Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **American Lobster Management Board**

FROM: **American Lobster Technical Committee**

DATE: **April 16, 2024**

SUBJECT: **Technical Report on Lobster Resource and Fishery Effort on the Northern Edge**

The Atlantic States Marine Fisheries Commission's Lobster Technical Committee (TC) was tasked by the American Lobster Management Board (Board) at the Commission's 2024 Winter Meeting to compile information on the lobster resource and fishery in and around the Northern Edge of Georges Bank. This task is in response to a potential action at the New England Fishery Management Council (NEFMC) that is considering allowing scallop fishery access on the Northern Edge of Georges Bank to a currently closed Habitat Management Area (Figure 1). The Board requested information that could help characterize potential impacts on the lobster population and fishery in the area. The Board was specifically interested in information describing the presence and abundance of lobsters, including ovigerous females, on a seasonal basis, as well as seasonal fishery effort in the area. The TC met via webinar two times following the Winter Meeting to discuss and develop the report.

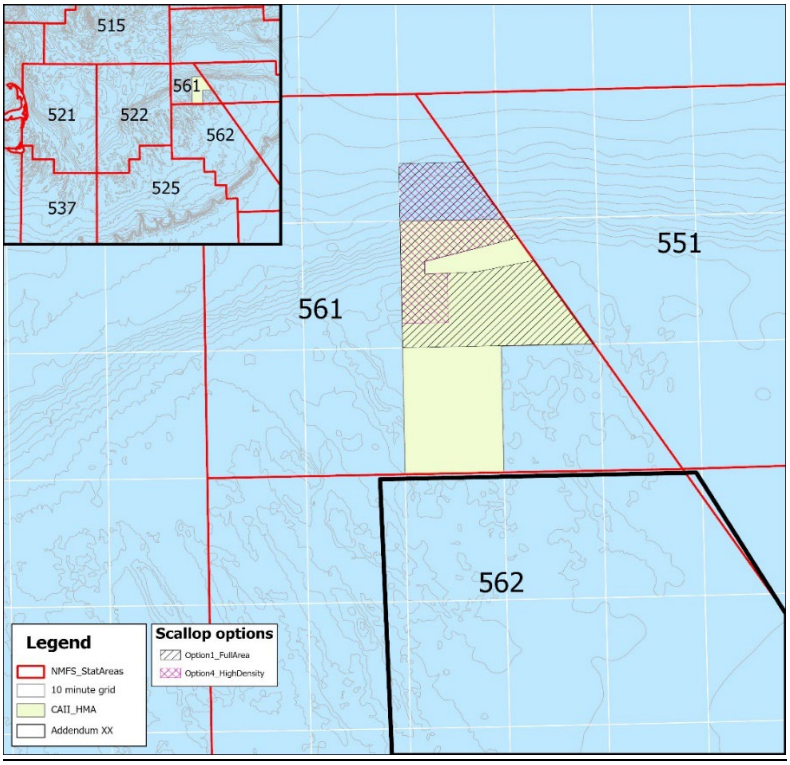

Figure 1. The Habitat Management Area on the northern edge of George's Bank, along with the portion of Closed Area II affected by the Addendum XX trap gear removal agreement (black outline). Two of the four scallop access options under consideration are shown. Inset: Large scale view of Georges Bank, surrounding NMFS Statistical Areas, and the Habitat Management Area (HMA).

Data Used in the Analysis

The TC explored a number of sources for data within and near the Habitat Management Area (HMA) on the northern edge of the Bank. Note that data specifically within the HMA are relatively limited. The various data sources and how the data were used in this report are described below.

Northeast Fishery Science Center (NEFSC) Trawl Survey

The Northeast Fishery Science Center conducts an annual bottom trawl survey in the spring and fall throughout the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight and has recorded survey catch data on lobsters since the late 1960's, including size, sex, and egg-bearing status. This region of Georges Bank receives limited but consistent survey effort. Between 2000 and 2023, this survey completed 60 tows in the deep area off the bank and 122 tows on the bank in NMFS Statistical Area 561, approximately evenly split between the Spring and Fall surveys. We used these data to characterize the spatial distribution and seasonal shifts of the lobster resource.

Coonamessett Farm Foundation (CFF)

The Coonamessett Farm Foundation (CFF) has conducted Seasonal Scallop Surveys on Georges Bank intermittently between 2012 and 2023, using both standard and experimental scallop dredges (Table 1). Specific sample locations, timing and frequency of sampling, and gear designs have varied somewhat over the years in response to specific management concerns raised. Tows did not occur within the HMA, but work was focused on and around the northeastern portion of the Bank. CFF staff collected biological data on all lobsters caught during the survey, including sex, size, shell hardness, egg-bearing status, and damage associated with capture. Available data can be used to describe the seasonality of lobster catch on the Bank in the scallop gear in those years with sufficient sampling. Data can also be used to describe the catch characteristics (size, sex ratio, etc.) and damage to lobsters caught in scallop dredge gear. It is important to note that selectivity of scallop gear for lobsters is unknown.

Table 1. Number of tows conducted each month and year by the CFF scallop survey from 2012-2023.

	Annual tows											
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Jan		92	182		122		98	98				98
Feb		58					98	22	78			98
Mar		150	182					76			100	
Apr		92					98	98				98
May		90									100	
Jun		182					98	96	78			98
Jul		156										
Aug		26		248		84	96	78	76	100	90	
Sep		182				94	90					
Oct		152		122		94	78	72			84	
Nov	152	30		122						80		
Dec	150	182				98	98	68				

Commercial Fisheries Research Foundation (CFRF)

The Commercial Fisheries Research Foundation's (CFRF) Lobster Research Fleet provides demographic data (sex ratio, size structure, reproductive characteristics) on the lobster catch in traps (commercial and ventless) within the proposed scallop area options. These data are not necessarily representative of overall fishing effort within the areas and should only be interpreted for demographic data in the areas sampled. There were 4,881 lobsters sampled within the areas from September 2013 through March 2023. Only ten of these lobsters were sampled with ventless traps and were excluded from the data set while the remaining lobsters were sampled with commercial traps. Therefore, demographic data are further constrained by gear selectivity of the commercial traps. All lobsters sampled by the CFRF Lobster Research Fleet were sampled

from the northern and eastern overlapping portions of the option 1 (Full), 2 (North), and 4 (High Density) areas. Data were all from a single vessel and, therefore, spatial coordinates are confidential and cannot be shown on a map. No lobsters were sampled from the option 3 (South) area.

Federal Observer Data

Federal fishery observers from NOAA's Northeast Observer Program (NEFOP) record detailed data on vessel fishing activities, gear configurations, and catch. NEFOP observer coverage is generally sparse for the lobster fishery as there is no federal mandate to monitor the lobster fishery. However, due to an interest in finfish bycatch, there was some enhanced coverage from 2013-2015 that can be informative for this work. NEFOP observer coverage from 2013-2015 in Stat Area 561 included precise spatial information on 598 observed hauls, sampling 24,016 lobsters. We used these data for validating spatial patterns observed in the Vessel Trip Reports and characterizing the sex ratios, length compositions, and presence of egg-bearing females.

Harvester Logbook Program

To characterize the spatial distribution of ovigerous lobsters on Georges Bank, AOLA and NHF&G collaboratively developed an industry logbook to collect standardized data from the participating industry members as reported in Henninger and Carloni (2016). The logbook data fields included: date, location, fishing depth, number of traps hauled, total lobsters hauled, and total ovigerous lobsters hauled. Catch information from 2015 was reported from Statistical Areas 464, 465, 512, 561, 562, 522, and 525, representing 16 vessels across three States (New Hampshire, Massachusetts, and Rhode Island). Data were used to calculate the proportion of catch from each trawl that were ovigerous and plotted via ArcView GIS to visualize the spatial distribution.

AOLA Tagging Study

A collaborative grant between AOLA, NH Fish and Game, and Maine Department of Marine Resources was conducted from 2015-2020. A total of 17,704 lobsters were tagged by four organizations: Coonamessett Farm Foundation (CFF, n = 920), Maine Department of Marine Resources (ME DMR, n = 5,377), and MRAG Americas (MRAG, n = 11,407). Tagging took place in both inshore and offshore portions of Lobster Management Area 1 (LMA 1), as well as Lobster Management Area 3 (LMA 3), which included Georges Bank. Here, we present a subset of those data to evaluate movement throughout the area of interest on the northeastern portion of Georges Bank (Rzeszowski in prep.).

Federal Vessel Trip Reports (VTRs)

Until recently, federally-permitted lobster vessels were not required to submit vessel trip reports unless the vessel carried permits for other species that required trip reporting, as is common for vessels lobstering on Georges Bank. Vessel trip reports include information on date and location of fishing effort, reported with a single set of latitude/longitude coordinates, fishing effort, and landings. From querying the CAMS landings database, which accounts for missing trip reports with dealer reports, we determined that virtually all trips in this region since 2013 were represented in federal VTR's. Thus, we consider these data to have effectively captured the effort and landings for the region of interest. We use these data for reporting on the spatial distribution and seasonality of fishing effort and landings in the area of interest and adjacent habitats.

