Fisheries and Oceans Canada / Pêches et Océans Canada

NOAA FISHERIES
NATIONAL MARINE FISHERIES SERVICE

CERT

Comité d'évaluation des ressources transfrontalières

Document de travail 2014/23

Ne pas citer sans
autorisation des auteurs

TRAC

Transboundary Resources Assessment Committee

Working Paper 2014/23

Not to be cited without
permission of the authors

The August 2013 Flatfish Survey on Georges Bank

Michael Martin and Christopher M. Legault

National Marine Fisheries Service
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02556

Ce document est disponible sur l'Internet à :

This document is available on the Internet at :

http://www.mar.dfo-mpo.gc.ca/science/TRAC/trac.html

Canada

ABSTRACT

A pilot flatfish survey was conducted on the US portion of Georges Bank during August 2013 with a goal of providing a population estimate for yellowtail flounder in this region. This survey was designed and conducted with the fishing industry using two commercial vessels and a net designed to catch yellowtail flounder. Fishermen classified the region into two strata: one expected to have high densities of yellowtail flounder and the other expected to have low densities of yellowtail flounder. Stations were randomly assigned within these strata, with the high density stratum allocated more stations. The high efficiency trawl could not be fished everywhere on Georges Bank, so some stations were moved during the survey. Results showed much higher catch rates in the high density stratum than in the low density stratum, with some heterogeneity within each stratum. Catch rates within the high density stratum generally increased from south to north and from west to east and were generally higher at night than during the day. Size and age distributions were similar in the two strata and similar to the NEFSC 2013 fall survey, despite the latter catching many fewer yellowtail flounder. Estimation of the yellowtail flounder population for the entire Georges Bank region requires estimating the proportion of the population on the Canadian side of the bank and the catchability of the net. The authors suggest a reasonable range of possible values is 4,000 mt to 10,000 mt, with higher likelihood of being closer to the lower end of the range than the upper end of the range.

Introduction

In August 2013, the Northeast Fisheries Science Center, with cooperation of the fishing industry, conducted a pilot flatfish survey on Georges Bank. Survey planning meetings were held June through August 2013 with fishermen, net manufacturers, and NMFS scientists. The goal of these meetings was to define the stratification of the survey, the gear to be used, and the trawling protocols to allow the best possible estimate of yellowtail flounder biomass, in particular, on Georges Bank. The survey was conducted in August 2013 using two commercial vessels using the agreed stratification, gear, and protocols. A Resource Survey Report describing the towing locations and catches of yellowtail flounder and winter flounder was released in December 2013 (available at http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/rsr/coop/coop_gbffsurvey_2013/large_file.pdf). This paper describes the survey in more detail and expands the catch rates to estimate the total biomass of yellowtail flounder within the survey area. Relationships between catch rates and other factors such as depth and bottom temperature are also presented.

Methods

The survey area was limited to the US portion of Georges Bank due to an inability to conduct the survey using commercial vessels on the Canadian side of Georges Bank. The survey area was stratified into two high density areas and the rest was considered a low density area based on discussions with fishermen (Fig. 1). These two strata were defined using a three by three nautical mile grid which was overlaid on the study area. There were 925 grid cells total, with 168 in the high density stratum and 757 in the low density stratum.

Prior to the survey, an attempt was made to distinguish towable versus untowable grids using bottom type classifications from Harris and Stokesbury (2010). These authors used video observations to classify the bottom type as sand, pebble, cobble, or boulder. A grid was classified as untrawlable if there was any boulder or cobble present within the grid or if there was >50% pebble. This reduced the number of grids from 925 to 619 trawlable, with most of the reduction in the low density stratum (Table 1; Fig. 2).

An initial random allocation of 150 stations was made in each stratum, with a much higher density of sampling within the high density stratum (89 stations) than in the low density stratum (61 stations; Fig. 3). This emphasis on the high density stratum was made to reduce the overall variance and to ensure that the areas identified by fishermen as likely to exhibit high catch rates were adequately sampled.

The trawl used in this survey was previously used in the yellowtail flounder cooperative research survey during 2003-2005 (Valliere and Pierce, 2007). It is a two-seam, two-bridle flounder net. The sweep has 4” rubber cookies. The gear uses 20 fathom bridles with 5 fathom extensions. There were two modifications to improve catch of smaller fish: 1) the mesh size in the lower wings and first bottom belly was reduced from 20 cm to 12 cm and 2) a 1” codend liner was used. The doors used in this study were 84 inch 734 kg

Thyboron type IV. A 23 fathom restrictor wire between the doors was used to ensure consistency in door spread. This gear was designed specifically to have high catchability of yellowtail flounder and consistent net opening to improve the estimation of yellowtail flounder abundance in the study area. The choice of gear limited the area that could be fished though, as harder and rockier bottom could not be sampled (see below).

The survey was conducted August 15-26, 2013 using two vessels, Mary K and Yankee Pride. Survey operations were conducted around the clock. The trawling protocols called for 20 minute tows (starting at winch lock) at a speed of 2.8 kts (2.6 – 3.0 kts were acceptable). The scope ratio was 4:1 for all depths. The captain of the vessel was allowed to select the specific tow path within a selected grid, but at least 75% of the tow was required be in the specified grid cell. If a given grid cell was determined by the captain to be not trawlable, or if a successful tow could not be made within the grid cell, then the station was moved to the nearest unoccupied grid cell in the correct stratum. Door spread was measured using a Simrad ITI system aboard the Yankee Pride. Temperature and depth were collected at three second intervals using a Seabird SBE39.

Once a tow was brought on board, both yellowtail flounder and winter flounder were sorted and weighed and everything else was returned to the water as quickly as possible. If less than 150 fish of either species was caught, all the fish were measured for length. For larger catches of either species, a random subsample of 150 fish was measured for length. Scale samples for ageing yellowtail flounder were collected using the standard NEFSC bottom trawl sampling protocols.

After one week it was clear the 150 initially allocated stations would be completed before the end of the survey. The decision was made to add 25 more random stations (Fig. 4). For logistic purposes, the remaining tows at this time were assigned to the two vessels to allow completion of these stations in the most efficient pattern. This decision was made based on observations of consistent door spreads (41-42 m) under the assumption that the catch rates of the two vessels would be similar. However, this decision resulted in some differences in mean catch rates between the two vessels that would not be expected had all tows been randomly assigned to the vessels (see below).

Catch rates by stratum were expanded to area swept calculations based on the footprint of the tow relative to either the total survey area or the towable survey area. The time the net was fishing on the bottom was estimated from the SBE39 depth data. Distance fished for each tow was estimated from smoothed global positioning satellite data. The mean door spread was measured from spread sensor data, or estimated from other tows when the door spread data were unavailable for that tow. Distance fished multiplied by mean door spread resulted in the area swept estimate of each tow. Catch per tow was standardized to the same footprint and expanded to either the total or trawlable area. Standard stratified random variance calculations were used to estimate the uncertainty in the total population estimates.

Results and Discussion

There were a total of 169 stations successfully sampled, 103 in the high density stratum and 66 in the low density stratum (Fig. 5). This represents sampling of 69% and 14% of the available grids in the high and low density strata respectively, with 27% of the available grid cells sampled overall. Catch rates were higher in the high density stratum than in the low density stratum, as expected (Table 2; Fig. 6). Expansion of these catch rates to the entire survey area resulted in approximately equal portions of the yellowtail population in the two strata and estimates of total biomass of 3,760 mt and 10.58 million fish (Table 3). Expansion of the catch rates to the trawlable area only caused the proportion of yellowtail to be lower in the low density stratum than high density stratum and resulted in estimates of total biomass of 2,846 mt and 7.93 million fish (Table 4).

Catch per tow varied by vessel within the low density stratum but not within the high density stratum (Fig. 7). Analysis of variance (ANOVA) found significant differences at the 5% level between low and high density strata and between vessels within the low density stratum but not between vessels within the high density stratum. The difference by vessel within the low density stratum is due to the Yankee Pride having a few catches similar to those in the high density stratum. These large catches by the Yankee Pride in the low density stratum occurred mostly in grid cells adjacent to the high density stratum due to either low density stations being moved or to the re-allocation of stations by vessel when it appeared the survey would end early (Figs. 4-6). This indicates that the stratum designation may not be sufficient and in this case cause the population estimates for the low density stratum to be biased high. The differences by vessel are not thought to be an indication of catchability differences, but rather simply a result of the locations that were sampled by the two vessels having different densities of yellowtail flounder.

