NEW ENGLAND FISHERY MANAGEMENT COUNCIL

DRAFT
2013 Stock Assessment and Fishery Evaluation (SAFE) Report

Small-Mesh Multispecies

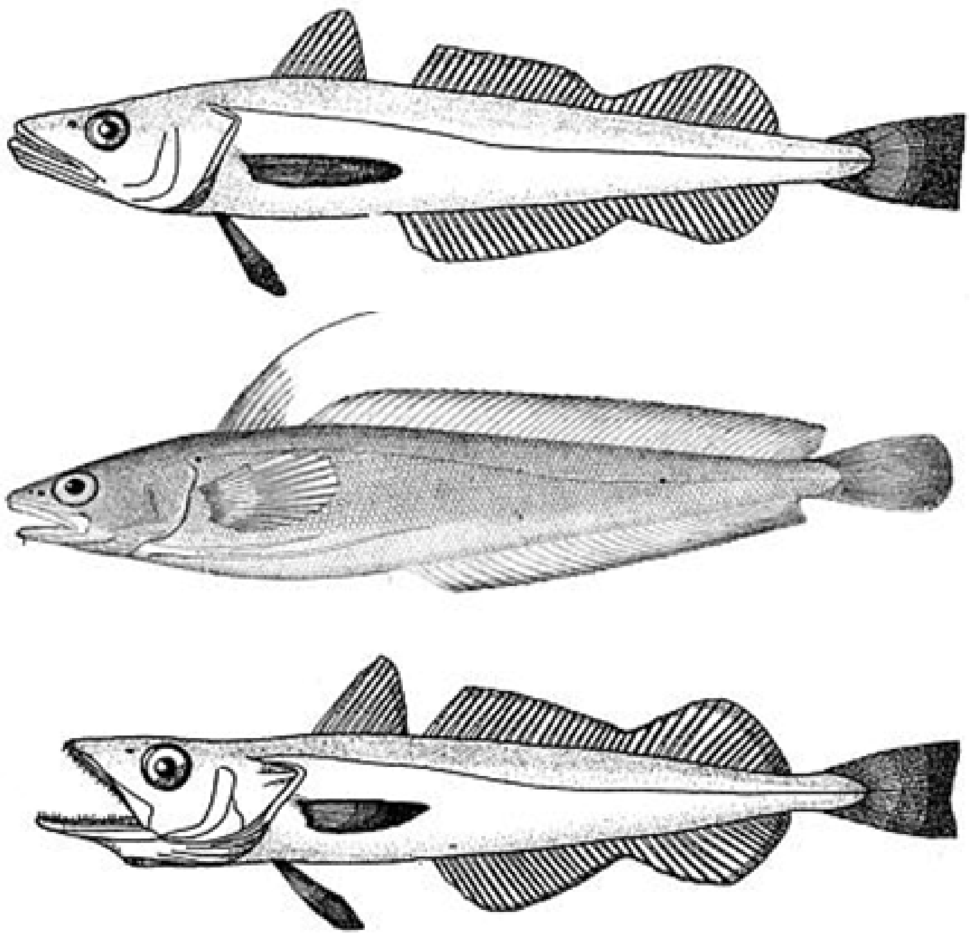


Table of Contents

List of Tables

List of Figures

1.0 Executive Summary

This Stock Assessment and Fishery Evaluation (SAFE) Report was prepared by the New England Fishery Management Council's Whiting Plan Development Team (PDT). The biological and sociological information for New England's small-mesh multispecies complex (silver hake, red hake and offshore hake) are updated in this report.

Each of the small-mesh multispecies stocks is updated according to the current overfishing definitions and most recent trawl survey information. ABC and ACL recommendations are also provided for the 2015-2017 fishing years. The PDT set the ABC for both silver hake stocks using the 25th percentile and both red hake stocks using the 40th percentile. The OFL for northern and southern silver hake are set at 43,608 mt and 60,148 mt, respectively. The OFL for northern and southern red hake are set at 331 mt and 3,534 mt, respectively. The PDT assessed the performance of the fishery and analyzed and identified current fishery trends. The number of vessels participating in the whiting fishery has steadily increased while vessels landing small mesh multispecies has decreased. All small-mesh multispecies catches decreased from 2012 to 2013. The trends differ from red hake and silver hake, with red hake discards making up a much larger percentage of catch than silver hake. Overall landings have decreased slightly from 2010-2013. The stock assessment update shows that both stocks of silver hake are not overfished and overfishing is not occurring. Both stocks of red hake are not overfished, however overfishing is occuring in the northern stock and not occurring in the southern stock. This is a change from the previous assessment, where no overfishing was occurring in the northern red hake stock.

2.0 ABC/ACL Recommendations

The following recommendations and advice are given to the New England Fishery Management Council's Scientific and Statistical Committee (SSC) for setting the acceptable biological catch (ABC) specifications for the 2015-2017 fishing years. Specifications will be reviewed by the Council at the September 2014 meeting and approved as final at the November 2014 meeting, with the intention of becoming effective on May 1, 2015.

The Whiting PDT makes no recommendations for changing the formulation or basis for setting silver and red hake ABCs, or estimation of the overfishing limits (OFL). The Northeast Fisheries Science Center (NEFSC) prepared an assessment update using the same procedures that were applied to the 2010 Benchmark assessment (http://www.nefsc.noaa.gov/publications/crd/crd1102/index.html), including catch (landings, discards, and transfers-at-sea for bait) data through calendar year 2013. Survey biomass indices were updated through fall 2013 for northern and southern silver hake[1], spring 2014 for northern red hake[2], and spring 2013 for southern red hake[3]. As before, the southern silver hake ABC is adjusted by 4 percent to account for the average catches of offshore hake, which are often mixed with silver hake or have often been misreported as landings of silver hake.

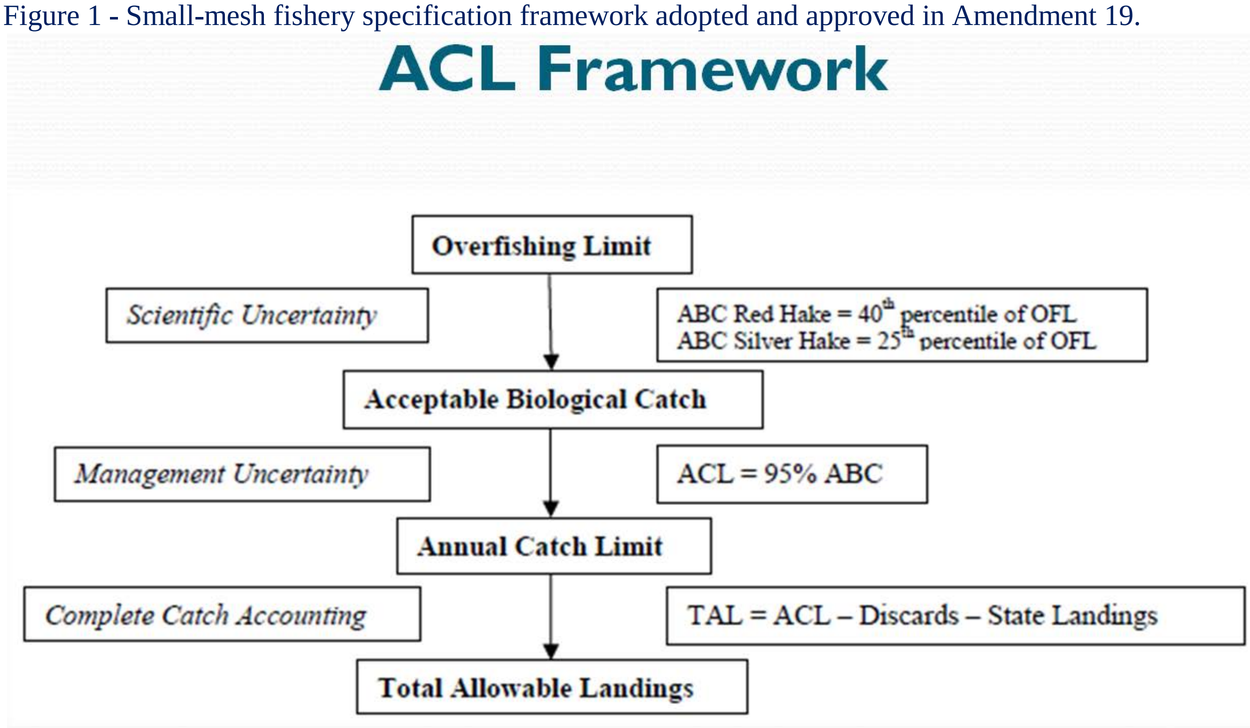
---

[1] The silver hake assessment is reliant on the fall survey and for setting ABCs because the benchmark assessment deemed it to be the most representative of trends in stock biomass.
[2] The red hake assessment is reliant on the spring survey and for setting ABCs because the benchmark assessment deemed it to be the most representative of trends in stock biomass. The spring 2014 survey data are final and audited.
[3] The spring survey in 2014 could not be used in the southern stock management area because a substantial fraction of strata were unsampled because of mechanical problems with the vessel.

Following the previous Council set specifications in Amendment 19 for the 2012-2014 fishing years, the PDT calculated ABCs associated with a range of scientific uncertainty to provide specification advice. Not only were the catch and survey data updated with new information, but the NEFSC updated the estimate of scientific uncertainty to give advice about ABC levels. For Amendment 19, the Council chose to set the silver hake ABC using the 25th percentile on the distribution of scientific uncertainty estimates, which equated to a very low probability of overfishing. This choice was made in part due to the economic and ecological importance of silver hake. For red hake, the Council set the ABC using the 40th percentile on the cumulative frequency distribution of the scientific uncertainty estimates, which was less conservative than the approach used for silver hake, but was still associated with a very low probability of overfishing. The rationale for this choice was the relatively low OFL for northern red hake, the relatively low economic value of red hake coupled with its less important for the northern red hake catch limits to create a "choke species" the small-mesh fishery resource. The SSC's advice to the Coun found at: http://www.nefmc.org/tech/Reports/Reports%20to%20Council% 11_Whiting.pdf . It should be noted that the OFL values derived median of the OFL probability distribution are slightly different due the skewness in the distribution of the OFL. For the purpose of this update, the point estimate is reported but if otherwise reported will be noted in the document.

Suggest deleting equation or revising variance formula. No longer consistent with the current spec approach (i.e. All HBB est. var. are used and not a mix of ALB and HBB in current spec)

Figure 1 - Small-mesh fishery specification framework adopted and approved in Amendment 19.



Northern silver hake: the assessment update estimates OFL at 43,608 mt. Using the 25th percentile of scientific uncertainty estimates, the ABC would be 24,383 mt and is estimated to have a near zero probability of overfishing. This ABC is an 85% increase over the 2012-2014 specification.

Table 1 - **Northern silver hake ABC options.** The first column provides the percentile of OFL from the cumulative probability distribution, with the associated catch level in column 2. Column 3 is the ratio of catch at the *x* percentile of OFL relative to median OFL (point estimate) and column 4compares catch at various percentile of OFL to 2013 catch. The last column shows the probability that the indicated catch (or at the ABC) would cause overfishing, accounting for the estimated scientific uncertainty. The yellow row represents the proposed 2015-2017 ABC based on the adopted s approach for ABC specification.

Scientific uncertainty percentile	Catch (thousand mt)	Percent of OFL point estimate	Percent of 2013 catch	Probability of overfishing (F > $FMSY_{Proxy}$)
5	9.96	22%	576%	0%
10	13.83	30%	799%	0%
20	20.85	45%	1205%	0%
25	**24.38**	**53%**	**1409%**	**0%**
30	28.05	61%	1621%	0%
40	36.19	79%	2092%	4%
45	40.79	89%	2358%	25%
50	**45.87**	**100%**	**2652%**	**68%**

Southern silver hake:, the update assessment estimates OFL at 60,148 mt. Using the 25th percentile of scientific uncertainty estimates, the ABC would be 32,424 mt and is estimated to have a near zero probability of overfishing. This ABC is a 2% decrease compared to the 2012-2014 specification. The 31,177 mt ABC estimate in the update assessment was increased by 4% to account for average catch proportions of offshore hake, according to the thorough analysis of species composition in the benchmark assessment and regulations adopted in Amendment 19.

Table 2 - **Southern silver hake ABC options**.

The first column provides the percentile of OFL from the cumulative probability distribution, with the associated catch level in column 2. Column 3 is the ratio of catch at the *x* percentile of OFL relative to median OFL (point estimate) and column 4compares catch at various percentile of OFL to 2013 catch. The last column shows the probability that the indicated catch (or at the ABC) would cause overfishing, accounting for the estimated scientific uncertainty. The yellow row represents the proposed 2015-2017 ABC based on the adopted approach for ABC specification.

Scientific uncertainty percentile	Catch (thousand mt)	Percent of OFL point estimate	Percent of 2013 catch	Probability of overfishing (F > $FMSY_{Proxy}$)
5	12.34	21%	215%	0%
10	17.39	29%	302%	0%
20	26.55	44%	462%	0%
25	**31.18**	**52%**	**542%**	**0%**
30	36.05	60%	627%	0%
40	46.81	78%	814%	4%
45	52.97	89%	921%	27%
50	59.69	100%	1038%	56%

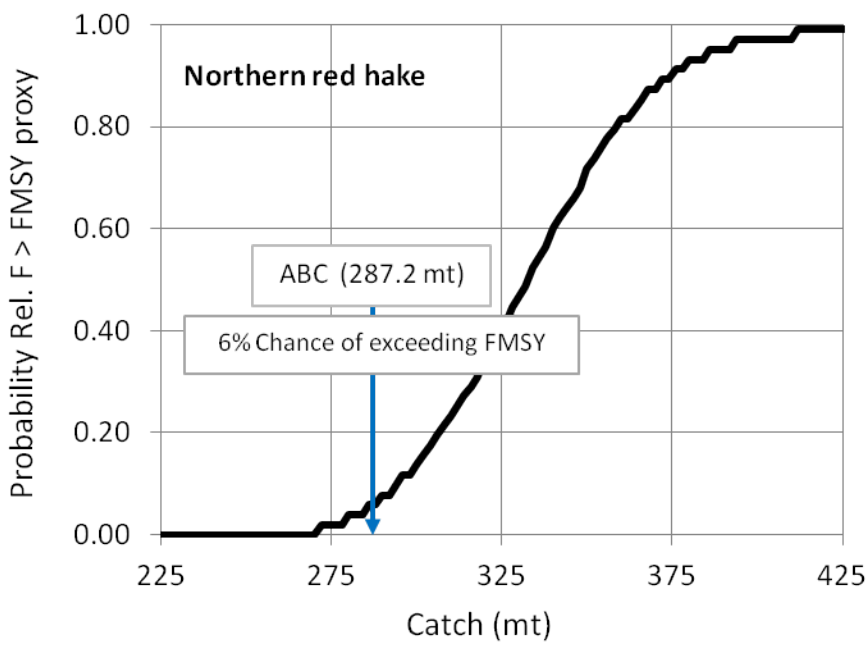
Northern red hake: the assessment update estimates OFL at 331 mt. Using the 40th percentile of scientific uncertainty estimates, the ABC would be 287 mt and is estimated to have a near zero probability of overfishing. This ABC is a 3% increase compared to the 2012-2014 specification. Due to the relatively precise estimate of scientific uncertainty (see Figure 2), there may be room for increasing the ABC relative to the OFL using a higher value on the cumulative frequency distribution of scientific uncertainty. On one hand, a higher catch limit may not significantly increase risk of continuing overfishing. On the other hand, a higher catch limit on the cumulative uncertainty distribution may not substantially increase the ABC value either (Table 3). One concern that should be considered is that a substantial fraction (> 10%Percent) of the 2014 survey biomass consisted of an incoming year class (fish less than 21 cm).