Results: The Lobster Resource in the Northern Edge Area

Relative Abundance, Seasonality, and Spatial Distribution

Catch in the NEFSC spring trawl survey indicates there is relatively higher abundance off the Bank than on, averaging nine lobsters per tow off the bank and three lobsters on the bank. In contrast, the fall survey shows higher abundance on the Bank than off with averages of two lobster per tow off the bank and eleven lobsters on the bank. Tows inside the proposed access areas consistently catch lobsters but in relatively small to moderate numbers (Figure 2). The largest recorded catch in the area, for a single tow, was 303

lobsters, recorded in the Fall of 2022, on the bank, inside the HMA and south of the Full Access area (Figure 2, bottom panel).

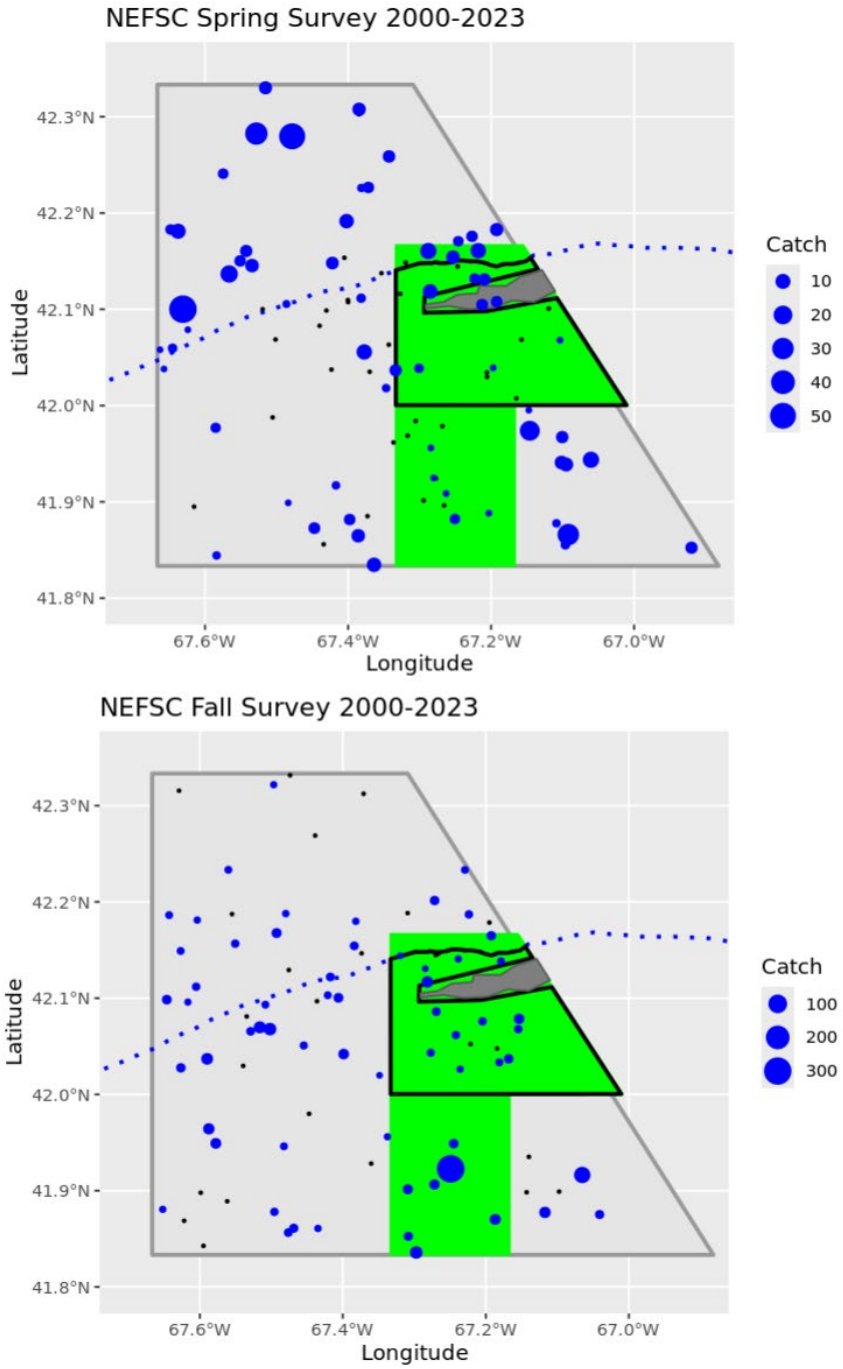

Figure 2. Locations and catch from NEFSC Spring (top) and Fall (bottom) trawl surveys in NMFS Area 561 from 2000-2023. Green shaded area is the HMA, and black outline within it is the Full Access scallop option under consideration by the NEFMC, cropped to the NEFSC scallop strata. The dashed blue line represents the northern-most boundary of the NMFS sea scallop survey strata, near the 100 m depth contour. Catch prior to 2008 are converted to Bigelow units.

The CFF scallop survey tows occurred both on George's Bank and off the edge into deeper surrounding waters over the course of the survey. To examine seasonality as well as the size and sex of lobsters from this data set, we focused on a time period during which the tows were all on top of the Bank and occurred during a mostly consecutive time period from August of 2017 through the end of 2019 (see Table 1). These data show a consistent seasonal pattern in the catch of lobsters on the Bank in the scallop gear. Catch was low during winter and spring, increased slightly in June, and was highest from August through October before dropping back to low levels in December (Figure 3).

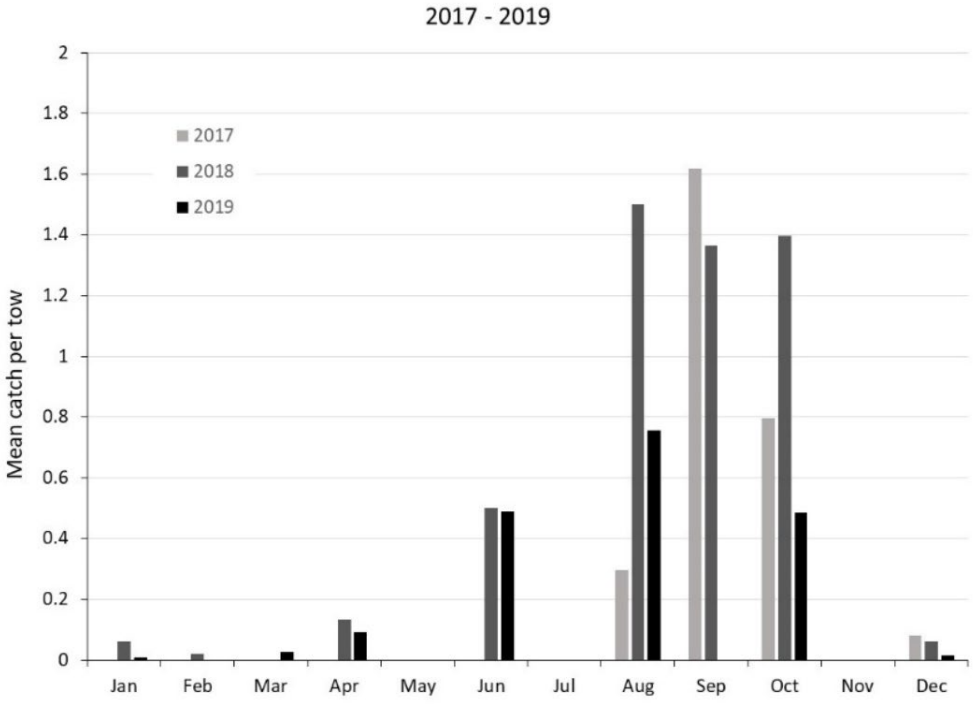

Figure 3. Mean catch of lobsters per tow in the CFF bycatch survey from August 2017 through December 2019.

Sex and Size Composition

The sex ratio of catches in the NEFSC bottom trawl surveys is consistently female-skewed (Figure 4). Catch averages 62% female On-Bank in the spring, but is otherwise typically 80% female or higher for spring Off-Bank and fall On- or Off-Bank. Large females, 95 – 135mm CL, are particularly abundant On- Bank in the Fall.

From 2017-2019 the CFF scallop survey observed 865 lobsters on the Bank, ranging in size from 36 mm CL to 216 mm CL. Most of these lobsters were caught during the late summer to fall months (Figure 3). The catch was predominantly female (91%), and 93% of the lobsters were larger than 100 mm CL (Figure 5). Fifty-seven percent of the females were egg-bearing.

