from 1994-2006, despite large increases in biomass within the closures. While recruitment on Georges Bank has improved recently, it is still unclear whether the more recent increase in recruitment on GB is due to closures, effort reductions, or random fluctuations, or some combination of these. Therefore it is possible that area closures are having a positive impact on recruitment, but it has yet to be proven.

Another issue that comes into play when evaluating the potential benefits of closed areas and recruitment success is **density dependence.** It is possible that biomass in open areas may contribute less in terms of fertilization success because animals are more spread out. Scallops are typically more concentrated in closed areas; therefore, **if recruitment success is density dependent for sea scallops, closed areas could increase overall yield by improving recruitment success (Smith and Rago, 2004).**

Smith and Rago 2004 considered spatial aspects of growth and reproduction for development of reference points for sea scallops. The paper explains that the renewal process, or relationship between stock size and recruitment, involves poorly understood aspects of reproductive biology and difficult to quantify processes governing successful fertilization and survival. **There probably is some linkage, but it was not certain in 2004, and it is still not certain today. In addition, there are numerous environmental effects as well, and large year classes may be driven more by favorable environmental effects than population size.** The paper also points out that closures cannot increase yield from increased egg production from closures if the magnitude of fishing effort in the remaining open areas increases. If closures cause effort to displace and increase in open areas, gains in yield can be compromised. **Overall, the research suggests that concentrating effort in lower productivity areas may be an effective way to reduce recruitment variability, improve yield, and ensure that the reproductive capacity of the resource remains high. There are signals that recruitment patterns on Georges Bank are more likely driven primarily by natural cycles, and not by closed areas. There has also been extensive research about correlations between mass spawning events and environmental variables such as temperature increases or phytoplankton blooms.** Bonardelli et al. (1996) studied the correlation of spawning and temperature for sea scallops and found **strong correlation with either a sharp temperature increase or strong temperature fluctuations.** Another study in the Gulf of St. Lawrence, Canada concluded that **phytoplankton blooms appear to be associated with spawning events** (Arsenault and Himmelman, 1998).

Questions have been raised as to whether long-term closures may have potentially **positive** impacts on the resource because they contain large proportions of total scallop larvae. The PDT agrees that the existing habitat closures, "CAI Non-Access", "NL Non-Access", and especially "Closed Area II Non-Access", contain a relatively large proportion of total scallop spawning stock biomass. For example, using 2014 biomass estimates in Scallop Framework 26, the EFH closed areas were estimated to contain about 15% of total biomass and 20% of exploitable biomass. **Therefore, the current EFH closed areas do contain a relatively large proportion of total scallop larvae, and that may be having positive impacts on the resource overall if recruitment has increased as a result of the closures, but the impacts of long-term closed areas on increased recruitment overall are still uncertain. In conclusion, the impacts of closed areas on increased spawning success and scallop yield are currently uncertain. Because cycles in recruitment have been observed before areas were closed on Georges Bank, and similar cycles have continued after closures, the Scallop Plan Development Team does not believe that changes to habitat closures on Georges Bank would have a large impact on recruitment. The sense is that Georges Bank is a mixed pool and the larvae production in that area is rather saturated.**

In other areas, including the Mid-Atlantic, that is not the case because that sub-region is not a mixed larval pool. If there is no spawning advantage from scallops in high density closed areas, then there is a net loss in yield from long-term closures. But if there are areas that increase fertilization success and contribute to increased recruitment overall in open areas, then closures of these areas may be beneficial and increase overall scallop yield. **In conclusion, closed areas may help prevent overfishing as part of an overall management system, but there does not seem to be strong evidence to date that they directly increase scallop recruitment success on Georges Bank. With a greater understanding of these important linkages it is possible, and potentially a very good idea, for the Council to consider specific closures to increase scallop recruitment in a future scallop action.** While some of the current and/or proposed habitat closures may have beneficial impacts on scallop biomass and recruitment, it should be noted that increased scallop yield is not the primary goal of the Omnibus Habitat Amendment. Measures to increase scallop recruitment and yield could be considered in a separate action to the Scallop FMP.

