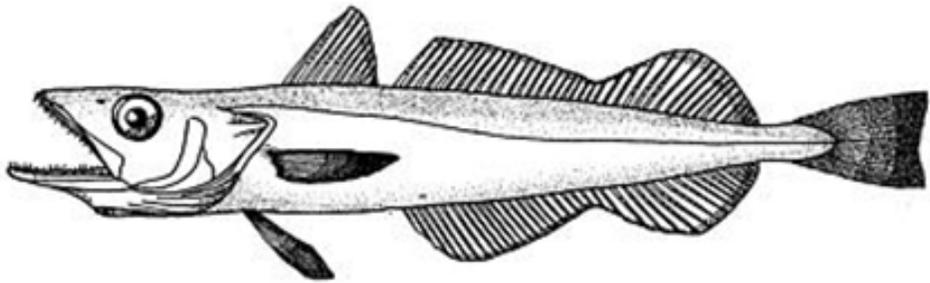
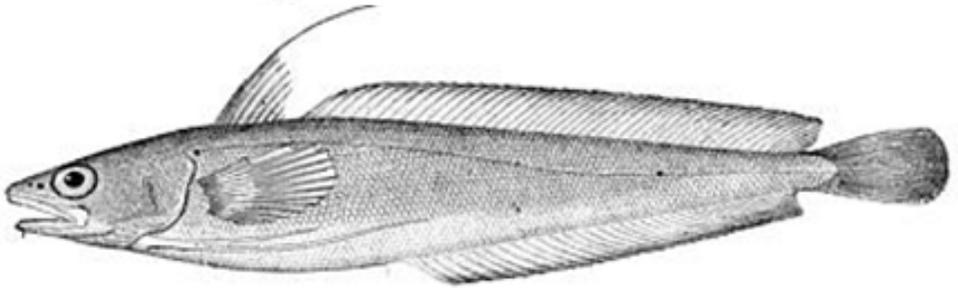
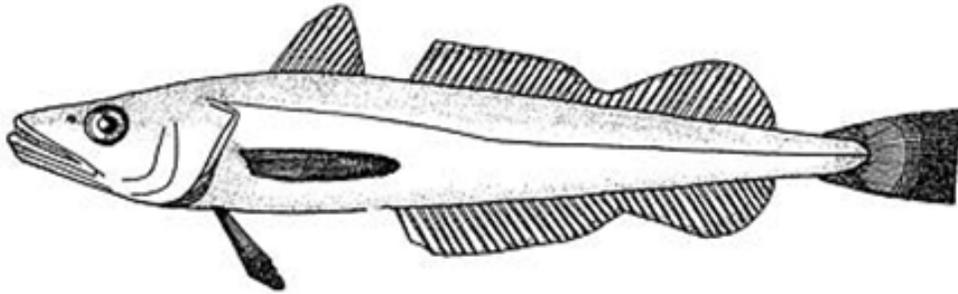


NEW ENGLAND FISHERY MANAGEMENT COUNCIL

**Annual Monitoring Report
for Fishing Year 2015**



1.0 Executive Summary

This Annual Monitoring Report (AMR) was prepared by Greater Atlantic Regional Fisheries Office (GARFO) and the Northeast Fisheries Science Center (NEFSC), and reviewed by the New England Fishery Management Council's Whiting Plan Development Team (PDT) which added conclusions and recommendations (Section 3.0).

Except for northern red hake, the 2015 catches were below the ACLs. Southern silver and red hake stock biomasses appear to be trending lower, approaching the minimum biomass threshold.

In 2015, the northern red hake catch exceeded the ACL by 24.6% (see Section 5.1) which will trigger a post-season AM in 2017, unless the Council, with appropriate justification or data, takes or requests other action. Without any action, GARFO would reduce the 2017 in-season AM trigger (reducing the northern red hake possession limit to an incidental level, 400 lbs.) from 62.5% of the quota to 37.9% of the quota (see Section 3.1).

Updating the survey biomass indices (see Section 6.0) through fall 2015 (for silver hake) and spring 2016 (for red hake), there is little indication that the northern red hake stock is increasing more than expected following the strong 2013 year class. In fact, the spring 2016 biomass index is slightly lower than the 2015 index. Stock biomass for northern silver hake is well above the target and relatively stable at that level since 2012.

The PDT points out that the southern silver hake and southern red hake stock biomass is declining and beginning to approach an overfished condition. The 3-year moving average, used to define when the small-mesh multispecies stocks are overfished, for southern silver hake biomass has been declining and approaching the minimum biomass level. In fact, the 2016 biomass index is now below the threshold. The annual southern red hake biomass index was above the minimum biomass threshold for all three years, but not by much.

The minimum biomass thresholds for small-mesh multispecies stocks are based on stock conditions in a specific period of time, when it is thought that the stocks were in a relatively healthy condition. This reference period was updated for red hake to 2010, but was not adjusted for silver hake. Given recent environmental trends, a re-evaluation of these reference periods for their consistency with modern resource productivity may be warranted. The last benchmark assessment was completed in 2011 (silver hake: <http://www.nefsc.noaa.gov/publications/crd/crd1102/silverhake.pdf> and red hake: <http://www.nefsc.noaa.gov/publications/crd/crd1102/redhake.pdf>) using data through 2009.

Section 5.2 updates information about groundfish bycatch in the small-mesh multispecies fishery exemption areas, to the extent that data and time allow. Section 5.2 provides total sub-component groundfish catch estimates for vessels targeting whiting and whiting/squid. During the analytic period, groundfish catch in the small-mesh multispecies fishery has generally declined, but bounced up in 2014, primarily due to increases in haddock catches. Fishing effort characterized by number trips and vessels by statistical area has declined over the time series and has remained low through 2015.

In addition, a more detailed analysis of haddock bycatch on observed trips compares total observed catch and catch rates (discard to kept-all) in 2008-2013 with 2014 and 2015. The analysis shows that there has been a significant increase in haddock catches in the small-mesh multispecies exemption areas fishery, but it does not appear to result from changes in season or location fished, or in the amount of fishing activity. It will be difficult and require more extensive analysis to explore whether increases are due to changes in net configuration. On the other hand, it is pretty clear the increasing haddock catch rate is attributable to the very large 2013 year class in both the Gulf of Maine (Small-Mesh Area I) and on

Georges Bank (Cultivator Shoals Area fishery). These haddock would be selected by small-mesh trawls as one-year olds in 2014 and two-year old in 2015.

Given the results in this document, the PDT does not recommend that the Council change the default action (reducing the AM trigger from 62.5% to 37.9% of the quota) in response to 2015 catches of northern red hake exceeding the Annual Catch Limit (ACL). The PDT, however, recommends that, in a future action, the Council re-examine the effectiveness of the in-season AM to prevent the red hake catches from exceeding the ACLs. In the northern management area, the fishing year catches have exceeded the annual ACL in five out of five years.

2.0 Table of Contents

1.0	Executive Summary	1
2.0	Table of Contents	3
2.1	List of Tables	3
2.2	List of Figures.....	4
2.3	List of Maps.....	5
3.0	Conclusions and Recommendations	6
3.1	Fishery Performance and Accountability Measures	6
4.0	Management Background	8
5.0	Fishery Performance Report	13
5.1	Annual Catch Limit Accounting.....	13
5.1.1	Red hake summary.....	14
5.1.2	Silver hake summary.....	14
5.2	Groundfish Bycatch in the Small-Mesh Multispecies Fishery	19
5.2.1	Northern Fishery Management Area (NFMA)	19
5.2.2	Southern Fishery Management Area (SFMA)	33
6.0	Trends in survey biomass indices	38
6.1	Red hake.....	39
6.2	Silver hake	44
7.0	Whiting PDT Members and Contributors to this Document	49
8.0	References	49

2.1 List of Tables

Table 1.	Northern area exemption program seasons.....	9
Table 2.	Mesh size dependent possession limits.....	9
Table 3.	Updated 2016-2017 red hake specifications and existing 2015-2017 silver hake specifications.....	12
Table 4.	Fishing year 2015 red hake landings and discards by stock area.....	17
Table 5.	Fishing year 2015 silver hake landings and discards by stock area.....	18
Table 6.	Trends in small-mesh trips (top) and vessels (bottom) targeting silver hake and landing more than 7,500 lbs. by statistical area. Source: NMFS VTR data base.....	23
Table 7.	Northern red hake NEFSC spring survey biomass in Albatross units (kg/tow) from 1968-2016.....	40
Table 8.	Southern red hake NEFSC Spring Survey biomass in Albatross units (kg/tow) from 1968-2016	42
Table 9.	Northern silver hake NEFSC fall survey biomass in Albatross units (kg/tow) from 1963-2015	45

Table 10. Southern silver hake NEFSC fall survey biomass in Albatross units (kg/tow) from 1963-2015	47
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2.2 List of Figures

Figure 1. 2015 and 2016 weekly landings of northern red hake compared to the Total Allowable Landings (TAL, or quota).....	7
Figure 2. Small-mesh fishery specification framework adopted and approved in Amendment 19.	7
Figure 3. Estimated discard rate (total catch) by fishing year and the ratio between northern red hake catch and its annual catch limit (ACL). Source: GARFO.....	8
Figure 4. Estimated groundfish catch for stocks overlapping the Northern Fishery Management Area in the squid and squid/whiting fisheries (top) and trends in small-mesh multispecies fishing effort (bottom), 2010-2014.	22
Figure 5. Trends in total annual bycatch rates for northern groundfish stocks in the small-mesh multispecies fishery. Source: Groundfish PDT estimates of sub-component groundfish bycatch, 2015.	24
Figure 6. Small mesh exemption areas (white) and reported fishing patterns derived from 2014 Vessel Trip Reports, showing the boundaries of three-digit statistical catch reporting areas.	25
Figure 7. Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for Small Mesh Area I. Observed tows include sea sampling and at-sea monitoring of trawl hauls targeting and catching at least 1000 lbs. of silver hake (Source: NMFS OBDBS and ASM data). Revenue was derived from reported landings and location on Vessel Trip Reports with price data assigned by year, month, and species (Source: NMFS Social Sciences Branch analysis).....	26
Figure 8. Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for Small Mesh Area I. Data sources are described in Figure 7.....	27
Figure 9. Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Raised Footrope Exemption Areas. Data sources are described in Figure 7.	28
Figure 10. Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Raised Footrope Exemption Areas. Data sources are described in Figure 7.	29
Figure 11. Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Cultivator Shoal Exemption Area. Data sources are described in Figure 7.	30
Figure 12. Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Cultivator Shoal Exemption Area. Data sources are described in Figure 7.	31
Figure 13. Trends in age 1 haddock recruitment with 90% bootstrap probability intervals to show uncertainty. Source: NMFS 2016	32
Figure 14. Estimated groundfish catch for stocks overlapping the Southern Fishery Management Area in the squid and squid/whiting fisheries (top) and trends in small-mesh multispecies fishing effort (bottom), 2010-2014.	34

Figure 15. Trends in total annual bycatch rates for northern groundfish stocks in the small-mesh multispecies fishery. Source: Groundfish PDT estimates of sub-component groundfish bycatch, 2015.	35
Figure 16. Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Southern Georges Bank fishing area. Data sources are described in Figure 7.	36
Figure 17. Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Southern Georges Bank fishing area. Data sources are described in Figure 7.	37
Figure 18. Survey catch of northern and southern red hake in kg/tow for the NEFSC spring survey. The LEFT panel shows the survey time series average and the RIGHT panel depicts the most recent data. Note the 2009-2016 survey values were adjusted from Bigelow to Albatross IV equivalents	39
Figure 19. Northern red hake NEFSC Spring survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.	41
Figure 20. Northern red hake NEFSC spring survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series	41
Figure 21. Southern red hake NEFSC Spring survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.	43
Figure 22. Southern red hake NEFSC spring survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.	43
Figure 23. Northern silver hake NEFSC fall survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.	46
Figure 24. Northern silver hake NEFSC fall survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.	46
Figure 25. Southern silver hake NEFSC fall survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.	48
Figure 26. Northern silver hake NEFSC fall survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.	48

2.3 List of Maps

Map 1. Small-mesh exemption areas in the Gulf of Maine and Georges Bank.....	13
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3.0 Conclusions and Recommendations

3.1 *Fishery Performance and Accountability Measures*

Catches and landings of northern silver hake, southern whiting, and southern red hake remained well below their specifications. Catches for northern silver hake were 24% of the annual catch limit (ACL), 17 percent of the ACL for southern whiting, and 41 percent of the ACL for southern red hake. No in-season AMs were triggered and no post-season AMs are required.

The in-season AM was triggered on August 19 2015 for northern red hake (<http://www.greateratlantic.fisheries.noaa.gov/regs/2014/July/14mulnrhpossessionlimitreductiontr.pdf>), which had been subject to overfishing in 2013. This in-season trigger reduced the northern red hake possession limit from 3,000 to 1,500 and then to 400 lbs. This AM capped targeting and landings, but did not keep catches from exceeding the ACL. Final catches for 2015 were estimated to be 750,149 lbs, or 124.6% of the ACL. This is more than the 5% tolerance allowed by the FMP and thus **additional post-season AM adjustments are warranted.**

Although not formally a part of the AMR for the 2015 fishing year, the fishing year 2016 landings for northern red hake appear to be tracking ahead of 2015. Thus the in-season AM will be triggered a few weeks earlier than it was in 2015, despite the higher 2016 quota. Catches for the 2016 fishing year will be estimated in next year's AMR.

Given the overage in 2015, the pace of the 2016 fishery toward the 2016 ACL, which was re-estimated in an update assessment, approved by the Scientific and Statistical Committee, and raised in 2016 by a Supplemental Information Report to account for increasing northern red hake biomass, the Whiting PDT does not recommend an action to change or prevent the default post-season AM trigger from taking effect. Because northern red hake post-season AMs have been triggered for several years, the PDT recommends that the Council consider re-evaluating the effectiveness of the in-season AM to keep catches from exceeding the ACL. A plot of discard rates by stock is shown in Figure 3.

Figure 1. 2015 and 2016 weekly landings of northern red hake compared to the Total Allowable Landings (TAL, or quota).

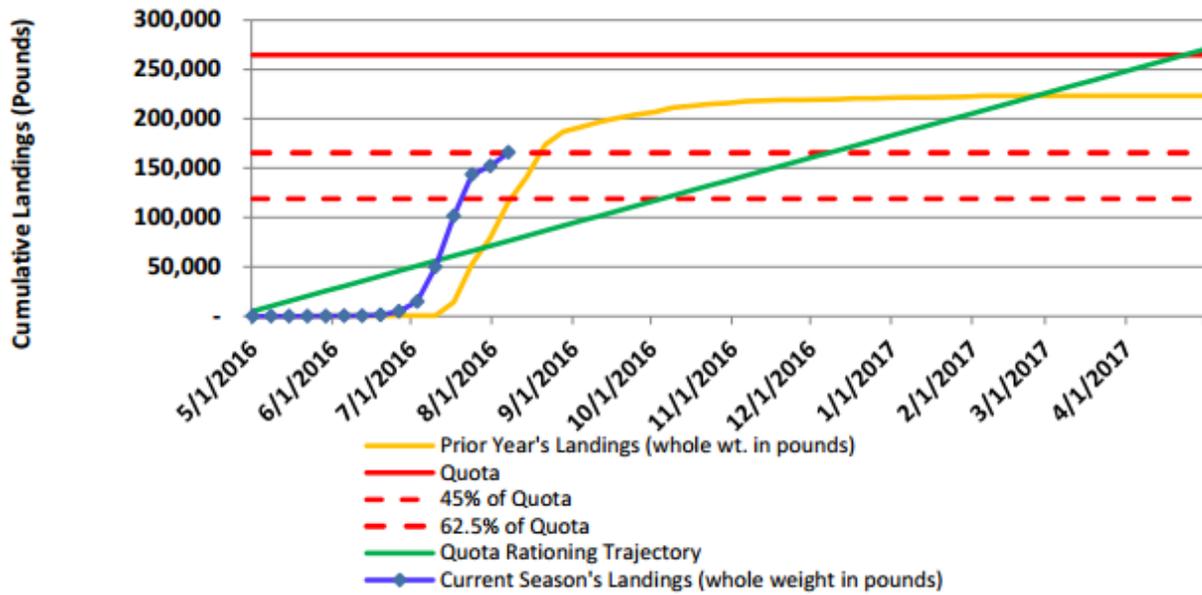


Figure 2. Small-mesh fishery specification framework adopted and approved in Amendment 19.