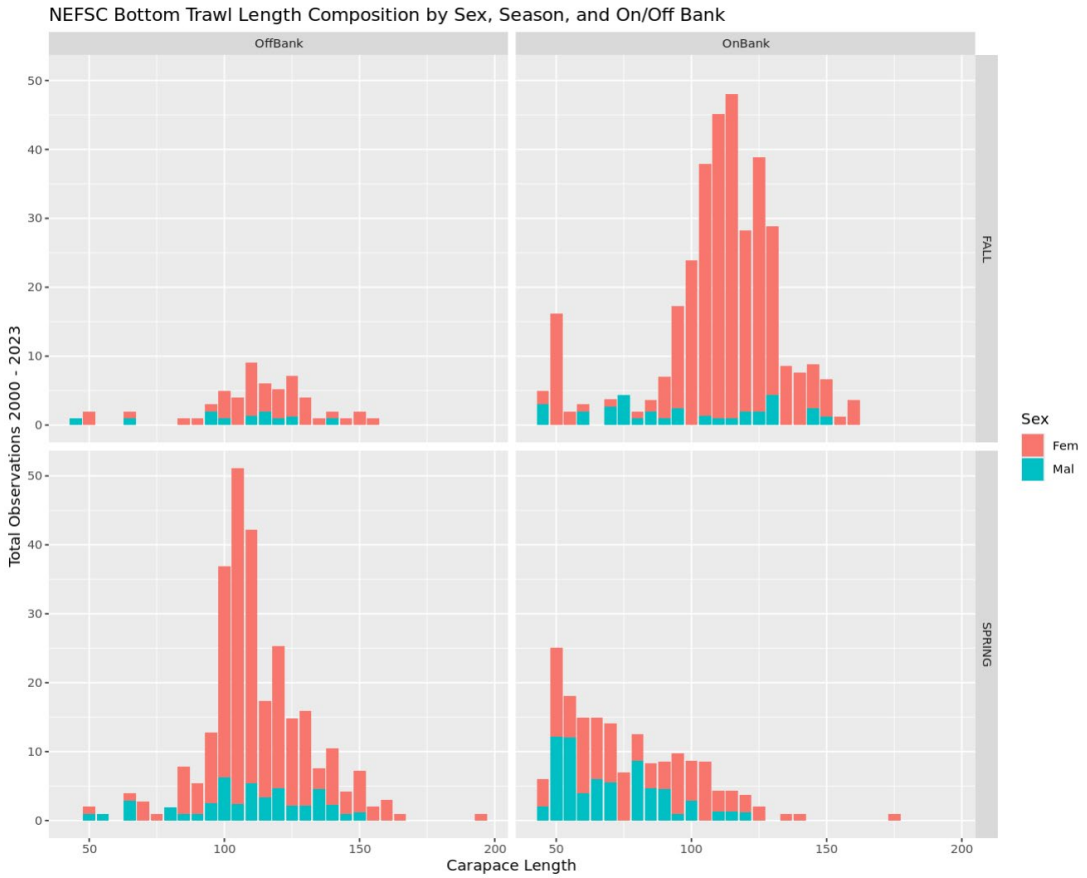

Figure 4. Catch composition in the NEFSC bottom trawl by sex, season, and On/Off Bank.

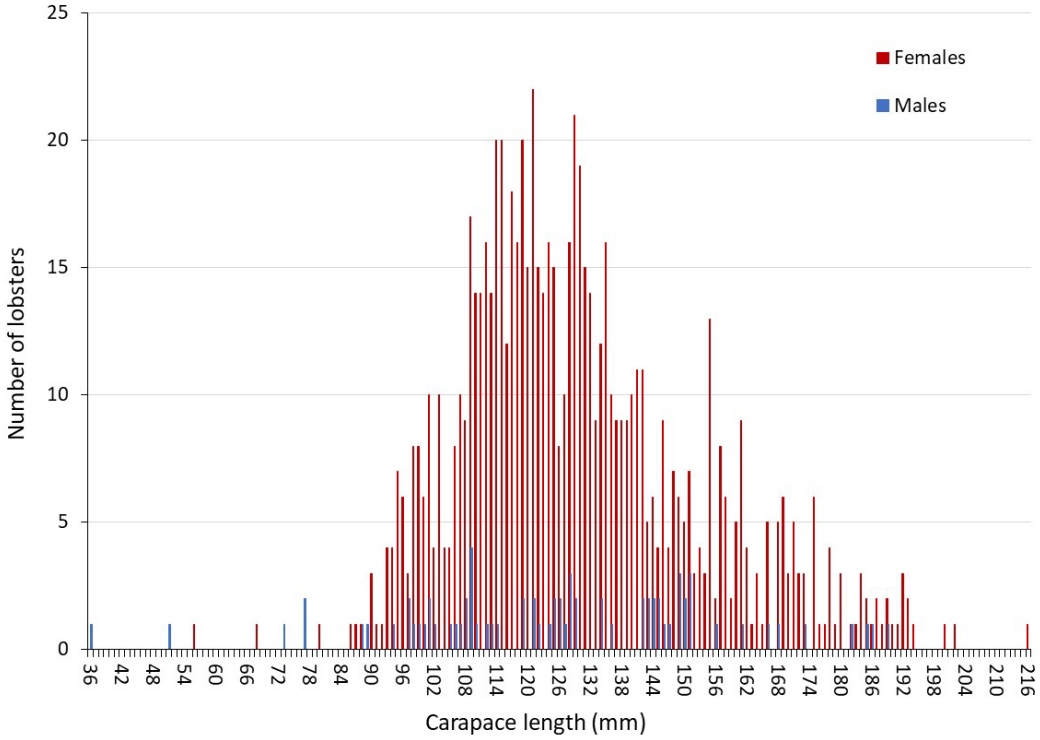

Figure 5. Size distribution of males and females from the CFF bycatch survey, 2017-2019.

Sex ratios from the CFRF fleet data show female-skewed catch within the scallop access areas throughout the year with an increasingly female dominated catch in the spring and summer months (quarters 2 and 3; Figure 6). Length compositions of females are relatively stable throughout the year with peaks in or around the 103mm CL bin (103-107mm CL; Figure 7). Length compositions of males shift from larger sizes in the fall and winter months to slightly smaller size structures in the spring and summer months. The prevalence of egg-bearing females increases with size and is highest across well-sampled sizes in quarter 1, lowest in quarter 2, and similar at intermediate levels during quarters 3 and 4 (Figure 8). The prevalence of females with v-notches also increases with size and is similar throughout the year.

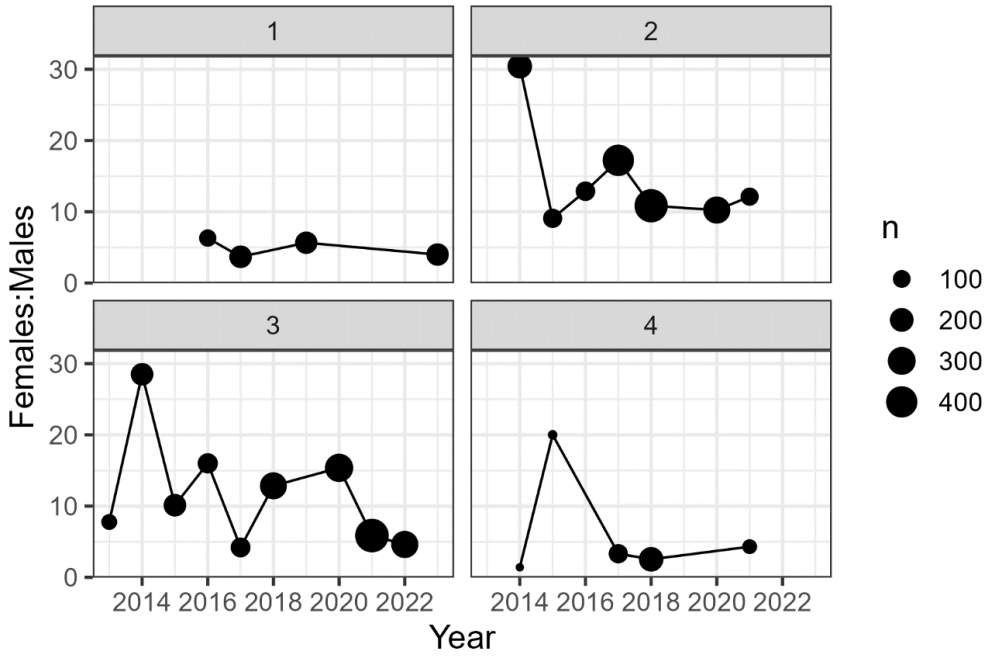

Figure 6. Quarterly (seasonal) ratios of female to male lobsters sampled by the CFRF Lobster Research Fleet. The size of the point is scaled to the number of lobsters sampled. 1 = January – March, 2 = April – June, 3 = July – September, 4 = October – December.