A sensitivity analysis was conducted to demonstrate the importance of this boundary placement on the population estimates. The 12 grid cells (11 of which were towable) along the northern and western boundary of the high density stratum in Closed Area II were artificially re-assigned from the low density stratum to the high density stratum. This increased the mean catch rate of yellowtail in the new high density stratum and decreased the mean catch rate of yellowtail in the new low density stratum. These changes in catch rate and size of the stratum resulted in 8-9% increase in population estimates in the high density stratum, 34-44% decrease in the low density stratum, and 10-17% decrease in the total population (Table 5).

In the high density stratum, catch per tow (kg) increased from south to north and from west to east (Fig. 8). This indicates there is an additional source of heterogeneity within the stratum, which impacts the variability of the estimated mean for the stratum. The mean catch rate could be biased high or low depending on the relative sampling rate of the higher catch regions relative to the lower catch regions within the high density stratum.

Catch per tow (kg) was generally higher during the night than during the day but did not appear to be strongly impacted by temperature (Fig. 9). However, the largest catch occurred close to noon and low catches occurred around the clock. The temperatures observed during this survey (7-16 degrees C) demonstrate that yellowtail flounder can withstand large temperature changes seasonally because NMFS spring survey temperatures associated with yellowtail flounder catch are much lower (3-6 degrees C; Helser and Brodziak, 1996).

The length distributions of yellowtail flounder caught in the two strata were similar (Fig. 10). The only notable difference occurred in the 38-42 cm length bins where the high density stratum was larger than the low density stratum. The largest yellowtail flounder observed was in 48 cm and was located in the low density stratum.

A total of 993 yellowtail flounder were aged from the flatfish survey (Table 6). Application of age-length keys for each stratum resulted in similar age distributions by strata (Fig. 11). The oldest yellowtail flounder found in the high and low density strata were seven and six years old, respectively. Calculation of total mortality for yellowtail flounder ages four and older for each stratum using catch curves produced estimates of 2.0 and 2.5 for the high and low density strata, respectively.

The NEFSC fall survey is conducted on Georges Bank in October. The 2013 fall survey value continued a decline seen for the past few years (Fig. 12). The total number of yellowtail flounder caught during the 2013 NEFSC fall survey was much lower than the number caught during the flatfish survey (Table 6). Despite the much lower number of fish sampled, the NEFSC fall 2013 survey produced a similar length and age distribution to that from the flatfish survey (Figs. 13-14). The NEFSC fall survey was conducted over the entire Georges Bank, including Canadian waters, using a stratified random sampling design.

The flatfish survey was conducted only in US waters of Georges Bank. Expansion of the population estimates to account for the Canadian waters on Georges Bank can be done in a number of ways. One approach is simply to expand the total estimates based on the proportion of Georges Bank in Canadian waters (20%) using the equation All = US / (1-Can). This converts the population biomass estimates for the US total and US trawlable from 3,760 mt and 2,846 mt to 4,700 mt and 3,558 mt, respectively. An alternative approach is to use the US/Canada sharing agreement approach of averaging the fraction of yellowtail biomass on each side of the Hague Line from the three bottom trawl surveys (Stone et al. 2012). In 2011, the most recent year available, the fraction of yellowtail biomass in Canadian waters was 14%, resulting in total Georges Bank estimates of 4,372 mt and 3,309 mt for the original total and trawlable US areas. The US/Canada sharing agreement uses a lowess smooth of the mean survey proportions when making the allocations. For 2011, this resulted in 63% on the Canadian side, which results in estimates of 10,162 mt and 7,692 mt for the US total area and US trawlable area. When this smoothed survey proportion was updated in 2013, the 2012 value was 20% in Canadian waters, demonstrating that even the smoothed values can be quite unstable. Another option for estimating the proportion of yellowtail biomass on the Canadian side of Georges Bank is to use the catches from the two countries which have averaged 11% Canadian (range 5-19%) over the past five years. This approach results in entire Georges

Bank estimates of 4,225 mt and 3,198 mt for the expansions from the total and trawlable US areas, respectively.

The final issue to address for using the flatfish survey data to estimate the total population of yellowtail flounder on Georges Bank is the catchability of the gear. A study to examine the relative efficiencies of this trawl, the standard bottom trawl used in the spring and fall bottom trawl survey on the Bigelow, and HabCam, an underwater imaging system used on scallop surveys performed by the NEFSC. The study plan called for the derivation of three separate estimates of abundance, two from the side-by-side towing of this net with the Bigelow net, and a third from transects performed with the HabCam vehicle. This study was not performed as scheduled due to the federal government shutdown in October 2013, but has been tentatively rescheduled for October 2014. In the meantime, there is no reliable method to accurately estimate gear efficiency. Although the bridles used during the survey were much shorter than those typically used by commercial fishermen, some herding by the bridles almost certainly occurred. There was almost certainly some escapement under the cookie sweep, even though this net was designed to catch yellowtail flounder. Since door spread was used, the gear efficiency was likely less than one, but we currently have no way to estimate the actual value. The population estimates will increase by a factor of 1/gear efficiency should good estimates of this value become available.

Conclusions/Summary/Recommendations

Despite the steps taken to standardize the fishing gear, and the relatively large number of stations sampled in this survey, the inability to sample in Canadian waters, and unknown gear efficiency preclude accurate estimates of the yellowtail flounder population on Georges Bank in August 2013. The authors feel a reasonable range of possible values is 4,000 mt to 10,000 mt, with higher likelihood of being closer to the lower end of the range than the upper end of the range. Refinement of this estimate may be possible after the results of the gear efficiency planned for fall 2014 are known.

Given this inability to accurately estimate population size and the fact that the size and age distribution of the flatfish study closely matched the results from the fall bottom trawl survey, there do not appear to be any compelling reasons to conduct future dedicated flatfish surveys on Georges Bank. The large expense of conducting a flatfish specific survey cannot be justified given these results.

Literature Cited

Harris, B.P. and K.D.E. Stokesbury. 2010. The spatial structure of local surficial sediment characteristics on Georges Bank, USA. Cont. Shelf Res. 30:1840-1853.

Helser, T.E. and J.K.T. Brodziak. 1996. Influence of temperature and depth on distribution and catches of yellowtail flounder, Atlantic cod, and haddock in NEFSC bottom trawl surveys. Northeast Fisheries Science Center Reference Document 96-05e. 24 p.

Stone, H.H, L. O’Brien, and L. Van Eeckhaute. 2012. Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2013. TRAC Ref. Doc. 2012/06. 25 p.

Valliere, A. and S. Pierce. 2007. Southern New England industry-based yellowtail flounder survey, 2003–2005. Pilot Study Report. Retrieved from http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/ytibsrpt.pdf.

Tables

Table 1. Number of trawlable and untrawlable grids within the study area.

Stratum	Trawlable	Untrawlable	Total
High Density	150 (89%)	18 (11%)	168
Low Density	469 (62%)	288 (38%)	757

Table 2. Mean catch per tow (pounds) by stratum.

Stratum	Mean	Maximum
High Density	58.7	808.7
Low Density	13.0	178.3

Table 3. Expanded population estimates for yellowtail flounder in metric tons and millions of fish for the entire survey area.

Stratum	biomass (mt)	min biomass (mt)	max biomass (mt)	population (millions)	min population (millions)	max population (millions)
high density	1,888	1,256	2,519	5.05	3.49	6.61
low density	1,873	617	3,128	5.53	1.86	9.19
Total	3,760	2,353	5,168	10.58	6.59	14.56

Table 4. Expanded population estimates for yellowtail flounder in metric tons and millions of fish for the estimated trawlable survey area only.

stratum	biomass (mt)	min biomass (mt)	max biomass (mt)	population (millions)	min population (millions)	max population (millions)
high density	1,685	1,121	2,249	4.51	3.12	5.90
low density	1,160	382	1,938	3.42	1.15	5.69
Total	2,846	1,883	3,808	7.93	5.27	10.60

Table 5. Sensitivity analysis for placement of northern and western boundary of high density stratum within Closed Area II.

Estimate	Stratum	Original	New Boundary	Relative Change
Population	High Density	5.05	5.46	8%
(millions)	Low Density	5.53	3.67	-34%
Entire area	Total	10.58	9.13	-14%
Biomass	High Density	1,888	2,056	9%
(mt)	Low Density	1,873	1,052	-44%
Entire area	Total	3,760	3,108	-17%
Population	High Density	4.51	4.88	8%
(millions)	Low Density	3.42	2.25	-34%
Trawlable	Total	7.93	7.14	-10%
Biomass	High Density	1,685	1,839	9%
(mt)	Low Density	1,160	647	-44%
Trawlable	Total	2,846	2,486	-13%

Table 6. Comparison of the flatfish survey conducted in August 2013 and the NEFSC fall bottom trawl survey conducted in October 2013 on Georges Bank.