Finally, relative to impacts on the scallop resource, questions have been raised as to whether large scallops impact settlement and growth of smaller scallops. **There is no evidence that removing larger scallops has positive effects on smaller scallops. In fact, scallop larvae need hard substrate to attach to for settlement success.** If there is limited hard substrate in sandy areas for example, larvae can attach to larger scallops instead. This has been documented in video surveys on Georges Bank. **Larger scallops also produce more larvae than smaller scallops, and if scallops are density dependent, there may be beneficial impacts on spawning success if scallops are more concentrated and closer together** (MacDonald and Thomspon, 1985)

There is no evidence that crowding impacts growth. The NEFSC has a large database of aged scallops; growth is calculated by measuring the distance between rings on the shell. If growth was impacted negatively by crowding in closed areas, the distance between rings would be smaller than in open areas. But the opposite was found, growth is faster in closed areas and higher density portions of closed areas do not grow slower than less dense portions of closed areas (Hart and Chute, 2009).

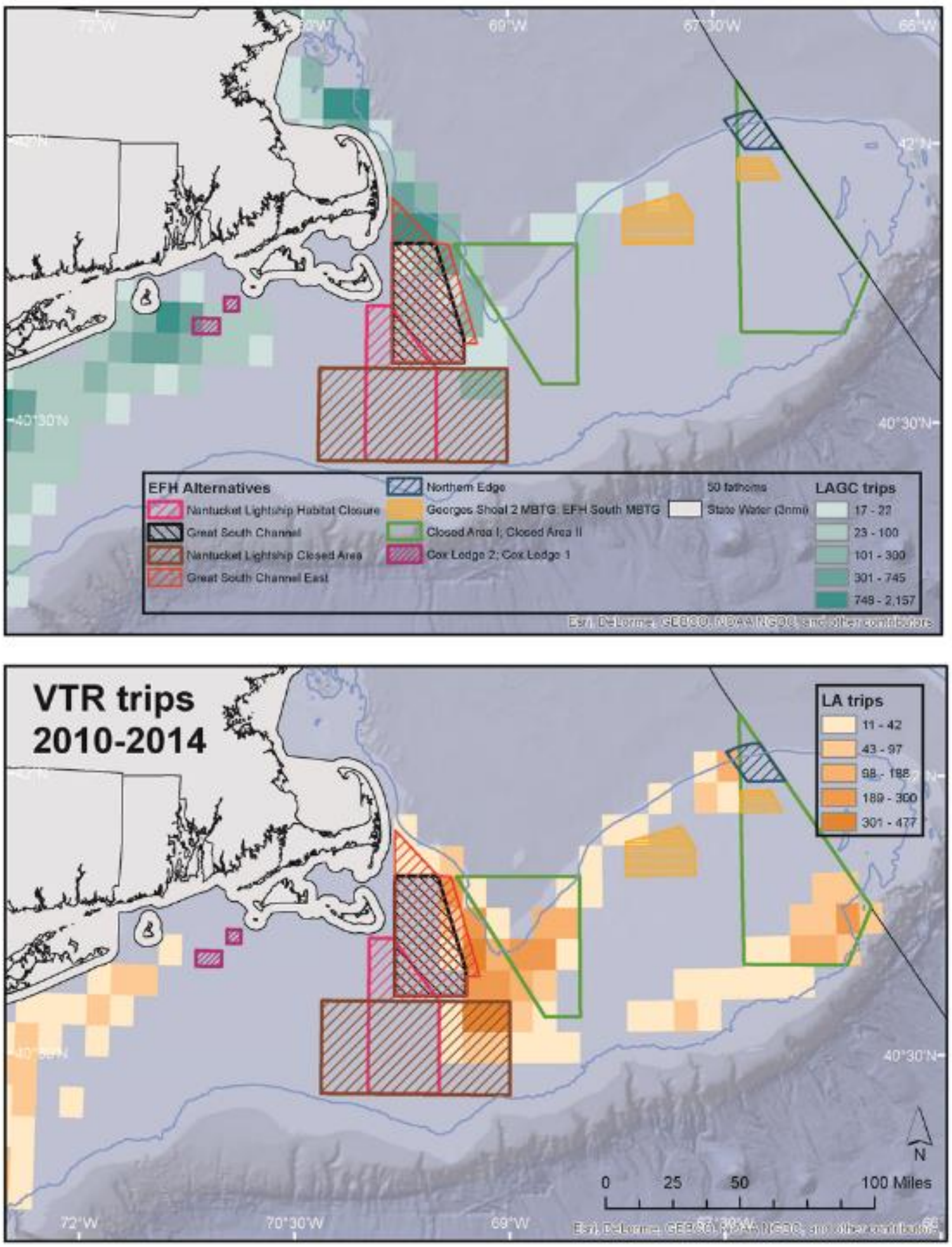
As for food, small scallops eat smaller sized phytoplankton; larger scallops are filtering out larger food in the water column. Overall, scallops are not found in very high densities; one scallop per square meter is considered dense. The most concentrated areas like the cod HAPC has densities of about one scallop per square meter on average, with more dense patches throughout. **Even at those relatively high densities, scallops are not removing large portions of food from the water column. Therefore, growth is not food limited, even in high density areas.**