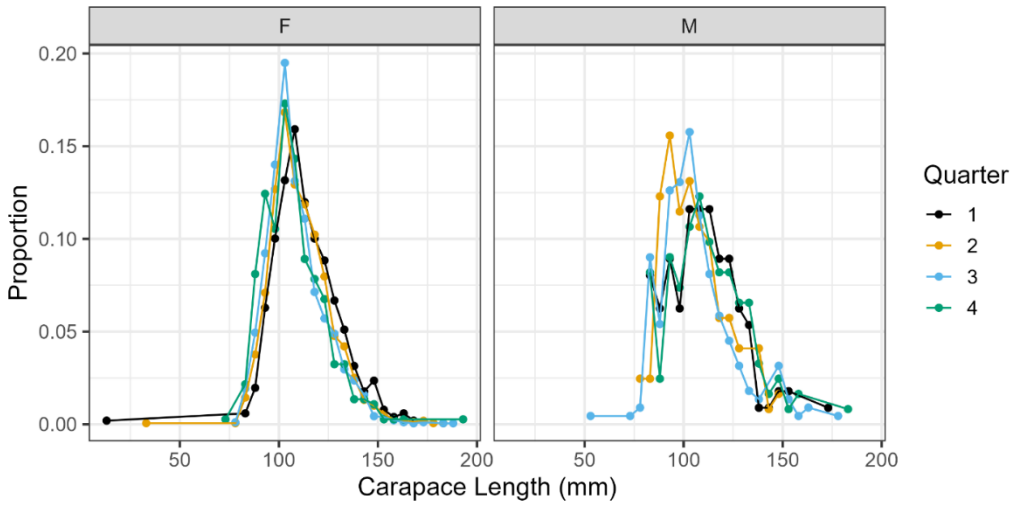

Figure 7. Quarterly length compositions of female and male lobsters sampled by the CFRF Lobster Research Fleet.

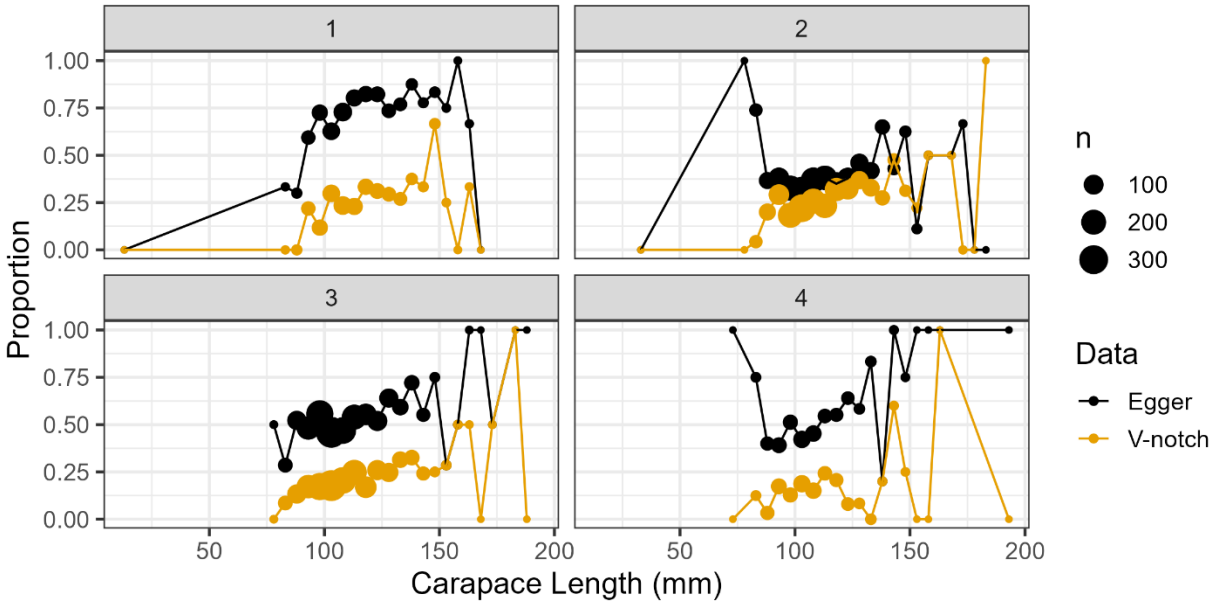

Figure 8. Quarterly proportions of female lobsters sampled by the CFRF Lobster Research Fleet bearing eggs or v-notched. The size of the point is scaled to the number of lobsters sampled.

Most of the available NEFOP observer data were from locations off the Bank; 70% of observed hauls and 78% of sampled lobsters occurred Off Bank. The observed catch was consistently female-dominated (88% of catch) with 34% of females bearing eggs (Figure 9). Modal size compositions for most months are between 100 and 110mm CL.

Distribution of Ovigerous Females

The offshore lobster fleet Harvester Logbook program documented 13,047 trap hauls. Logbooks reported lobster catch activity from Statistical Areas (SA) 464, 465, 512, 561, 562, 522, and 525. A total of 48,342 lobsters were counted, of which 19,051 were ovigerous females. The proportion of ovigerous lobsters per trap trawl is depicted in Figure 10. In general, the proportion of catch comprised of ovigerous lobsters was high on top of the eastern portions of Georges Bank (SA 561 and 562). Lower catch rates were observed on western Georges Bank (SA 522 and 525), as well as areas north of Georges Bank in SA 464 and 465.

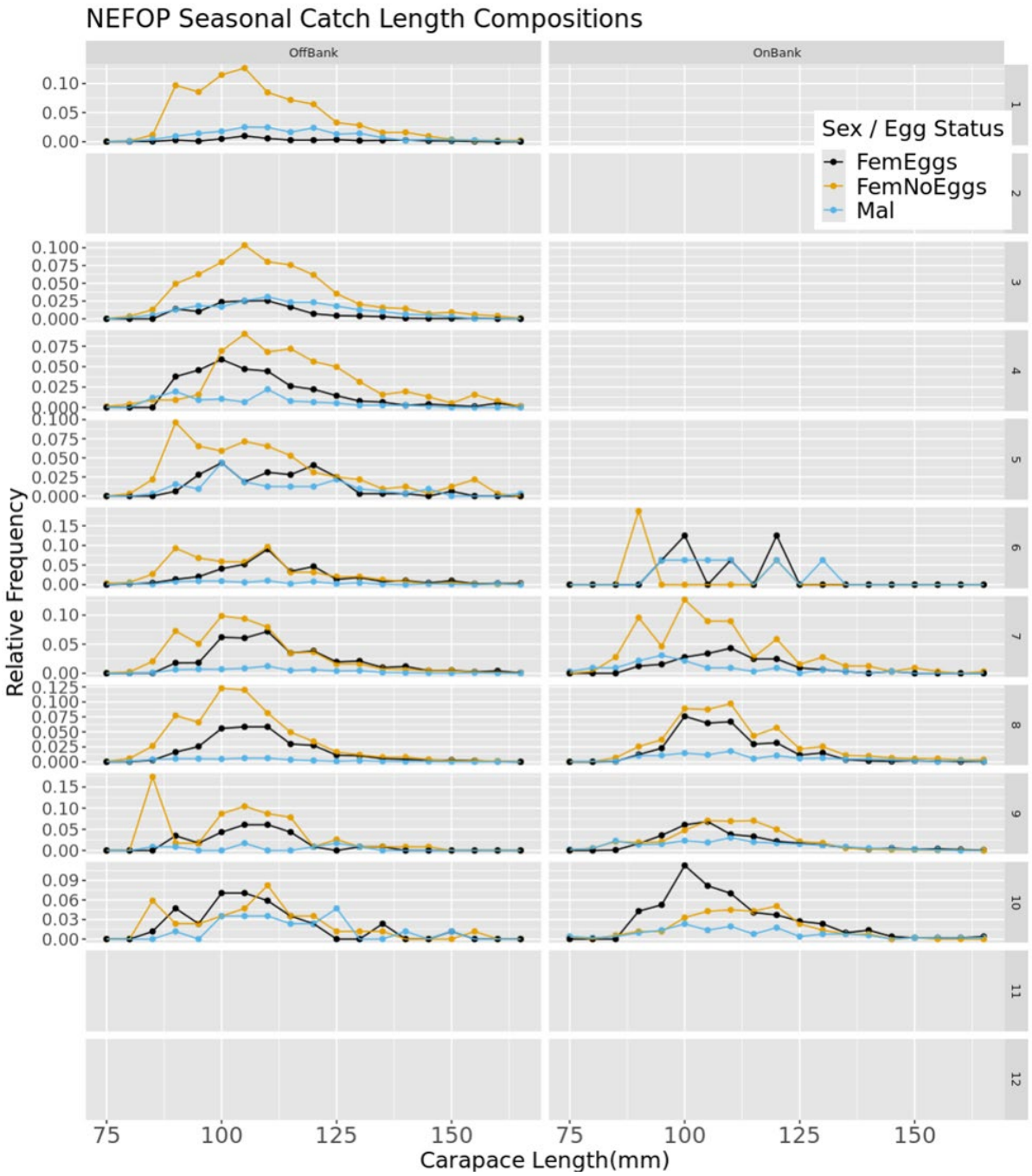

Figure 9. Monthly length compositions by sex and egg-bearing status On and Off Bank from NEFOP observer data.