	Flatfish	Fall
Nvessels	2	1
Nstrata	2	9
Ntows	167	56
Npos	134	24
YT #	8432	305
YT kg	3107	105
smallest YT	18	6
largest YT	48	46
youngest YT	1	0
oldest YT	7	6
Naged	993	177

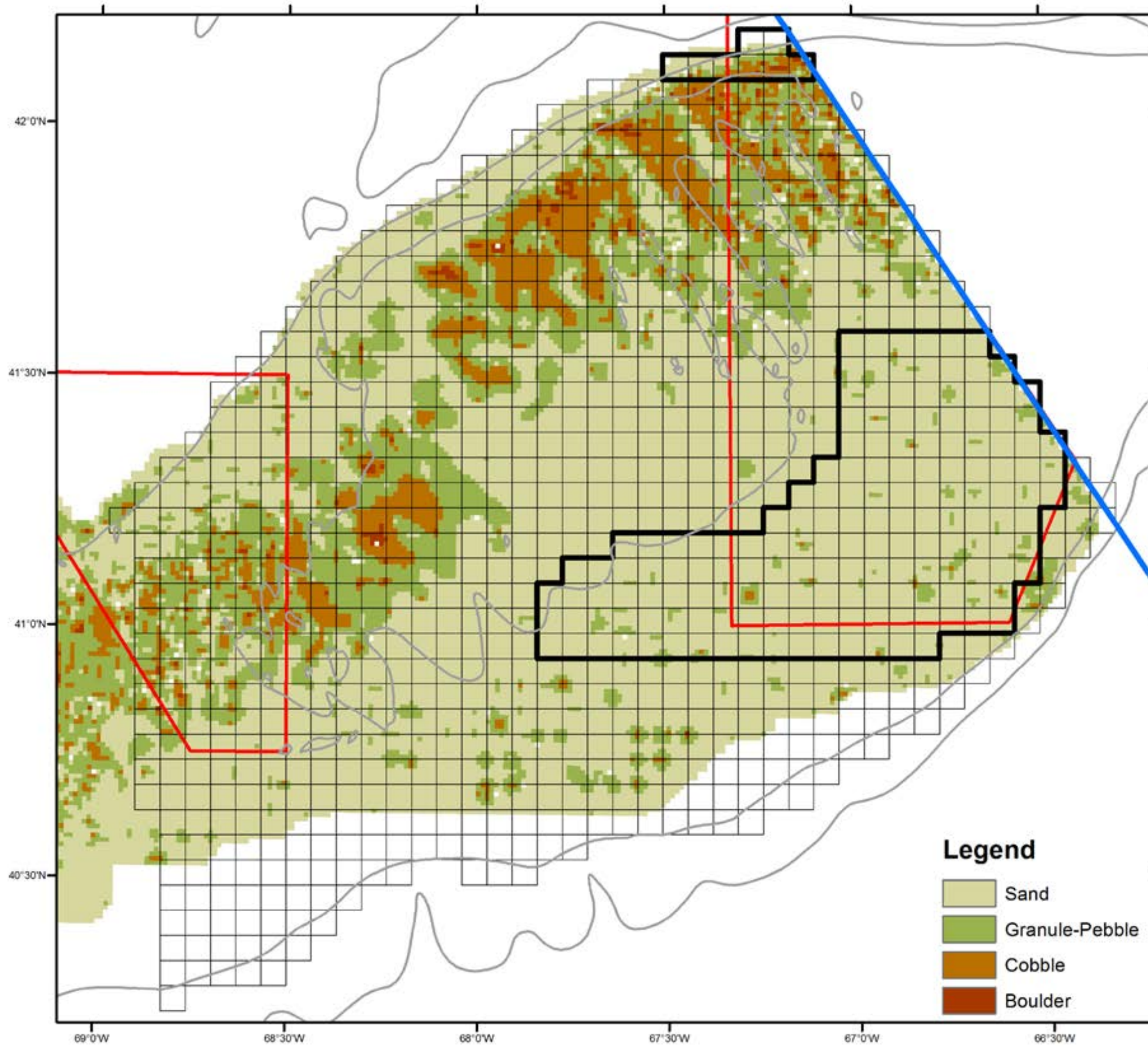

Figure 1. Survey area with stratification. High density areas are outlines in dark black lines. Closed Areas are denoted by red lines. Grey squares denote 3 by 3 nautical mile squares which were used to randomly assign station locations. The estimated sediment types are from Harris and Stokesbury (2010).

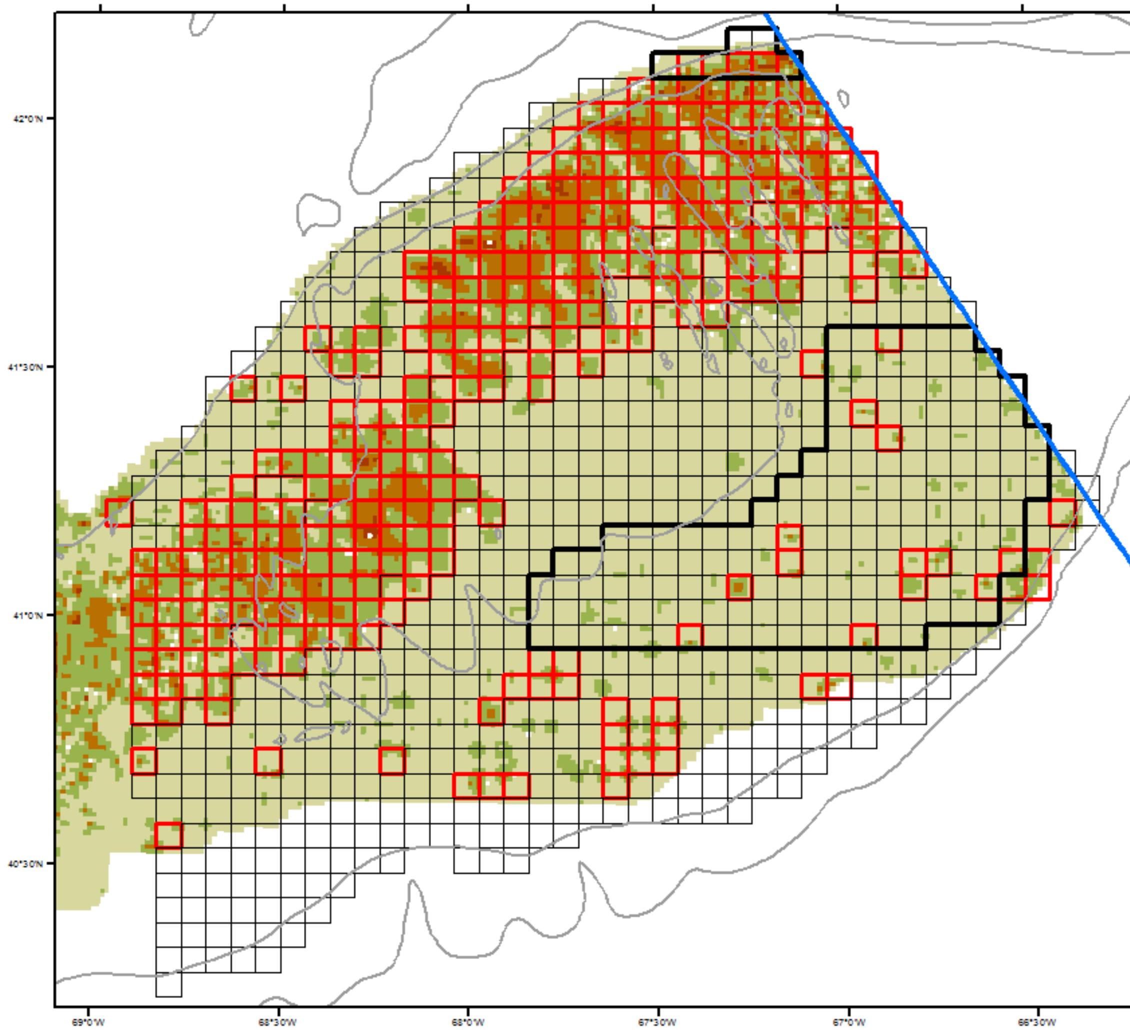

Figure 2. Location of grid cells estimated to be untrawlable, denoted by red outlines.