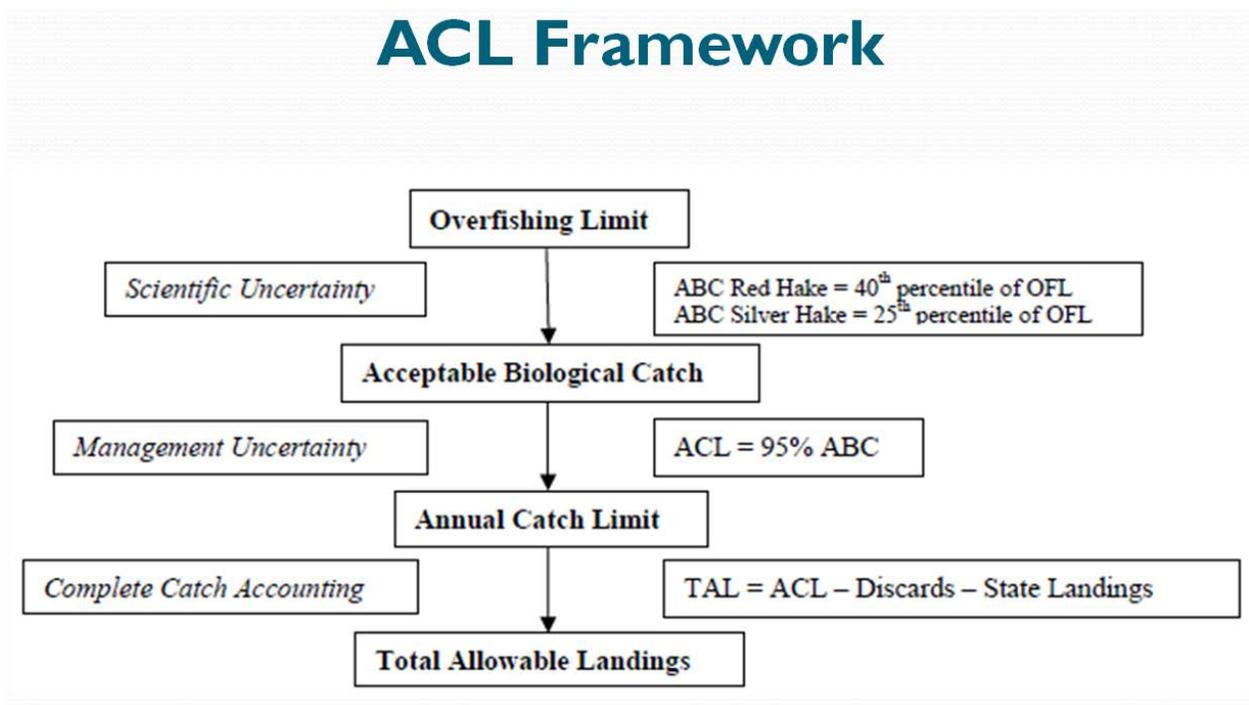
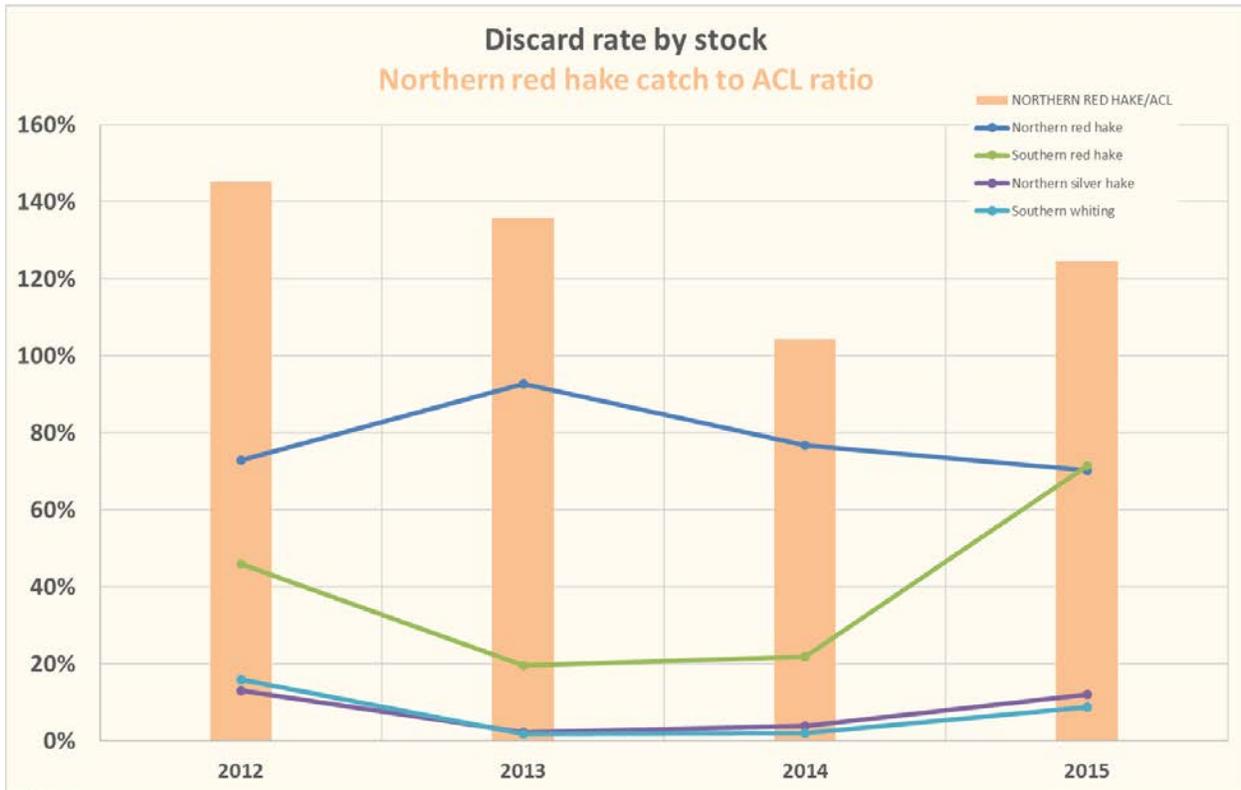


Figure 3. Estimated discard rate (total catch) by fishing year and the ratio between northern red hake catch and its annual catch limit (ACL). Source: GARFO.



4.0 Management Background

The small-mesh multispecies fishery consists of three species: Silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and offshore hake (*Merluccius albidus*). There are two stocks of silver hake (northern and southern), two stocks of red hake (northern and southern), and one stock of offshore hake, which primarily co-occurs with the southern stock of silver hake. There is little to no separation of silver and offshore species in the market, and both are generally sold under the name “whiting.” Throughout the document, “whiting” is used to refer to silver hake, and combined offshore and silver hake catches.

Collectively, the small-mesh multispecies fishery is managed under a series of exemptions from the Northeast Multispecies Fishery Management Plan. The Northeast Multispecies FMP requires that a fishery can routinely catch less than 5% of regulated multispecies to be exempted from the minimum mesh size. In the Gulf of Maine and Georges Bank Regulated Mesh Areas (Map 1), there are six exemption areas, which are open seasonally (Table 1).

Table 1. Northern area exemption program seasons

	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Cultivator			June 15 – October 31									
GOM* Grate			July 1 – November 30									
Small I			July 15 – November 30									
Small II	– June 30								January 1 –			
Cape Cod RFT†					Sept 1 – Nov 20							
					September 1 – December 31							

* GOM = Gulf of Maine

† RFT = Raised Footrope Trawl

The Gulf of Maine Grate Raised Footrope area is open from July 1 through November 30 of each year and requires the use of an excluder grate on a raised footrope trawl with a minimum mesh size of 2.5 inches. Small Mesh Areas I and II are open from July 15 through November 15, and January 1 through June 30, respectively. A raised footrope trawl is required in Small Mesh Areas I and II, and the trip limits are mesh size dependent. Cultivator Shoal Exemption Area is open from June 15 – October 31, and requires a minimum mesh size of 3 inches. The Raised Footrope Trawl Exemption Areas are open from September 1 through November 20, with the eastern portion remaining open until December 31. A raised footrope trawl, with a minimum mesh size of 2.5-inch square or diamond mesh, is required. The Southern New England and Mid-Atlantic Regulated Mesh Areas are open year-round and have mesh size dependent possession limits for the small-mesh multispecies.

The mesh size dependent possession limits (Table 2) for all the areas with that requirement are:

Table 2. Mesh size dependent possession limits

Codend Mesh Size	Silver and offshore hake, combined, possession limit	Northern red hake	Southern Red Hake
Smaller than 2.5"	3,500 lb	3,000 lb/1500 lb	5,000 lb
Larger than 2.5", but smaller than 3.0"	7,500 lb	3,000 lb/1500 lb	5,000 lb
Equal to or greater than 3.0"	30,000 lb (40,000 lb in Southern Area)	3,000 l/1500 lb b	5,000 lb

The exemption areas were implemented as part of several different amendments and framework adjustments to the Northeast Multispecies FMP. In 1991, Amendment 4 incorporated silver and red hake and established an experimental fishery on Cultivator Shoal. Framework Adjustment 6 (1994) was intended to reduce the catch of juvenile whiting by changing the minimum mesh size from 2.5 inches to 3 inches. Small Mesh Areas I and II, off the coast of New Hampshire, were established in Framework Adjustment 9 (1995). The New England Fishery Management Council (Council) established essential fish habitat (EFH) designations and added offshore hake to the plan in Amendment 12 (2000). Also in Amendment 12, the Council proposed to establish limited entry into the small-mesh fishery. However, that measure was disapproved by the Secretary of Commerce because it did not comply with National Standard 4¹ as a result of measures that benefited participants in the Cultivator Shoal experimental fishery and because of the “sunset” provision that would have ended the limited entry program at some date. The Raised Footrope Trawl Area off of Cape Cod was established in Framework Adjustment 35 (2000). A

¹ National Standard 4 states that measures “shall not discriminate between residents of different States,” and that fishing privileges must be “fair and equitable to all such fishermen.”

modification to Framework Adjustment 35 in 2002 adjusted the boundary along the eastern side of Cape Cod and extended the season to December 31 in the new area. Framework Adjustment 37 modified and streamlined some of the varying management measures to increase consistency across the exemption areas. In 2003, Framework Adjustment 38 established the Grate Raised Footrope Exemption Area in the inshore Gulf of Maine area.

The Northeast Multispecies FMP was implemented primarily to manage the commercial cod and haddock fisheries in the Gulf of Maine and Georges Bank². The FMP is complicated and has been changed numerous times since 1985 (almost 20 Council amendments and over 50 framework adjustments; not including dozens of emergency, interim, and Secretarial amendments implemented outside of the Council process.) A few of those amendments and several framework adjustments have addressed the small-mesh fishery specifically and are described below.

Amendment 1 (1987) reduced the spatial footprint of the winter inshore whiting fishery in order to protect struggling large mesh species like redfish, gray sole, and dabs; focused the small-mesh target species to large-mesh species ratio on a selected set of species; and reduced the size of the Georges Bank whiting fishery area to protect yellowtail flounder.

Amendment 2 (1989) made some additional, minor changes to the exempted fishery program for whiting and other small-mesh stocks.

Amendment 4 (1991) established the Cultivator Shoals Exemption Area and formally incorporated silver hake and red hake into the FMP. This amendment also established a minimum mesh size for the directed small-mesh fishery as well. This was intended to control mortality of whiting and red hake in this fishery.

Amendment 5 (1994) established an overfishing definition for red hake, and implemented some other minor modifications to small-mesh management, including a standardized bycatch amount of 500 lb of large-mesh groundfish.

Framework Adjustment 3 (1994) modified the 500-lb bycatch limit to reduce the incentive for vessels to target groundfish with small mesh. This action changed the limit to “10-percent of the total weight of fish on board, or 500 lb, whichever is less.” This preserved the Council’s original intent of minimizing mortality on juvenile groundfish, while allowing the legitimate small-mesh fishery to continue.

Framework Adjustment 6 (1994) was intended, in part, to reduce juvenile whiting mortality in the Cultivator Shoals whiting fishery and modified the requirements of that program.

Framework Adjustment 9 (1995) established Small Mesh Areas I and II in the Gulf of Maine and implemented the requirements for fishing in those areas.

An **Adjustment to Amendment 7** (1996) made some minor modifications to non-groundfish bycatch limits in the Cultivator Shoals fishery.

² The large-mesh species (cod, haddock, pollock, flounders, etc.) were commonly referred to as the “regulated” species because they were the focus of management originally. That term is confusing as almost all of the commercially viable stocks are now “regulated.” This document refers to the management of those species as the “groundfish fishery” or the “large-mesh multispecies fishery.”

Amendment 12 (1999/2000) addressed a number of small-mesh issues. This amendment officially incorporated offshore hake into the FMP; established essential fish habitat designations for all three small-mesh species; standardized the mesh-size based possession limits (see below); required a Letter of Authorization for several small-mesh exemption areas; and established a provision to allow the transfer of up to 500 lb of small-mesh multispecies at sea. Amendment 12 also proposed a limited access permit program for this fishery. However, that program was not implemented because NMFS determined that it did not comply with the requirement to treat residents of different states equally (National Standard 4.)

Framework Adjustment 35 (2000) established the Raised Footrope Trawl Exemption Area off Cape Cod. A **Modification to Framework 35** (2002) modified the boundaries and seasons of the Cape Cod exemption areas.

Framework Adjustment 37 (2003) eliminated some of the now unnecessary provisions from Amendment 12, clarified the transfer-at-sea provisions, and reinstated the full season (back to an October 31 end date) for the Cultivator Shoal Exempted Fishery. This framework also standardized the types and amounts of incidental species that could be retained in the small-mesh exemption areas between Small Mesh Areas I and II and the Cape Cod Exemption Area.

A new **Control Date** (2003) was formally established with the intentions of developing a limited access permit program.

Framework Adjustment 38 (2003) established the Inshore Gulf of Maine Grate Raised Footrope Trawl Exemption Area along the coast of Maine.

A **Secretarial Amendment** (2012) brought this portion of the FMP into compliance with the Magnuson-Stevens Act requirements to have (1) annual catch limits and (2) measures to ensure accountability for each Council managed fishery. A Secretarial Amendment was necessary because the development of Amendment 19, the mechanism through which the Council was intending to adopt the new requirements, was delayed.

Amendment 19 (2013) allowed the Council to incorporate updated stock assessment information and adopt the annual catch limit structure implemented in the 2012 Secretarial Amendment. Amendment 19 modified the accountability measures, adopted new biological reference points, and established a trip limit for red hake.

Framework Adjustment 50 (2013) established a separate, sub-annual catch limit of Georges Bank yellowtail flounder for the small-mesh fishery (whiting and squid fisheries.)

Framework Adjustment 51 (2014) implemented accountability measures for that sub-annual catch limit.

2015-2017 Specifications (2014) changed the ABC specifications for northern silver and red hakes as well as southern whiting and red hake stocks. The action also included a modification of the northern red hake possession limit to reduce future risk of overfishing as well as a correction to the post-season AM that was triggered when 2013 catches exceeded the ACL by more than five percent.

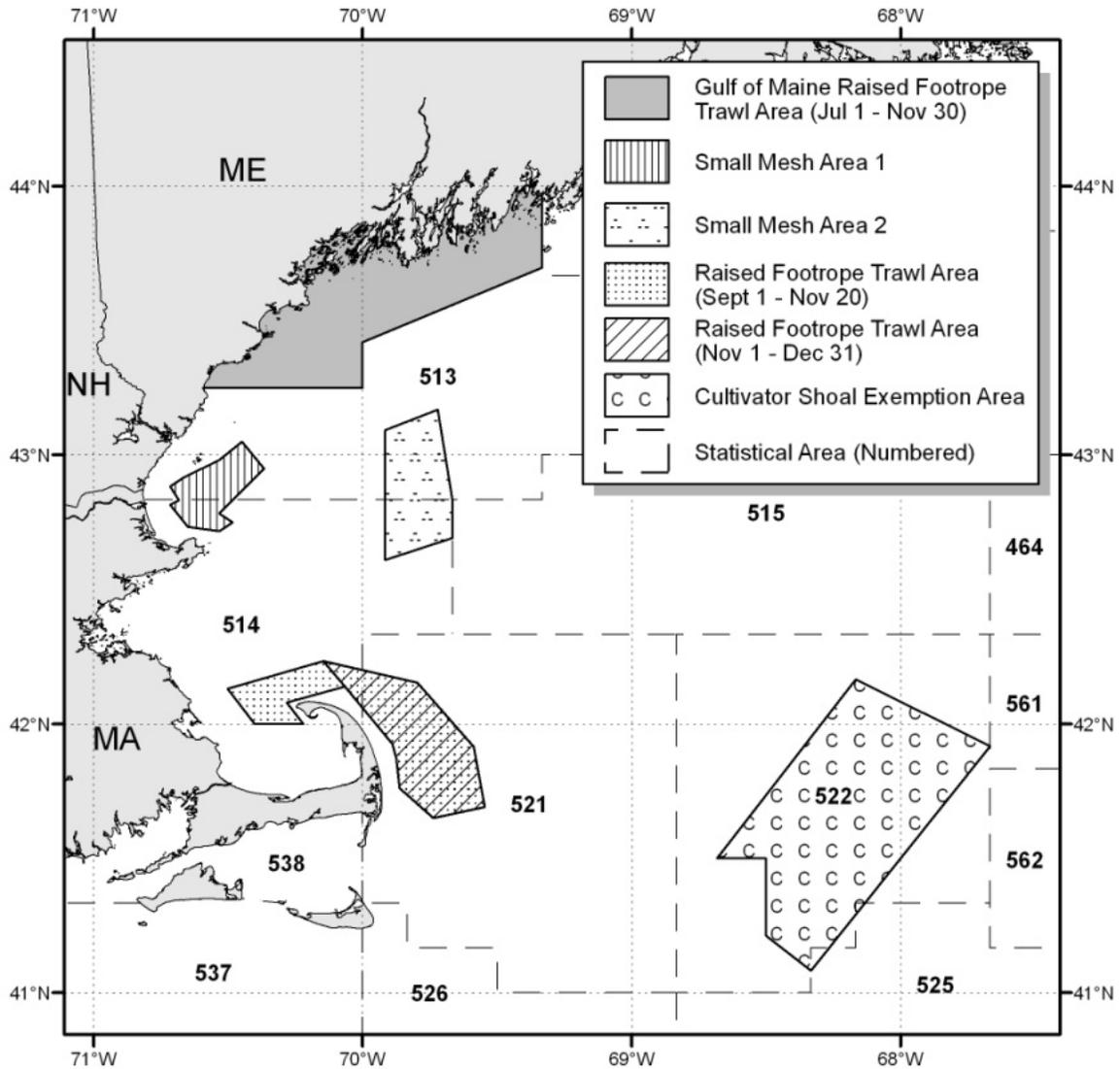
2016 Supplemental Information Report (2016) changed the northern and southern red hake specifications in response to an update assessment, requested by the Council due to uncertainty in the estimated size of a

2013 year class of northern red hake and difficulty using the 2014 spring survey data due to unsampled standard strata. The northern red hake ABC increased by 72.6% to 496 mt and the southern red hake ABC declined by 46.0% to 1,717 mt. Scientific uncertainty and discard estimates were also updated and other specifications were changed to be consistent with the new analysis, reviewed by the Council's Scientific and Statistical Committee. Accounting for scientific uncertainty and discards, the northern red hake TAL increased by 15.6% to 120 mt and the southern red hake TAL declined by 43.0% to 746 mt. The following table summarizes the changes.

Table 3. Updated 2016-2017 red hake specifications and existing 2015-2017 silver hake specifications.