One issue that does seem to be density dependent is mortality from predators. When scallops are concentrated, mortality from predators is increased, especially when scallops are small. There have been seeding experiments in Canada that evaluated mortality at different density levels, and mortality was higher for juvenile scallops in higher densities (Barbeau et al, 1996). In 2003 there was a very large year class of scallops in the Elephant Trunk Access Area in the Mid-Atlantic. The area was closed to fishing in 2004 and based on surveys conducted in the area each year, it was evident that natural mortality of juvenile scallops was very high (**Error! Reference source not found.**). After the scallops reached larger sizes the mortality reduced, and fishing was allowed in the area in 2007.

Scallops will eventually die in long-term closures because they are relatively sessile and will not move large distances into areas where they might be subject to fishing mortality, especially as they age. If increasing scallop yield was the only goal of fisheries management in the Northeast, then large long-term closures may not be the ideal tool. However, there are other goals of closures in this region and those need to be weighed against changes in scallop yield. There may be some benefits to the scallop resource from area closures if total recruitment increases, but there are costs as well from the yield lost within the closed area(s).

Fishing Activity

Map 3 – FY2010-2014 scallop fishing locations from all LAGC IFQ trips (top) and LA trips (bottom). VTR location binned by ten minute square. Note: Ten minute squares are colored only when three or more vessels fished during this time period. Areas not colored represent 0-3 vessels. The colored areas, therefore, represent the most intensively utilized areas. As there are no dredge exemption areas east of Closed Area I, trips mapped in that location are assumed to be reporting errors.