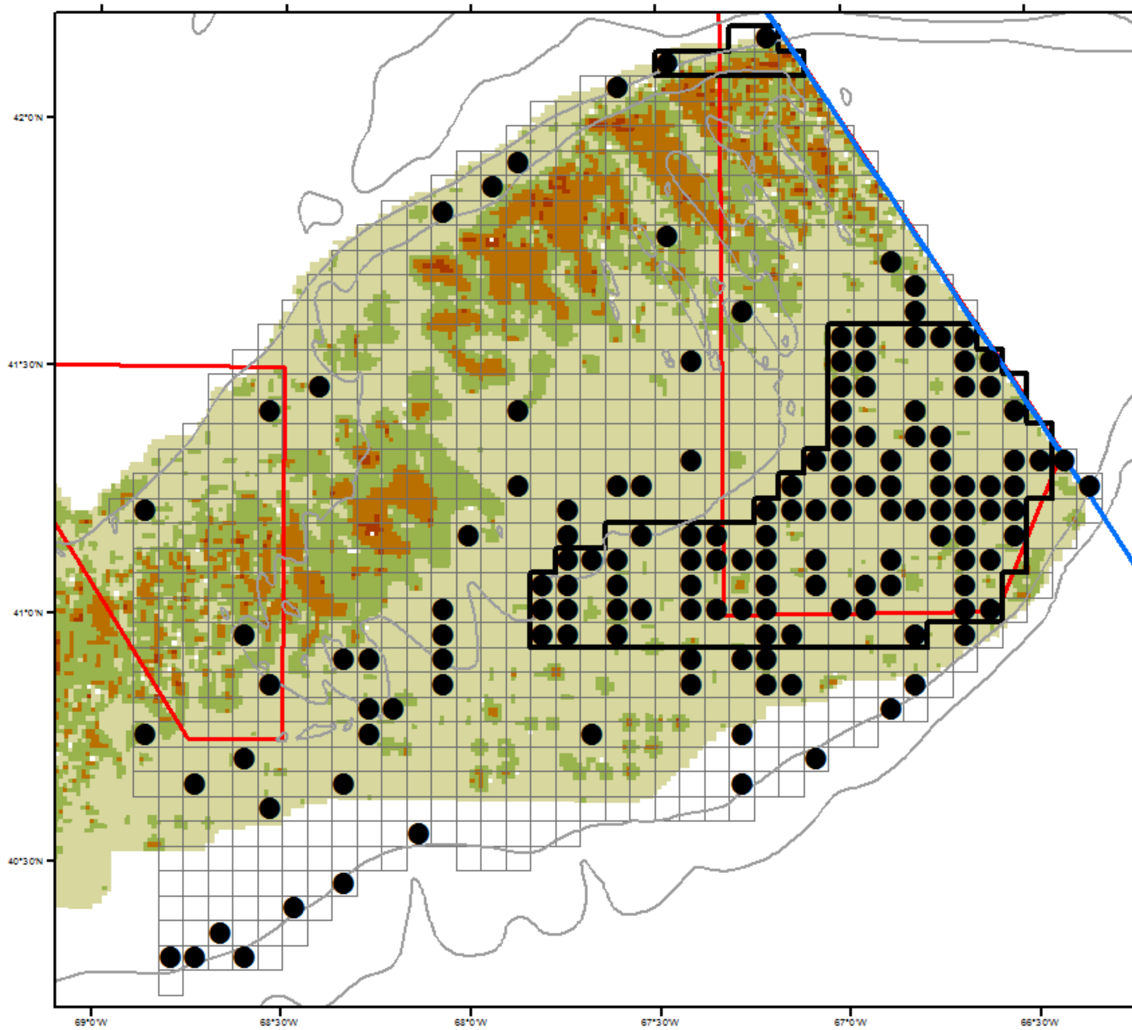

Figure 3. Original location of tows randomly selected within each stratum.

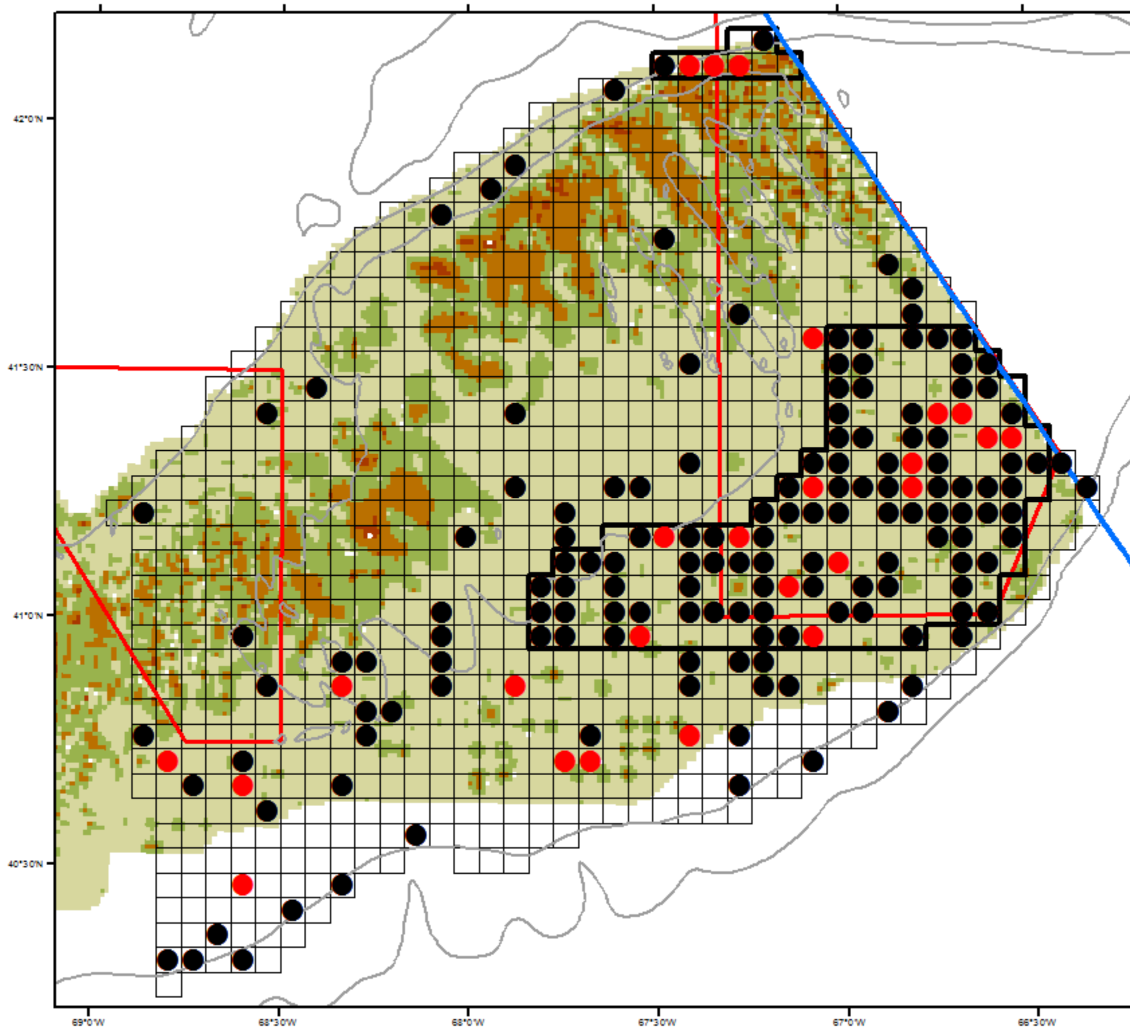

Figure 4. Location of added stations, denoted by red circles, relative to the original station allocations, denoted in black circles.