Stock	OFL (mt)	ABC (mt)	ACL (mt)	Change from prev. spec.	TAL (mt)	Change from prev. spec.
Northern red hake	556	496	471	+72.6%	120	+15.6%
Northern silver hake	43,608	24,383	23,161	0%	19,948.7	0%
Total	44,164	24,670	23,632	0.8%	20,068.7	NA
Southern red hake	1,816	1,717	1,631	-46.0%	746	-43.0%
Southern whiting	60,148	31,180	29,621	0%	23,833.4	0%
Total	61,964	32,897	31,252	-4.3%	24,579.4	NA

Map 1. Small-mesh exemption areas in the Gulf of Maine and Georges Bank



5.0 Fishery Performance Report

5.1 Annual Catch Limit Accounting

Annual catch limits were implemented for the small-mesh fishery, via Secretarial Amendment, on May 1, 2012, and adopted by the Council through Amendment 19 to the Northeast Multispecies FMP later that year. These catch limits were implemented for fishing years 2012 through 2014, revised catch limits were implemented for 2015-2017. This report contains complete catch accounting information for fishing year 2015. Catch accounting information for fishing year 2014 can be found in the 2014 Annual Monitoring Report

(<http://s3.amazonaws.com/nefmc.org/2014-Annual-Monitoring-Report-2.pdf>). The annual catch limit was derived using the procedure shown in Figure 2. The specifications are listed in Table 3.

5.1.1 Red hake summary

Northern red hake commercial landings increased by 27% from 2014 to 2015 (Table 4). Likewise, northern red hake discards also increased, but less substantially (15%). In total, northern red hake catches increased by 18% from 2014 to 2015. The northern red hake in-season accountability measure reduce the possession limit to 400 lb on August 19, 2015, which was a few weeks later than the possession limit reduction in 2014 (August 5). Southern red hake commercial catches decreased between 2014 and 2015 by 37%.

Compared to the 2012-2014 discard estimate used in the specifications setting, the 2015 average northern red hake discards have decreased only slightly, from 71 to 70% of total catch in 2015. The discard estimates have increased compared to the previous average for southern red hake (71.5 up from 51%) and decreased for northern silver hake (15 down to 11% in 2015), and southern whiting, which decreased to 6.5% of total catch. Landings by vessels only permitted to fish in state waters was less than a percent of the total landings for all four stocks combined in 2015.

5.1.2 Silver hake summary

Northern silver hake catches declined from 2014 to 2015, with an 18% decrease in total catch, well below the catch limits (22.5% of the ACL was harvested in 2015.). Meanwhile, southern whiting catches decreased substantially by 41%.

While combined, small-mesh multispecies landings made up 76% of the total catch in 2015, the trends are very different for red hake versus silver hake/whiting. Red hake discards are a very significant source of catch (71% for the two stocks combined). On the other hand, silver hake/whiting discards are a much smaller portion of the catch, just 10% of the two stocks combined.

The Secretarial Amendment implemented, and Amendment 19 modified, accountability measures for the small mesh fishery. There are both in-season and post-season accountability measures for this fishery. The in-season accountability measure is a reduction in the trip limit to a lower level or to the incidental level when a specified percentage of the total allowable landings limit has been landed. During the fishing year, if landings have exceeded the trigger percentage of the total allowable landings (TAL), NMFS will then reduce the possession limit for the remainder of the fishing year. Under the FMP, the possession limits for southern red hake, northern silver hake and southern silver hake are reduced to the incidental level when 90% of the TAL is reached. For northern red hake, two trigger points are established that lower possession limits to constrain catch: A reduction in the possession limit to 1,500 lbs when 45%

of the TAL is reached; and a reduction to the incidental catch limit of 400 lbs. when 62.5% of the TAL is harvested.

The post-season accountability measure takes effect when a small-mesh multispecies stock exceeds the annual catch limit (ACL) in a given fishing year, requiring the in-season accountability measure (incidental trigger percentage) to be reduced on a percentage basis from the existing trigger percentage. The reduction in catch earlier in the season is intended to extend the fishery and avoid overages in subsequent fishing years.

In fishing year 2012, the incidental possession limit trigger was 90% for all four stocks small-mesh multispecies stocks. Because the northern red hake ACL was exceeded by 45%, in 2013??? the incidental possession limit trigger was reduced from 90% to 45%. However, due to an error in the catch estimates for 2013, the possession limit reduction trigger point for reducing the possession limit for northern red hake to 400 lb was adjusted from 45% to 62.5% of the TAL. Future accountability measures for fishing years in which the catch exceeds the ACL will be deduced from the corrected 62.5-percent trigger.

This tiered northern red hake possession limits were included in the final specifications packages for the 2015-2017 fishing years. That action also reduced the northern red hake possession limit from 5,000 lb to 3,000 lb to delay the in-season accountability measure until later in the season and restrict the chance of an ACL overage, as occurred in fishing years 2012 and 2013. Additionally, it established a new in-season possession limit trigger point that will reduce possession limits for northern red hake to 1,500 lb when estimated landings reach 45% of the TAL.

In FY 2015 the northern red hake ACL was 273 mt, with a TAL of 104.2 mt. Northern red hake catch, including landings and discards, was 340 mt which exceeded the ACL by 24.6%. **Consequently, the regulations require that the possession limit trigger be reduced from 62.5% of the TAL to 37.9% of the TAL.** If implemented for the 2017 fishing year which begins on May 1, 2017, the possession limit for northern red hake will be reduced from 3,000 lbs to 400 lbs once 37.9% of the TAL is landed³. The reduced trigger would remain in effect until the New England Fishery Management Council changes it through specifications or a framework action.

NMFS published specifications for the small mesh multispecies fishery for 2015-2017 on May 28, 2015, based on stock assessment updates using data through 2014. The Northeast Fisheries Science Center completed a stock assessment update in 2015, using survey data through 2015. The 2015 update revealed that the northern red hake stock is increasing in biomass, while the southern red hake stock biomass is decreasing. In light of this updated assessment, NMFS modified the northern and southern red hake specifications for 2016-2017 in a final rule published in June 2016. That action increased the TAL and catch limits for northern red hake and decreased the TAL and catch limits for southern red hake.

³ The northern red hake in-season possession limit reduction from 3,000 to 1,500 lbs. would be superceded by the 400 lbs. AM trigger when landings reach 37.9% of the quota.

Despite the increase in the TAL, in 2016, the small-mesh fishery met the northern red hake possession limit trigger of 62.5% of the TAL only a few weeks into the season, on August 16, 2016, resulting in the reduction of possession limits to the 400-lb. incidental catch limit. As a result, the fishery will operate with this incidental possession limit for the remainder of the season as a means of constraining landings to avoid exceeding the TAL. Even if the TAL is reached and northern red hake landings are halted, the ACL could still be exceeded due to discards.

Under the regulations pertaining to the post-season AM, the reduction in the AM trigger (as a percentage of the ACL) is the default measure and automatically becomes effective by Notice Action. These regulations also give the Council the option of modifying measures, including the in-season AM, by initiating a framework action at the September Council meeting, after GARFO completes its report and the Whiting PDT has provided its management advice. The Council should consider the following options because the 2016 (and 2017) northern red hake ACL increased by 72.5 % and northern red hake biomass appears to be increasing/decreasing according to the latest survey indices (see Section 6.0).

Options

1. **Default:** Consistent with the regulations at 648.90(b)(5)(ii), *post season adjustment for an overage*, NMFS will reduce the possession limit trigger, which would restrict the fishery to incidental levels once 37.9% of the TAL is harvested. Currently, the fishery is restricted to incidental levels when 45% of the landings are reached. The change to a 37.9% trigger will prolong fishery through reduced landings and incentivize fishermen to avoid red hake discards which count toward the ACL. However, it could inhibit the catch of northern silver hake, a stock that is not fully utilized and catch has remained well below the established limits. The Council will need to determine whether the trigger percentage should be changed through a framework action.
2. **Initiate framework action:** If there is sufficient reason to expect that exceeding the ACL would not cause overfishing or that the fishery is unlikely to exceed the ACL if the status quo (45%) AM trigger remains in place, the Council could approve and recommend a status quo alternative that would retain the current AM trigger. Data supporting this action would be needed, but given that the 2016 fishery is running ahead of the pace for 2015, supporting this action may be difficult unless the ACL were also modified (which would require a full update assessment).
3. **Emergency action:** The Council could take a “wait and see” approach, asking the Regional Administrator to take action to implement the default AM trigger adjustment only if there was evidence that the 2016 (and 2017) was unlikely to be exceeded with the current triggers or that the northern red hake stock biomass had substantially increased. A re-evaluation of the ACL would probably be needed for the latter consideration. In either case, a framework action would not fit into the time-frame needed for implementation on May 1, 2017 (start of the fishing year).
- 4.

Table 4. Fishing year 2015 red hake landings and discards by stock area.

	Pounds	Metric tons	Percent of ACL (273 mt)	Percent of Total Catch	Percent Change from 2014
Northern red hake commercial landings	223,406	101	37.1%	29.8%	27.0%
Northern red hake state-permitted only vessel landings	5	0	0.0%	0.0%	100.0%
Northern red hake estimated discard	526,738	239	87.5%	70.2%	15.0%
Northern red hake recreational landings (MRIP)	4,350	2	n/a	n/a	-99.0%
Northern red hake catch*	750,149	340	124.6%	100.0%	18.0%
	Pounds	Metric tons	Percent of ACL (3,021 mt)	Percent of Total Catch	Percent Change from 2014
Southern red landings	964,572	438	14.5%	28.4%	-37.0%
Southern red state-permitted only vessel landings	3,387	2	0.1%	0.1%	-179.0%
Southern red estimated discard	2,422,813	1,099	36.4%	71.5%	39.0%
Southern red recreational landings (MRIP)	55,501	25	n/a	n/a	-282.0%
Southern red catch*	3,390,772	1,538	50.9%	100.0%	17.0%

Table 5. Fishing year 2015 silver hake landings and discards by stock area.

	Pounds	Metric tons	Percent of ACL (23,161 mt)	Percent of Total Catch	Percent Change from 2014
Northern silver hake commercial landings	4,909,266	2,227	9.6%	87.6%	-13.0%
Northern silver hake state-permitted only vessel landings	23,739	11	0.0%	0.0%	-23.0%
Northern silver hake estimated discard	674,340	306	1.3%	12.0%	-54.0%
Northern silver hake recreational landings (MRIP)	39,592	18	n/a	n/a	7.0%
Northern silver hake catch*	5,607,345	2,543	23.9%	100.0%	-18.0%
	Pounds	Metric tons	Percent of ACL (29,261 mt)	Percent of Total Catch	Percent Change from 2014
Southern whiting landings	8,065,003	3,658	12.5%	91.3%	-37.0%
Southern whiting state-permitted only vessel landings	3,016	1	0.0%	0.0%	-350.0%
Southern whiting estimated discard	765,442	347	1.2%	8.7%	-82.0%
Southern whiting recreational landings (MRIP)	-	-	n/a	n/a	-
Southern whiting catch*	8,833,461	4,007	13.7%	100.0%	-41.0%

5.2 Groundfish Bycatch in the Small-Mesh Multispecies Fishery

Recent concerns have been raised about the amount of regulated groundfish bycatch taken by small-mesh fishing for whiting in exemption areas, particularly for haddock. For this reason, the PDT conducted an analysis in this year's Annual Monitoring Report of trends in total estimated bycatch, in total effort targeting whiting, and trends in haddock bycatch amounts, rates, and location of observed tows. More detailed analysis for other species and for specific gear configurations (raised footrope, rope separator, and standard trawls in the Cultivator Shoals Area, for example) were not possible at this time.

GARFO estimates groundfish catches by stock and capture gear in October for the previous May to April fishing year, using a combination of bycatch rates (discard/kept-all) on observed trips, statistical area and gear fished from vessel trip reports (VTRs), and landings reported by wholesale fish dealers and processors. The most recent data are published on the GARFO Multispecies page at <http://www.greateratlantic.fisheries.noaa.gov/aps/monitoring/nemultispecies.html>.

Regulated groundfish catches attributable to small mesh fishing for whiting and red hake are estimated in Table 7 of the report: "FY 2014 Northeast Multispecies Other Sub-Component Catch Detail (mt)", under the columns labeled "Whiting" and "Squid/Whiting". These categories include small-mesh fishing in exempted areas and is differentiated from the "Squid" and other small mesh components based on the target species reported on the VTRs. Groundfish catch estimates for the 2015 fishing year are expected to become available in October 2016.

Trends in annual groundfish catch estimates from 2010 to 2015 for the "Squid/Whiting" category are summarized and presented in the figures below. These data are compared with small-mesh multispecies fishing effort derived from VTR data by small-mesh multispecies management area (i.e. north/south) to evaluate whether changes in groundfish bycatch have been the result of changes in small-mesh multispecies fishing effort or changes in the abundance or availability of groundfish stocks to the small-mesh multispecies fishery.

Following these summary tables, maps of groundfish bycatch rates on observed tows during 2007 to 2015 are plotted to show where the highest amounts of groundfish bycatch per tow were observed.

5.2.1 Northern Fishery Management Area (NFMA)

Usually there are too few samples to provide reliable estimates of total bycatch by exemption area, particularly when the kept fish are commonly reported by three-digit statistical areas that are larger and do not coincide with boundaries of exemption areas. Thus the estimated catches of groundfish stocks that overlap the NFMA are shown in Figure 4. This groundfish stock overlap generally covers all of the small-mesh multispecies exemption areas, except for the Cultivator Shoals Area which generally overlaps with Georges Bank groundfish stocks, but also overlaps with some northern groundfish stock boundaries. Thus comparisons are made using the 'Whiting' fishery (which is defined by the Groundfish PDT as trips targeting whiting) that generally occurs in the small-mesh multispecies exemption areas and the 'Squid/Whiting' fishery (which is defined by the Groundfish PDT as trips targeting squid and whiting) that generally occurs in the Cultivator Shoals Area only. Due to inconsistencies in the small-mesh multispecies fishery and groundfish stock boundaries, it is impossible to summarize the bycatch estimates and small-mesh multispecies with exactly consistent boundaries. General trends and conclusions, however, can be drawn from the existing information.

In the 'Whiting' fishery, estimated bycatch of groundfish stocks generally declined from 2010 to 2013 (Figure 4). The estimated total bycatch declined from 18.7 to 3.0 mt. The bycatch rate also declined from 1.4% to 0.3% of total landings on these trips. In 2014, however, total groundfish bycatch increased to 10.7 mt and 0.5% of total landings. Most of the increase was due to bycatch of Gulf of Maine haddock which increased to 9.4 mt (of the 10.7 mt total) and 0.4% (of the 0.5% total).

In the 'Squid/Whiting' fishery, estimated total groundfish bycatch declined from 48.2 mt in 2010 to 22.1 mt in 2014. Bycatch rates likewise declined from 3.6% in 2010 to 1.0% of total landings in 2014 (Figure 5). Over this period, the groundfish bycatch composition changed however, with Gulf of Maine haddock becoming more dominant in 2014 (3.4 mt; 0.15%).

Changes in bycatch can arise from three fundamental causes: increases in fishing effort in the fishery; changes in fishing locations, gear, or timing which bycatch species are relatively more available to the fishery, and changes in the abundance of the bycatch species. The first condition can be examined using vessel trip report (VTR data). The second condition can be evaluated using sea sampling data (assuming that there are no sampling biases affecting the comparison). The third condition can be examined by changes in the survey abundance index or estimates of stock size.

Trends in fishing effort (trips and number of vessels fishing) on trips landing 7,500 or more pounds of silver hake are given in Table 6. These data are categorized by calendar year and statistical area. The statistical areas, exemption area boundaries, and distribution of 2014 fishing effort (expressed as total revenue for VTR reported landings on trips targeting whiting) are shown in Figure 6. Most of the fishing effort in the Gulf of Maine occurred in the western section of Small Mesh Area I (SMA1), which overlaps statistical areas (SAs) 513 and 514. A much smaller amount of fishing effort occurred in Small Mesh Area II and in the Raised Footrope Areas (RFAs), near Cape Cod in SA 521. Substantial whiting fishing effort occurs in the Cultivator Shoals Area, primarily just outside of the NE corner of Closed Area I and along the northern edge of Georges Bank. The Cultivator Shoals Area effort falls entirely within SA 522. Other whiting fishing effort in the Southern Fishery Management Area occurs along the southern edge of Georges Bank in SAs 525 and 562, as well as in Southern New England and the Mid-Atlantic in SAs 537, 539, 612, and 616.

Since 1997, there has been a general trend of declining fishing effort in all areas. Total effort declined from 982 trips by 298 vessels in 1997 to 395 trips by 73 vessels in 2015. In 2013-2015, total effort has been historically low but stable, 395-450 trips made by 73 to 94 vessels. This general trend holds true for most statistical areas as well. Comparing 2015 to 2014, there was a small increase from 21 made by 5 vessels to 31 trips by 7 vessels in SAs 513 and 514. But in SAs 522 and 525, fishing effort declined from 205 trips by 13 vessels to 111 trips by 13 vessels.

Looking more closely at haddock bycatch on observed trips (NEFOP and ASM), the distribution of fishing effort in SMA1 between 2007-2012 (Figs ???; right panel) and 2014-2015 (Figure 7, left panel) have remained relatively constant, centered on the western side of SMA1. There does appear to be a slight increase in total haddock catches on observed tows (Figure 7) generally in 2014-2015, compared to previous years. Catch rates (discard to kept all) does not appear to have changed much, but there is some evidence of higher haddock catch rates on tows made at the ends of the geographical distribution. There is insufficient observed tow data to determine whether there is a significant difference in haddock catch rates for different trawl gear configurations in the small mesh fishery.

In the RFAs (Figure 9 and Figure 10), fishing effort appears to have declined near the tip of Cape Cod (which was poorly sampled by NEFOP during 2007-2013) and slightly increased off the outer cape. Haddock catches on observed 2014-2015 tows (Figure 9, left panel) increased compared to 2007-2013

(Figure 9, right panel), particularly in 2015, but the 2014-2015 observed fishing effort has a similar geographical distribution as before. Haddock catch rates have increased (Figure 10), particularly in 2015.