Scallop Revenue Data – from VTR data

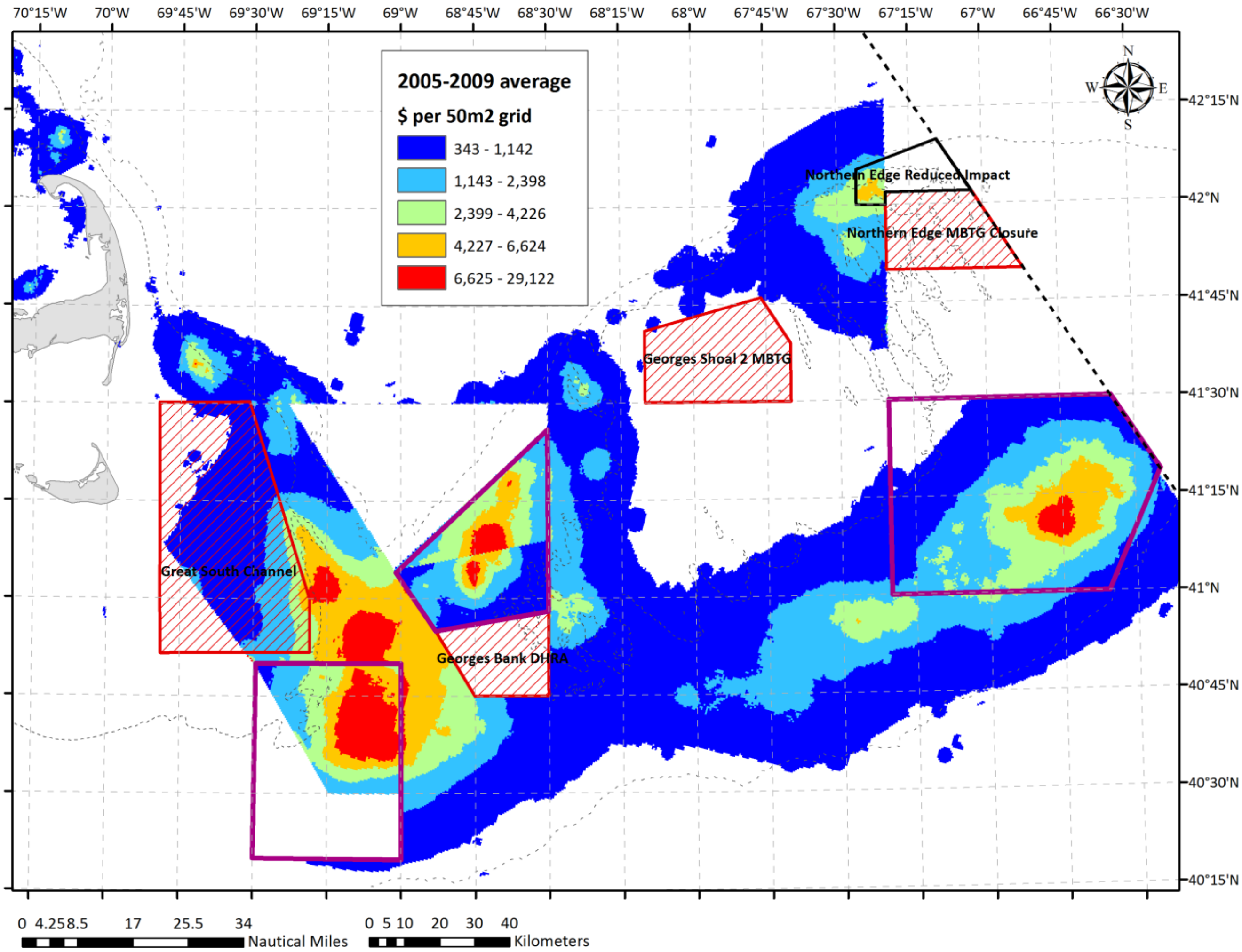
Excerpted/Summarized from Vol 4 of OHA2 FEIS:

Vessel Trip Report (VTR) data was used to spatially identify the magnitude and composition of scallop dredge fishing revenues (both LA and GC) for two time periods (FY2005-2009, FY2010-2014). Harvesters report a single spatial position for each stat area/gear fished. Previous studies have identified that the self-reporting underreports switches in gear and statistical area over the course of a fishing trip (Palmer and Wigley 2007, 2009). Furthermore, given that commercial fishing trips can be quite long, a single spatial point recorded on the VTR is unlikely to adequately represent the actual footprint of fishing on any given trip. For OHA2, the NEFSC developed a statistical approach in order to better represent the footprint of fishing associated with the self-reported spatial data point.