Table 3 - **Northern red hake ABC options**.

The first column provides the percentile of OFL from the cumulative probability distribution, with the associated catch level in column 2. Column 3 is the ratio of catch at the *x* percentile of OFL relative to median OFL (point estimate) and column 4compares catch at various percentile of OFL to 2013 catch. The last column shows the probability that the indicated catch (or at the ABC) would cause overfishing, accounting for the estimated scientific uncertainty. The yellow row represents the proposed 2015-2017 ABC based on the adopte approach for ABC specification.

Scientific uncertainty percentile	Catch (thousand mt)	Percent of OFL point estimate	Percent of 2013 catch	Probability of overfishing ($F > FMSY_{Proxy}$)
5	0.077	24%	21%	0%
10	0.137	43%	38%	0%
20	0.204	63%	56%	0%
25	0.228	71%	63%	0%
30	0.250	78%	69%	0%
35	0.269	84%	74%	0%
40	**0.287**	**89%**	**79%**	**6%**
45	0.305	95%	84%	17%
50	**0.322**	**100%**	**88%**	**37%**

Figure 2 - Risk of exceeding F_{MSY} for northern red hake.



For southern red hake, the assessment update estimates OFL at 3,534 mt. Using the 40th percentile of scientific uncertainty estimates, the ABC would be 3,179 mt and is estimated to have a 29 percent

(Figure 3) probability of overfishing. This ABC is an 8% decrease compared to the 2012-2014 specification.

Table 4 - **Southern red hake ABC options**.

The first column provides the percentile of OFL from the cumulative probability distribution, with the associated catch level in column 2. Column 3 is the ratio of catch at the x percentile of OFL relative to median OFL (point estimate) and column 4compares catch at various percentile of OFL to 2013 catch. The last column shows the probability that the indicated catch (or at the ABC) would cause overfishing, accounting for the estimated scientific uncertainty. The yellow row represents the proposed 2015-2017 ABC based on the adopted approach for ABC specification.

Scientific uncertainty percentile	Catch (thousand mt)	Percent of OFL point estimate	Percent of 2013 catch	Probability of overfishing ($F > FMSY_{Proxy}$)
5	2.08	61%	189%	0%
10	2.34	69%	213%	0%
20	2.68	79%	244%	10%
25	2.82	83%	257%	14%
30	2.95	87%	268%	17%
35	3.07	90%	279%	23%
40	**3.18**	**93%**	**289%**	**29%**
45	3.29	97%	299%	35%
50	**3.40**	**100%**	**309%**	**41%**

Figure 3 - Risk of exceeding F_{msy} for southern red hake. (**Update figure**)

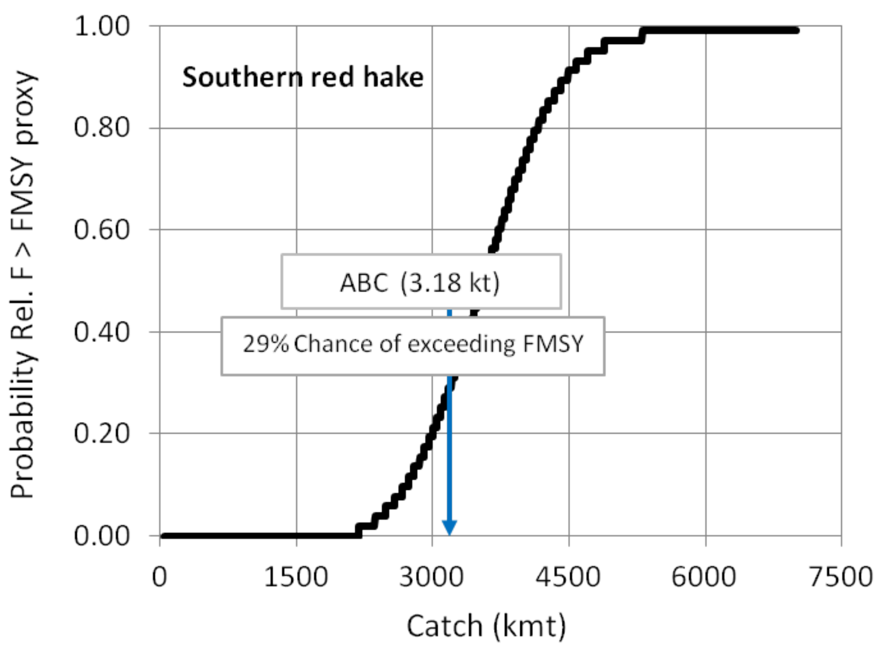


Table 5 - Summary of 2015-2017 ABC specification and OFL estimates for small mesh multispecies, not adjusted for catches of offshore hake. OFL are based on the point estimate and not the median from the OFL probability distribution.

	OFL (mt)	ABC (mt)	P(>OFL)	Change in ABC compared to 2012-2014
Northern silver hake	43,608	24,383 @ 25th percentile	< 1%	85% increase
Southern Whiting	60,148	31,177 @ 25th percentile	< 1%	2% decrease
Northern red hake	331	287 @ 40th percentile	6%	3% increase
Southern red hake	3,534	3,179@ 40th percentile	29%	8% decrease

3.0 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 offshore and silver hake combined 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 (Figure 4), there are six exemption areas, which are open seasonally (Table 6).

Table 6 - 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 7) for all the areas with that requirement are:

Table 7 - Mesh Size Dependent Possession Limits

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

The exemption areas were implemented as part of several different amendments and framework adjustments to the Northeast Multispecies FMP (**Error! Reference source not found.**). 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 4[4] 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 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 Bank[5]. 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.

[4] 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."

[5] 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 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.

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.

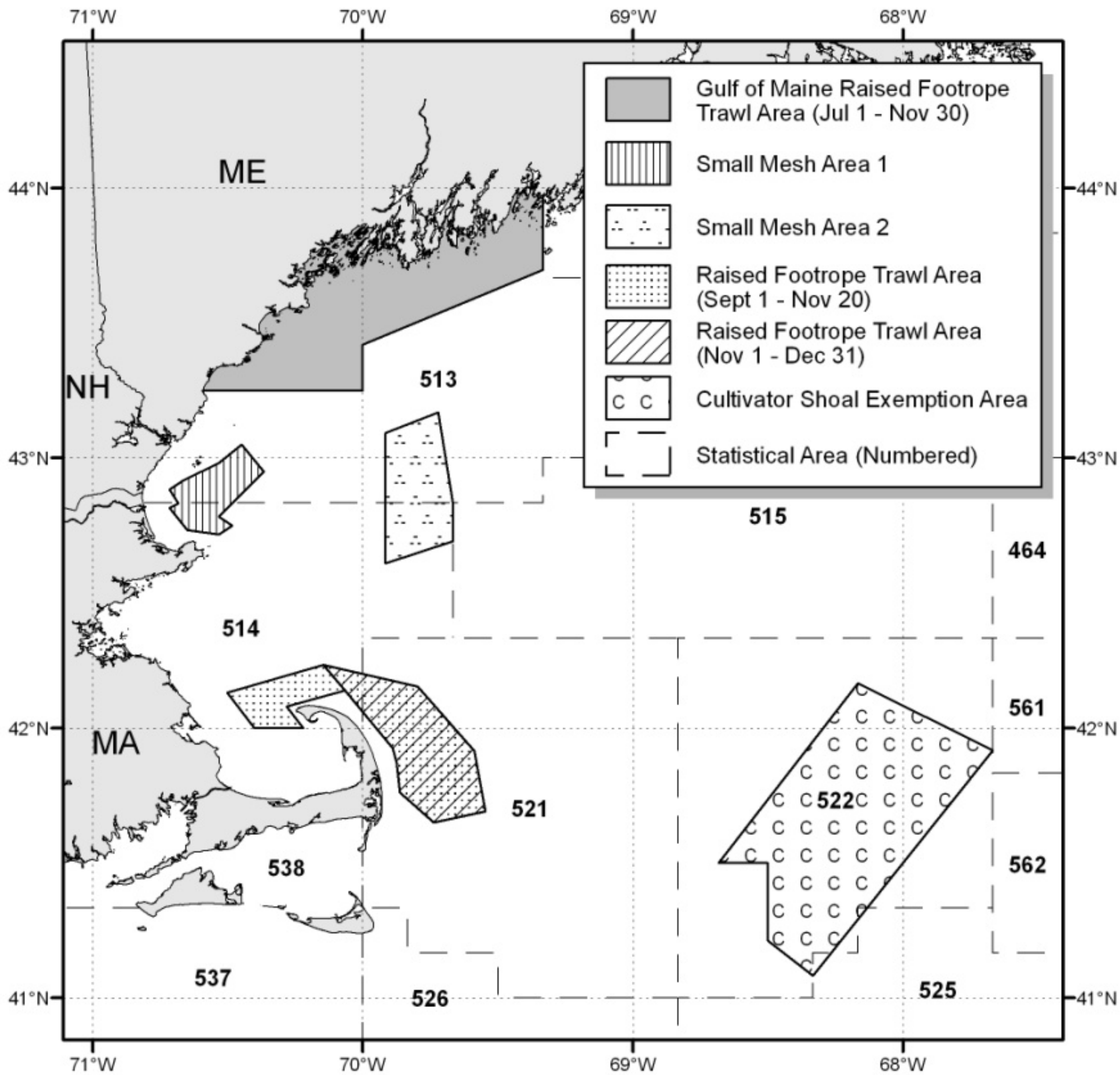
A **Secretarial Amendment** (2012) brought this portion of the FMP into compliance with the Magnuson-Stevens Act requirements to have (1) annual catch limits and (2) measures to ensure accountability for each Council managed fishery. A Secretarial Amendment was necessary because the development of Amendment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

Figure 4 - Small-Mesh Exemption Areas in the Gulf of Maine and Georges Bank



Vessels participating in any of the exemption areas must have a Northeast Multispecies limited access or open access category K permit and must have a letter of authorization from the Regional Administrator to fish in Cultivator Shoal and the Cape Cod Raised Footrope areas. Most of the areas (Small Mesh Areas I and II, the Cape Cod Raised Footrope areas, Southern New England Exemption Area, and the Mid-Atlantic Exemption Area) have mesh size dependent possession limits for silver and offshore hake, combined (Table 7). The Gulf of Maine Grate Raised Footrope Area has a possession limit of 7,500 lb, with a 2.5-inch minimum mesh size, and Cultivator Shoal has a possession limit of 30,000 lb, with a 3-inch minimum mesh size.

The red hake possession limit is 5,000 lb, regardless of area fished. Amendment 19 also implemented a 40,000 lb possession limit for vessels fishing in the southern stock area.

4.0 Fishery Performance Report

4.1 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. This report contains complete catch accounting information for fishing years 2012 and 2013 (Table 9 and Table 10), as the 2014 fishing year is ongoing. The annual catch limit was derived using the procedure described in Figure 1. The specifications are listed in Table 8.

Table 8 - Fishing Year 2012-2014 Specifications

	Northern Red Hake	Northern Silver Hake	Southern Red Hake	Southern Whiting
Overfishing Limit (OFL)	314 mt	24,840 mt	3,448 mt	62,301 mt
Acceptable Biological Catch (ABC)	280 mt	13,177 mt	3,259 mt	33,940 mt*
Annual Catch Limit (ACL)	266 mt	12,518 mt	3,096 mt	32,295 mt
Discard Estimate (2008-2010)	65% (173 mt)	26% (3,255 mt)	56% (1,718 mt)	13% (4,198 mt)
State-Waters Landings (3%)	2.8 mt	278 mt	42 mt	842 mt
Federal TAL (mt)	90.3 mt	8,985 mt	1,336 mt	27,255 mt
Federal TAL (lb)	199,077.4 lb	19,809,243 lb	2,945,376 lb	60,086,990 lb

* Includes an increase of 4 percent to account for offshore hake catch.

Northern red hake is the only stock that has exceeded its annual catch limit since the implementation of these specifications. All small-mesh multispecies catches decreased from 2012 to 2013. Southern red hake catch decreased by a small amount, from 37 percent to 35.5 percent. Northern silver hake catch was almost 18 percent of the catch limit in 2012, but less than 14 percent in 2013. Likewise, southern whiting dropped slightly from 20 percent to 18 percent, and even northern red hake catch dropped from 145 percent of the annual catch limit to 136 percent.

Compared to the 2008-2010 discard estimate used in the specifications setting, the 2012-2013 average northern red hake discards have increased, from 65 to 70 percent. The discard estimates have decreased compared to the previous average for southern red hake (56 down to 49 percent) and northern silver hake (26 down to 14 percent). Meanwhile, the discards have remained at 13 percent for southern whiting. Landings by vessels only permitted to fish in state waters averaged 3 percent.

While combined, small-mesh multispecies landings make up 77 percent of the total catch, the trends are very different for red hake versus silver hake/whiting. Red hake discards are a very significant source of catch (ranging from 46 percent to 73 percent); whereas, silver hake/whiting discards are a much smaller portion of the catch (averaging 14 percent.)

Beginning in fishing year 2014, the northern red hake possession limit trigger was reduced to 45 percent of landings. This reduces the possession limit from 5,000 lb to 400 lb for the remainder of the fishing year, effective August 5, 2014. However, because such a large portion of the total catch is discards, and a significant portion of those discards occurring before the possession limit was reduced in fishing year 2012, a lower possession limit reduction trigger may not help constrain the fishery within its annual catch limit moving forward.

Table 9 - Fishing Year 2012 Red Hake Landings and Discards by Stock Area

	Pounds	Metric tons	Percent of ACL (266 mt)	Percent of Total Catch
Northern red hake commercial landings	229,771	104	39.2%	27%
Northern red hake research landings	0	0	0%	0%
Northern red hake state-permitted only vessel landings	275	0	0%	0%
Northern red hake estimated discard	621,592	282	106.0%	73%
Northern red hake recreational catch (MRIP)	718	0.3	n/a	0%
Northern red hake catch*	851,638	386	145.2%	100%
Southern red hake landings	1,280,755	581	18.8%	50%
Southern red hake research landings	7,562	3	0.1%	0%
Southern red hake state-permitted only vessel landings	88,211	40	1.3%	3%
Southern red hake estimated discard	1,163,991	528	17.1%	46%
Southern red hake recreational catch (MRIP)	85,779	39	n/a	3%
Southern red hake catch*	2,540,519	1,152	37.2%	100%

* Total catch does not include recreational landings as the Annual Catch Limit does not include recreational landings.

Table 10 - Fishing Year 2012 Whiting Landings and Discards by Stock Area

	Pounds	Metric tons	Percent of ACL (12,518 mt)	Percent of Total Catch
Northern silver hake commercial landings	4,200,989	1,906	15.2%	87%
Northern silver hake research landings	1	0	0.0%	0%
Northern silver hake state-permitted only vessel landings	31,547	14	0.1%	1%
Northern silver hake estimated discard	615,554	279	2.2%	13%
Northern silver hake recreational landings (MRIP)	15,774	7	n/a	0%
Northern silver hake catch*	4,848,091	2,199	17.6%	100%
Southern whiting landings	11,113,309	5,041	15.6%	78%
Southern whiting research landings	39,257	18	0.1%	0%
Southern whiting state-permitted only vessel landings	911,212	413	1.3%	6%
Southern whiting estimated discard	2,256,994	1,024	3.2%	16%
Southern whiting recreational landings (MRIP)	0	0	n/a	0%
Southern whiting catch*	14,320,773	6,496	20.1%	100%

* Total catch does not include recreational landings as the Annual Catch Limit does not include recreational landings.