The pattern of small mesh fishing in the Cultivator Shoals Area has remained about the same, with most total fishing effort concentrated along the NE boundary of Closed Area I (Figure 11 and Figure 12), with less effort to the NE along the northwestern edge of Georges Bank. Observed haddock catches have increase in all fished areas. There were a few observed tows in a shallower portion of Georges Bank with higher haddock catches, a fishing area that was not evident in the 2014 VTR data. Catch rates in 2014-2015 (Figure 12, left panel) were substantially higher (over 10% of kept biomass) in nearly all areas whereas much lower catch rates were observed in 2007-2013 (Figure 12, right panel).

Finally, trends in haddock biomass for the Gulf of Maine stock (overlapping SMA 1 and 2) and the Georges Bank stock (overlapping the RFAs and the CSA) are revealing, but are not yet available for 2015. Particularly interesting are the trends resulting from the very strong 2013 year class of haddock for both stock areas (Figure 13). In the Gulf of Maine, the 2013 year class increased to 26.5 million fish compared to 5.3 million fish averaged over 2007-2013. Recruitment for the Georges Bank stock, increased to 3.4 billion fish, compared to the 74.8 million fish averaged over 2007-2013. The 2013 year class were age 1 in 2014 and age 2 in 2015.

In conclusion, increases in total haddock catch in 2014 (and probably in 2015) does not appear to be due to increasing small-mesh multispecies fishing effort or changes in the distribution of fishing effort. More than likely, **the increases in haddock catches appear to be the result of some extraordinary haddock year classes that have become vulnerable to the small-mesh fishing gear (as well as to many other gears), which have occurred in nearly all exemption areas to a greater or lesser extent.**

Figure 4. Estimated groundfish catch for stocks overlapping the Northern Fishery Management Area in the squid and squid/whiting fisheries (top) and trends in small-mesh multispecies fishing effort (bottom), 2010-2014.

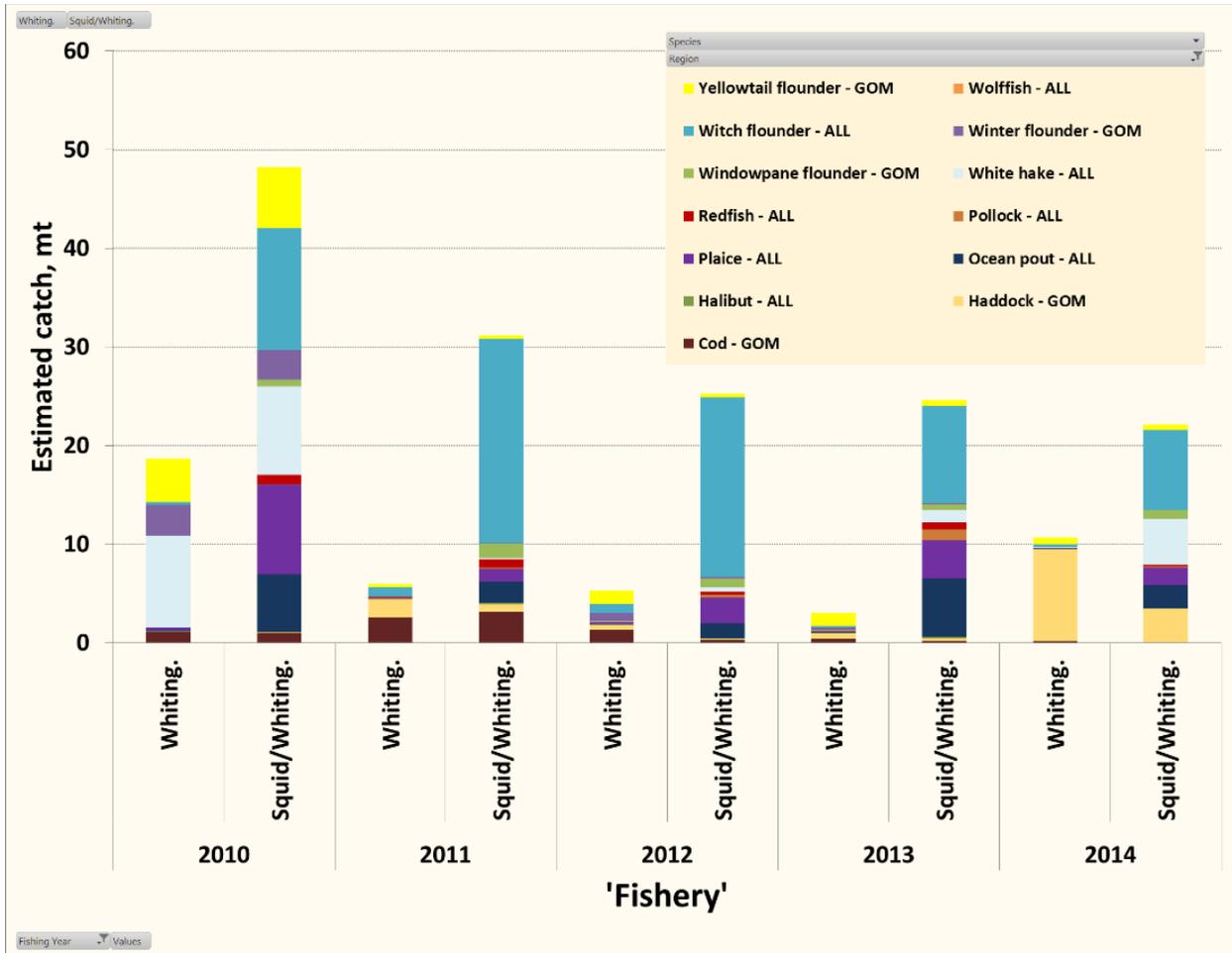


Table 6. Trends in small-mesh trips (top) and vessels (bottom) targeting silver hake and landing more than 7,500 lbs. by statistical area. Source: NMFS VTR data base.

Statistical area																							
Calendar year	512	513	514	515	521	522	525	526	533	534	537	538	543	561	562	611	612	613	615	616	Other	Grand Total	
Trips over 7500 lbs of whiting																							
1997		15	25	4	1	85	98	5	5	1	333				12	8	26	113	3	224	24	982	
1998		5	37		1	111	125	2	2	1	354	2			13	5	13	38	3	136	28	876	
1999		1	79	1	1	131	122	12	1		227			2	7	2	10	21	6	89	15	727	
2000		5	56	2	23	92	120	11	1	5	377				38	1	2	44	1	43	16	837	
2001		3	56		44	174	122	17	1		356	1	1	12	30	1	4	34	5	102	16	979	
2002		5	10	44		6	129	51	7	1	3	124	0		16	14	24	4	1	90	8	537	
2003		2	18		12	100	214	2	2		99			2	40			0	4		41	4	540
2004			1	1	18	44	202	6		1	157		5		34			7	1		87	5	569
2005		2	14		1	36	175	3	2	7	150		1		25			3	5		103	3	530
2006		1	3		3	58	107		3		72				26	4	10	2			101	2	392
2007		13	5		2	59	115	4			176				53	6	33	3	0		70	3	542
2008			15		2	14	114	3			141				47	6	7	6			61	8	424
2009		2	14		1	41	143	1			163		1		54	4	45	10	1		75	32	587
2010			20		1	87	95				111		1		131	2	2	3	1		77	10	541
2011		6	18		3	86	115	3		1	88		1		83	3	14	10	2		93	13	539
2012		13	13		17	59	87	1			103	1			62	9	12	12			88	11	488
2013		3	4		8	67	80	9			63				90	3	1	3	1		40	26	398
2014		4	17		10	131	76	5			83	0			50	6	12	2			52	2	450
2015			31	2	39	61	50				47		1		107		2	5			37	13	395
Vessels making one or more trips over 7500 lbs whiting																							
1997		11	15	3	1	15	24	6	5	1	74				7	6	15	38	3	54	20	298	
1998		5	16		1	21	26	2	1	1	73	1			8	7	10	18	3	49	20	262	
1999		2	26	1	3	18	21	11	2		65			2	5	3	9	18	4	32	11	233	
2000		1	16	2	5	12	20	6	1	5	80				7	1	1	28	1	23	15	224	
2001		2	14		7	26	29	12	1		59	1	1	1	9	6	5	24	2	47	12	258	
2002		1	2	12		3	22	15	6	1	2	36	1		6	5	8	5	1		20	10	156
2003		1	7		8	18	31	2	1		30			1	11			1	5		14	6	136
2004			3	1	3	12	28	5		1	42		3		7			7	1		24	4	141
2005		1	1		1	5	18	2	2	1	27		1		7		2	6			29	2	105
2006		2	3		2	15	13		2		22				9	3	4	3			30	1	109
2007		2	2		2	11	17	3			53				12	4	12	3	1		25	2	149
2008			7		1	3	15	2			34				10	1	5	5			25	8	116
2009		2	3		1	4	10	1			41		1		8	3	14	11	1		25	9	134
2010			4		1	12	17				29		1		13	5	1	3	2		26	8	122
2011		1	2		1	9	11	2		1	22		1		9	2	7	10	2		25	12	117
2012		2	3		2	5	9	1			35	1			6	7	5	10			20	9	115
2013		1	1		1	6	15	1			22				5	3	2	3	1		10	5	76
2014		1	4		1	4	9	3			30	1			7	1	6	3			19	5	94
2015			7	1	5	5	8				24		1		7		1	5			7	2	73
Total Trips over 7	5	85	470	10	193	1565	2211	91	18	19	3224	4	11	16	918	74	220	326	25	1609	239	11333	
Total Vessels ma	1	36	146	8	49	223	336	65	16	12	798	5	9	4	153	57	108	205	22	504	161	2918	

Figure 5. Trends in total annual bycatch rates for northern groundfish stocks in the small-mesh multispecies fishery. Source: Groundfish PDT estimates of sub-component groundfish bycatch, 2015.

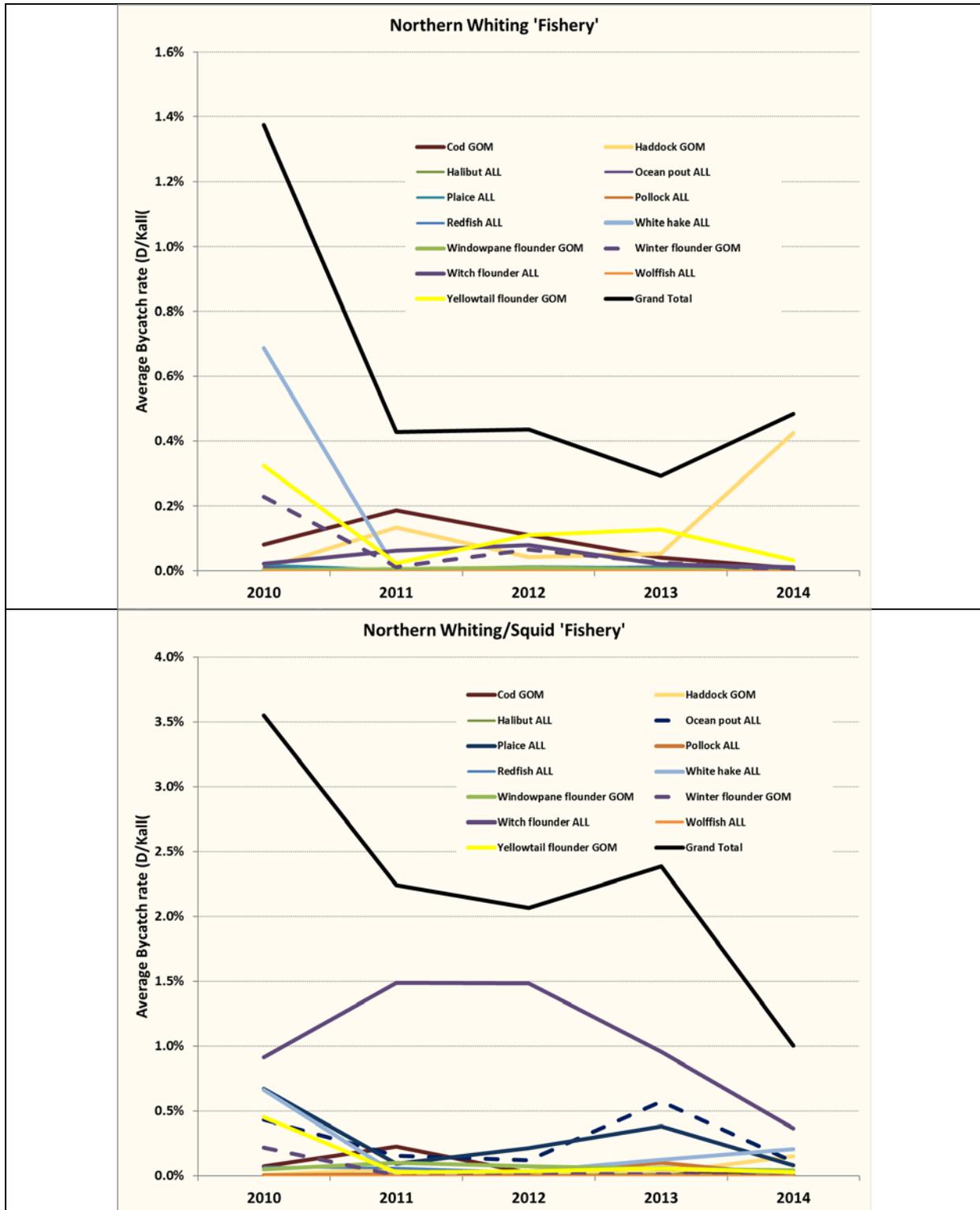


Figure 6. Small mesh exemption areas (white) and reported fishing patterns derived from 2014 Vessel Trip Reports, showing the boundaries of three-digit statistical catch reporting areas.

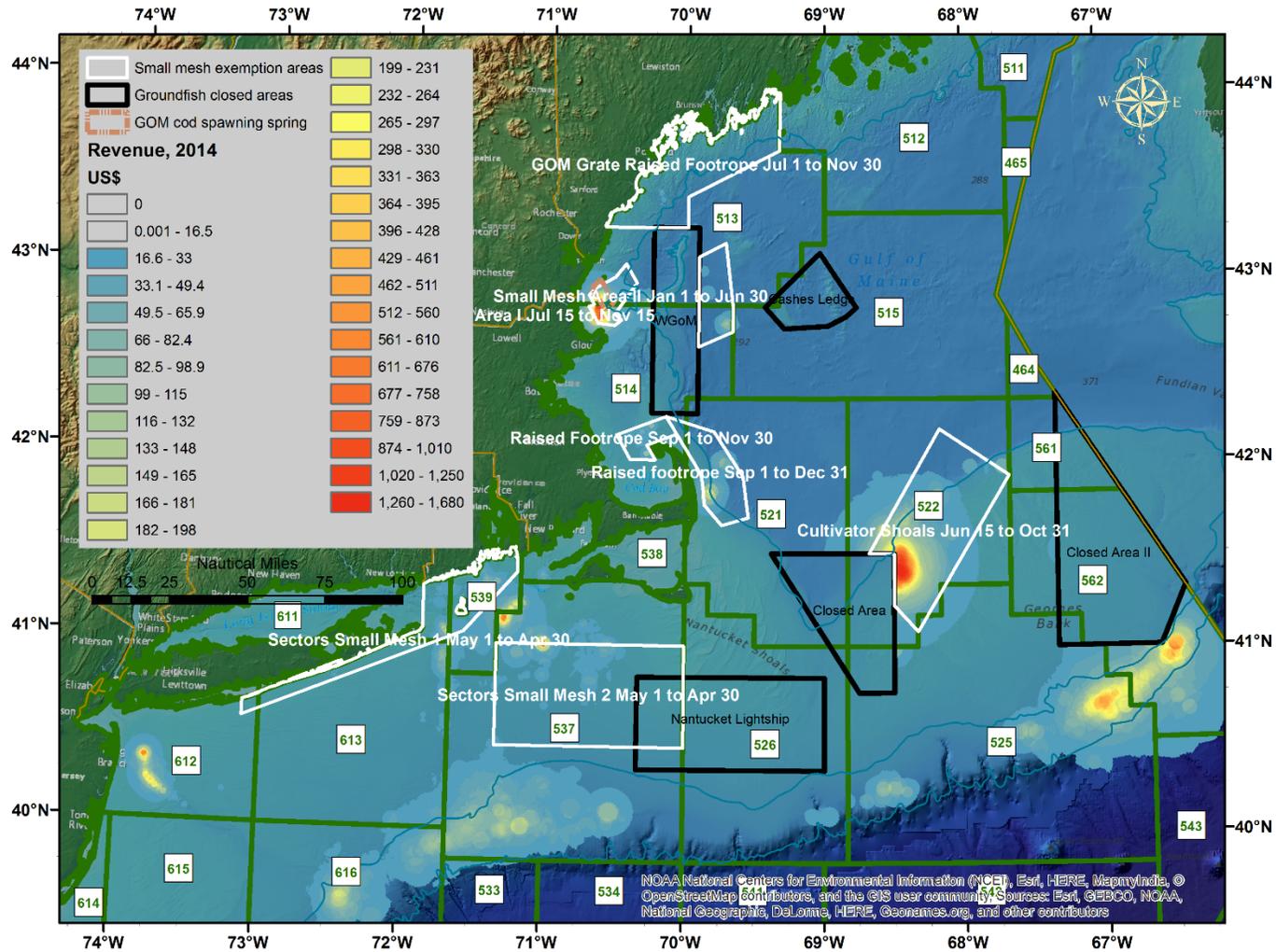


Figure 7. **Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for Small Mesh Area I.** Observed tows include sea sampling and at-sea monitoring of trawl hauls targeting and catching at least 1000 lbs. of silver hake (Source: NMFS OBDDBS and ASM data). Revenue was derived from reported landings and location on Vessel Trip Reports with price data assigned by year, month, and species (Source: NMFS Social Sciences Branch analysis).