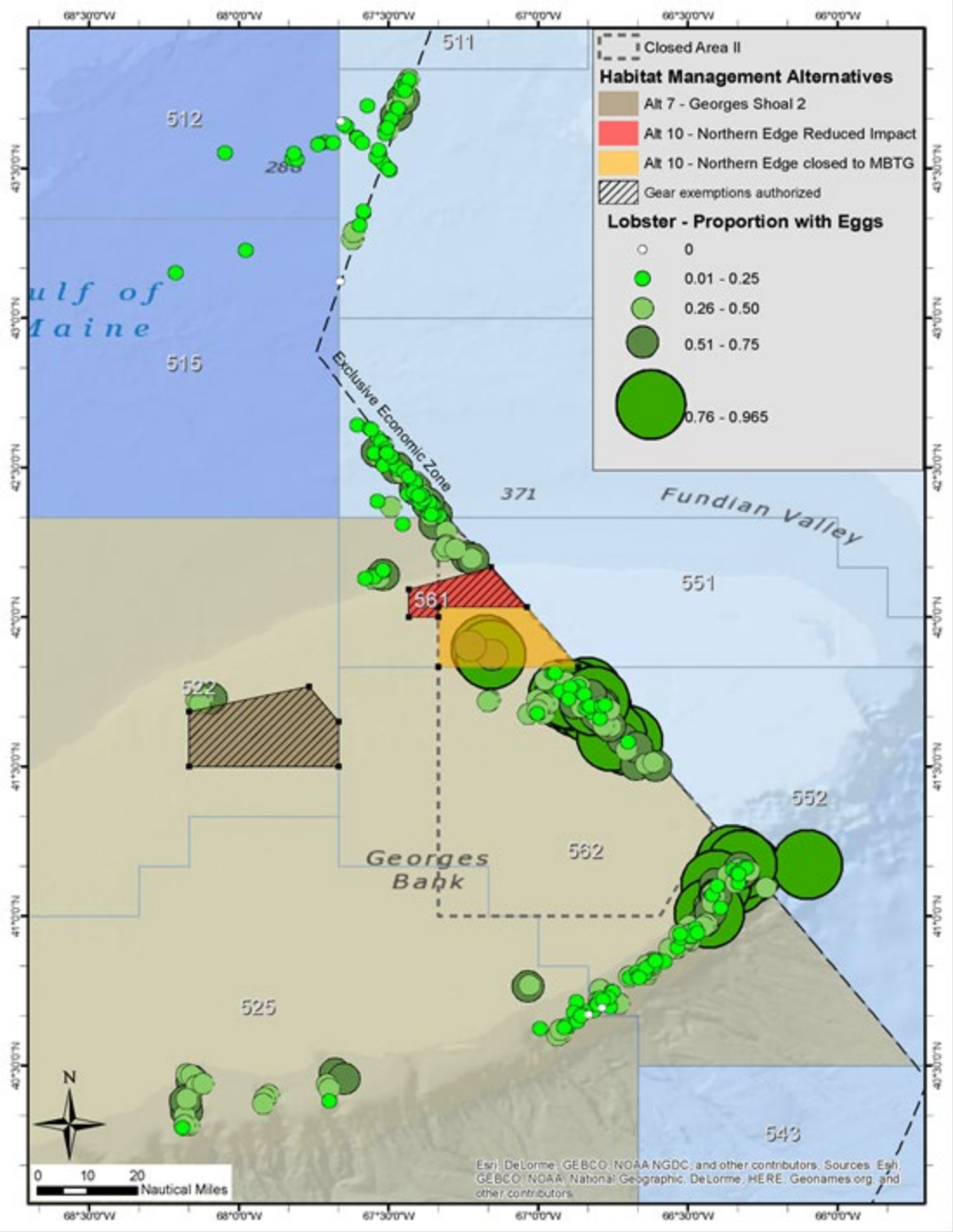

Figure 10. Distribution of ovigerous lobsters reported via industry supported logbooks, 2015. Each bubble represents the proportion of lobsters that were ovigerous from each randomly selected trawl. Plot taken from Henninger & Carloni 2016 to give general idea of spatial distribution of egg bearing lobsters throughout Georges Bank. Note, Habitat Management Alternatives are from past proposals and do not line up with most recent scallop management option.

Movement Patterns

We used release and recapture data from the AOLA tagging project to assess the potential movement of lobsters on/around the Northern Edge of Georges Bank under different management scenarios. We grouped release and recapture data for each individual lobster by the season of release to consider the seasonality of movement. Movement around Georges Bank and the area of interest is most prevalent during quarters 2 through 4, with low levels of movement in quarter 1 (Figure 11).

There are some important caveats to consider when assessing movement with passive tagging:

1) There is an industry agreement in portions of this area which doesn't allow for lobster trap fishing annually from November 1 through June 15, and thus recaptures during this closure would be low due to the lack of effort.
2) Passive tagging data are inherently biased due to spatial and temporal changes in fishing pressure. Low effort within this area in the winter months does not mean the area is devoid of lobsters, or that lobsters are not moving through the area. These methods rely on recaptures from the commercial fleet, and if effort is low recapture rates will also be low.;
3) These plots are only representative of commercial discard lobsters that were tagged and subsequently recaptured.
4) All movements are assumed straight lines from release to recapture location. While this method can give us some information as to the movement of lobsters in the area of interest, standardized surveys which are independent of commercial effort are a better method to determine seasonal use.

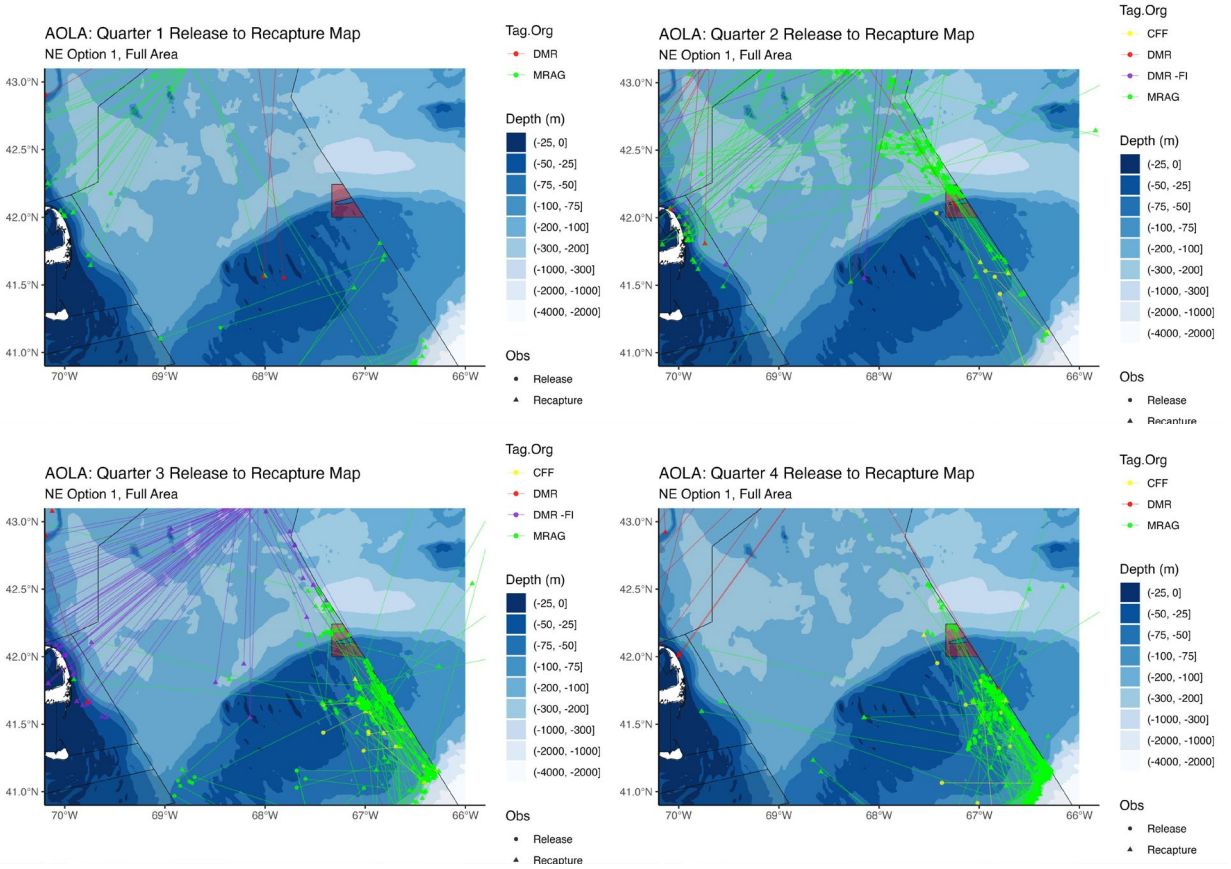

Figure 11: Spatial distribution of lobster release and recapture data grouped by quarter of release with individual path tracks mapped over NOAA's *marmap* bathymetric basemap and the Northern Edge Georges Bank Scallop Management Option 1 area.