Table 11 - Fishing Year 2013 Red Hake Landings and Discards by Stock Area

	Pounds	Metric tons	Percent of ACL (266 mt)	Percent of Total Catch
Northern red hake commercial landings	253,309	115	43.2%	31.8%
Northern red hake state-permitted only vessel landings	-	-	0%	0%
Northern red hake estimated discard	543,388	246	92.7%	68.2%
Northern red hake recreational catch (MRIP)	5,477	2.5	n/a	n/a
Northern red hake catch*	796,697	361	135.9%	100.0%
Southern red hake landings	1,079,335	490	15.8%	44.6%
Southern red hake state-permitted only vessel landings	4,644	2	0.1%	0.2%
Southern red hake estimated discard	1,338,764	607	19.6%	55.3%
Southern red hake recreational catch (MRIP)	163,837	74	n/a	n/a
Southern red hake catch*	2,422,743	1,099	35.5%	100.0%

* Total catch does not include recreational landings as the Annual Catch Limit does not include recreational landings.

Table 12 - Fishing Year 2013 Whiting Landings and Discards by Stock Area

	Pounds	Metric tons	Percent of ACL (12,518 mt)	Percent of Total Catch
Northern silver hake commercial landings	3,160,615	1,434	11.5%	82.7%
Northern silver hake state-permitted only vessel landings	63,863	29	0.2%	2%
Northern silver hake estimated discard	599,370	272	2.2%	15.7%
Northern silver hake recreational landings (MRIP)	99,099	45	n/a	n/a
Northern silver hake catch*	3,823,848	1,734	13.9%	100.0%
Southern whiting landings	11,264,810	5,110	15.8%	88.9%
Southern whiting state-permitted only vessel landings	30,927	14	0.0%	0.2%
Southern whiting estimated discard	1,371,754	622	1.9%	10.8%
Southern whiting recreational landings (MRIP)	650	0	n/a	n/a
Southern whiting catch*	12,667,491	5,746	17.8%	100.0%

* Total catch does not include recreational landings as the Annual Catch Limit does not include recreational landings.

4.2 Permit Information

Any vessel issued a limited access Northeast multispecies permit categories A, C, E, and F or an open access Northeast multispecies permit category K can fish for and land small mesh multispecies. As such, the number of category K permits is not necessarily related to the number of participating vessels (Table 13). The number of vessels landing small mesh multispecies has steadily decreased from 1996, when 736 vessels reported landings, to a low of 336 vessels in 2005. A moderate increase in the number of participating vessels has occurred since 2005, with 381 vessels reporting small mesh landings in 2013, the last year for which data are available. (Figure 5) Section 3.4 describes the geographical changes of where the participants are landing fish.

A similar trend can be seen in the number of dealers reporting buying small-mesh multispecies has remained relatively stable, ranging from a high of 140 dealers in 1996, to a low of 78 in 2005, and back up to 92 in 2013. In addition, as described in the following section, where the participating dealers are located has changed.

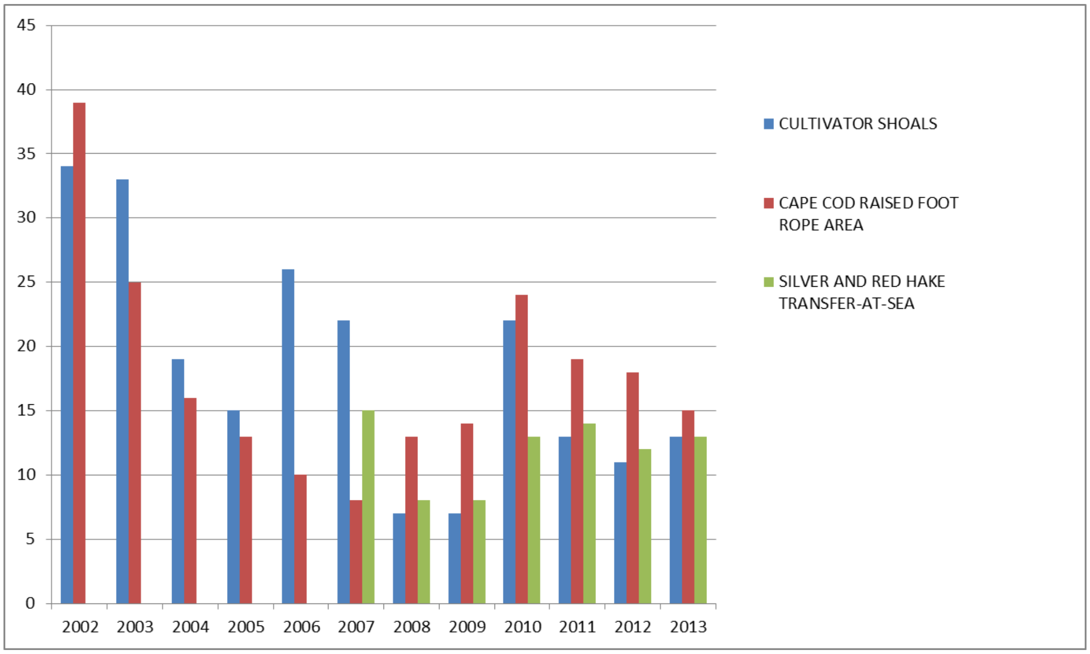
Table 13 - Number of Northeast Multispecies Category K Permits, and the Number of Vessels Landing Small-Mesh Multispecies

Fishing Year	Number Of Northeast Multispecies Category K Permits Issued	Number Of Vessels Landing Small-Mesh Multispecies, All Permit Categories
1996	150	736
1997	441	710
1998	546	731
1999	640	736
2000	736	703
2001	773	651
2002	848	561
2003	866	511
2004	964	391
2005	1,080	336
2006	1,054	351
2007	1,039	399
2008	1,022	406
2009	972	436
2010	934	369
2011	831	388
2012	824	389
2013	802	381

Figure 5 - Number of Federally Permitted Vessels and Dealers Reporting Small-Mesh Multispecies by Calendar Year. ***Note change in scale for number of dealers.***

Participation in the small-mesh fishery in the Gulf of Maine/Georges Bank Regulated Mesh Area is only allowed in specific exemption programs, as described in the Background section. Some of these exemption programs require the vessel owner to obtain a Letter of Authorization (LOA) from the Regional Administrator in order to participate. The Cultivator Shoals Whiting Exemption Area and the Raised Footrope Trawl Exemption Area around Cape Cod require an LOA. In addition, vessels may transfer a portion of their catch to another vessel at sea, provided they have an LOA. The trends in LOA issuance are shown in Figure 6.

Figure 6 - Issuance of Letters of Authorization for the Small Mesh Fishery by Fishing Year



4.3 Trends in Revenue and Port Participation

Figure 7 illustrates the value of small-mesh multispecies by states with a major interest in this fishery over time. There are small-mesh landings in other states in any given year, however, most of them cannot be displayed because of confidentiality reasons. As such, this report displays the revenue over time of just the top five states with involvement in the small mesh fishery.

Figure 8 shows the same information by port of landing for the top five ports with reported small-mesh multispecies landings. For the most part, these ports have maintained consistent participation, with the exception of a sharp decrease for Point Judith, Rhode Island, and a less steep increase for Gloucester, Massachusetts.

Figure 7 - Trends in Small Mesh Revenues by State of Landing

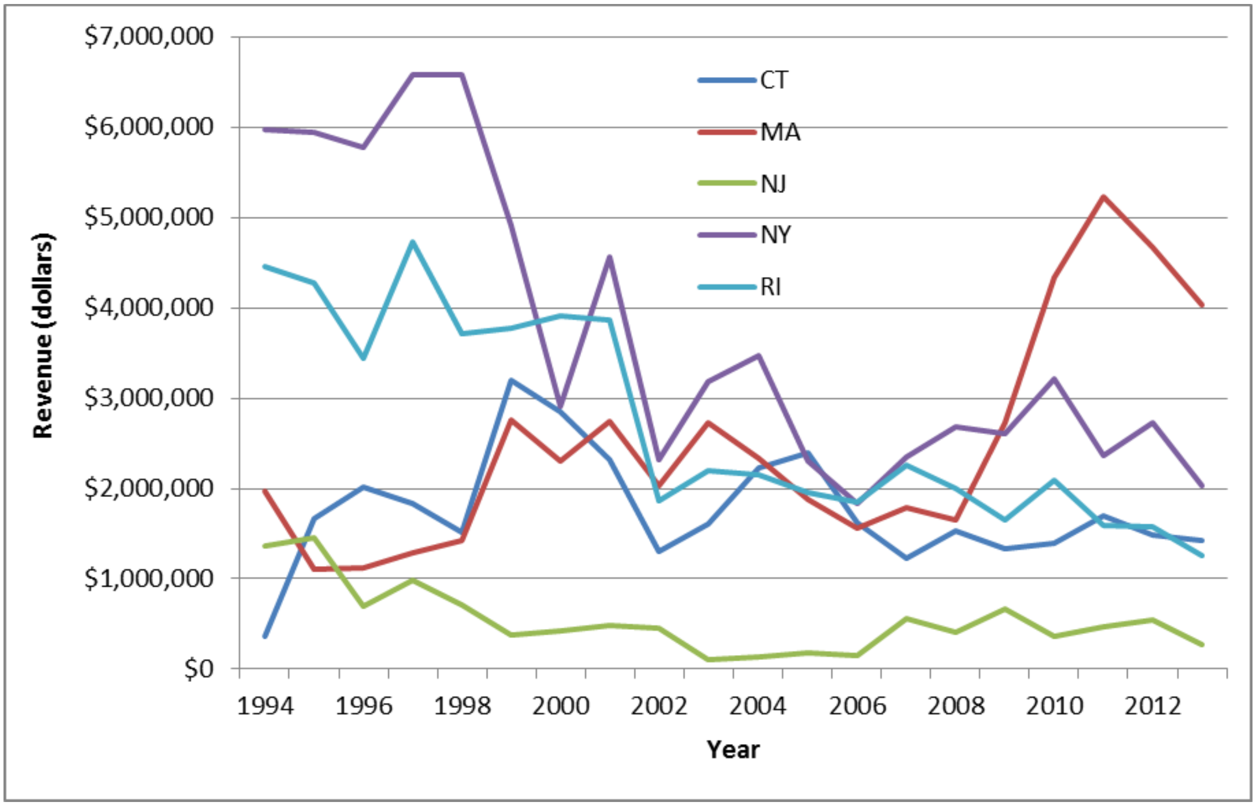
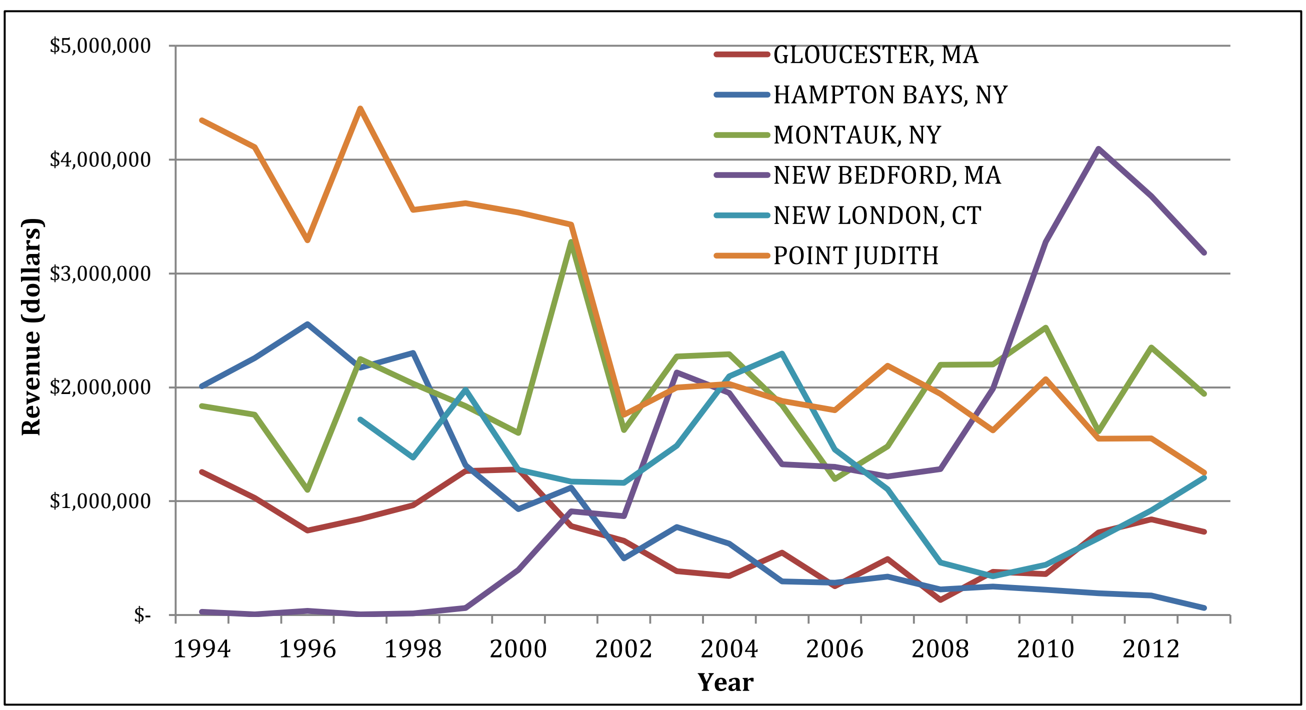


Figure 8 - Trends in Small-Mesh Revenue by Port of Landing



4.4 *Dependence on Small-Mesh Fishery*

Because small-mesh multispecies are landed both as directed stocks as well as incidentally to several other fisheries, it can be useful to examine the level of dependence vessel owners have on this fishery. Because of confidentiality reasons, some of the dependence categories have been combined. In general, for the overwhelming majority of vessels that land small-mesh species, it contributes only a fraction of their overall revenue. There are a handful of vessels that appear to depend heavily on small-mesh multispecies, but especially with historical data, the information as displayed should be interpreted with caution. Figure 9 shows the proportion of total annual dealer-reported revenue derived from small-mesh multispecies of vessels that had at least one dealer-reported small-mesh multispecies targeted trip in a calendar year (a small-mesh multispecies targeted trip is defined as a trip with 50% or more of revenue derived from small-mesh multispecies). On average, from 1994-2013, 73 percent of vessels, with at least one reported small-mesh multispecies targeted trip, generate less than 20 percent of their overall revenue from this fishery. Of those, 56 percent of vessels generate less than 10 percent of their revenue from the small-mesh multispecies fishery. On average, only 7 percent of vessels generate 50 percent or more of their revenue from the small-mesh multispecies fishery. (Table 14) There are so few vessels in any given year that are highly dependent on revenue from this fishery, that they cannot be displayed by 10 percent categories, due to confidentiality reasons.