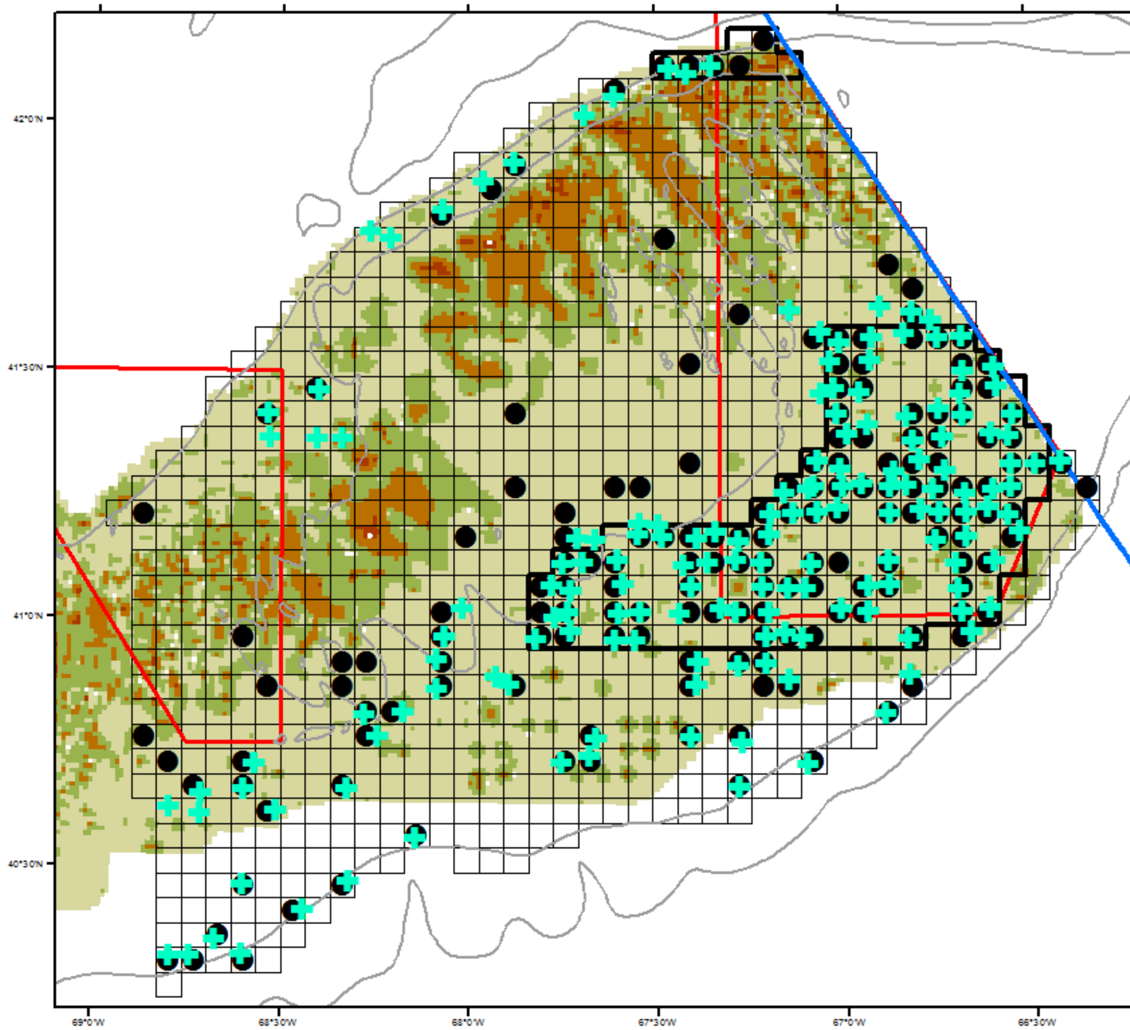

Figure 5. Midpoints of successful tows, denoted by blue crosses, and original tow locations, denoted by black circles.

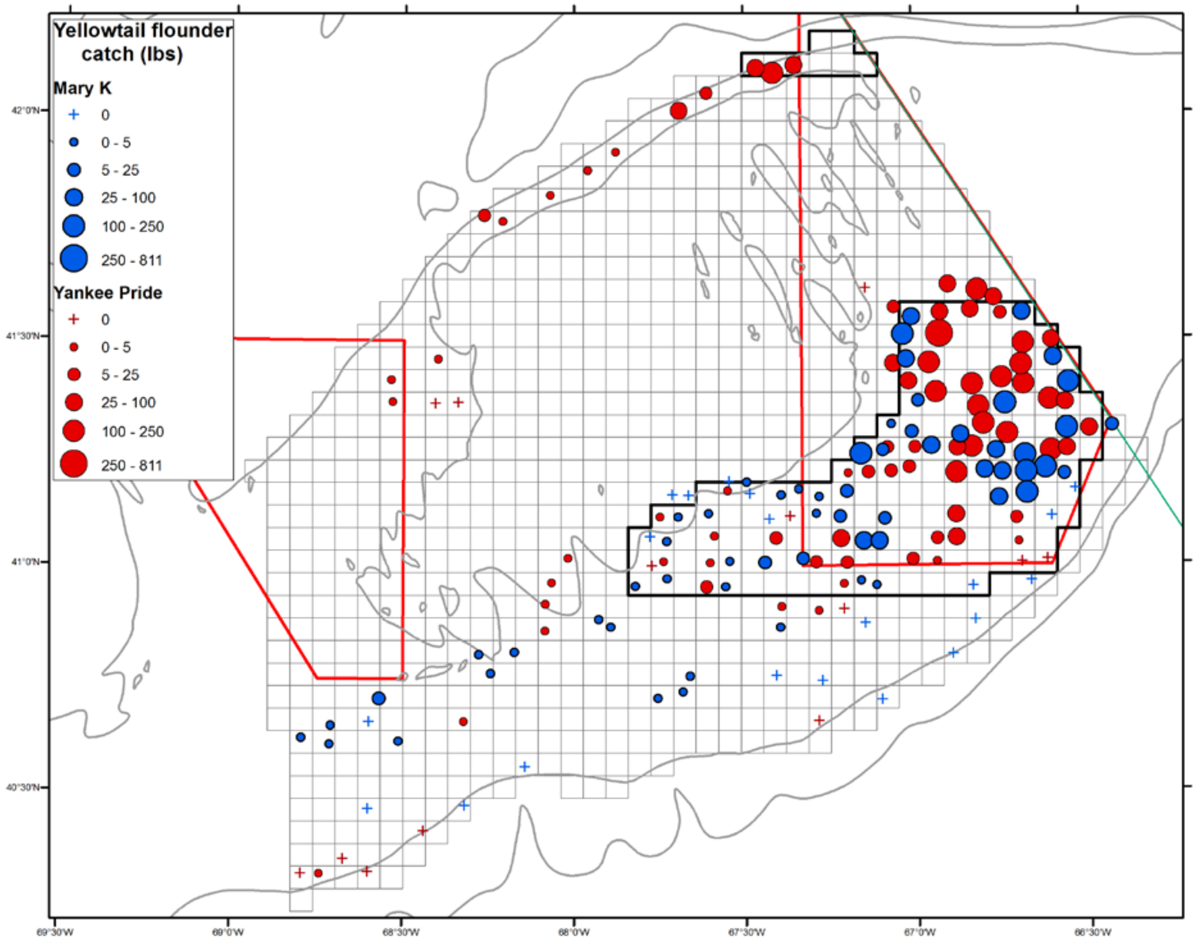

Figure 6. Catches of yellowtail flounder during the survey. The colors denote the two vessels and the size of the symbol denotes the amount of yellowtail flounder caught in pounds.