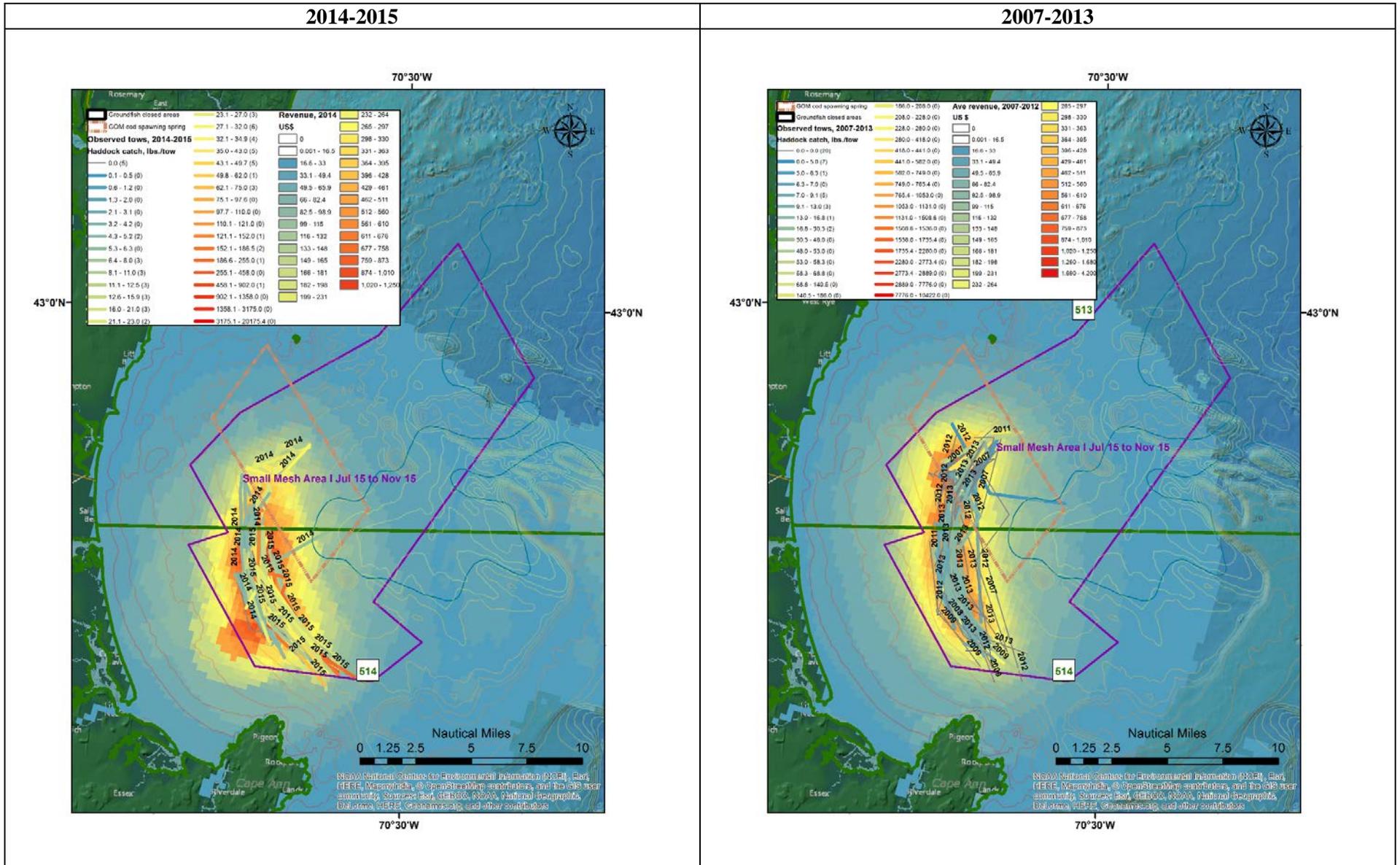


Figure 8. **Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for Small Mesh Area I.** Data sources are described in Figure 7.

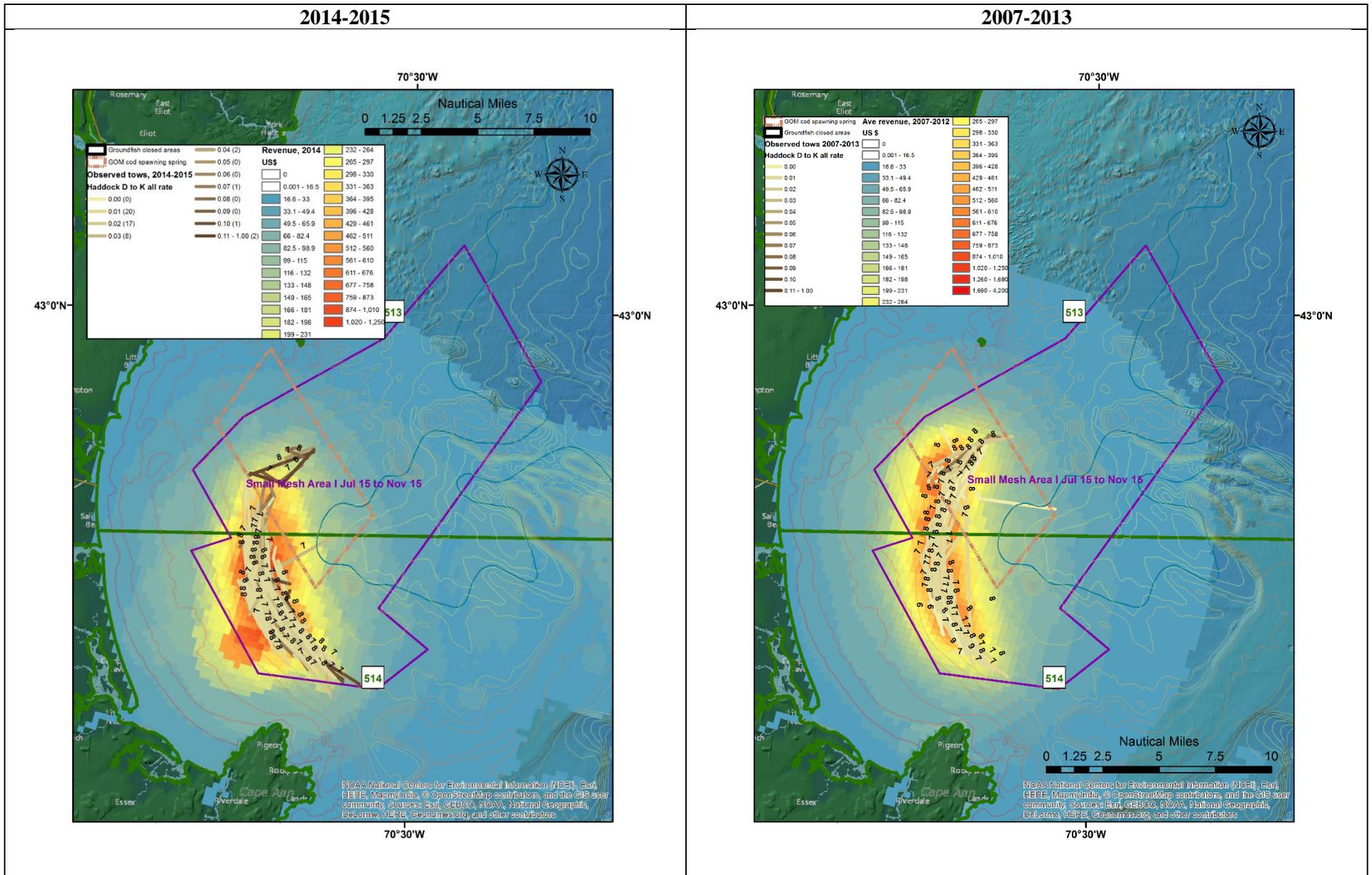


Figure 9. **Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Raised Footrope Exemption Areas.**
 Data sources are described in Figure 7.

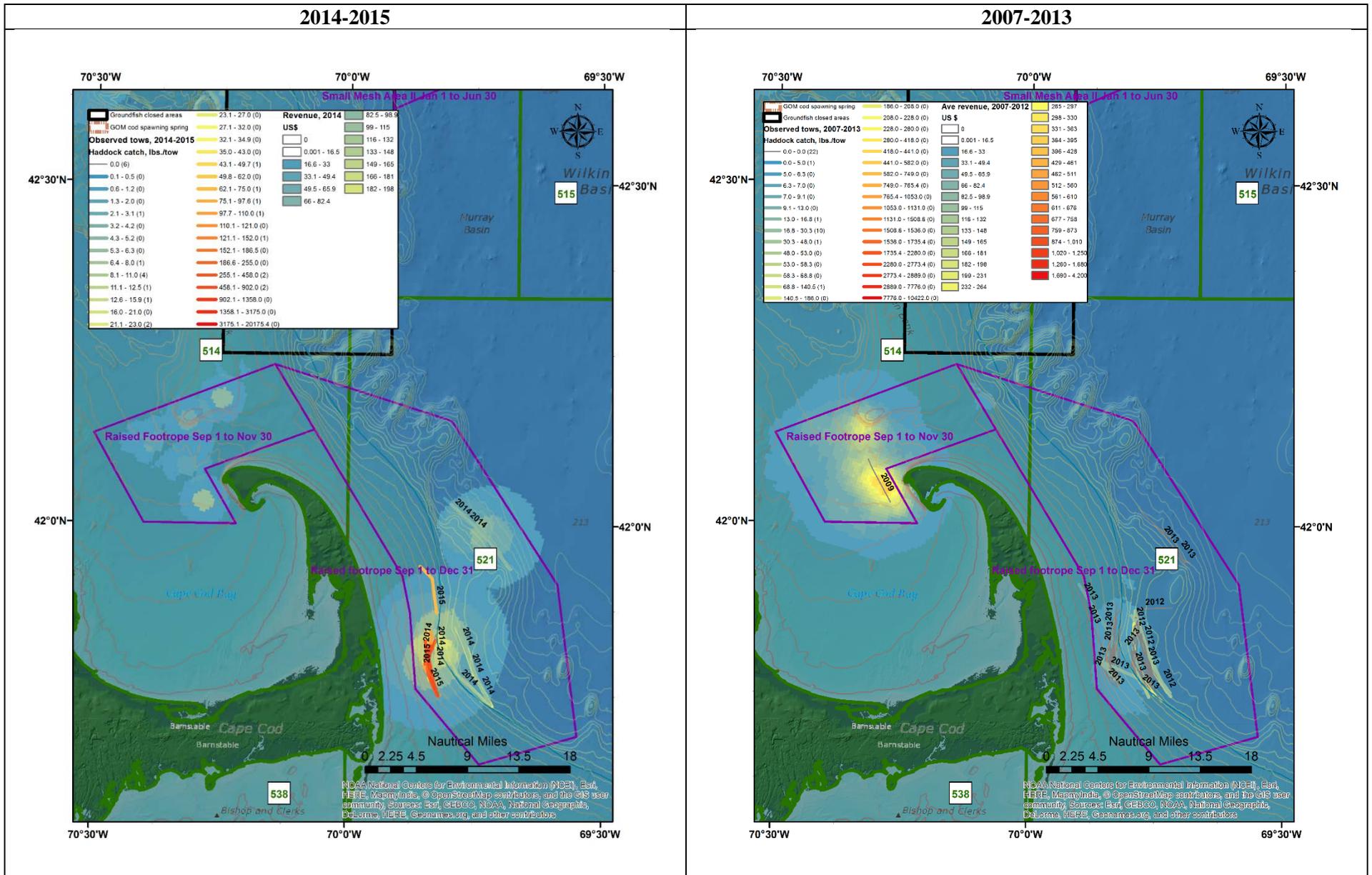


Figure 10. **Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Raised Footrope Exemption Areas.** Data sources are described in Figure 7.

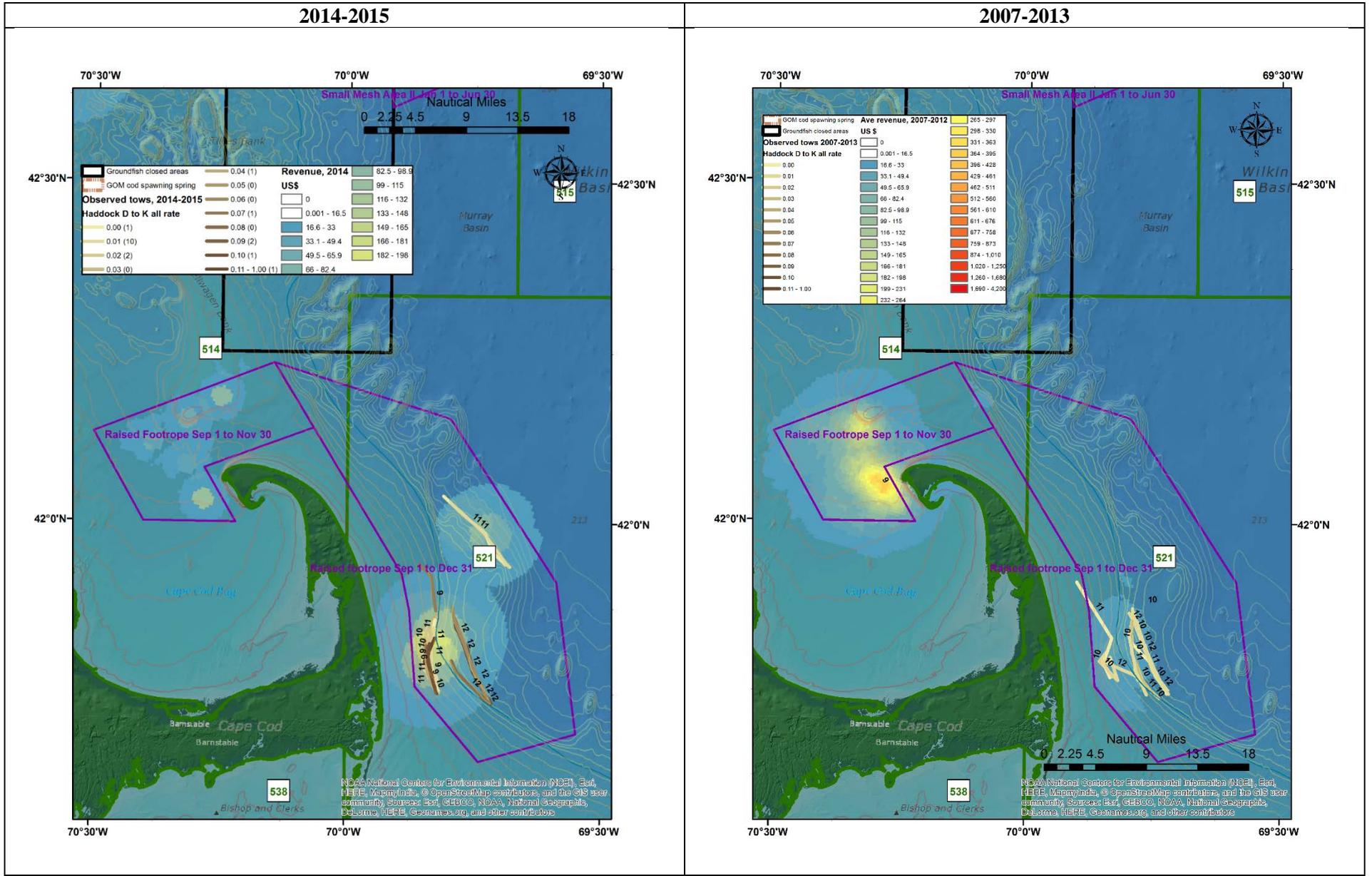
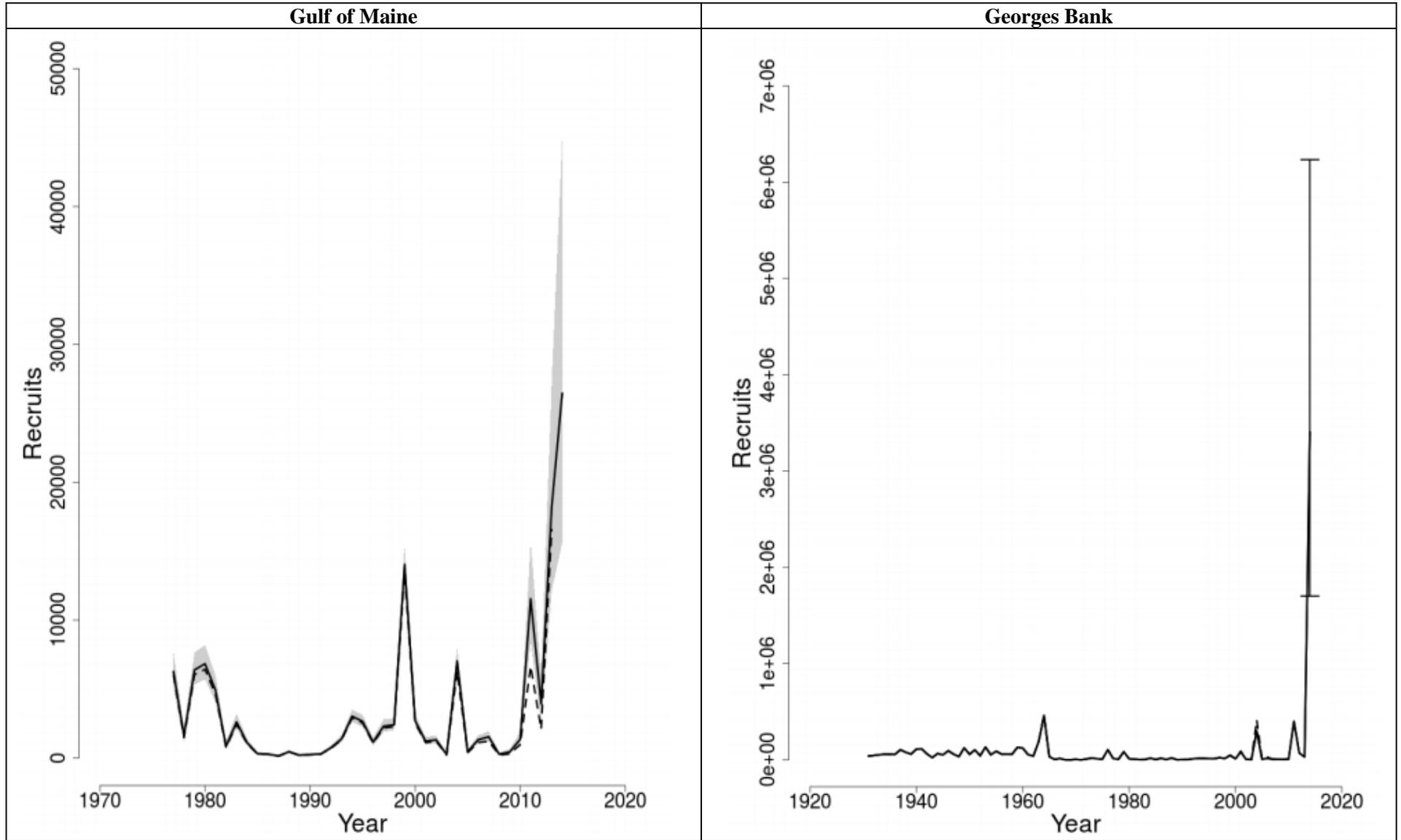


Figure 13. Trends in age 1 haddock recruitment with 90% bootstrap probability intervals to show uncertainty. Source: NMFS 2016



5.2.2 Southern Fishery Management Area (SFMA)

Most of the effort with groundfish bycatch is categorized as a mixed squid/whiting fishery based on targeting as defined by the Groundfish PDT when estimating total groundfish bycatch. Effort in this area is mainly concentrated on the southern portion of Georges Bank, south and southwest of Closed Area II, in SAs 525 and 562. Total effort in these two SAs generally declined from 204 trips made by 38 vessels in 2001 to 181 trips by 16 vessels in 2014 and 157 trips by 15 vessels in 2015.