Likewise, there are very few, if any, dealers who heavily depend on the revenue generated by small-mesh multispecies. The percentage of dealers whose reported revenue from small-mesh multispecies between 0 and 10 percent averaged 78 percent over the time period (Table 15). Again, the percent dependence categories needed to be collapsed to protect confidentiality. As seen with the previous information, there is a peak around 1997, a low between 2005 and 2006, a steady increase to 2010, and a decline from 2010 to 2013. (Figure 9 and Figure 10)

Figure 9 - Total Number of Vessels, by Percent Dependence on Small-Mesh Multispecies

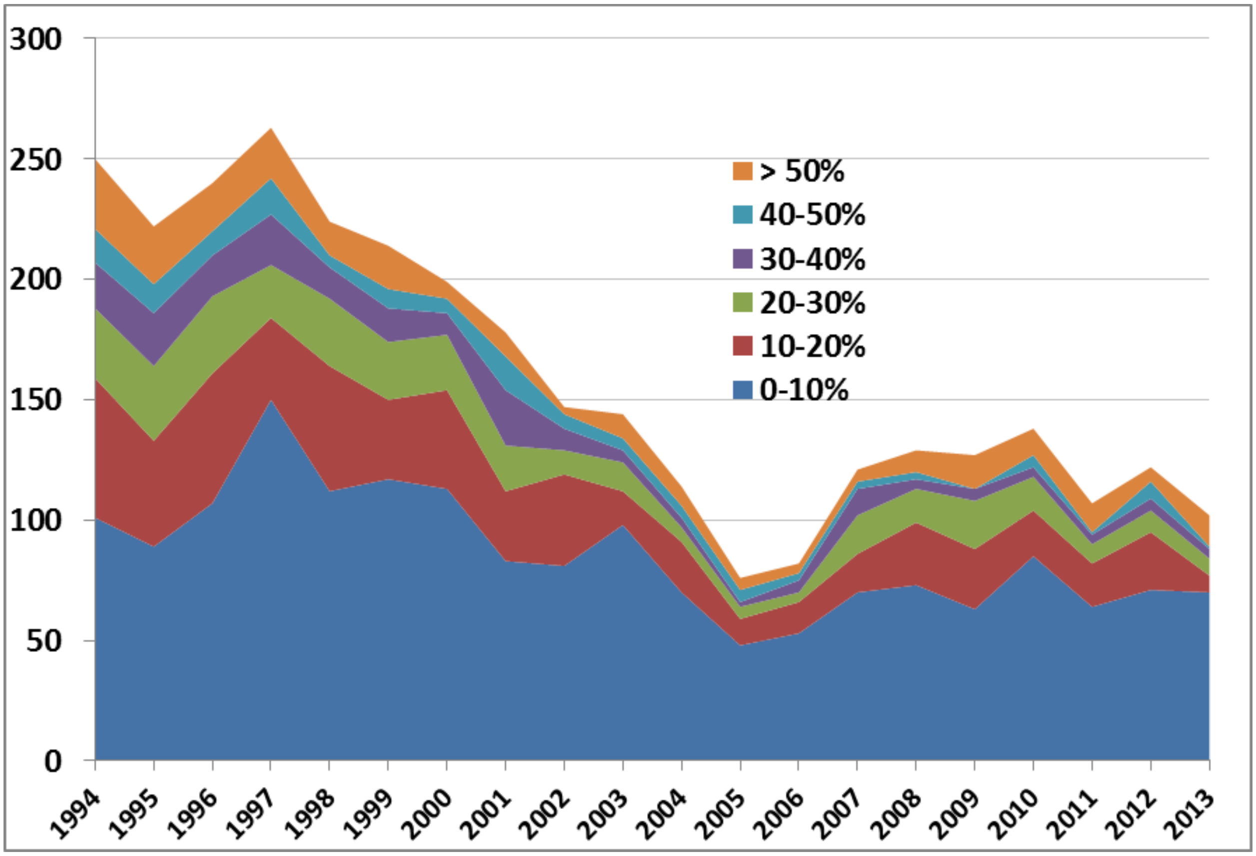


Table 14 - Annual Proportion of Vessels by Percent Dependence Category

Calendar year	0-10%	10-20%	20-30%	30-40%	40-50%	> 50%
1994	40%	23%	12%	8%	6%	12%
1995	40%	20%	14%	10%	5%	11%
1996	45%	23%	13%	7%	4%	8%
1997	57%	13%	8%	8%	6%	8%
1998	50%	23%	13%	6%	2%	6%
1999	55%	15%	11%	7%	4%	8%
2000	57%	21%	12%	5%	3%	4%
2001	47%	16%	11%	13%	8%	6%
2002	55%	26%	7%	6%	4%	2%
2003	68%	10%	8%	3%	3%	7%
2004	61%	18%	5%	4%	4%	7%
2005	63%	14%	7%	3%	7%	7%
2006	65%	16%	5%	6%	4%	5%
2007	58%	13%	13%	9%	2%	4%
2008	57%	20%	11%	3%	2%	7%
2009	50%	20%	16%	4%	0%	11%
2010	62%	14%	10%	3%	4%	8%
2011	60%	17%	7%	4%	1%	11%
2012	58%	20%	7%	4%	6%	5%
2013	69%	7%	7%	4%	1%	13%
Average	56%	17%	10%	6%	4%	7%

Figure 10 - Number of Dealers by Revenue Percent-Dependence on Small-Mesh Multispecies

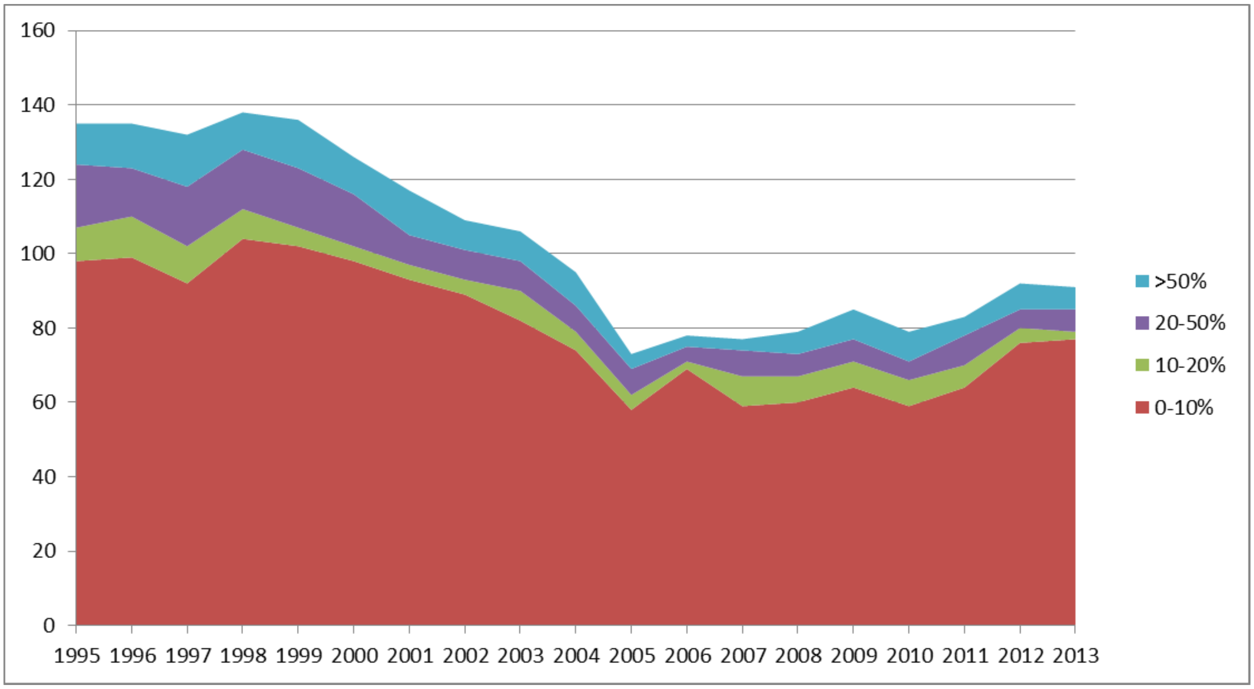


Table 15 - Annual Proportion of Dealers Reporting Small-Mesh Multispecies by Percent Dependence Category

Calendar year	0-10%	10-20%	20-50%	>50%
1995	73%	7%	13%	8%
1996	73%	8%	10%	9%
1997	70%	8%	12%	11%
1998	75%	6%	12%	7%
1999	75%	4%	12%	10%
2000	78%	3%	11%	8%
2001	79%	3%	7%	10%
2002	82%	4%	7%	7%
2003	77%	8%	8%	8%
2004	78%	5%	7%	9%
2005	79%	5%	10%	5%
2006	88%	3%	5%	4%
2007	77%	10%	9%	4%
2008	76%	9%	8%	8%
2009	75%	8%	7%	9%
2010	75%	9%	6%	10%
2011	77%	7%	10%	6%
2012	83%	4%	5%	8%
2013	85%	2%	7%	7%
Average	78%	6%	9%	8%

4.5 Trends in Landings

Over the time series, the Southern Management Area has averaged approximately 80 percent of the total landings of small-mesh multispecies and 82 percent of the average nominal revenues (Table 16). Landings and nominal revenues were much higher at the beginning of the time series, dropped off in the early 2000's, rose slightly until 2010, and have decreased slightly in the most recent three years. (Figure 11) As reported by industry members, there does appear to be some relationship between the revenues generated from the squid fishery (Longfin and *Illex*, combined) with landings of small-mesh multispecies, such that in years with higher squid revenues, there were fewer small-mesh multispecies landings (Figure 12).

As shown in Figure 13, the price per pound appears to be higher in more recent years than earlier in the time series, as adjusted for inflation.

Figure 11 - Small-Mesh Multispecies Revenue and Landings by Stock Area

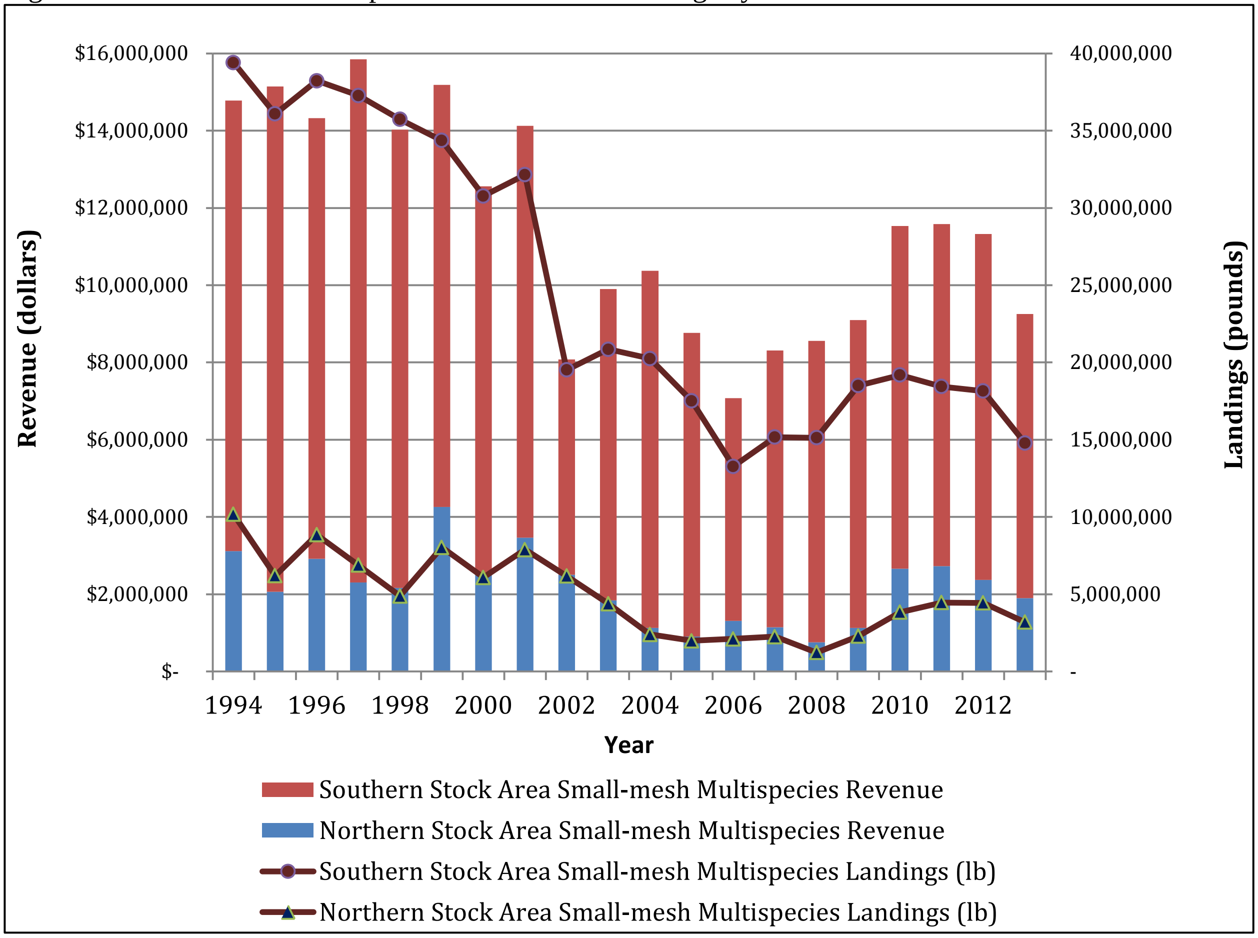


Table 16 - Small-Mesh Multispecies Revenue and Landings by Stock Area

	Northern Stock Area Revenue		Southern Stock Area Revenue		Total Revenue	Northern Stock Area Landings (lb)		Southern Stock Area Landings (lb)		Total Landings (lb)
1994	$3,117,633	21%	$11,659,716	79%	$14,777,349	10,177,145	26%	29,227,870	74%	39,405,015
1995	$2,061,589	14%	$13,079,218	86%	$15,140,807	6,207,227	17%	29,873,688	83%	36,080,915
1996	$2,916,236	20%	$11,410,356	80%	$14,326,592	8,850,997	23%	29,379,847	77%	38,230,844
1997	$2,302,082	15%	$13,546,640	85%	$15,848,722	6,885,970	18%	30,389,849	82%	37,275,819
1998	$2,163,531	15%	$11,864,147	85%	$14,027,678	4,889,806	14%	30,837,838	86%	35,727,644
1999	$4,261,250	28%	$10,922,901	72%	$15,184,151	8,036,403	23%	26,333,671	77%	34,370,074
2000	$2,500,264	20%	$10,058,457	80%	$12,558,721	6,093,574	20%	24,675,855	80%	30,769,429
2001	$3,467,618	25%	$10,658,165	75%	$14,125,783	7,886,656	25%	24,262,162	75%	32,148,818
2002	$2,500,995	31%	$5,581,551	69%	$8,082,546	6,186,408	32%	13,327,434	68%	19,513,842
2003	$1,842,937	19%	$8,056,325	81%	$9,899,262	4,392,621	21%	16,465,806	79%	20,858,427
2004	$1,130,785	11%	$9,238,371	89%	$10,369,156	2,401,395	12%	17,850,056	88%	20,251,451
2005	$905,957	10%	$7,858,430	90%	$8,764,387	1,983,527	11%	15,525,597	89%	17,509,124
2006	$1,312,401	19%	$5,764,568	81%	$7,076,969	2,112,433	16%	11,166,404	84%	13,278,837
2007	$1,146,992	14%	$7,160,053	86%	$8,307,045	2,258,560	15%	12,913,878	85%	15,172,438
2008	$754,850	9%	$7,800,884	91%	$8,555,734	1,233,887	8%	13,892,388	92%	15,126,275
2009	$1,124,576	12%	$7,973,097	88%	$9,097,673	2,293,147	12%	16,212,916	88%	18,506,063
2010	$2,657,599	23%	$8,876,890	77%	$11,534,489	3,842,272	20%	15,342,278	80%	19,184,550
2011	$2,724,154	24%	$8,856,862	76%	$11,581,016	4,460,644	24%	13,982,530	76%	18,443,174
2012	$2,367,837	21%	$8,960,154	79%	$11,327,991	4,437,236	24%	13,718,450	76%	18,155,686
2013	$1,899,198	21%	$7,357,861	79%	$9,257,059	3,195,603	22%	11,589,744	78%	14,785,347
Total	**$43,158,484**	**18%**	**$186,684,646**	**82%**	**$229,843,130**	**97,825,511**	**20%**	**396,968,261**	**80%**	**494,793,772**