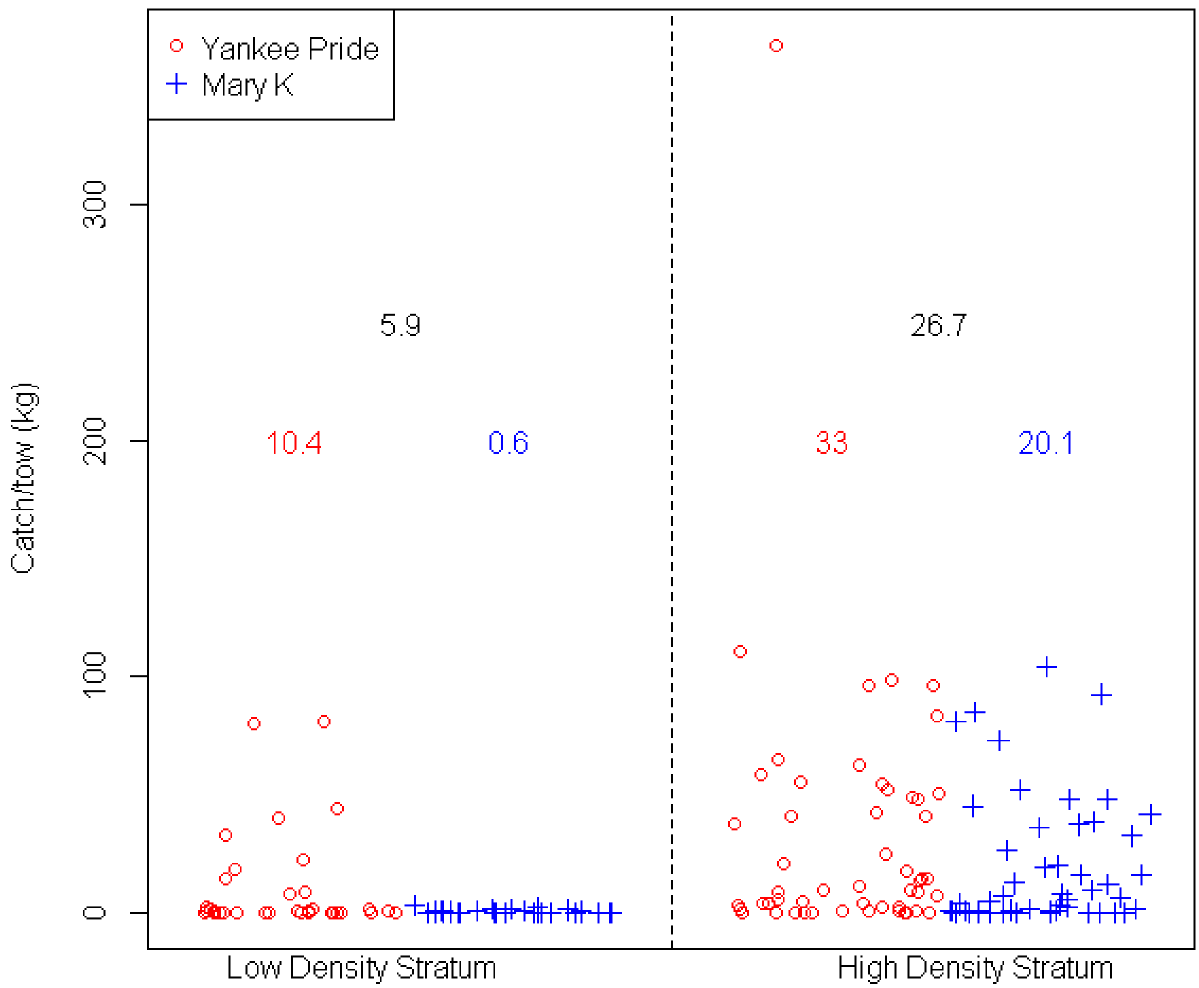

Figure 7. Catch per tow (kg) by vessel (denoted by the two colors and symbols) in the two strata. The values along the x-axis are jittered to show different stations. The black numbers within the plot represent the mean catch rate by stratum. The red and blue numbers within the plot denote the mean catch rate by vessel and stratum.

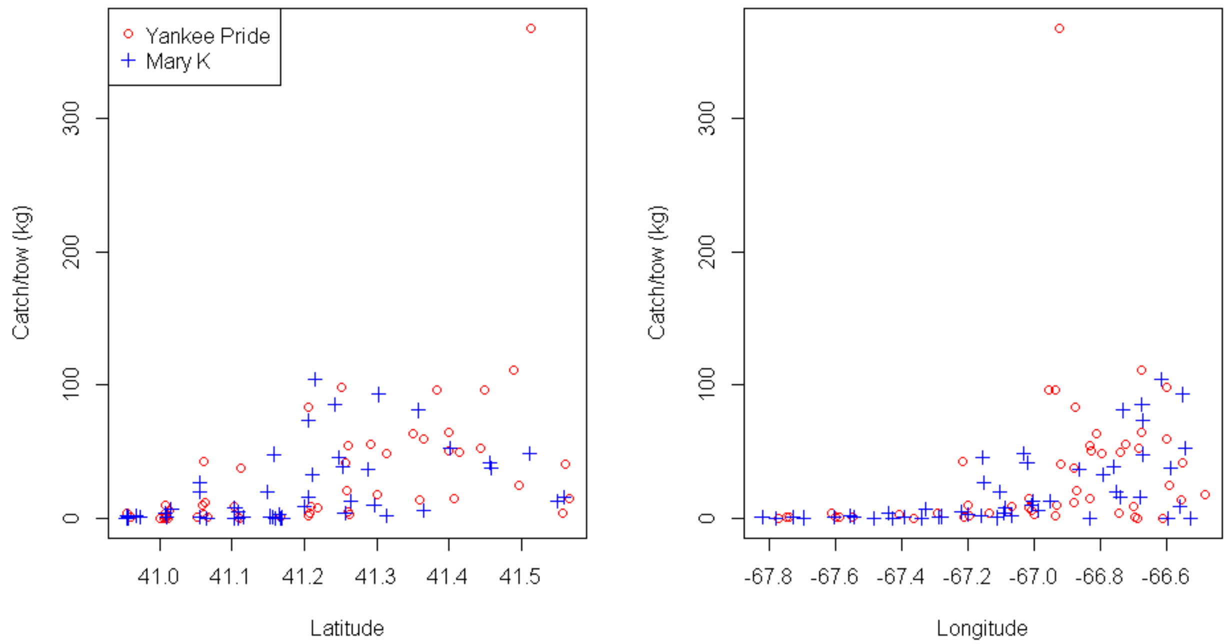

Figure 8. Catch per tow (kg) by vessel, denoted by different colors and symbols, within the high density stratum from south to north (left panel) and west to east (right panel).

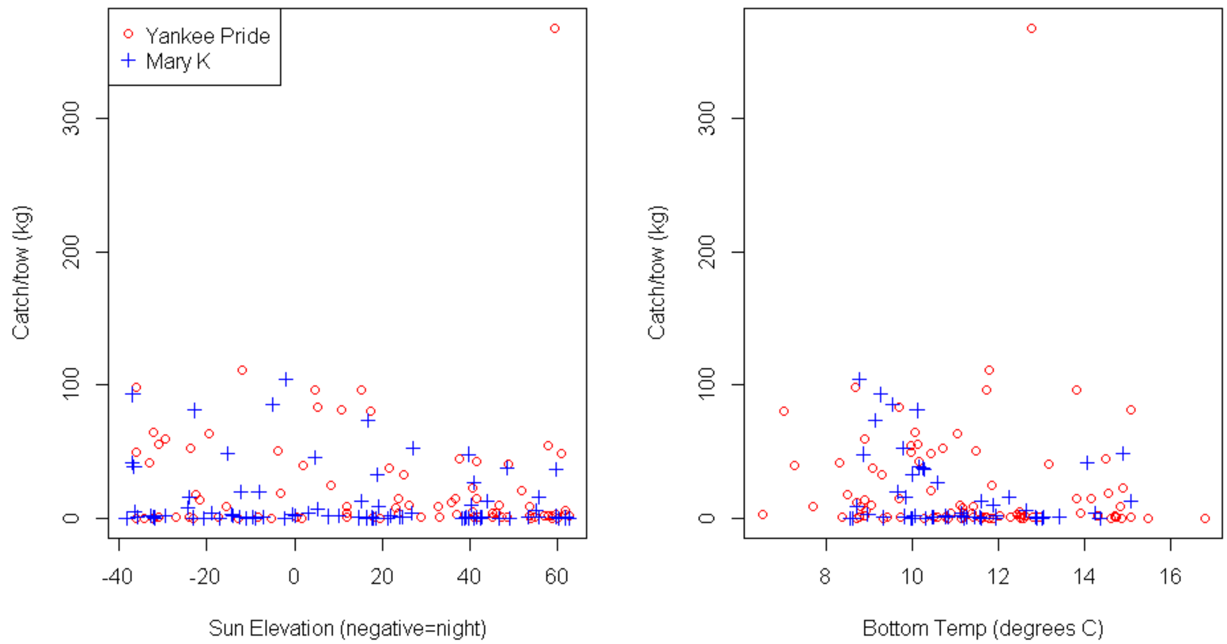

Figure 9. Catch per tow (kg) by vessel, denoted by colors and symbols, relative to sun elevation (night is sun elevation less than zero; left panel) and bottom temperature (right panel).