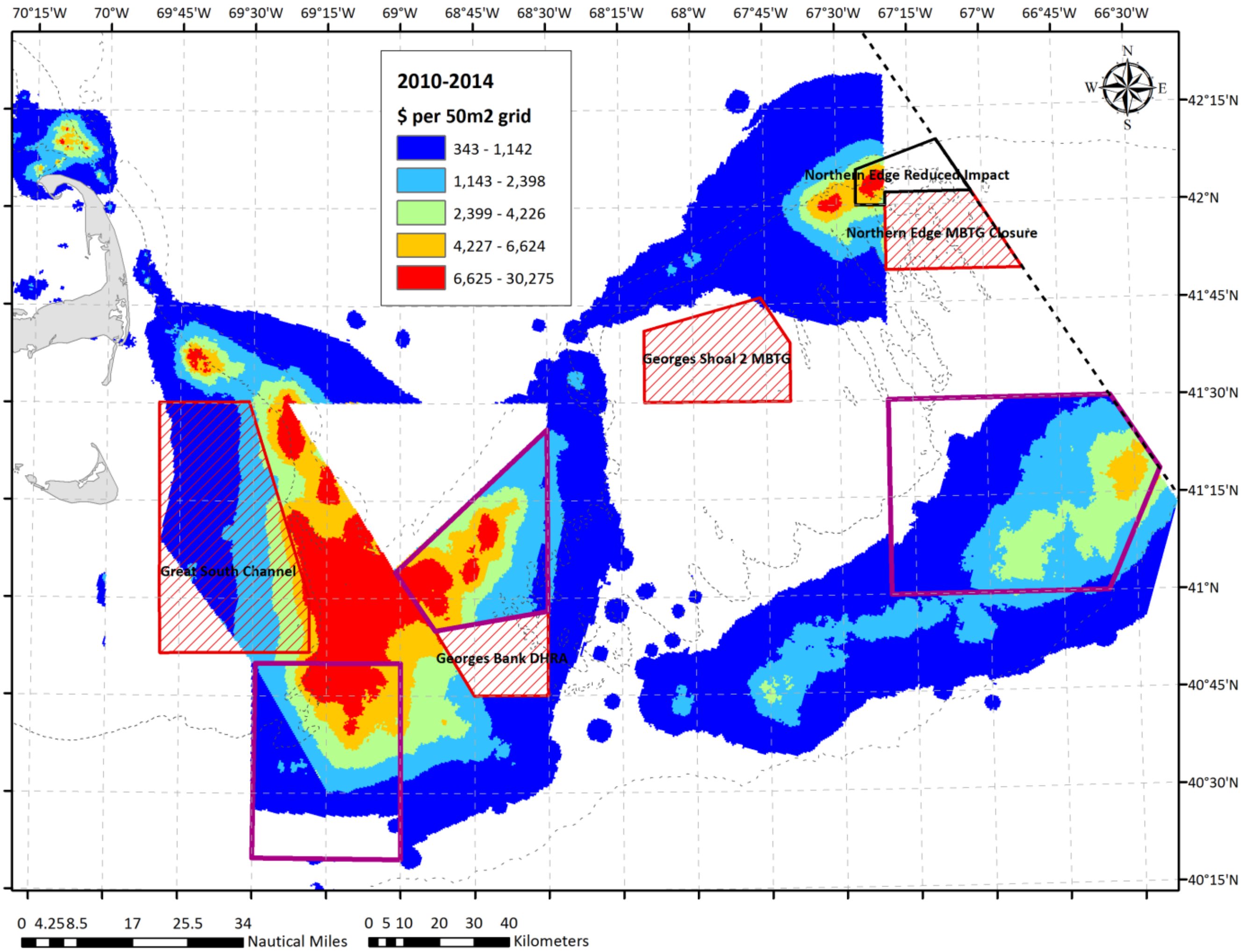
The analysis joins observed haul positions with the VTR data, to estimate a cumulative distribution function (cdf) of the distance between observed hauls and self-reported VTR points. The cfd was modeled to estimate the probability that all the hauls associated with a trip fall within a given distance from the self-reported VTR location, as a function of variables that would be expected to influence the actual footprint of fishing. For example, it is likely that longer trips have hauls dispersed across larger geographical areas when compared to shorter trips. This in turn means that the VTR locations are less and less representative of the spatial footprint of a trip's fishing activity as trips increase in length. The model can then be used to estimate confidence intervals for the fishing footprint of each and every VTR point in the database, regardless of whether it was observed through the NEFOP program. This allows for a more realistic spatial footprint of trips to be represented, which in turn provides a better understanding of the fishing occurring in and around areas being considered for area management. Model results and a regression analysis were used to estimate the 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentile confidence intervals for all the VTR points from calendar years. The following VTR revenue maps were created by linking trip-level gross landings generated from VTR reported landings and average monthly with confidence intervals of VTR point data.

Methods:
DePiper GS. 2014. Statistically assessing the precision of self-reported VTR fishing locations. NOAA Tech Memo NMFS NE 229; 16 p. doi: 10.7289/V53F4MJN. Available at http://nefsc.noaa.gov/publications/tm/tm229/

Map 4 - VTR revenue density map, FY2005-2009



Map 5 - VTR revenue density, FY2010 - FY2014



Scallop fishing location – VMS data

VMS data from 2007-2015 filtered by speed (4.5 knot cut off). Every location summarized to points at 1 minute intervals and binned into 3 minute squares for LA and LAGC fishery separately. Total estimate of days fished by each fleet per 3 minute square. The PDT has also evaluated the degree of overlap and relative importance of overlap for each fishery.

Map 6 – LA scallop fishing activity (FY2014)