Figure 12 - Small-Mesh and Squid Revenue

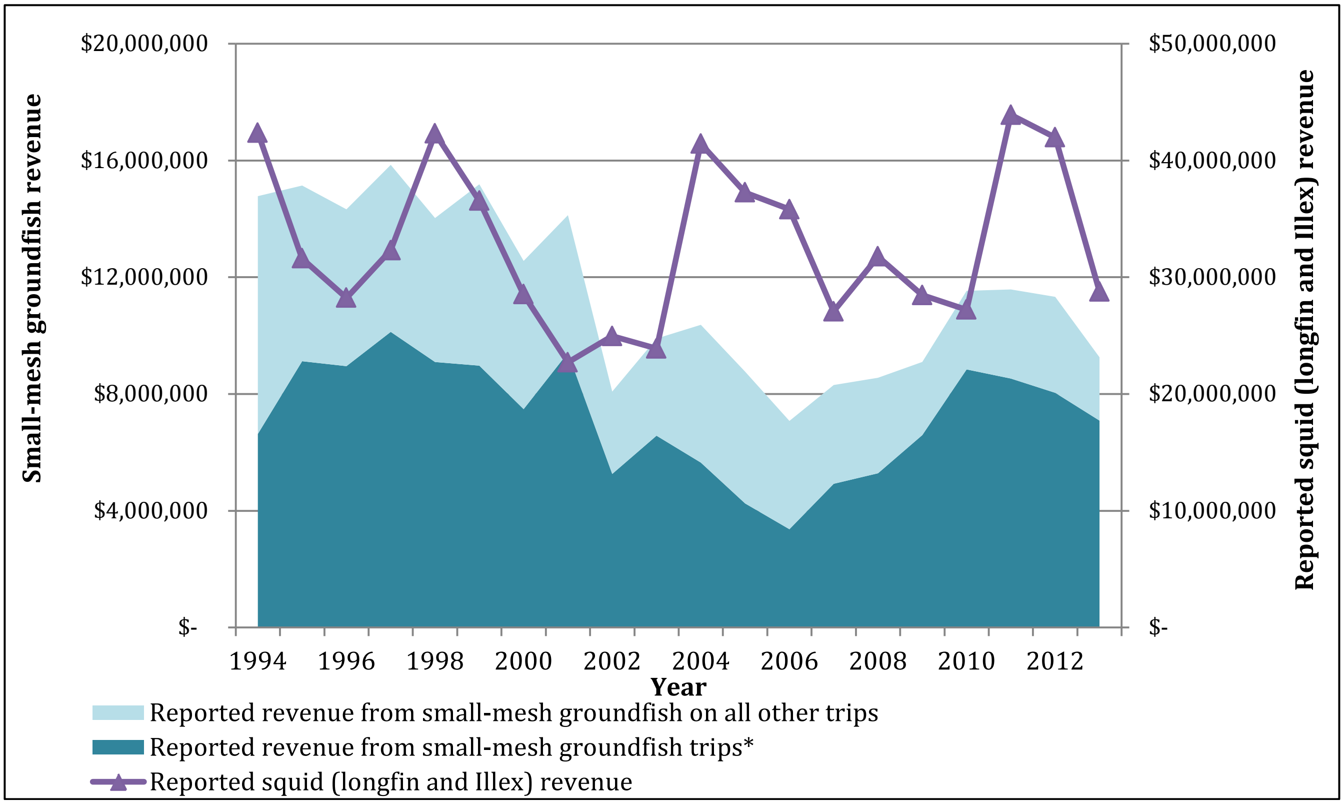


Figure 13 - Calendar year annual average dockside price vs. landings volume from small-mesh multispecies **directed trips** (more than 50% of dealer-reported revenue from the trip was derived from small-mesh multispecies) during 1994-2013.

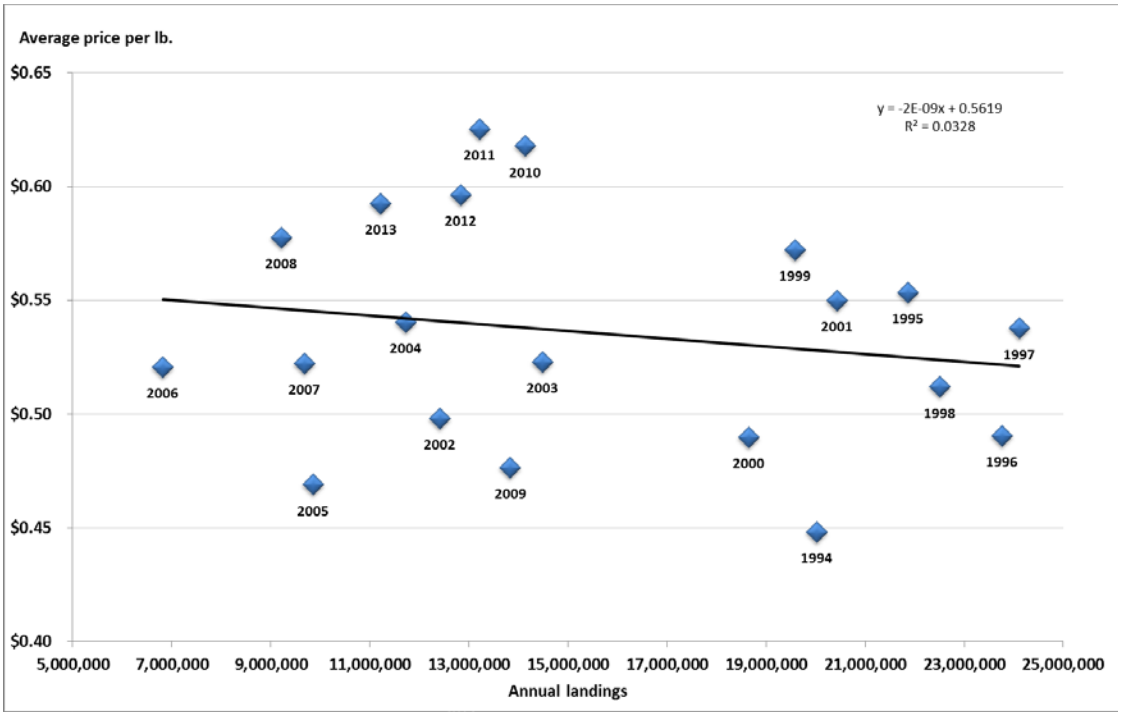
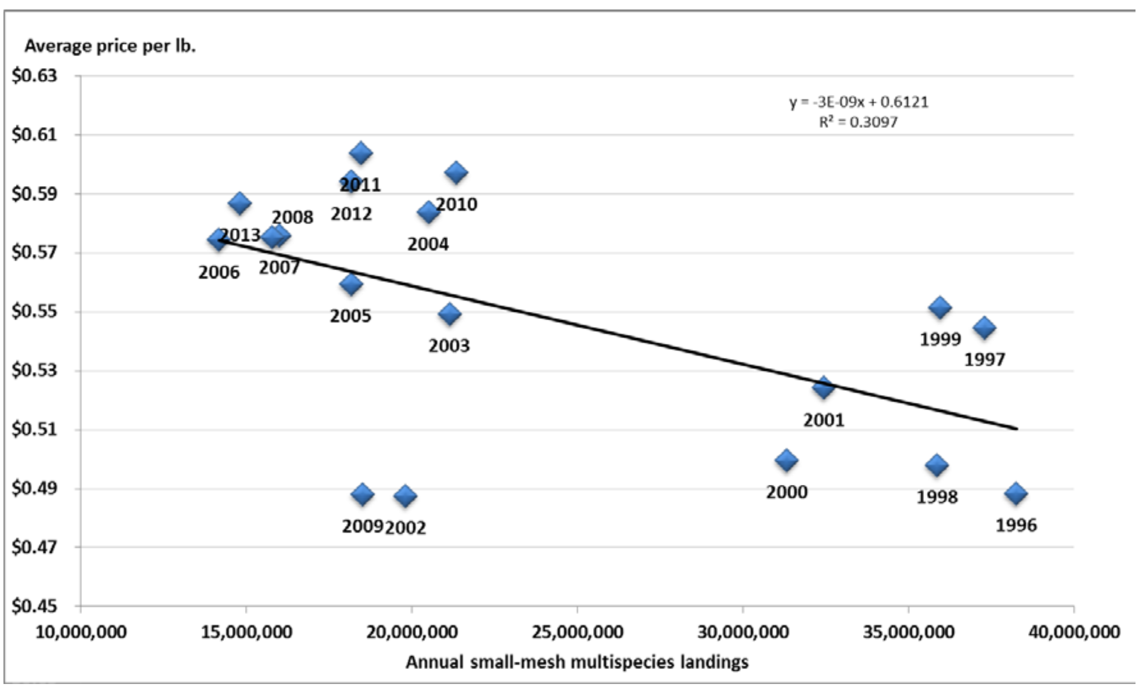


Figure 14 - Calendar year annual average dockside price vs. landings volume from small-mesh multispecies **all trips** landing small mesh multispecies during 1994-2013.



5.0 Fishery Cost Information

5.1 Background

Commercial fishing vessels typically incur three major types of costs: fixed costs, variable costs and crew payments. Fixed costs, or non-trip costs, include all those costs that fishing vessel owners incur regardless how many fishing trips are taken. Some non-trip costs incurred by the vessel owner are associated with the each of the vessels owned, such mooring and dockage fees and vessel insurance premiums. Other non-trip costs are associated with the vessel owner's overall fishing business, and can be thought of as overhead costs, such as office expenses, professional fees, and business vehicle use costs. Trip costs, or operating costs, are those costs typically incurred during a fishing trip. Finally, the vessel owner makes payments to crew that he or she employs, which may include a hired captain for trips where the vessel owner is not the vessel operator. The term "annual costs" is sometimes used to refer to the combination of fixed costs and crew payments.

5.2 Fixed Cost and Crew Payment Information for Small Mesh Multispecies Vessels

At this time, an annual time series for fixed costs is not available. The Social Sciences Branch (SSB) of NEFSC has been working to collect data on annual costs, which consist of fixed costs and crew payments. This cost data is needed to meet the legislative requirements of the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, Executive Order 12866 and the Regulatory Flexibility Act, and allows the SSB to provide estimates of the economic and social impacts of proposed and final fishery management actions.

In 2012, SSB/NEFSC launched a modified cost data collection program after a careful review of an earlier cost data collection efforts.[6] These efforts included a cost data collection, designed to collect fixed costs and crew payments, that sampled each commercial fishing vessel in the Northeast region, in each year, over the three years from 2006-2008. This initial effort to collect fixed cost and crew payment data yielded inadequate response rates, beginning with a high of 22% in 2006, but falling to 8% by 2008.

The SSB's most recent cost data collection effort included increased outreach, as well as a modified survey instrument and a stratified sampling approach to reduce respondent burden and fatigue. In 2012, a re-designed cost survey was mailed to commercial vessel owners in the Northeast region for cost incurred in 2011. In 2013, the cost survey instrument was modified very slightly based on challenges that arose in the data collected from the previous year's survey. The survey instrument used for costs incurred in 2012 contained seven sections: Section A focused on questions about vessel characteristics; Section B collected repair and maintenance, as well as upgrade and improvement costs; Section C contained questions about vessel related costs; Section D focused on questions about operating (trip) costs; Section E collected information about crew payments; Section F focused on costs associated with the vessel owner's overall fishing business, which may include more than one vessel; and Section G inquired about other costs not covered in the previous sections of the survey instrument.

The modified survey effort aimed to sample approximately half of the population of commercial fishing vessels in the Northeast region each year. Vessels for the survey were selected using stratified sampling from the commercial fishing vessel population in the Northeast based on primary gear group (dredge,

[6] See Das, An overview of the annual cost survey protocol and results in the northeastern region (2007-2009). NOAA Technical Memorandum NMFS-NE-226, 2014.

gillnet, handgear, pot/trap, purse seine, and trawl) and vessel length (larger than the average vessel in the primary gear group and smaller than the average vessel in the primary gear group). If a vessel owner owned more than one vessel, he or she was sent a survey for one vessel only. The number of vessel owners that received the survey for costs incurred in 2011 was 1,457; for costs incurred in 2012, 1,778 vessel owners received a survey. Vessel owners received the cost survey by mail, and could return it either in hard copy by mail, or complete it online using a unique password.

Overall response rates for the annual cost survey were 28.9% (372 surveys) for costs incurred in 2011 and 20.6% (367 surveys) for costs incurred in 2012. Statistical testing was performed to explore non-response bias and other potential biases. The survey data was then weighted to address these issues. The SSB is concerned with the data collection burden placed on commercial fishermen by this survey and other data collection efforts both within the National Marine Fisheries Service (NMFS) and externally. Therefore, at this time the SSB intends to repeat the cost survey over a two-year period every third year. In the next cycle of this cost survey, the cost survey will be mailed in early 2015 to approximately half the population of commercial fishing vessel in the Northeast, sampled by strata, for costs incurred in 2014. Over time, this will enable the SSB to maintain a time series of data for fixed costs and crew payments, improving its ability to perform economic analyses and inform the fisheries management decision making process.

Data on annual costs for vessels that derive 50% or more of their revenue from small-mesh multispecies are limited due to the small percentage of vessels with that level of dependence on small-mesh multispecies as a percentage of their total revenue, and the resulting small numbers of vessels with small-mesh multispecies as the primary species group that were sampled and then returned the annual cost survey for years 2011 and 2012. Therefore, annual cost data from all trawlers is presented below, before turning to a discussion of annual cost data from vessels for which small-mesh multispecies represented the highest percentage of total revenue earned by the vessel by species group.

Table 17 displays the number of vessels in the primary gear group of "trawl" that were sampled for costs incurred in years 2011 and 2012, and the number of surveys that were returned for trawlers. This data is displayed based on vessel length – smaller than or larger than the average trawler in the Northeast commercial fleet, which was 61' long.

Table 17 - Annual Cost Survey Response from Vessels with Primary Gear Group "Trawl"

STRATA	2011			2012		
	No. Sampled	**No. Returned**	**Response Rate (%)**	**No. Sampled**	**No. Returned**	**Response Rate (%)**
Small Trawl	100	28	28.00	112	12	10.71
Large Trawl	101	33	32.67	86	22	25.58

Table 18 presents summary statistics for vessels that responded to the annual cost survey for survey years 2011 and 2012 with primary gear group "trawl". The total revenue data presented was taken from the Commercial Fisheries Database System, commonly referred to as the "dealer data". The total revenue data presented below does not include any revenue that may have been earned from leasing out quota. Vessel age is calculated based on information from the permit data base. The estimated market value of the vessel was reported by the vessel owner in his or her survey, and includes all equipment, fishing gear, permits and fishing history.

Table 18 - Characteristics of Trawlers Responding to the Annual Cost Survey.