Total groundfish bycatch for Georges Bank stocks (Figure 14) declined from 183.3 mt in 2010 to 49.8 mt in 2012 and increased slightly to 70.9 mt in 2013. Total bycatch in 2014 increased to 179.8 mt, mostly due to a substantial increase in haddock bycatch. Catch rates (Figure 15) similarly declined from 3.0% in 2010 to 0.9% in 2012, then increased to 1.5% in 2013 and 4.5% in 2014.

Similar to the pattern for the CSA, observed haddock catches in 2014-2015 increased compared to 2007-2013 (Figure 16). Fishing was a little less prevalent to the SW of Closed Area II in 2014-2015 than it was before, but the observed haddock catches in all areas of Southern Georges Bank increased across the board. Elevated catch rates above 5% were recorded on a number of observed tows during both periods (Figure 17).

Although fewer observed tows and reported fishing effort occurred SW of Closed Area II during 2014-2015, there does not appear to be a noticeable pattern that would have caused an increase in haddock catches. Changes in gears used, changes in fishing patterns, or increases in fishing effort have not been observed. Thus increases in recent haddock bycatch appears to be the result of the very strong 2013 year class of haddock (Figure 13).

Figure 14. Estimated groundfish catch for stocks overlapping the Southern Fishery Management Area in the squid and squid/whiting fisheries (top) and trends in small-mesh multispecies fishing effort (bottom), 2010-2014.

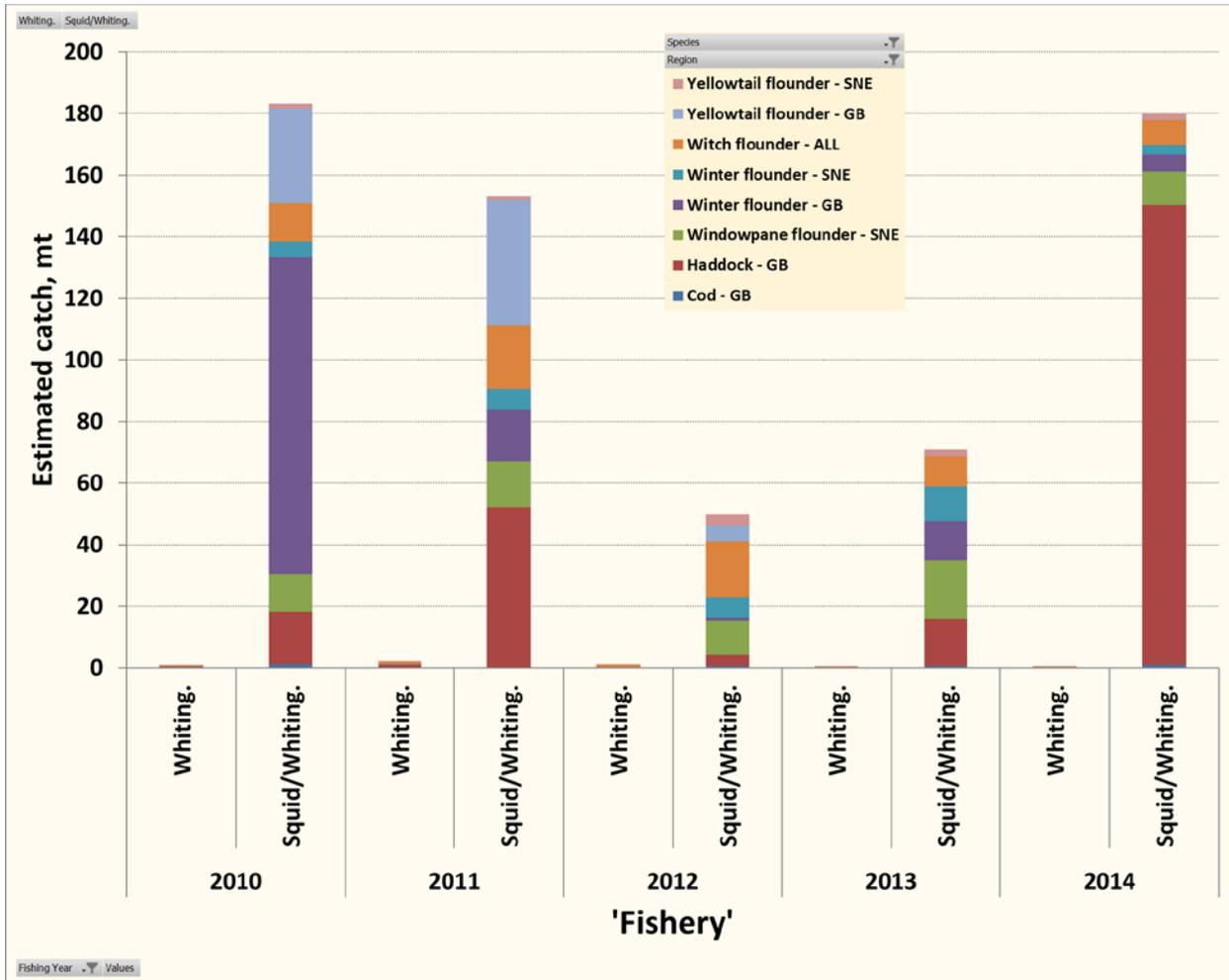


Figure 15. Trends in total annual bycatch rates for northern groundfish stocks in the small-mesh multispecies fishery. Source: Groundfish PDT estimates of sub-component groundfish bycatch, 2015.

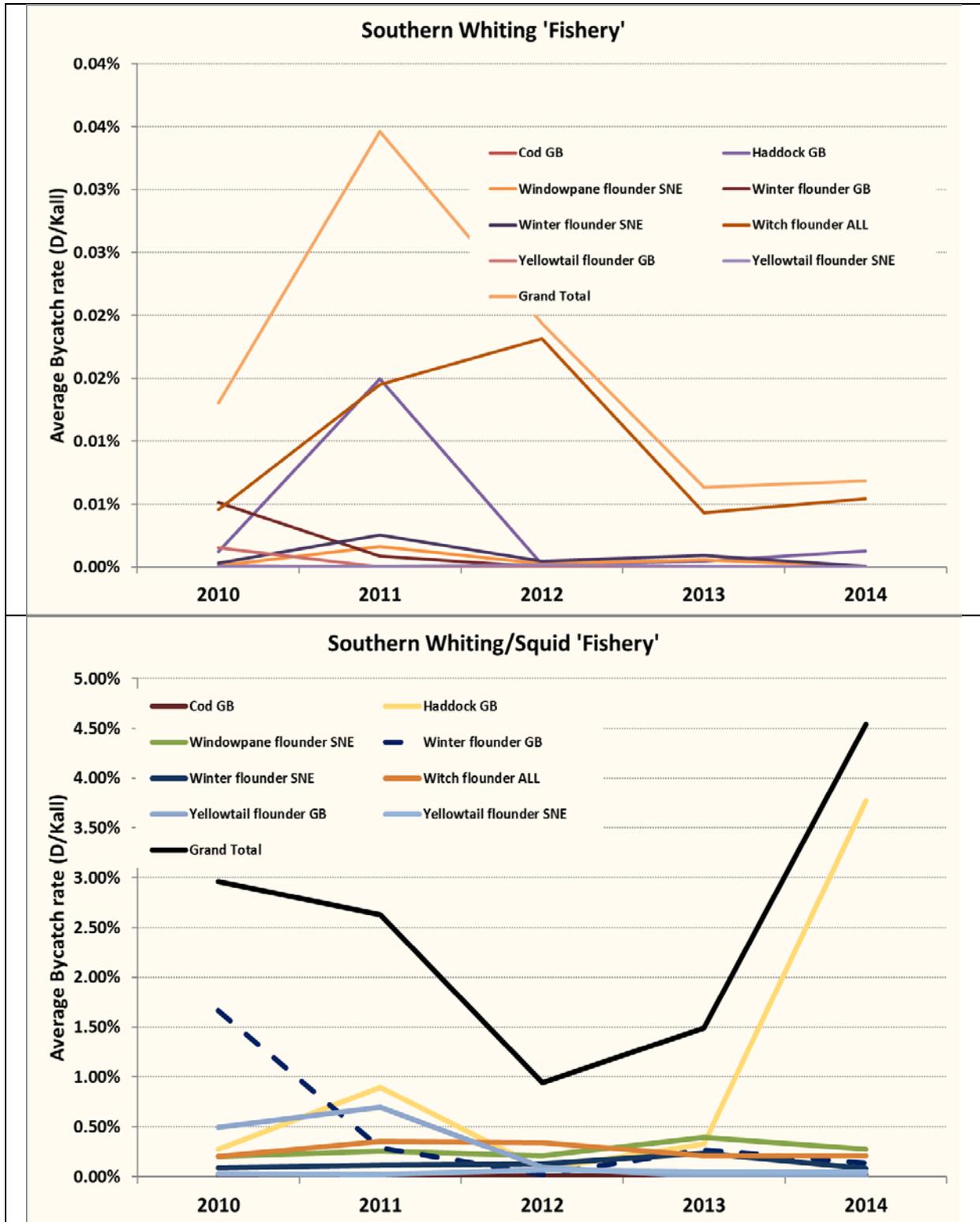


Figure 16. **Observed haddock bycatch per tow plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Southern Georges Bank fishing area.** Data sources are described in Figure 7.

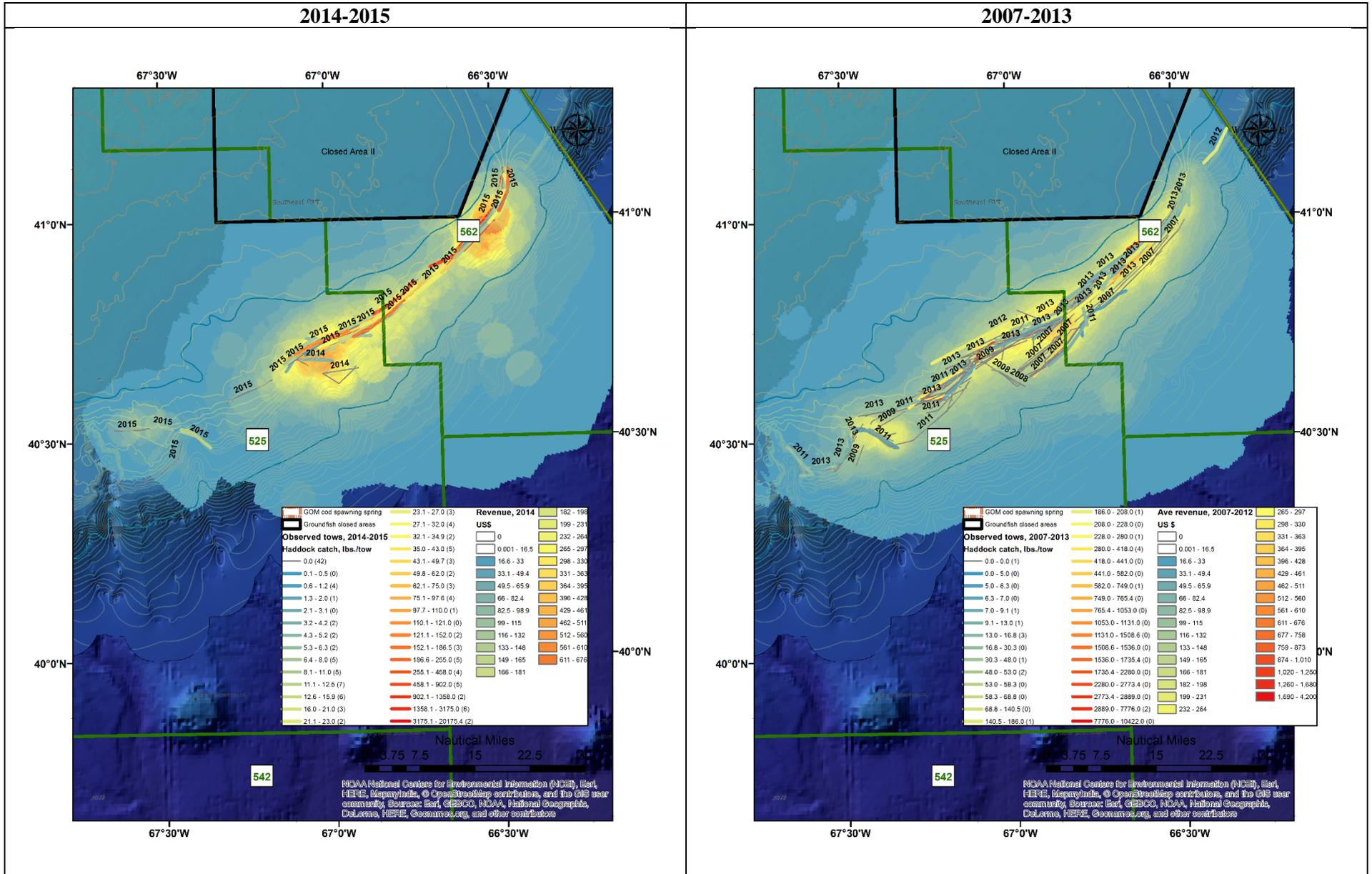
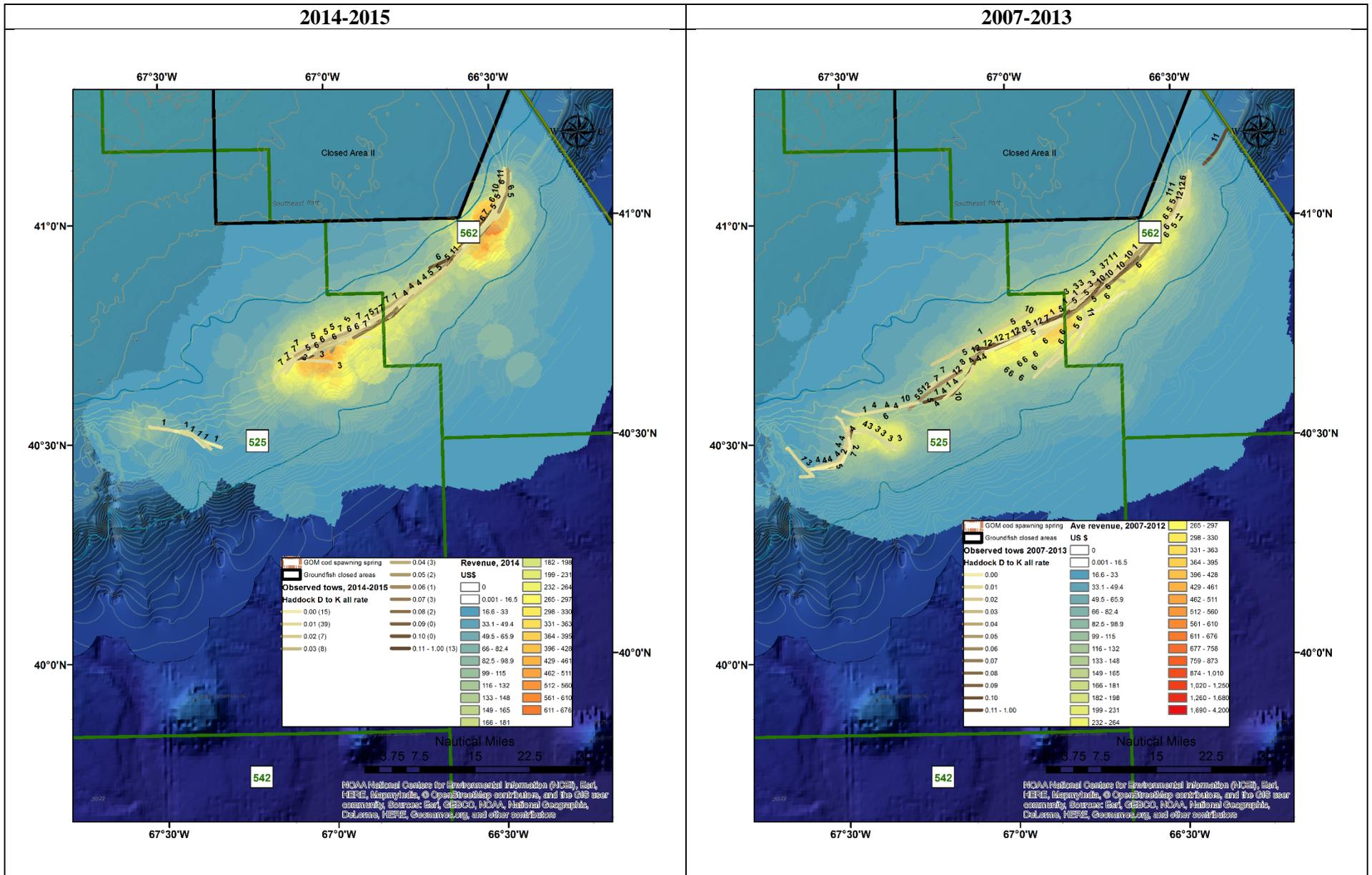


Figure 17. **Observed haddock discard to kept-all rate plotted over estimated 2014 (left) and 2007-2012 revenue (right) for the Southern Georges Bank fishing area.** Data sources are described in Figure 7.