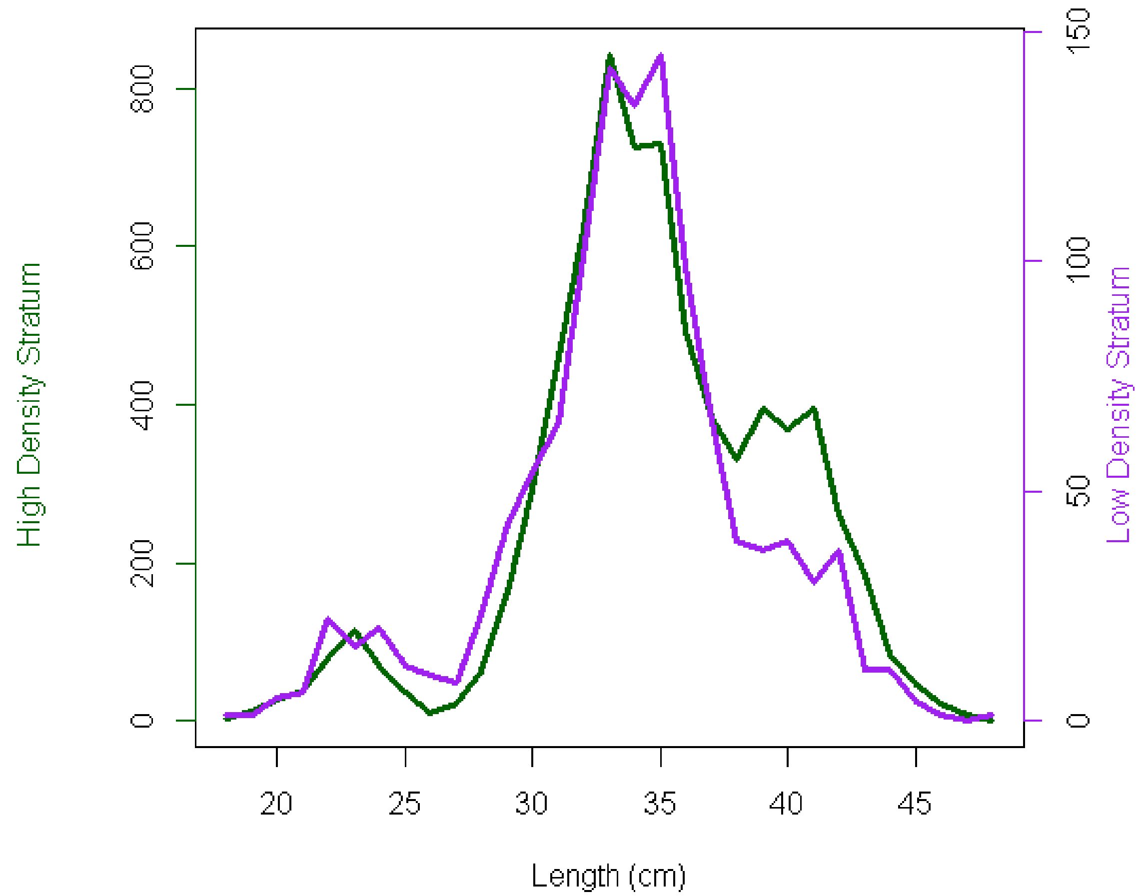

Figure 10. Length frequency distributions for high (green, left axis) and low (purple, right axis) density strata.

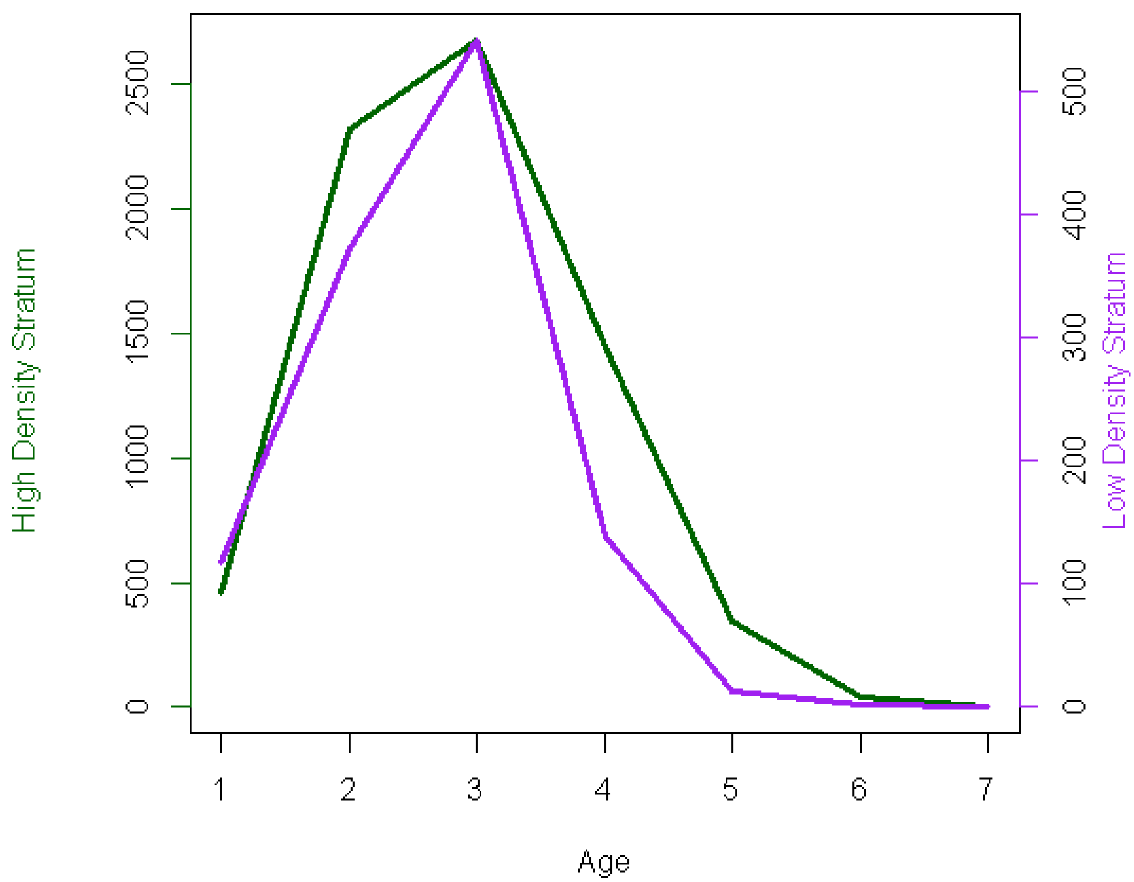

Figure 11. Age frequency distributions for high (green, left axis) and low (purple, right axis) density strata.

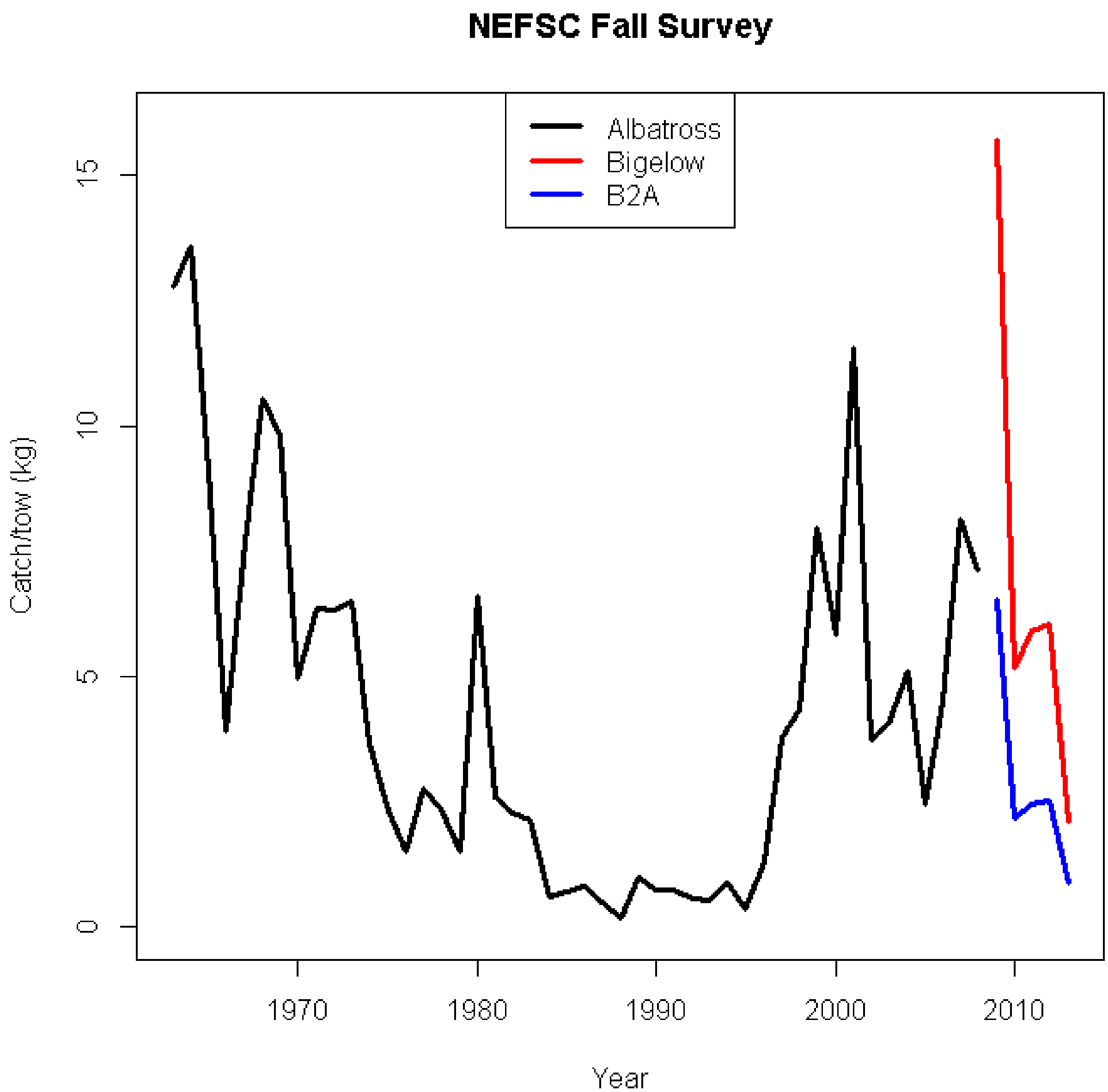

Figure 12. Time series of catch/tow (kg) from the NEFSC fall survey. The black line denotes years when the Albatross IV was the survey vessel. The red line denotes the catch rate from the Bigelow and the blue line denotes the Bigelow catch rate converted to Albatross catch rates by applying length-based calibration coefficients.