STRATA		n	Mean	Median	Standard Dev	Min	Max
Small Trawl	**Total Revenue ($2013)**	40	$179,156.61	$114,929.46	$174,896.03	$1,107.85	$669,238.28
	Est. Market Value ($2013)	39	$336,883.18	$164,800.00	$421,708.29	$144.20	$1,854,00.00
	Vessel Age (years)	40	31.88	30.00	16.64	6.00	84.00
Large Trawl	**Total Revenue ($2013)**	52	$745,412.57	$692,289.70	$669,433.63	$19,285.72	$3,474,016.96
	Est. Market Value ($2013)	49	$808,321.23	$618,000	$863,502.57	$51,000.00	$5,665,000.00
	Vessel Age (years)	52	33.5	33.00	10.03	12.00	67.00

The re-design of the cost survey instrument attempted to address both the need to distinguish between a true zero cost for a particular category during a given survey year versus non response, and the need to distinguish between typical repair and maintenance costs, and upgrade and improvement costs.

For each cost category, the respondent was given the opportunity to indicate his or her total expenses for that category for the survey year, or check off a box that indicated no costs incurred that year for that category. Nevertheless, some vessel owners may not have indicated when they had a true zero cost for a particular category by checking off the box. If the respondent did not indicate a value for a given cost category and did not check off the box that indicated a true zero cost, a missing value was assumed.

The assignment of expenses to either the repair and maintenance category or to the upgrade and improvement category presented a challenge for survey re-design. Upgrade and improvement expenditures incurred by the vessel owner represent an investment in the capital associated with the fishing vessel, and the annual depreciation of this capital should be accounted for. The re-designed survey instrument asked respondents to allocate expenses to either the repair/maintenance or the upgrade/improvement category. However, results from focus group sessions, during which versions of the survey instrument were pre-tested, suggest that many vessel owners struggle with deciding whether a given expense represents a typical repair or maintenance cost, or an upgrade or improvement cost. Therefore, the survey instrument also asked respondents to describe the upgrade or improvement, and adjustments to the category to which an expense was assigned were made if necessary.

Table 19 presents summary statistics for major cost categories based on expenses reported for 2011 and 2012 by smaller than average and larger than average vessels with primary gear group “trawl”. All costs have been presented in real 2013 U.S. dollars. The major cost categories are repair and maintenance costs, upgrade and improvement costs, fishing business costs, operating (trip) costs and payments to crew, including payments to a hired captain, where applicable. Although 40 smaller than average and 55 larger than average trawl vessels responded to the annual cost survey, not every vessel incurred a cost or indicated zero cost for each of the items included in each major cost category.

Vessel owners were asked to report annual repair and maintenance costs in the following areas: haul out costs (including expenses for taking the vessel out of the water and any transportation costs associated with the haul out), propulsion engine (e.g. engine, drive train, exhaust/cooling systems), deck equipment and other machinery, hull, fishing gear, wheelhouse and electronics (e.g. radar, GPS, VMS, sounder, radio, depth/temperature/net sensors), processing/refrigeration, safety equipment and any other repair and maintenance expenses not included by the sub-categories listed above. Upgrade and improvement costs were also collected for the same categories under that repair and maintenance expenses were collected for; these upgrade and improvement expenses were adjusted for depreciation.

Fishing business costs collected by the annual cost survey for vessels with primary gear group “trawl” in the 2011 and 2012 survey years are also summarized in Table 18. Some of the information collected about fishing business costs by the survey was specific to the vessel for which the vessel owner received a survey. These expenses included mooring/dockage fees, permit and/or license fees, vessel insurance premiums for either hull or protection and indemnity (P&I) insurance, quota or Days-at-Sea (DAS) lease payments, vessel activity or quota monitoring costs (e.g. observer costs), and crew benefits. In addition, information about fishing business overhead costs was collected. These costs include workshop or storage expenses, office expenses, business vehicle usage costs, business travel costs, association fees (e.g., co-operative, fishing organization, sector, and union fees), professional fees (e.g., settlement, accounting and legal fees), principal and interest paid on business loans, advertising costs and costs associated with non-crew labor services (e.g., night watchman and office secretary wages and benefits). These may be spread out among one or more commercial fishing vessels that are owned by the vessel owner. If a vessel owner responding to the survey owned multiple vessels, an approximation was made allocating a portion of these fishing business overhead costs to the vessel for which he or she received an annual cost survey. Not every vessel incurred each one of the expenses included in fishing business costs.

A summary of operating, or trip costs, reported by trawl vessels for survey years 2011 and 2012 is also reported in Table 19. Note that annual operating costs for a particular vessel are expected to vary based on the number of trips taken per year, as well as the type of trips taken by the vessel. Vessel owners were asked to indicate their total operating (trip) expenses for the survey year for the vessel for which they received a survey, including expenses for fuel/oil/filter, ice, fresh water for use in the vessel, general fishing supplies, catch handling (e.g. auction, lumping, grading, shipping and sales representation), communications (not including office phone expenses), general crew supplies, food and drinking, and any other operating costs not covered in the items listed above. A total of 7 vessels (4 smaller than average, 3 larger than average) with primary gear group "trawl" did not report any operating expenses.

The final major cost category represented in Table 19 is total annual payments to crew, including hired captains for trips where the vessel owner was not the vessel operator. Eight small trawl vessels and one large trawl vessel did not report any crew payments.

Table 19 - Summary of Annual Costs by Major Cost Category for Vessels Responding to the Annual Cost Survey with Primary Gear Group "Trawl" (real 2013 U.S. Dollars).

STRATA	Cost Description	n	Mean	Median	Stand Dev	Min	Max
SMALL	REPAIR/MAINT	37	$18,782.32	$13,144.14	$16,950.68	$1,184.50	$64,066.00
	UPGRADE/IMP[1]	27	$1,771.96	$872.67	$2,122.94	$72.86	$8,423.11
	FISHING BUSINESS	38	$38,456.65	$28,117.58	$48,869.59	$561.00	$1,461,352.76
	OPERATING (TRIP)	36	$43,407.76	$41,429.175	$31,954.46	$103.00	$127,695.28
	CREW[2]	32	$48,236.00	$32,789.61	$51,028.46	$2,652.00	$226,472.28
LARGE	REPAIR/MAINT	52	$74,506.71	$52,157.02	$93,120.27	$5,253.00	$624,972.07
	UPGRADE/IMP[1]	30	$5,289.53	$4,016.55	$4,824.94	$103.00	$17,352.15
	FISHING BUSINESS	37	$138,718.84	$88,827.72	$118,795.61	$510.00	$477,802.58
	OPERATING (TRIP)	49	$305,796.41	$252,269.46	$267,434.10	$875.50	$1,183,470.00
	CREW[2]	51	$215,034.70	$180,243.42	$195,905.21	$214.20	$893,712.46

[1] After adjustment for depreciation.
[2] Includes payment to a hired captain, if applicable.

Five vessels of the 95 vessels (5.26%) that responded to the annual cost survey for costs incurred in 2011 and 2012 with primary gear group "trawl" were identified as small mesh multispecies vessels. A vessel is defined as a small mesh multispecies vessel if small mesh multispecies accounted for the maximum share of the revenue earned by the vessel in that year. No vessels that responded to the survey were identified as small mesh multispecies vessel outside those vessels in the trawl primary gear group.
Table 20 displays the number of small mesh multispecies vessels that were sampled for costs incurred in years 2011 and 2012, and the number of small mesh multispecies vessels that returned the annual cost survey.

Table 20 - Annual Cost Survey Responses from Small Mesh Multispecies Vessels.

Survey Year	No. of Vessels Sampled	No. of Returned Surveys	Response Rate (%)
2011	4	3	75.00
2012	9	2	22.22

Due to confidentiality concerns, the remaining tables presenting results obtained from the annual cost survey from small-mesh multispecies vessels will be pooled for the 2011 and 2012 survey years. Table 21 contains summary information about the characteristics of the five small-mesh multispecies vessels that responded to the annual cost survey for either survey year 2011 or 2012. The total revenue data presented was taken from the Commercial Fisheries Database System, commonly referred to as the "dealer data" This does not include revenue that may have been earned by leasing out quota. Vessel age is calculated based on information from the permit data base. The estimated market value of the vessel was reported by the vessel owner in his or her survey, and includes all equipment, fishing gear, permits and fishing history.

Table 21 - Characteristics of Small-Mesh Multispecies Vessels Responding to Annual Cost Survey.

	n	Mean	Median	Standard Dev	Min	Max
Total Revenue ($2013)	5	$774,258.87	$241,105.91	$986,628.88		
Est. Market Value ($2013)[1]	5	$493,500.00	$306,000.00	$354,945.42		
Vessel Length (feet)	5	61.98	48.00	22.9	44.00	93.00
Vessel Age (years)	5	34.20	32.00	7.95	26.0	46.0

[1] The vessel owner's report of the estimated market value of the vessel, including all equipment, fishing gear, permits and fishing history, in real 2013 U.S. dollars.

Table 22 presents summary statistics for major costs categories based on expenses reported for 2011 and 2012 by all small-mesh multispecies vessels that responded to the annual cost survey for costs incurred in 2011 and 2012. All costs have been presented in real 2013 U.S. dollars. The major cost categories are repair and maintenance costs, upgrade and improvement costs, fishing business costs, operating (trip) costs and payments to crew, including payments to a hire captain, where applicable. All five small-mesh multispecies vessels responding to the annual cost survey reported repair/maintenance expenses for the survey year, ranging from $2,958.00 to $210,635.00, with a mean value of $76,821.40 Four of the five responding small-mesh multispecies vessels reported upgrade/improvement expenditures. After accounting for depreciation, annual upgrade/improvement expenditures ranged from $4,970.48 to $15,956.83, with an average of $8,698.67. Fishing business costs were reported by four of the five responding small mesh multispecies vessels, with an average annual expense of $75,458.67. All five of the responding small mesh multispecies vessels reported annual operating, or trip, costs; these costs ranged from $45,390 to $1,183,470.00 (the largest amount of annual operating costs reported for a responding vessel with primary gear group trawl), with an average annual operating cost of $493,141,33. However, this average was heavily influenced by the largest annual operating cost reported for these vessels; median reported annual operating cost for these vessels was $69,444.66. All five responding small mesh multispecies vessels reported crew payments, ranging from $5,100.00 to $767,350.00, with an average annual crew payment of $240,189.48.

Table 22 - Summary of Annual Costs by Major Cost Category for Small Mesh Multispecies Vessels Responding to the Annual Cost Survey (real 2013 U.S. Dollars).

Cost Description	n	Mean	Median	Stand Dev	Min	Max
REPAIR/MAINT	5	$76,821.40	$58,916.00	$86,059.19	$2,958.00	$210,635.00
UPGRADE/IMP[1]	4	$8,698.67	$6,933.70	$5,074.35	$4,970.48	$15,956.83
FISHING BUSINESS	4	$75,458.67	$40,991.50	$71,263.91	$37,541.66	$182,310.00
OPERATING (TRIP)	5	$493,141.33	$69,444.66	$600,247.28	$45,390.00	$1,183,470.00
CREW[2]	5	$240,189.48	$77,250.00	$317,659.61	$5,100.00	$767,350.00

5.3 Variable Cost Information for Directed Small Mesh Multispecies Trips

Information about some trip costs is collected by observers as part of the Northeast Fishery Observer Program's (NEFOP) data collection effort. The Fisheries Sampling Branch oversees the NEFOP, which collects, processes, and manages the data obtained during commercial fishing trips. Biological and economic data are collected by trained personnel, known as observers, for scientific and management purposes. The economic data are obtained either via personal observation or by interviewing the captain.

Trip cost data collected by observers for a given trip includes tons of ice used during the trip, the price of ice per ton for ice purchased for the trip, the estimated number of gallons of fuel used during the trip, the price per gallon of fuel purchased for the trip, the price of fresh water purchased for the trip (not including drinking water), damage and loss estimates (not including the cost of normal wear and tear), the price paid for supplies purchased for the trip, the price paid for food and drinking water (including the observer's), the price of oil used on the trip, and the price of bait purchased for the trip.

From 1994 to 2013, a total of 439 directed small-mesh multispecies trips were observed, with 28.2% of these trips being multi-day trips. The number of days absent on these trips ranged from 0.15 days to 10.65 days, with an average value of 1.32 days absent and a median value of 0.50 days absent. Prior to 2007, there are years in the time series where very few directed small mesh multispecies were observed. Therefore, summary trip cost data is presented for the 1994-1999 and 2000-2006 periods with the years for each of those periods combined, and then for each year for 2007-2013. Table 23 presents total trip costs per day absent on directed small mesh multispecies trips. All costs have been converted to 2013 real U.S. dollars. No observed directed small mesh multispecies trips reported bait costs, which is consist with the use of trawl gear in this fishery. The total trip costs represented in Table 23 reflect costs for ice, fuel, fresh water for use on the vessel, supplies, food and drinking water, oil, and damage and loss costs. Fuel expenses account for the largest percentage of total trip costs per day absent; in 2013 fuel expenses, on average, were responsible for 80.73% of total trip expenses per day absent on observed directed small mesh multispecies trips. In 2008, the average value of trip costs per day absent spiked due to one vessel that incurred significant damage costs during a directed small mesh multi-species trip.

Table 23 - Total Trip Costs Per Day Absent on Directed Small Mesh Multispecies Trips (real 2013 U.S.Dollars).

Time Period	N	Mean	Median	Stand Dev	Min	Max
1994-1999	70	$557.79	$392.99	$857.44	$130.16	$7,243.52
2000-2006	73	$772.11	$607.27	$555.73	$109.66	$2,842.90
2007	15	$1,122.39	$1,127.46	$483.10	$502.03	$1,830.16
2008	10	$3,226.51	$1,347.52	$5,385.28	$963.79	$18,415.93
2009	40	$1,099.62	$972.11	$641.55	$438.91	$3,304.21
2010	53	$1,250.88	$1,082.21	$584.66	$386.27	$3,379.58
2011	46	$1,605.35	$1,328.88	$1,179.93	$383.59	$7,193.82
2012	46	$1,337.25	$1,006.65	$1,176.82	$411.50	$6,342.53
2013	83	$1,191.44	$1,012.34	$709.73	$382.83	$3,648.51

6.0 Small Mesh Multispecies Stock Assessment

6.1 Assessment (Index-Based) and Stock Status Update

Information used in this assessment update includes data from the NEFSC surveys, as well as commercial fishery data from vessel trip reports, dealer landings records and on-board fishery observers updated through 2013. The NEFSC bottom trawl survey switched from the FRV *Albatross IV* to the FSV *Bigelow* in spring 2009. Hence, survey data given here are in "*Albatross IV*" units. Following the accepted index approach from the 2010 benchmark assessment, this assessment update for both stocks of silver hake are based on the three year moving average of fall survey and exploitation indices for years 2011-2013. For northern red hake, the three year moving average of the spring survey index for years 2012-2014 and exploitation index for years 2011-2013 were used in this assessment update. In the case of the southern red hake stock, spring 2014 index was excluded from this update due to survey not covering the full southern area therefore the three year average spring survey and exploitation indices for years 2011-2013 were used instead.

Silver hake

In both stocks of silver hake, the three year average fall biomass index (15.72kg/tow in the north vs 1.70kg/tow in the south) are both well above the overfished management threshold (3.21 kg/tow in the north vs 0.83kg/tow in the south), influenced by the recent observed increases in the fall survey trends. The exploitation index measured as the ratio of catch to survey has remained consistently low since the previous benchmark assessment and well below (0.14 kt/kg in the north vs 3.86 kt/kg in the south) the management overfishing definition thresholds (2.78 kt/kg in the north vs 34.17 kt/kg in the south). Hence both stocks of silver hake are not overfished and overfishing is not occurring (Table 24 and Table 25; Figure 15**,** Figure 16 and Figure 17Figure 25).

Table 24 - ***Northern silver hake*** **-** Summary of total catch (kt), NEFSC fall survey biomass in albatross units (kg/tow) and index of relative exploitation ratios of total catch to the fall survey biomass (kt/kg) for northern silver hake. Note: This assessment update was based on the most recent three year average of both the fall survey biomass the relative exploitation ratio from 2011-2013.