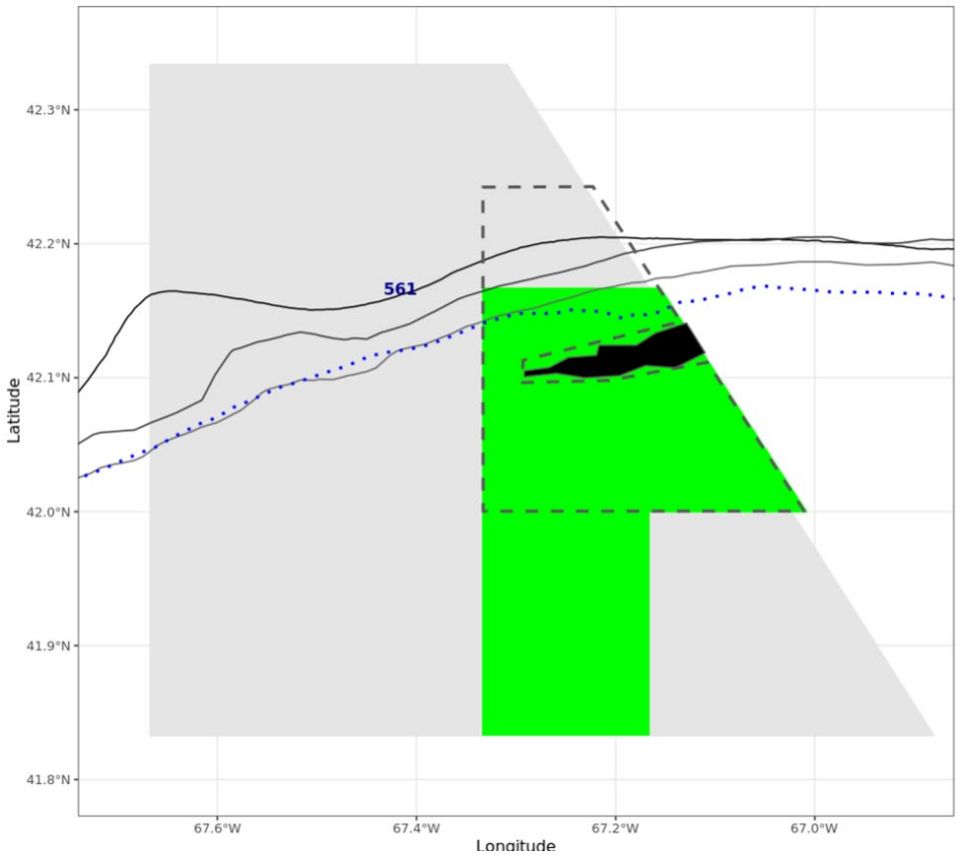

Figure 12. Extent of Statistical Area 561 (gray), the HMA (green), and delineated complex habitat (black). Isobaths of 100m, 140m, and 200m are included to illustrate the sharp change in bathymetry at the northern edge of the bank. The northern extent of the NMFS sea scallop survey strata is represented by the dotted blue line near the 100m isobath.

The spatial extent of the four scallop access areas under consideration extend off the Bank into the deeper waters (Figure 13). However, sea scallop distributions on this part of the Bank are generally constrained to depths of less than 100 m and the NEFSC scallop surveys do not sample deeper habitats to monitor the scallop resource. Thus, while the actual extent of different proposed access areas extend off the bank, we constrain the expected spatial distribution of scallop effort to within the NMFS sea scallop sampling strata and assess spatial overlap with the lobster fishery accordingly.

VTRs only have effort attributed to one location (a single latitude/longitude) but effort takes place over a larger area and supplied coordinate locations may not be accurate enough to characterize fine-scale variations in effort. Thus, we first report aggregate fishing effort information since 2013 for the entire statistical area, where we have higher confidence, and then examine landings patterns at the 10-minute square resolution, for which we have less confidence.

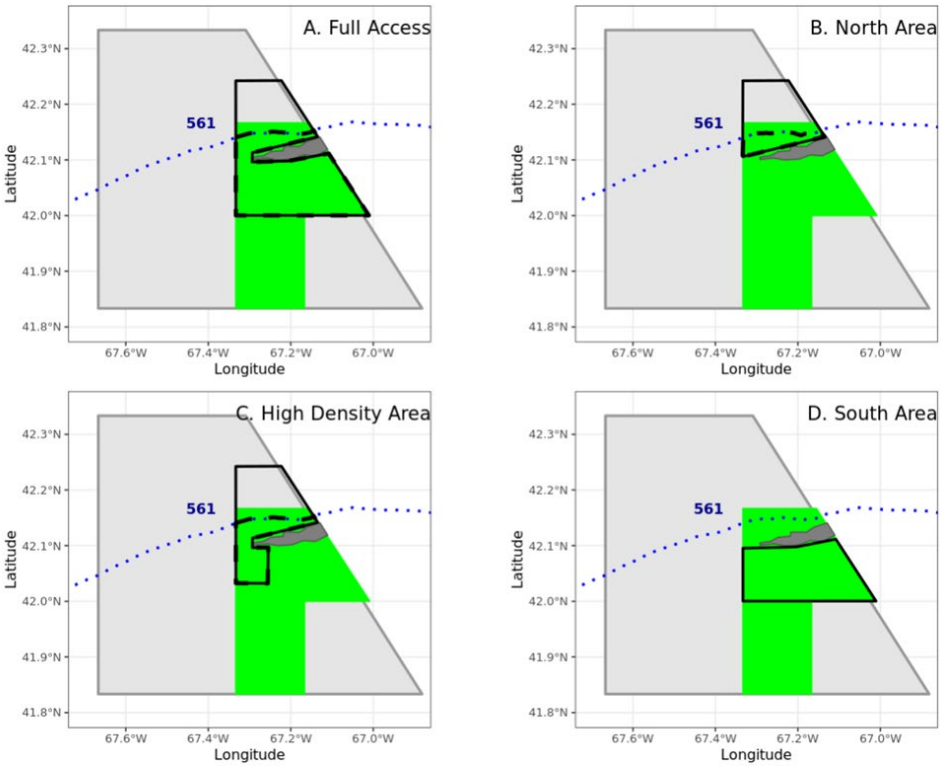

Figure 13. Extent of the alternate proposed access areas (solid black line) and trimmed to within presumed scallop habitat.

Since 2013, annual landings have averaged 740,000 lbs from 153 trip reports per year in SA 561. The number of lobster vessels reporting fishing on and off the bank vary seasonally. On average, five to six vessels have reported fishing north of the bank in the deeper waters December through July. This number then decreased during August through November (Figure 14). Conversely, peak vessel activity up on the bank happens in July through November, peaking around five vessels, then drops to near one vessel, on average, during the winter and spring months. We note that it is possible for one vessel to report fishing both on and off the bank in the same month. The seasonality of landings on the bank parallels the seasonality of vessels, being low in November through June but markedly higher in July through October (Figure 15). In contrast, landings are more constant year-round off the bank, being higher than on-bank in the winter and spring but substantially lower than on-bank during the summer and early fall.