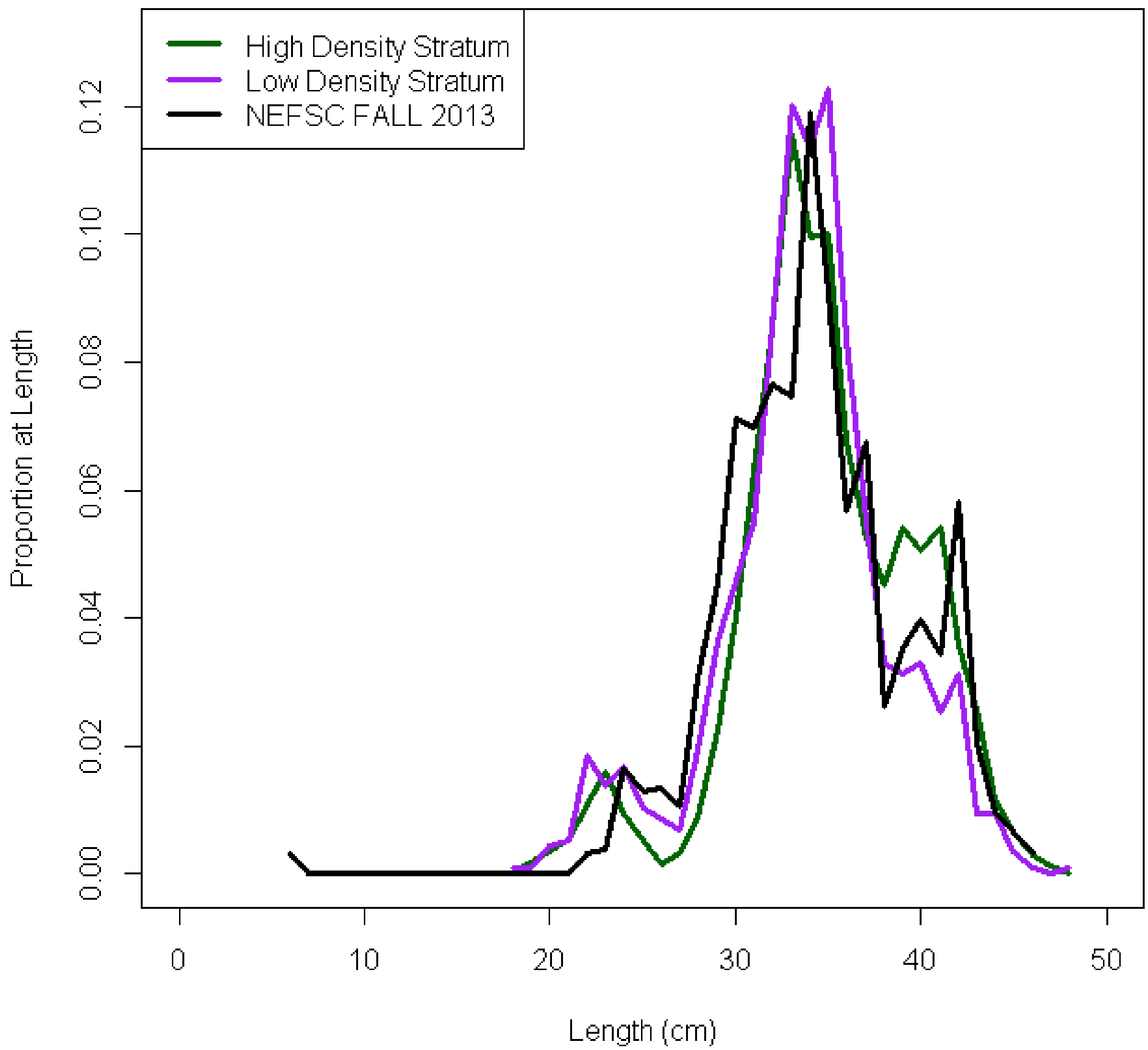

Figure 13. Proportions at length for high (green) and low (purple) density strata from the flatfish survey and from the NEFSC fall 2013 survey (black).

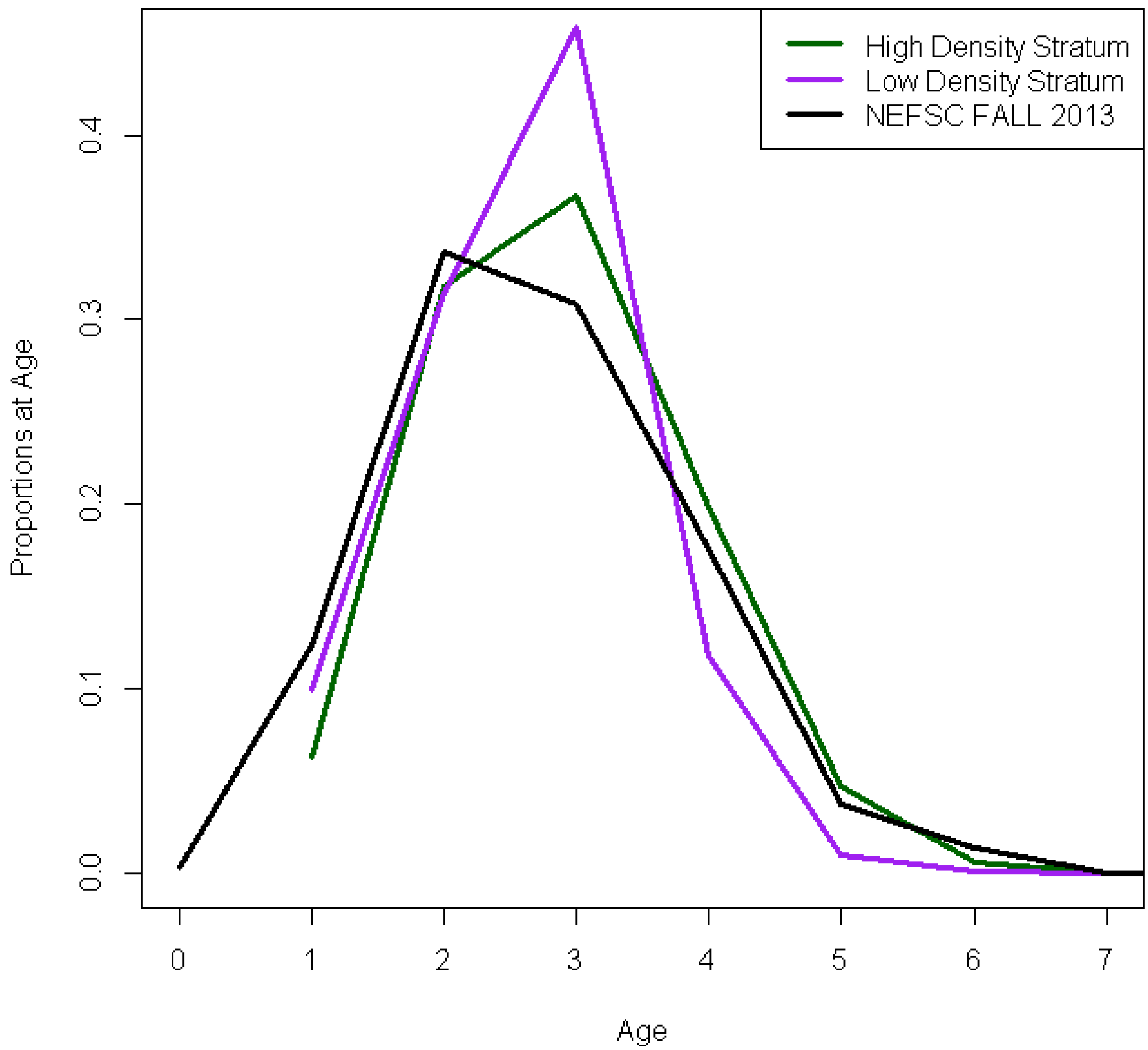

Figure 14. Proportions at age for high (green) and low (purple) density strata from the flatfish survey and from the NEFSC fall 2013 survey (black).