Year	Northern Fall Survey Arithmetic kg/tow	Northern Fall Survey 3-year Average	Northern Total Landings (000's mt)	Northern Discards (000's mt)	Northern Total Catch (000's mt)	Northern Exploitation Index (kg/000's mt)	Northern Exploitation Index 3-year Average
1955			53.36		53.36		
1956			42.15		42.15		
1957			62.75		62.75		
1958			49.90		49.90		
1959			50.61		50.61		
1960			45.54		45.54		
1961			39.69		39.69		
1962			79.00		79.00		
1963	23.10		73.92		73.92	3.20	
1964	4.34		94.46		94.46	21.77	
1965	7.06	11.50	45.28		45.28	6.41	10.46
1966	4.19	5.20	47.81		47.81	11.41	13.20
1967	2.27	4.51	33.37		33.37	14.70	10.84
1968	2.28	2.91	41.38		41.38	18.15	14.75
1969	2.41	2.32	24.06		24.06	9.98	14.28
1970	3.03	2.57	27.53		27.53	9.09	12.41
1971	2.67	2.70	36.40		36.40	13.63	10.90
1972	5.78	3.83	25.22		25.22	4.36	9.03
1973	4.12	4.19	32.09		32.09	7.79	8.60
1974	3.45	4.45	20.68		20.68	5.99	6.05
1975	8.09	5.22	39.87		39.87	4.93	6.24
1976	11.25	7.60	13.63		13.63	1.21	4.05
1977	6.72	8.69	12.46		12.46	1.85	2.66
1978	6.32	8.10	12.61		12.61	2.00	1.69
1979	6.18	6.41	3.42		3.42	0.55	1.47
1980	7.23	6.58	4.73		4.73	0.65	1.07
1981	4.52	5.98	4.42	2.64	7.05	1.56	0.92
1982	6.28	6.01	4.66	2.91	7.57	1.21	1.14
1983	8.76	6.52	5.31	2.64	7.95	0.91	1.22
1984	3.36	6.13	8.29	2.59	10.88	3.24	1.78
1985	8.28	6.80	8.30	2.56	10.86	1.31	1.82
1986	13.04	8.23	8.50	2.35	10.86	0.83	1.79
1987	9.79	10.37	5.66	2.11	7.77	0.79	0.98
1988	6.05	9.63	6.79	1.79	8.57	1.42	1.01
1989	10.53	8.79	4.65	2.32	6.96	0.66	0.96
1990	15.61	10.73	6.38	1.96	8.34	0.53	0.87
1991	10.52	12.22	6.06	1.26	7.31	0.69	0.63
1992	10.25	12.13	5.31	1.42	6.73	0.66	0.63
1993	7.50	9.42	4.36	0.69	5.05	0.67	0.67
1994	6.84	8.20	3.90	0.24	4.14	0.61	0.65
1995	12.89	9.08	2.59	0.63	3.22	0.25	0.51
1996	7.57	9.10	3.62	0.82	4.44	0.59	0.48
1997	5.66	8.71	2.80	0.24	3.05	0.54	0.46
1998	18.91	10.71	2.05	0.69	2.74	0.14	0.42
1999	11.15	11.91	3.45	0.74	4.19	0.38	0.35
2000	13.51	14.52	2.59	0.36	2.95	0.22	0.25
2001	8.33	11.00	3.39	0.48	3.87	0.46	0.35
2002	7.99	9.94	2.59	0.51	3.11	0.39	0.36
2003	8.29	8.20	1.81	0.20	2.01	0.24	0.37
2004	3.28	6.52	1.05	0.12	1.16	0.35	0.33
2005	1.72	4.43	0.83	0.06	0.89	0.52	0.37
2006	3.69	2.90	0.90	0.04	0.94	0.26	0.38
2007	6.44	3.95	1.01	0.75	1.76	0.27	0.35
2008	5.27	5.13	0.62	0.17	0.79	0.15	0.23
2009	6.89	6.20	1.04	0.19	1.23	0.18	0.20
2010	13.35	8.50	1.69	0.79	2.48	0.19	0.17
2011	9.97	10.07	1.93	0.12	2.04	0.20	0.19
2012	20.43	14.58	1.95	0.29	2.24	0.11	0.17
2013	16.75	15.72	1.37	0.25	1.62	0.10	0.14

Table 25 - ***Southern silver hake*** **-** Summary of total catch (kt), NEFSC fall survey biomass in albatross units (kg/tow) and index of relative exploitation ratios of total catch to the fall survey biomass (kt/kg) for southern silver hake. Note: This assessment update was based on the most recent three year average of both the fall survey biomass the relative exploitation ratio from 2011-2013.

Year	Southern Fall Survey Arithmetic kg/tow	Southern Fall Survey 3-year Average	Southern Total Landings (000's mt)	Southern Discards (000's mt)	Southern Total Catch (000's mt)	Southern Exploitation Index (kg/000's mt)	Southern Exploitation Index 3-year Average
1955			13.26		13.26		
1956			14.24		14.24		
1957			16.43		16.43		
1958			12.90		12.90		
1959			16.39		16.39		
1960			8.82		8.82		
1961			12.65		12.65		
1962			17.94		17.94		
1963	4.66		89.43		89.43	19.19	
1964	4.06		147.05		147.05	36.22	
1965	5.28	4.67	294.12		294.12	55.70	37.04
1966	2.64	3.99	202.32		202.32	76.64	56.19
1967	2.44	3.45	87.38		87.38	35.81	56.05
1968	2.73	2.60	58.16		58.16	21.30	44.58
1969	1.26	2.14	74.89		74.89	59.44	38.85
1970	1.35	1.78	26.83		26.83	19.87	33.54
1971	2.21	1.61	70.51		70.51	31.90	37.07
1972	2.13	1.90	88.18		88.18	41.40	31.06
1973	1.70	2.01	102.08		102.08	60.05	44.45
1974	0.85	1.56	102.40		102.40	120.47	73.97
1975	1.79	1.45	72.16		72.16	40.31	73.61
1976	1.99	1.54	64.61		64.61	32.47	64.42
1977	1.68	1.82	57.16		57.16	34.02	35.60
1978	2.50	2.06	25.83		25.83	10.33	25.61
1979	1.68	1.95	16.40		16.40	9.76	18.04
1980	1.63	1.94	11.68		11.68	7.17	9.09
1981	1.12	1.48	13.43	3.50	16.93	15.12	10.68
1982	1.56	1.44	14.15	4.65	18.80	12.05	11.44
1983	2.57	1.75	11.86	4.81	16.67	6.49	11.22
1984	1.40	1.84	12.96	4.88	17.84	12.74	10.43
1985	3.55	2.51	12.82	3.87	16.69	4.70	7.98
1986	1.45	2.13	9.70	4.33	14.03	9.68	9.04
1987	1.95	2.32	9.55	4.25	13.80	7.08	7.15
1988	1.78	1.73	8.95	4.50	13.45	7.56	8.10
1989	1.87	1.87	13.00	6.57	19.57	10.47	8.37
1990	1.52	1.72	13.02	5.97	18.99	12.49	10.17
1991	0.85	1.41	9.74	3.08	12.82	15.08	12.68
1992	0.99	1.12	10.53	3.45	13.98	14.12	13.90
1993	1.28	1.04	12.49	5.17	17.66	13.80	14.33
1994	0.79	1.02	12.18	5.94	18.12	22.94	16.95
1995	1.59	1.22	11.99	1.40	13.39	8.42	15.05
1996	0.45	0.94	12.13	0.48	12.61	28.02	19.79
1997	0.83	0.96	12.55	0.62	13.17	15.87	17.44
1998	0.57	0.62	12.56	0.53	13.09	22.96	22.28
1999	0.82	0.74	10.42	3.55	13.97	17.04	18.62
2000	0.72	0.70	9.47	0.33	9.80	13.61	17.87
2001	2.04	1.19	8.88	0.19	9.07	4.45	11.70
2002	1.18	1.31	4.89	0.41	5.30	4.49	7.52
2003	1.42	1.55	6.28	0.60	6.88	4.85	4.59
2004	1.24	1.28	6.97	1.20	8.17	6.59	5.31
2005	0.94	1.20	6.40	1.58	7.98	8.49	6.64
2006	1.42	1.20	4.58	0.16	4.74	3.34	6.14
2007	0.87	1.08	5.07	0.15	5.22	6.00	5.94
2008	1.36	1.22	5.58	1.03	6.61	4.86	4.73
2009	1.10	1.11	6.75	0.84	7.59	6.90	5.92
2010	2.82	1.76	6.39	0.78	7.17	2.54	4.77
2011	1.77	1.90	5.75	1.81	7.56	4.27	4.57
2012	1.98	2.19	5.43	1.02	6.45	3.25	3.35
2013	1.33	1.70	4.79	0.64	5.42	4.07	3.86

Figure 15 - ***Northern Silver hake*** fall survey biomass in kg/tow (LEFT) and relative exploitation ratios (RIGHT) of the total catch to the fall survey indices in kt/kg and associated 3-yr moving averages (red lines). The horizontal dash lines represent the biomass and overfishing thresholds and the solid line is the biomass target. The BOTTOM panels reflect the most recent 20 years of the entire time series.

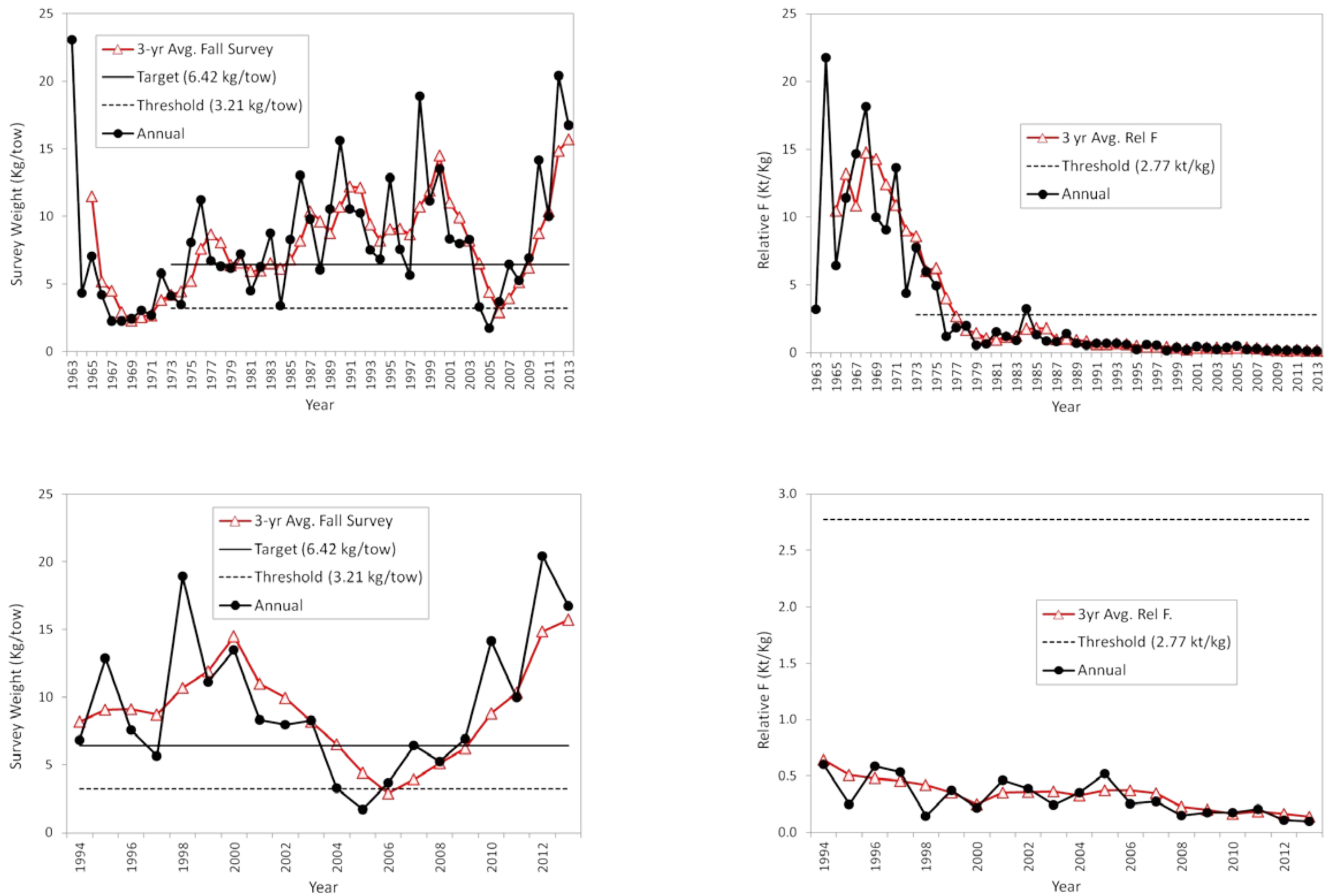
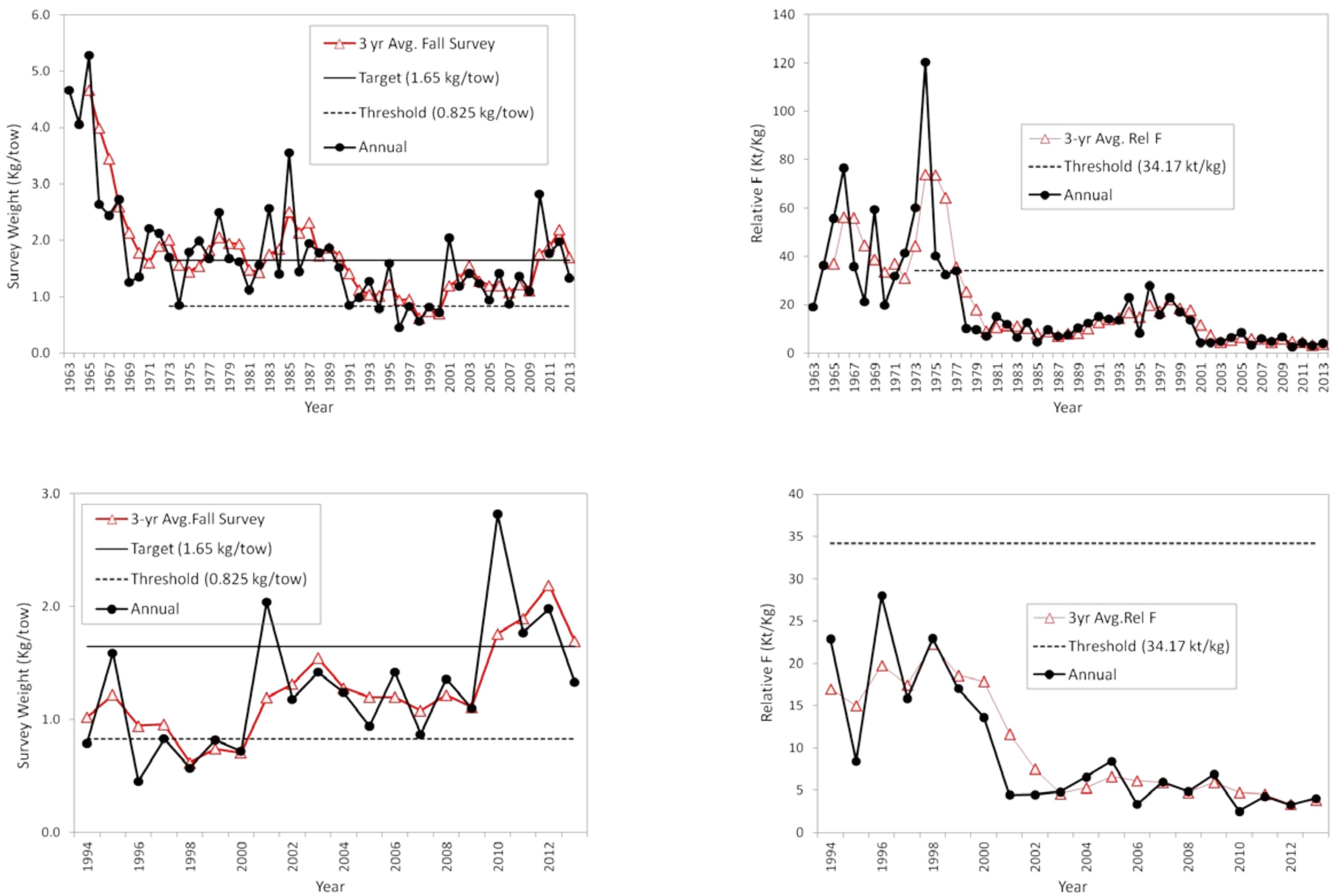
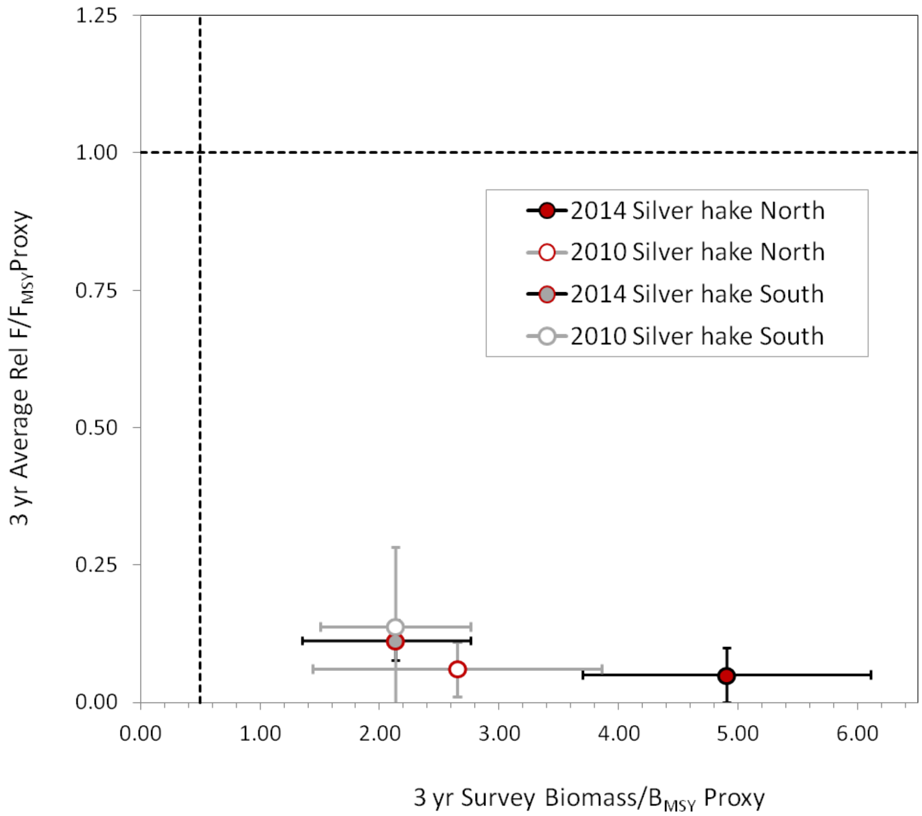