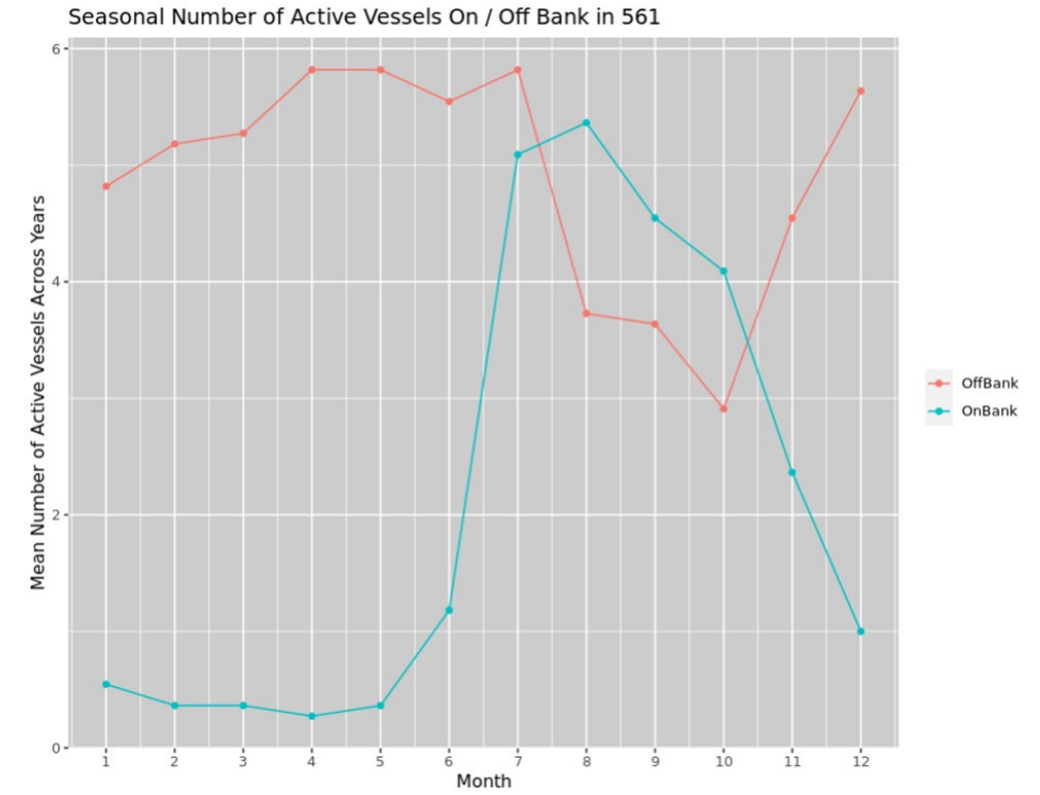

Figure 14. Seasonal average number of vessels reporting on the bank or north, off the bank, in NMFS Area 561. Note that it is possible for the same vessel to be recorded fishing both on and off the bank in the same month.

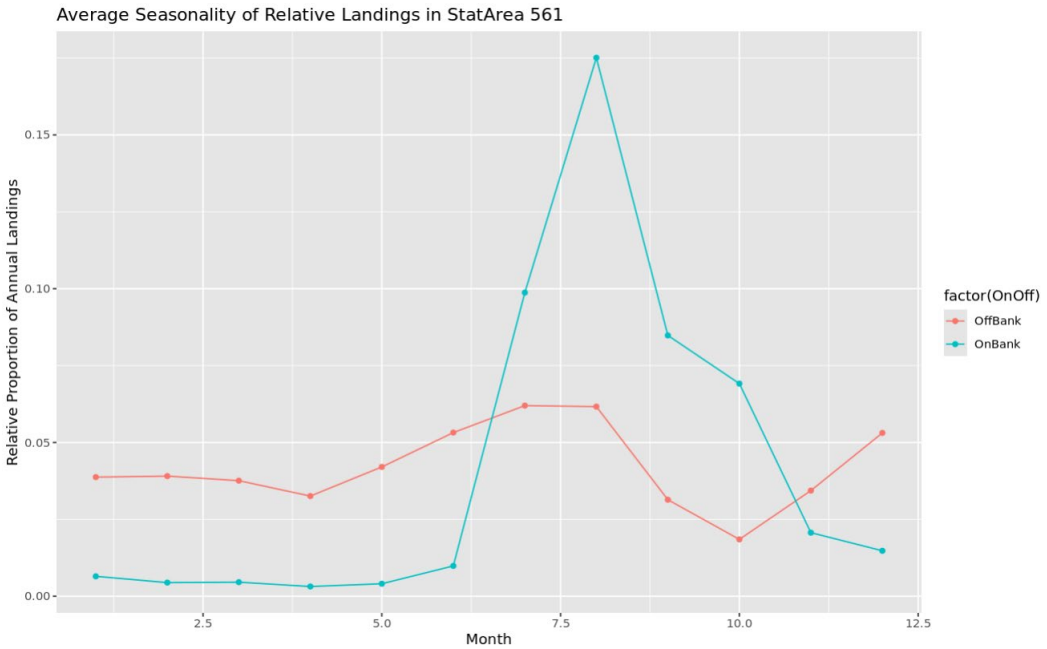

Figure 15. Seasonal average proportion of annual landings in NMFS Statistical Area 561 reported from on or off the bank by month.

This seasonal reversal of landings between off- and on-bank is evident at finer spatial scales as well (Figure 16). Higher landings are reported on the bank, south of the Full Access area in the months of July through October, where fishing in this area is much lower in the remaining months. The Full Access area alone provides a small to moderate amount of landings in these months, entailing less than 5% of the total landings for SA 561. We note that the majority of these landings are reported from the southeast portion of the Full Access area, such that the identified High Density Area represents a still smaller portion of annual landings. As always, our confidence in these low numbers is caveated by the assumption of the accuracy of the reported coordinates in the VTRs.

There is also limited spatial and seasonal data from NEFOP observer trips, mostly in 2014 and 2015, and vessels participating in the Commercial Fisheries Research Foundation (CFRF) biosampling program. While these datasets represent a small subsample of the total effort, our confidence in the spatial distribution of this effort is higher because observers record GPS coordinates for each individual observed haul. Maps from these two data sources are not presented to preserve confidentiality but both support the seasonal and spatial patterns reported above from the VTR data.

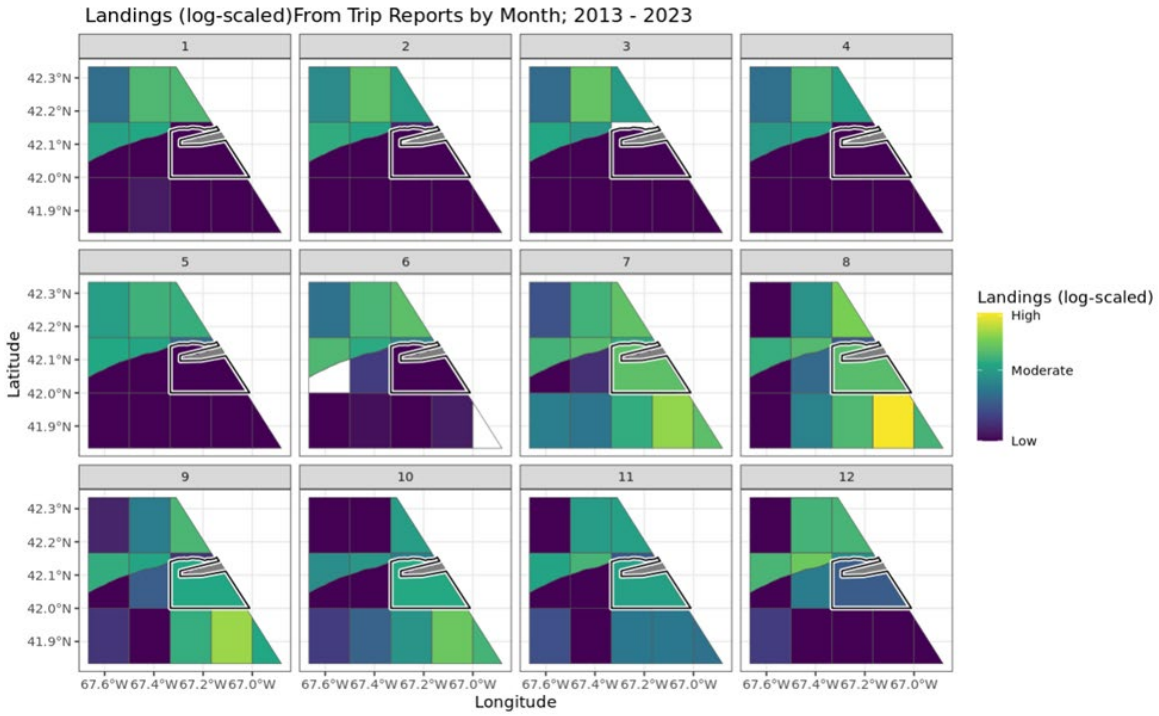

Figure 16. Monthly average seasonal landings for ten-minute squares, split between on- and off-bank. The Full Access extent is highlighted in the center left of each panel.

Results: Impact of scallop dredge gear to lobsters

Previous literature suggests that mobile gear, particularly dredge gear, can cause physical damage to lobsters, particularly those that have recently molted and have not hardened the shell completely. However, much of that work was conducted in inshore waters, where lobsters are much smaller than those observed on Georges Bank. To understand if/how larger lobsters are physically impacted by scallop dredge gear, we examined the full dataset from CFF (2012-2023, all tows).

Overall, 34.3% of all females (n=2060) and 46.3% of all males (n=216) had damage classified as 'lethal,' while 28.4% of females and 22.7% of males had moderate damage (Figure 17). Fifty-six percent of the females observed had eggs, and egg-bearing females seemed to be less damaged by the gear than non-ovigerous females; 45% of egg-bearing females had no damage while only 27% of non-egged females showed no damage. Females with eggs very likely had very hard, old shells, given that spawning typically occurs a year after molting. Lobsters that had recently molted were particularly vulnerable to lethal damage; 72.7% of those coded as soft or paper-shelled had lethal damage compared to 33.5% of hard-shelled lobsters.