6.0 Trends in survey biomass indices

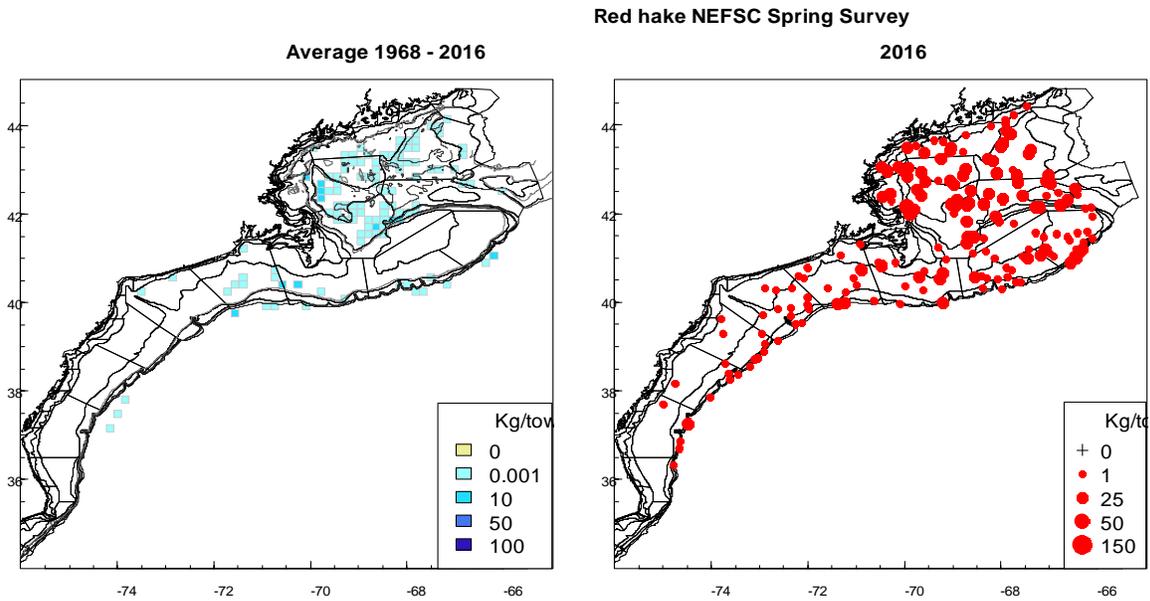
The Northeast Fishery Science Center (NEFSC) bottom trawl survey is the primary fishery independent data used for deriving the relative biomass for both red and silver hake. The NEFSC spring and fall bottom trawl surveys began in 1968 and 1963, respectively. The NEFSC bottom trawl survey has utilized three different vessels and three different door configurations throughout the time series of the survey. The largest change in the survey time series occurred in 2009 when the FSV Albatross was decommissioned and replaced by FSV Henry B. Bigelow. This resulted in changes not only to the vessel and doors, but also to the overall trawl gear survey protocols. Calibration experiments to estimate differences were conducted and summarized in Miller et al. (2010).

The NEFSC spring survey in the north occurs on average from late March to approximately late May while in the south; the survey timing is on average from mid-March to early May. The fall survey reaches the north early in October to late November and in the south, the timing of the survey on average is from Mid-September to early December. Although both survey timing exhibit some interannual variability, there were no long term shifts in the survey timing. Further, both survey time series trends of bottom temperature show no indication of long-term trends, though temperatures have been above average since 2010. Further, red hake spring survey distribution was evaluated for potential differences that may have occurred due to the recent delay in the timing of the 2016 spring survey. No obvious evidence of spatial shift in red hake distribution was observed relative to historic distribution (Figure18).

Following the accepted index approach from the 2010 benchmark assessment, the survey indices for both red and silver hake were only updated for this annual monitoring report using the three year moving average of the spring survey index for years 2014-2016 and the fall survey index for years 2013-2015. It should be noted that this update only considers information from fishery independent and does not include fishery dependent data and evaluation of the overfishing limit (OFL) and Allowable Biological Catch (ABC). The objective here is to gain some insights on the population trend from survey results and determine the biomass status relative the management threshold.

Overall, the northern stocks for both red and silver hake show increasing trend in the survey biomass and well above the management threshold while the southern stocks continue to show continued declining trends. The southern stock of silver hake is still currently above the management threshold while southern red hake stock is estimated at the management threshold. The low availability of smaller size fish in the south compared to the north is likely an indication of poor recruitment and partly could explain the cause for the recent declines in the south.

Figure 18. Survey catch of northern and southern red hake in kg/tow for the NEFSC spring survey. The LEFT panel shows the survey time series average and the RIGHT panel depicts the most recent data. Note the 2009-2016 survey values were adjusted from Bigelow to Albatross IV equivalents



6.1 Red hake

The update of the red hake spring survey biomass indicates that the northern stock is not overfished; however, the southern stock continues to decline and is currently at the biomass threshold reference point.

Although the estimated spring annual index for northern red hake stock declined by 28% between 2015 and 2016, the recent three-year average (2014-2016) of the NEFSC spring survey biomass increased by 29% from 3.55kg/tow (2015 three year moving average) to 4.58kg/tow in 2016 and is currently above the management threshold (1.27kg/tow; Table 7 and Figure 19). The increase in the 2016 northern red hake three-year average of the spring survey biomass can be attributed to the 2014 year class which was observed to be the second highest in the entire time series. The spring survey size distributions for northern red hake have remained fairly consistent in the recent 10 years with the mode of the catch generally between 27 cm and 32cm. The exception was in 2014 when the catch was dominated by smaller fish in 17cm size category (Figure 20).

The spring survey biomass for the southern stock of red hake has been declining in the recent five years. In 2016, the annual index was estimated at 0.58kg/tow, a 46% decrease from 2015 survey estimate (0.31kg/tow). The three-year average spring survey biomass also declined, but only by 18% from 0.62 kg/tow in 2015 to 0.51kg/tow in 2016, resulting in the current state of the southern red hake biomass at the management threshold (0.51kg/tow; Table 8 and Figure 21). It should be noted that the CV estimates for the recent three-year spring survey biomass ranged between 16% and 24%. Accounting for uncertainty (i.e. 90% confidence interval from bootstrap estimates) in the 2016 three year moving average estimates in the spring survey biomass, the stratified survey mean weights ranged from 0.38 kg/tow to 0.74kg/tow, indicating the stock could potentially be in an overfished condition. Similar to the northern stock, the size distribution was fairly consistent (mode ranging between 26-30cm); however, no indication of incoming young class in the recent years (Figure 22).

Table 7. Northern red hake NEFSC spring survey biomass in Albatross units (kg/tow) from 1968-2016

Year	Northern Spring Survey Arithmetic kg/tow	Northern Spring Survey 3-year Average	Year	Northern Spring Survey Arithmetic kg/tow	Northern Spring Survey 3-year Average
1968	1.14		1994	1.59	2.30
1969	0.64		1995	1.97	2.13
1970	0.54	0.77	1996	1.79	1.78
1971	0.65	0.61	1997	1.81	1.86
1972	1.56	0.92	1998	2.52	2.04
1973	4.31	2.17	1999	2.32	2.22
1974	2.43	2.77	2000	3.19	2.68
1975	4.25	3.66	2001	3.58	3.03
1976	3.37	3.35	2002	4.46	3.74
1977	2.66	3.43	2003	1.00	3.01
1978	2.57	2.87	2004	1.77	2.41
1979	2.04	2.42	2005	1.10	1.29
1980	3.88	2.83	2006	0.91	1.26
1981	6.35	4.09	2007	2.06	1.36
1982	2.13	4.12	2008	3.49	2.15
1983	3.70	4.06	2009	1.78	2.44
1984	2.98	2.94	2010	2.79	2.69
1985	3.91	3.53	2011	2.18	2.25
1986	3.26	3.38	2012	1.73	2.23
1987	2.94	3.37	2013	1.35	1.75
1988	2.00	2.73	2014	3.02	2.03
1989	1.65	2.20	2015	6.27	3.55
1990	1.33	1.66	2016	4.46	4.58
1991	1.62	1.53			
1992	2.50	1.82			
1993	2.82	2.31			

Figure 19. Northern red hake NEFSC Spring survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.

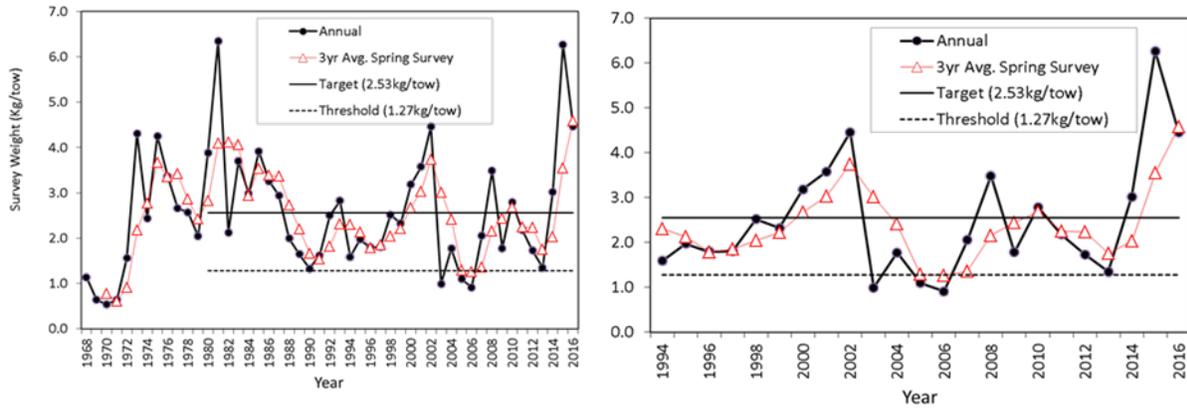


Figure 20. Northern red hake NEFSC spring survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series

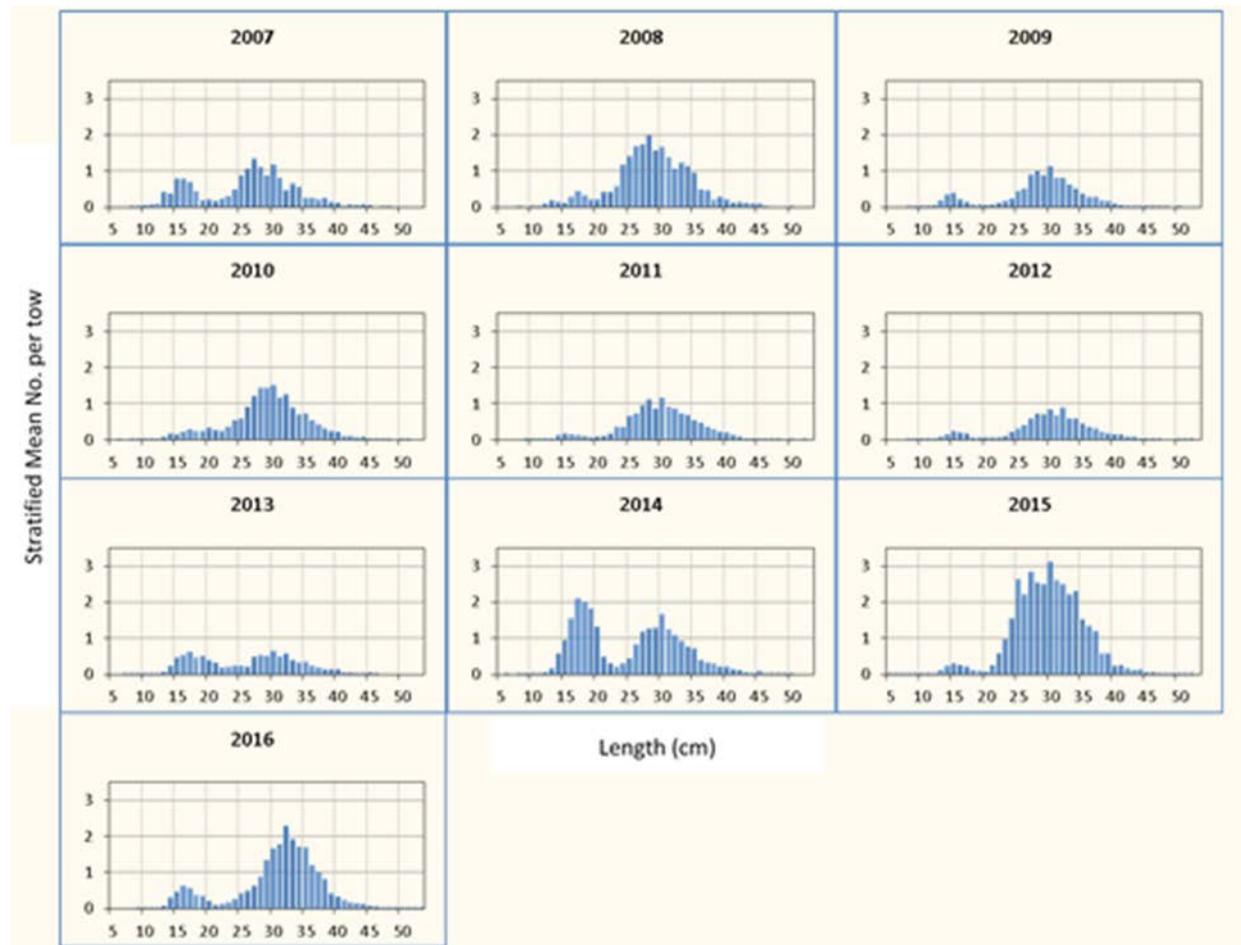


Table 8. Southern red hake NEFSC Spring Survey biomass in Albatross units (kg/tow) from 1968-2016

Year	Southern Spring Survey Arithmetic kg/tow	Southern Spring Survey 3-year Average	Year	Southern Spring Survey Arithmetic kg/tow	Southern Spring Survey 3-year Average
1968	1.29		1994	0.675	0.52
1969	1.08		1995	0.516	0.54
1970	1.72	1.36	1996	0.453	0.55
1971	3.49	2.10	1997	1.161	0.71
1972	3.59	2.93	1998	0.214	0.61
1973	3.99	3.69	1999	0.455	0.61
1974	2.84	3.47	2000	0.423	0.36
1975	3.18	3.34	2001	0.642	0.51
1976	5.31	3.78	2002	0.542	0.54
1977	2.3	3.60	2003	0.206	0.46
1978	7.65	5.09	2004	0.154	0.30
1979	1.51	3.82	2005	0.376	0.25
1980	2.38	3.85	2006	0.38	0.30
1981	4.61	2.83	2007	0.857	0.54
1982	3.34	3.44	2008	0.473	0.57
1983	2.21	3.39	2009	1.44	0.92
1984	1.33	2.29	2010	0.94	0.95
1985	1.39	1.64	2011	1.79	1.39
1986	1.73	1.48	2012	1.06	1.26
1987	0.88	1.33	2013	0.64	1.16
1988	1.01	1.21	2014	0.63	0.78
1989	0.49	0.79	2015	0.58	0.62
1990	0.71	0.74	2016	0.31	0.51
1991	0.61	0.60			
1992	0.47	0.60			
1993	0.42	0.50			

Figure 21. Southern red hake NEFSC Spring survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.

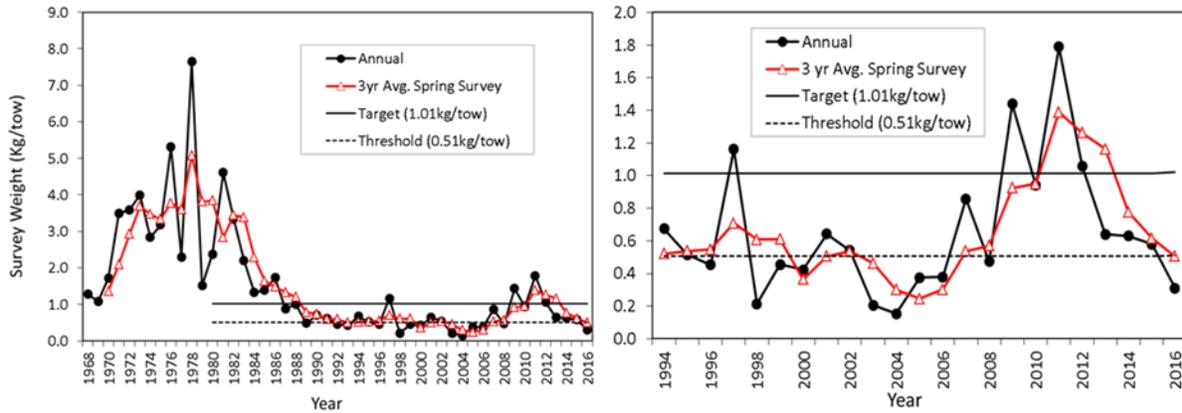
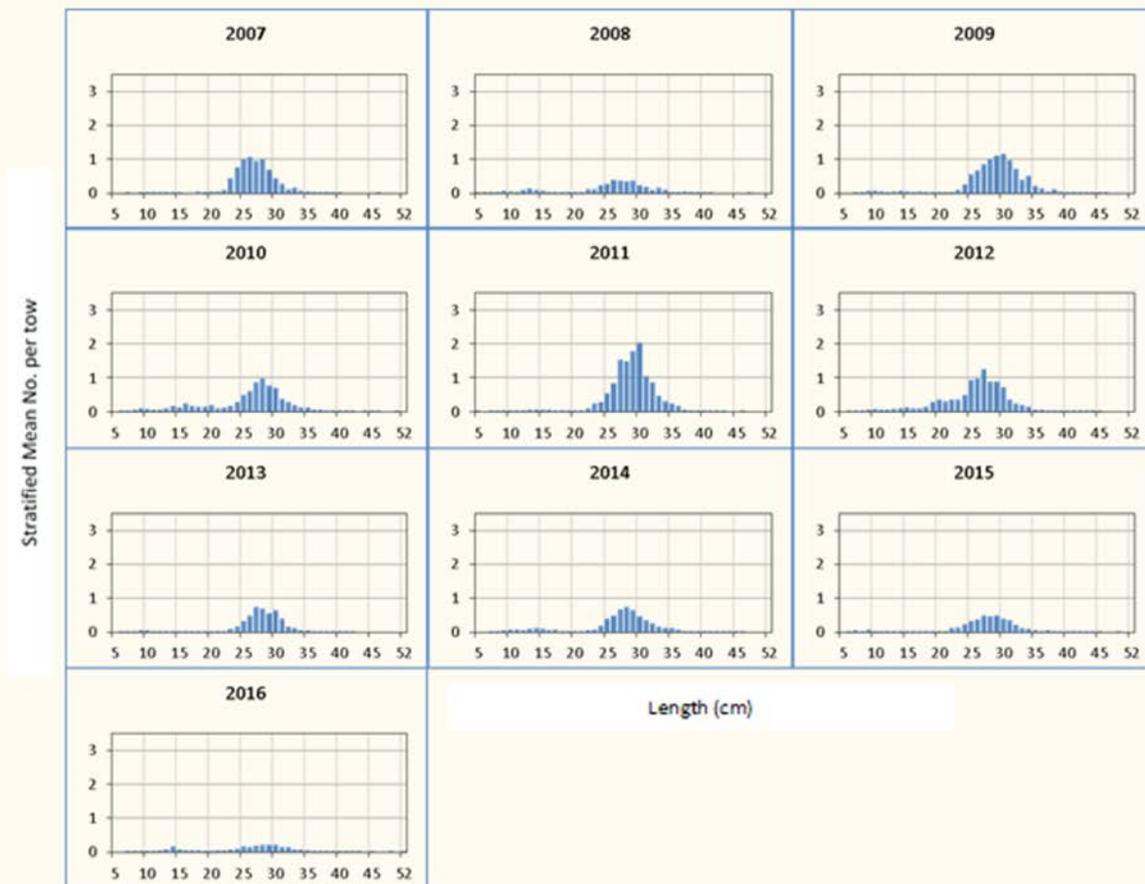


Figure 22. Southern red hake NEFSC spring survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.