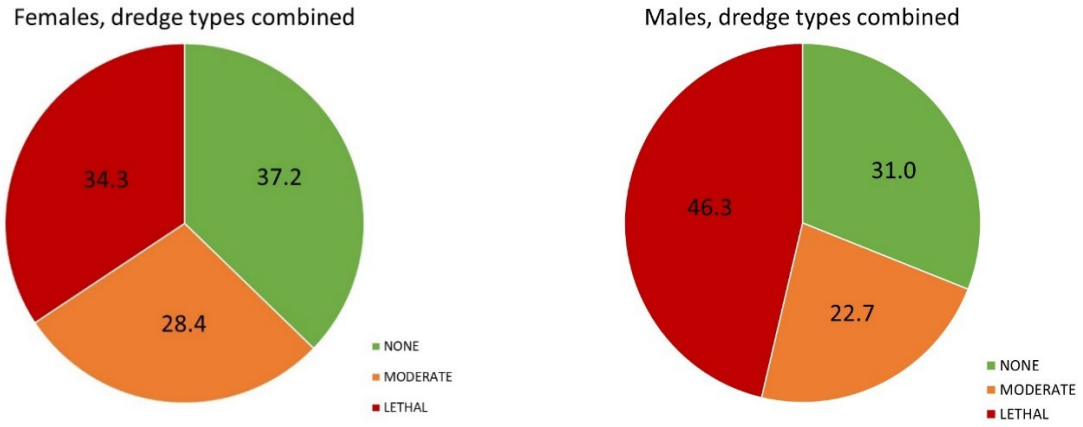

Figure 17. Overall damage rates (% of the catch) for female and male lobsters caught in the CFF scallop dredge bycatch survey (years and dredge types combined). N females = 2,060. N males = 216.

We also explored statistical models to examine the influence of size and shell hardness on damage. Model results were used to predict the probability of lobsters exhibiting major or lethal damage, where lethal damage represents a more severe subset of major damage.

We found that shell hardness was the most important predictor of damage, followed by egg-bearing status and carapace length (Figure 18). "Hardshell" lobsters were the least likely to exhibit major or lethal damage. Females with eggs were less likely to exhibit damage than males or females without eggs, which may also be a proxy for shell hardness as egg-bearing females presumably had molted at least a year prior. Probability of damage also increased above about 110mm CL, and 78% of all lobsters observed were larger than 110 mm. The lowest damage rates are predicted to occur in hardshelled eggers less than 100mm CL with rates of about 25% and 60% respectively for lethal and major damage. In contrast, a similarly sized lobster with a paper shell is predicted to experience lethal or major damage at rates of about 70% and >90%, respectively.

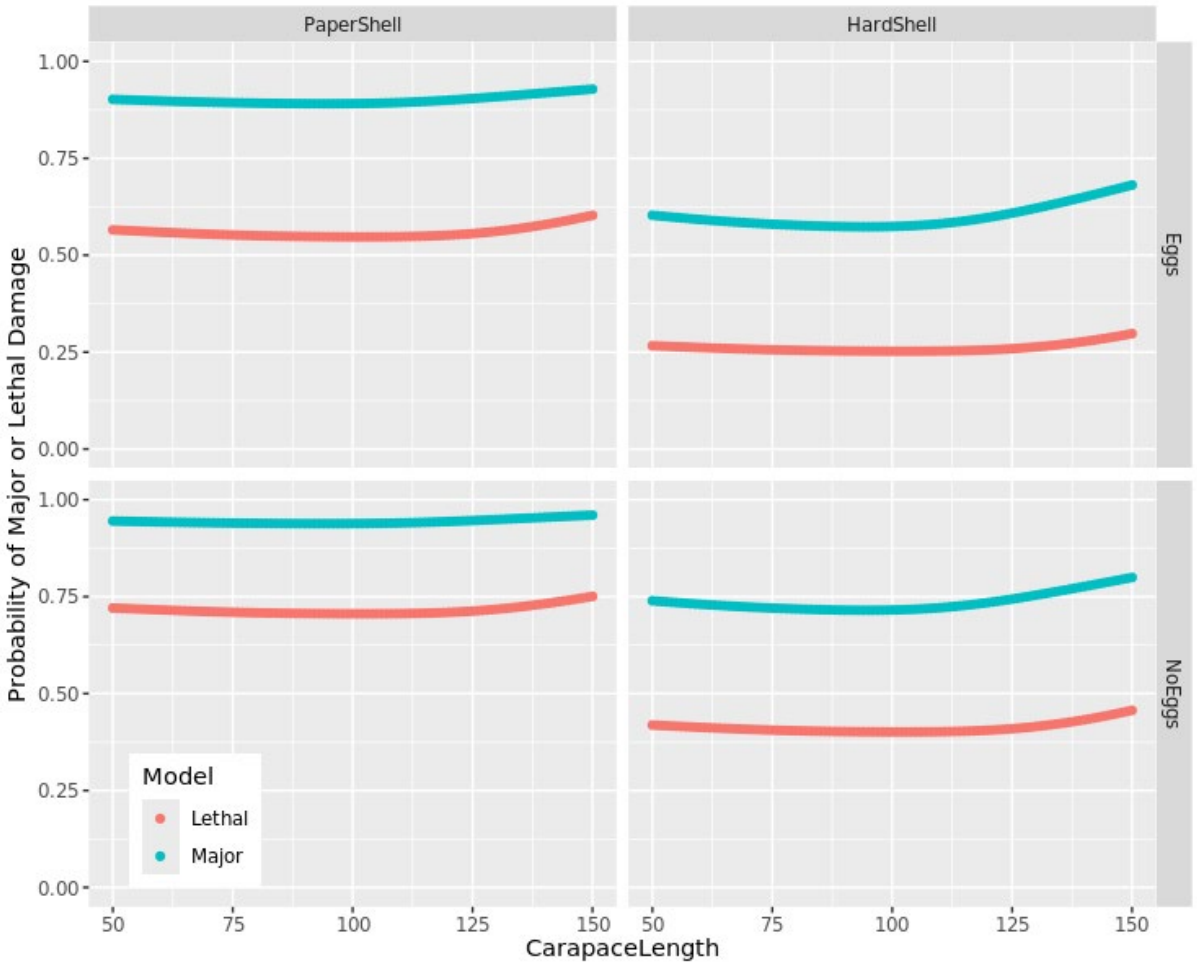

Figure 18. Probability of lobsters exhibiting major or lethal damage as observed in the CFF Seasonal Bycatch Survey.

Summary and Conclusions

Overall, the data indicate that although lobsters are present on top of George's Bank year-round, numbers are much higher in the late summer into fall. This is particularly true for large females. There are also good indications of large aggregations of egg-bearing females on top of the Bank, in and immediately south of the HMA in the late summer and fall. Industry data show consistently female-skewed sex ratios and catch that is comprised of large lobsters, mostly over 100 mm CL. Based on VTR data, moderate levels of fishing activity occur from July through November in the HMA, overlapping with the proposed scallop access options. In general, lobster fishing on top of the Bank is relatively important to the annual landings reported from NMFS Area 561.

In addition to the analyses described here, the TC has discussed the use of newly required tracking data from the lobster fleet to characterize the impacts to the lobster fishery that could result from opening this area to lobster gear. At this time, tracking data are extremely limited, given that only MA vessels were deployed in 2023 and NH vessels, which likely comprise a much larger component of the activity in the region, only have 1 month's of data available. Additionally, during the first year of data collection, there were known issues with several of the devices, creating gaps in the already limited data. With the incomplete data available at present, we can corroborate that the area is being used by lobster vessels.

However, until a year or more of data from the entire fleet are available, the tracking data cannot be used to quantify impacts.

The above results compiled from readily available data sources are consistent with existing information in the scientific literature. Several studies have shown that adult lobsters tend to exhibit seasonal movement patterns, migrating to deeper water in the colder months and to shoal waters in the warmer months (Cooper and Uzmann 1971; Krouse 1973; Campbell and Stasko 1986; Campbell 1986). Additionally, shoal areas with access to adjacent deep-water like Georges Bank appear to be particularly attractive to egg-bearing lobsters, and aggregations have been reported throughout the species range in areas with these bathymetric characteristics (Campbell and Pezzack 1986, Campbell 1990, Henninger and Carloni 2016, Carloni and Watson 2018, Carloni et al. 2021). These areas are likely attractive due to warm shallow water in the spring/summer months to brood eggs, and nearby deep calm water in the colder months for overwintering. There are still some unknowns regarding where larvae hatched in these areas are transported and eventually settle, however there is some evidence they could be retained on Georges Bank (Harding et al. 2005), or similar to Brown's Bank there may be transport to inshore Gulf of Maine (Harding & Trites 1987). Additional research is needed on this topic, though the high abundance of large (> 100mm CL) highly fecund lobsters on Georges Bank removes any doubt of the importance of this segment of the population to continued sustainability of the resource.

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