6.2 Silver hake

The update of silver hake fall survey biomass indicates that both the northern and southern stocks are both above management reference points and therefore not overfished.

While the biomass index for the northern stock of silver hake do show some interannual variability, the overall trend in the biomass index continues to increase, particularly in the recent decade. The 2016 annual fall survey was estimated at 19.49kg/tow, a 4% increase from the 2015 survey estimate of 18.77kg/tow. However, the calculated three-year average of the fall survey biomass in the north, slightly declined by only 2% from 18.65kg/tow in 2015 to 18.34kg/tow in 2016. The slight decrease in 2016 three year fall survey estimate can be attributed to the brief decline in the fall survey biomass between 2012 and 2013. In spite of the slight decline in the recent three year fall survey estimate, the current state of the northern silver hake biomass is still well above the management threshold (3.21kg/tow; Table 9 and Figure 23).

The survey size distribution for the northern stock of silver hake shows a moderate expansion in the availability of larger size fish in the catch, particularly in recent years. The apparent bimodal pattern observed in the survey size distribution is likely an indication of the presence of incoming year classes (< 21 cm), transitioning into the adult biomass (\geq 21cm). In 2015, there is a preliminary indication of a recruitment pulse in the north, however, future survey observations will be required to confirm the strength of this incoming year class (Figure 24).

In contrast to the northern stock, the southern stock of silver hake continues to show declining trends in the fall survey biomass. Since 2010, the annual survey biomass for the southern stock of silver hake has declined by 85% from 1.77kg/tow to 0.42kg/tow in 2015. Owing to the decline in the survey trends, the three-year average has also declined by 51% from 2.19kg/tow in 2012 to 1.06kg/tow in 2015. Although the three-year average of the fall survey biomass for the southern stock has been steadily declining in recent years, the current state of the stock biomass is still above the management threshold (0.83 kg/tow; Table 10 and Figure 25) but by only 28%. Survey size distribution for the southern stock also show a declining trend in both smaller sized and larger sized fish. With the exception of 2009, the low availability of small fish in the survey catch is likely an indication of poor recruitment in the southern stock. Should this trend of poor recruitment continue into the future, the southern stock could likely decline below the management threshold, resulting in the southern stock to be overfished.

Table 9. Northern silver hake NEFSC fall survey biomass in Albatross units (kg/tow) from 1963-2015

Year	Northern Fall Survey Arithmetic kg/tow	Northern Fall Survey 3-year Average	Year	Northern Fall Survey Arithmetic kg/tow	Northern Fall Survey 3-year Average
1963	23.10		1990	15.61	10.73
1964	4.34		1991	10.52	12.22
1965	7.06	11.50	1992	10.25	12.13
1966	4.19	5.20	1993	7.50	9.42
1967	2.27	4.51	1994	6.84	8.20
1968	2.28	2.91	1995	12.89	9.08
1969	2.41	2.32	1996	7.57	9.10
1970	3.03	2.57	1997	5.66	8.71
1971	2.67	2.70	1998	18.91	10.71
1972	5.78	3.83	1999	11.15	11.91
1973	4.12	4.19	2000	13.51	14.52
1974	3.45	4.45	2001	8.33	11.00
1975	8.09	5.22	2002	7.99	9.94
1976	11.25	7.60	2003	8.29	8.20
1977	6.72	8.69	2004	3.28	6.52
1978	6.32	8.10	2005	1.72	4.43
1979	6.18	6.41	2006	3.69	2.90
1980	7.23	6.58	2007	6.44	3.95
1981	4.52	5.98	2008	5.27	5.13
1982	6.28	6.01	2009	6.93	6.21
1983	8.76	6.52	2010	14.17	8.79
1984	3.36	6.13	2011	9.97	10.36
1985	8.28	6.80	2012	20.43	14.86
1986	13.04	8.23	2013	16.75	15.72
1987	9.79	10.37	2014	18.77	18.65
1988	6.05	9.63	2015	19.49	18.34
1989	10.53	8.79			

Figure 23. Northern silver hake NEFSC fall survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.

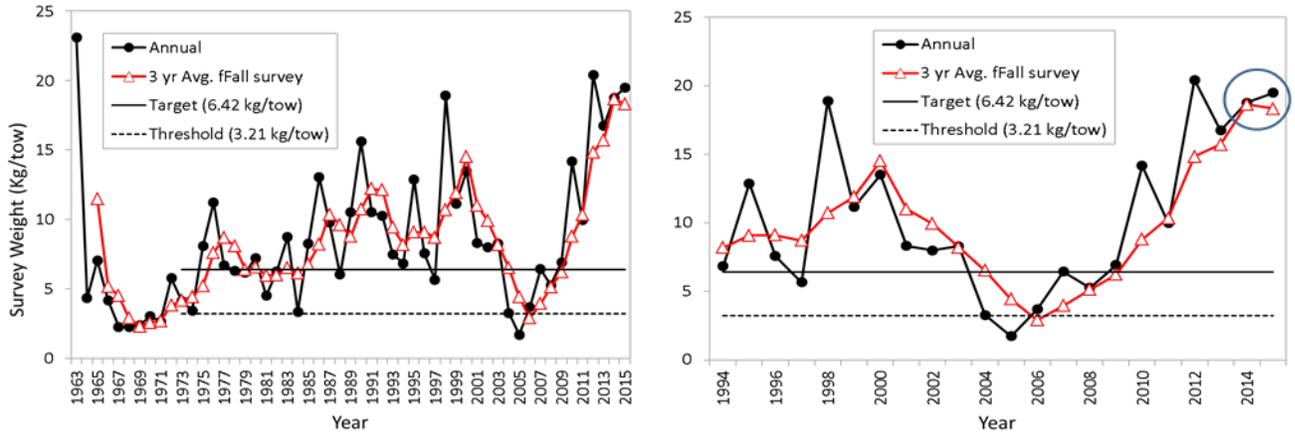


Figure 24. Northern silver hake NEFSC fall survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.

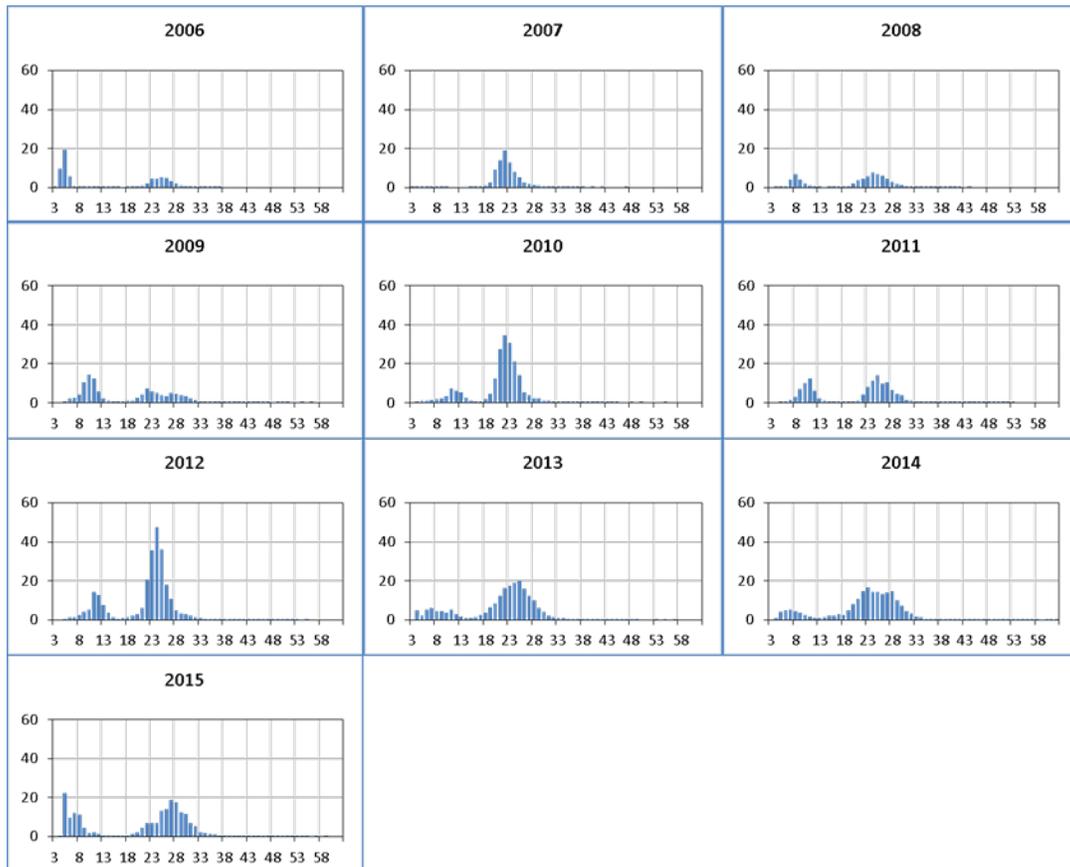


Table 10. Southern silver hake NEFSC fall survey biomass in Albatross units (kg/tow) from 1963-2015

Year	Southern Fall Survey Arithmetic kg/tow	Southern Fall Survey 3-year Average	Year	Southern Fall Survey Arithmetic kg/tow	Southern Fall Survey 3-year Average
1963	4.66		1990	1.52	1.72
1964	4.06		1991	0.85	1.41
1965	5.28	4.67	1992	0.99	1.12
1966	2.64	3.99	1993	1.28	1.04
1967	2.44	3.45	1994	0.79	1.02
1968	2.73	2.60	1995	1.59	1.22
1969	1.26	2.14	1996	0.45	0.94
1970	1.35	1.78	1997	0.83	0.96
1971	2.21	1.61	1998	0.57	0.62
1972	2.13	1.90	1999	0.82	0.74
1973	1.7	2.01	2000	0.72	0.70
1974	0.85	1.56	2001	2.04	1.19
1975	1.79	1.45	2002	1.18	1.31
1976	1.99	1.54	2003	1.42	1.55
1977	1.68	1.82	2004	1.24	1.28
1978	2.5	2.06	2005	0.94	1.20
1979	1.68	1.95	2006	1.42	1.20
1980	1.63	1.94	2007	0.87	1.08
1981	1.12	1.48	2008	1.36	1.22
1982	1.56	1.44	2009	1.10	1.11
1983	2.57	1.75	2010	2.82	1.76
1984	1.4	1.84	2011	1.77	1.90
1985	3.55	2.51	2012	1.98	2.19
1986	1.45	2.13	2013	1.33	1.70
1987	1.95	2.32	2014	1.44	1.59
1988	1.78	1.73	2015	0.42	1.06
1989	1.87	1.87			

Figure 25. Southern silver hake NEFSC fall survey biomass in stratified kg/tow (Albatross units) and the calculated 3-yr moving average (red line with triangle symbols). The LEFT panel depicts the full time series while the RIGHT panel is the truncated time series. The horizontal dash line represents the biomass threshold and the solid horizontal line is the biomass target.

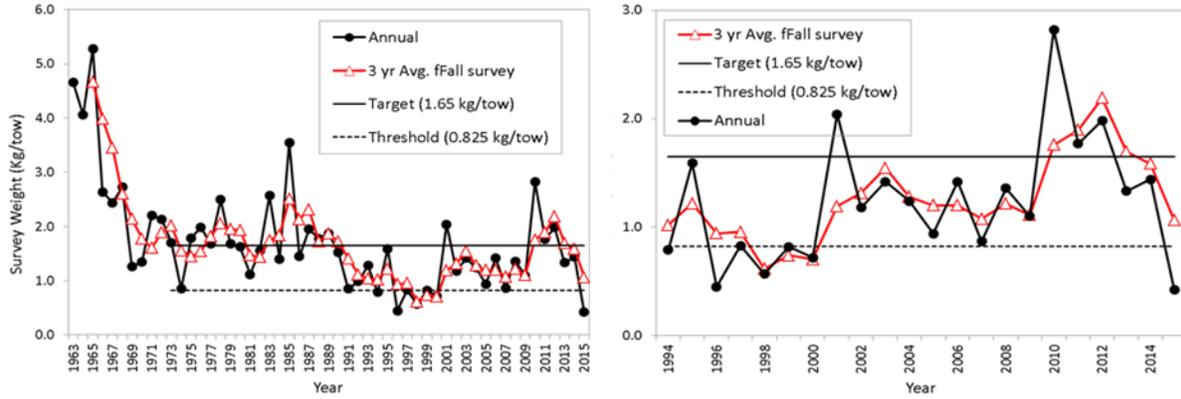
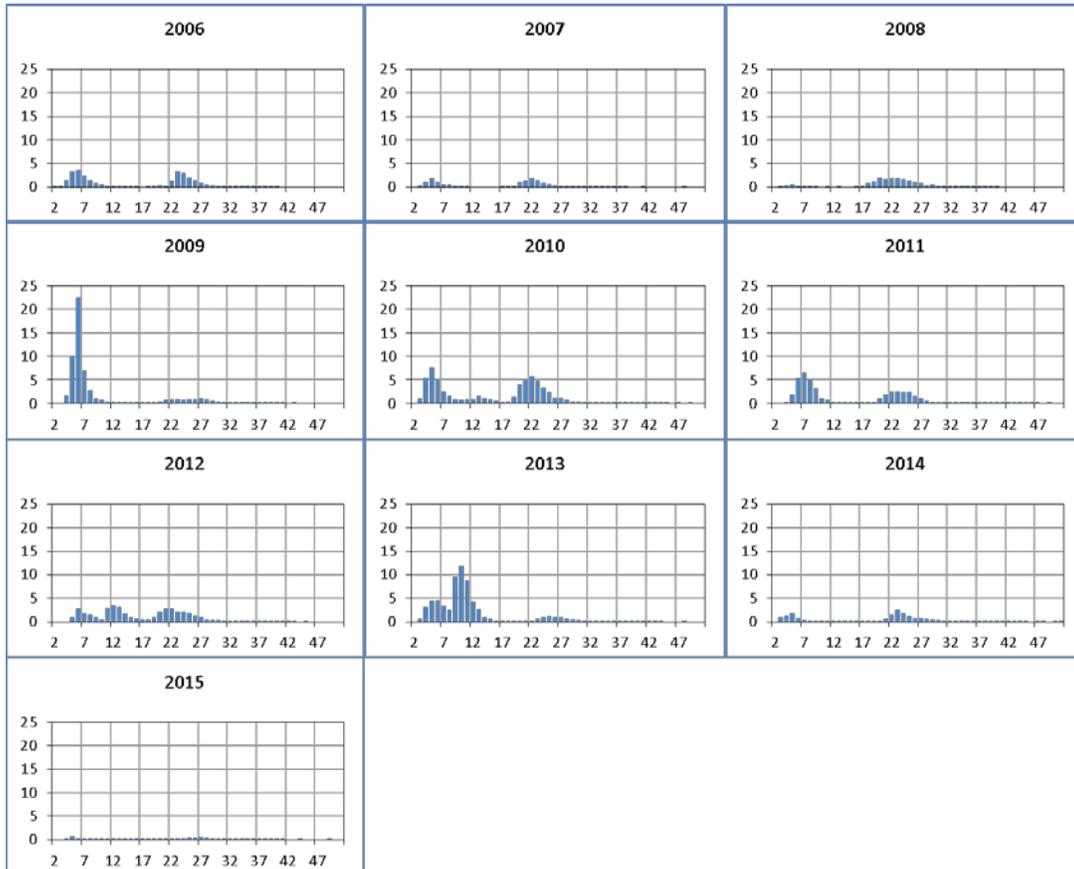


Figure 26. Northern silver hake NEFSC fall survey size distribution in stratified mean numbers per tow (Albatross units) for only the recent 10 years of the entire survey time series.



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8.0 References

National Marine Fisheries Service (NMFS). 2016. 2015 Northeast Groundfish Operational Assessments. NEFSC Ref. Doc. 15-24. <http://www.nefsc.noaa.gov/groundfish/operational-assessments-2015/>.