Figure 16 - ***Southern silver hake*** fall survey biomass in kg/tow (LEFT) and relative exploitation ratios (RIGHT) of the total catch to the fall survey indices in kt/kg and associated 3-yr moving averages (red lines). The horizontal dash lines represent the biomass and overfishing thresholds and the solid line is the biomass target. The BOTTOM panels reflect the most recent 20 years of the entire time series



.

Figure 17 - Silver hake biomass and fishing stock status plots for specification years 2012-2014 (labeled as 2010) and 2015-2017 (labeled as 2014) and associated 95% confidence intervals. The triangle and circle symbols are points estimates derived from the ratio of the most recent 3yr average index to proxy reference points while the 95% CI were calculated from the 5th and 95th percentile of the cumulative distribution of the recent 3year index of biomass and Relative F.



Red hake

The red hake assessment update indicates that both stocks are not overfished. However, overfishing is occurring in the northern stock while overfishing is not occurring in the southern stock of red hake. The recent three year arithmetic mean biomass index based on the NEFSC spring bottom trawl survey for the northern stock (2012-2014 = 2.03 kg/tow) and southern stock (2011-2013 = 2.42 kg/tow) were both above the proposed management threshold (1.27 kg/tow in the north vs 0.51 kg/tow in the south). The recent three year average exploitation index (0.170 kt/kg) was just above the management threshold in the north (0.163 kt/kg) and below (1.320 kt/kg) the management threshold in the south (3.038 kt/kg; Table 26 and Table 27**;** Figure 18**,** Figure 19 and Figure 20).

Table 26 - ***Northern red hake*** - Summary of total catch (kt), NEFSC spring survey biomass in albatross units (kg/tow) and index of relative exploitation ratios of total catch to the spring survey biomass (kt/kg) for northern red hake. Note: This assessment update was based on the most recent three year average of both the spring survey biomass (2012-2104) and the relative exploitation ratios from 2011-2013.

Year	Northern Spring Survey arithmetic kg/tow	Northern Spring Survey 3-year Average kg/tow	Total Northern Landings (000's mt)	Northern Discards (000's mt)	Northern Recreational Catch (000's mt)	Northern total Catch (000's mt)	Northern Exploitation Index (kg/000's mt)	Northern Exploitation Index 3-year Average (kg/000's mt)
1955								
1956								
1957								
1958								
1959								
1960			3.79			3.79		
1961			3.28			3.28		
1962			1.91	1.60	0.01	3.52		
1963			3.28	1.60	0.00	4.89		
1964			1.41	1.70	0.00	3.11		
1965			2.77	1.62	0.00	4.40		
1966			5.58	1.60	0.00	7.18		
1967			1.86	1.40	0.00	3.27		
1968	1.14		2.63	1.30	0.00	3.93	3.45	
1969	0.64		2.02	1.12	0.00	3.14	4.91	
1970	0.54	0.77	1.03	1.10	0.00	2.13	3.94	4.10
1971	0.65	0.61	4.81	1.16	0.00	5.97	9.21	6.02
1972	1.56	0.92	15.03	0.96	0.00	15.99	10.25	7.80
1973	4.31	2.17	15.29	0.91	0.00	16.20	3.76	7.74
1974	2.43	2.77	7.22	0.82	0.00	8.04	3.31	5.77
1975	4.25	3.67	8.70	1.20	0.00	9.90	2.33	3.13
1976	3.37	3.35	6.34	0.93	0.00	7.26	2.15	2.60
1977	2.66	3.43	0.89	1.08	0.00	1.98	0.74	1.74
1978	2.57	2.87	1.22	1.12	0.00	2.34	0.91	1.27
1979	2.04	2.42	1.52	1.22	0.01	2.75	1.35	1.00
1980	3.88	2.83	1.03	1.37	0.00	2.40	0.62	0.96
1981	6.35	4.09	1.25	1.32	0.03	2.60	0.41	0.79
1982	2.13	4.12	1.21	1.46	0.00	2.67	1.26	0.76
1983	3.70	4.06	0.90	1.35	0.00	2.25	0.61	0.76
1984	2.98	2.94	1.06	1.33	0.00	2.39	0.80	0.89
1985	3.91	3.53	0.99	1.27	0.00	2.26	0.58	0.66
1986	3.26	3.39	1.46	1.19	0.00	2.65	0.81	0.73
1987	2.94	3.37	1.01	1.05	0.00	2.07	0.70	0.70
1988	2.00	2.73	0.86	0.90	0.00	1.76	0.88	0.80
1989	1.65	2.20	0.78	1.45	0.00	2.22	1.35	0.98
1990	1.33	1.66	0.83	0.60	0.00	1.43	1.07	1.10
1991	1.62	1.53	0.74	0.82	0.00	1.56	0.96	1.13
1992	2.50	1.82	0.92	0.73	0.00	1.65	0.66	0.90
1993	2.82	2.32	0.77	0.08	0.00	0.85	0.30	0.64
1994	1.59	2.31	0.73	0.08	0.00	0.81	0.51	0.49
1995	1.97	2.13	0.19	0.06	0.00	0.25	0.13	0.31
1996	1.79	1.79	0.41	0.66	0.01	1.07	0.60	0.41
1997	1.81	1.86	0.34	0.13	0.00	0.46	0.26	0.33
1998	2.52	2.04	0.19	0.13	0.00	0.32	0.13	0.33
1999	2.32	2.22	0.22	0.47	0.00	0.69	0.30	0.23
2000	3.19	2.68	0.20	0.06	0.00	0.25	0.08	0.17
2001	3.58	3.03	0.22	0.14	0.00	0.36	0.10	0.16
2002	4.46	3.74	0.28	0.10	0.00	0.38	0.08	0.09
2003	1.00	3.01	0.21	0.09	0.00	0.30	0.30	0.16
2004	1.77	2.41	0.10	0.06	0.00	0.16	0.09	0.16
2005	1.10	1.29	0.10	0.06	0.00	0.15	0.14	0.18
2006	0.91	1.26	0.10	0.18	0.00	0.28	0.30	0.18
2007	2.06	1.36	0.07	0.13	0.00	0.20	0.10	0.18
2008	3.49	2.15	0.05	0.06	0.00	0.11	0.03	0.14
2009	1.75	2.43	0.09	0.10	0.00	0.18	0.10	0.08
2010	2.02	2.42	0.07	0.24	0.00	0.31	0.15	0.10
2011	2.18	1.98	0.14	0.10	0.00	0.24	0.11	0.12
2012	1.73	1.98	0.10	0.19	0.00	0.29	0.17	0.14
2013	1.35	1.75	0.10	0.22	0.00	0.31	0.23	0.1691
2014	3.02	2.03						

Table 27 - ***Southern red hake*** - Summary of total catch (kt), NEFSC spring survey biomass in albatross units (kg/tow) and index of relative exploitation ratios of total catch to the spring survey biomass (kt/kg) for southern red hake. Note: This assessment update was based on the most recent three year average of both the spring survey biomass (2011-2013) and the relative exploitation ratios from 2011-2013.

Year	Southern Spring Survey arithmetic kg/tow	Southern Spring Survey 3-year Average kg/tow	Total Southern Landings (000's mt)	Southern Discards (000's mt)	Southern Recreational Catch (000's mt)	Southern total Catch (000's mt)	Southern Exploitation Index (kg/000's mt)	Southern Exploitation Index 3-year Average (kg/000's mt)
1955								
1956								
1957								
1958								
1959								
1960								
1961								
1962			11.87	4.00	0.89	16.76		
1963			31.90	4.00	0.77	36.67		
1964			43.37	3.76	0.85	47.98		
1965			92.99	4.29	0.63	97.92		
1966			107.92	3.77	0.09	111.79		
1967			58.78	3.66	0.17	62.61		
1968	1.29		18.14	3.72	0.58	22.43	17.45	
1969	1.08		52.93	3.62	0.49	57.04	52.72	
1970	1.72	1.36	11.45	3.14	0.41	15.01	8.71	26.29
1971	3.49	2.10	35.13	2.31	0.29	37.73	10.82	24.08
1972	3.59	2.93	61.19	2.10	0.18	63.47	17.68	12.40
1973	3.99	3.69	51.36	2.24	0.32	53.92	13.51	14.00
1974	2.84	3.47	26.64	2.16	0.19	28.99	10.22	13.80
1975	3.18	3.34	19.98	1.76	0.05	21.79	6.85	10.19
1976	5.31	3.78	22.47	1.83	0.65	24.94	4.69	7.25
1977	2.30	3.60	7.06	1.82	0.75	9.63	4.19	5.24
1978	7.65	5.09	5.46	2.44	0.97	8.87	1.16	3.35
1979	1.51	3.82	7.59	2.67	0.25	10.50	6.94	4.09
1980	2.38	3.85	4.08	2.70	0.14	6.93	2.91	3.67
1981	4.61	2.84	2.32	2.72	0.18	5.21	1.13	3.66
1982	3.34	3.45	3.17	3.78	0.03	6.98	2.09	2.04
1983	2.21	3.39	1.44	3.89	0.14	5.47	2.48	1.90
1984	1.33	2.29	1.27	3.91	0.55	5.73	4.30	2.96
1985	1.39	1.64	0.90	2.97	0.03	3.90	2.80	3.19
1986	1.73	1.49	0.69	3.39	0.21	4.29	2.47	3.19
1987	0.88	1.33	0.94	3.31	0.47	4.73	5.38	3.55
1988	1.01	1.21	0.87	3.46	0.25	4.58	4.56	4.14
1989	0.49	0.79	0.93	5.01	0.44	6.37	13.09	7.68
1990	0.71	0.73	0.80	4.75	0.51	6.06	8.57	8.74
1991	0.61	0.60	0.93	2.61	0.29	3.82	6.26	9.30
1992	0.47	0.59	1.25	6.34	0.19	7.78	16.74	10.52
1993	0.42	0.50	0.92	5.31	0.09	6.32	14.91	12.63
1994	0.68	0.52	0.98	1.72	0.07	2.77	4.11	11.92
1995	0.52	0.54	1.43	1.33	0.05	2.80	5.43	8.15
1996	0.45	0.55	0.70	0.38	0.02	1.10	2.43	3.99
1997	1.16	0.71	1.00	2.42	0.17	3.59	3.10	3.65
1998	0.21	0.61	1.15	0.74	0.05	1.95	9.10	4.87
1999	0.46	0.61	1.35	1.06	0.05	2.46	5.42	5.87
2000	0.42	0.36	1.42	0.25	0.04	1.71	4.04	6.19
2001	0.64	0.51	1.47	0.14	0.02	1.63	2.54	4.00
2002	0.54	0.54	0.66	0.33	0.01	1.00	1.85	2.81
2003	0.21	0.46	0.62	0.35	0.02	0.99	4.79	3.06
2004	0.15	0.30	0.59	0.62	0.01	1.21	7.88	4.84
2005	0.38	0.25	0.36	1.01	0.06	1.42	3.77	5.48
2006	0.38	0.30	0.38	0.67	0.05	1.10	2.90	4.85
2007	0.86	0.54	0.47	1.55	0.02	2.04	2.37	3.02
2008	0.47	0.57	0.58	0.81	0.07	1.47	3.10	2.79
2009	1.34	0.89	0.58	0.87	0.10	1.54	1.15	2.21
2010	0.92	0.91	0.58	0.74	0.09	1.41	1.52	1.93
2011	1.79	1.35	0.50	1.01	0.115	1.62	0.91	1.19
2012	1.06	1.26	0.75	0.65	0.037	1.44	1.36	1.26
2013	0.64	1.16	0.44	0.58	0.076	1.10	1.71	1.32
2014	0.73	NA						

Figure 18 - ***Northern Red hake*** spring survey biomass in kg/tow (LEFT) and relative exploitation ratios (RIGHT) of the total catch to the spring survey indices in kt/kg and associated 3-yr moving averages (red lines). The horizontal dash lines represent the biomass and overfishing thresholds and the solid line is the biomass target. The BOTTOM panels reflect the most recent 20 years of the entire time series.

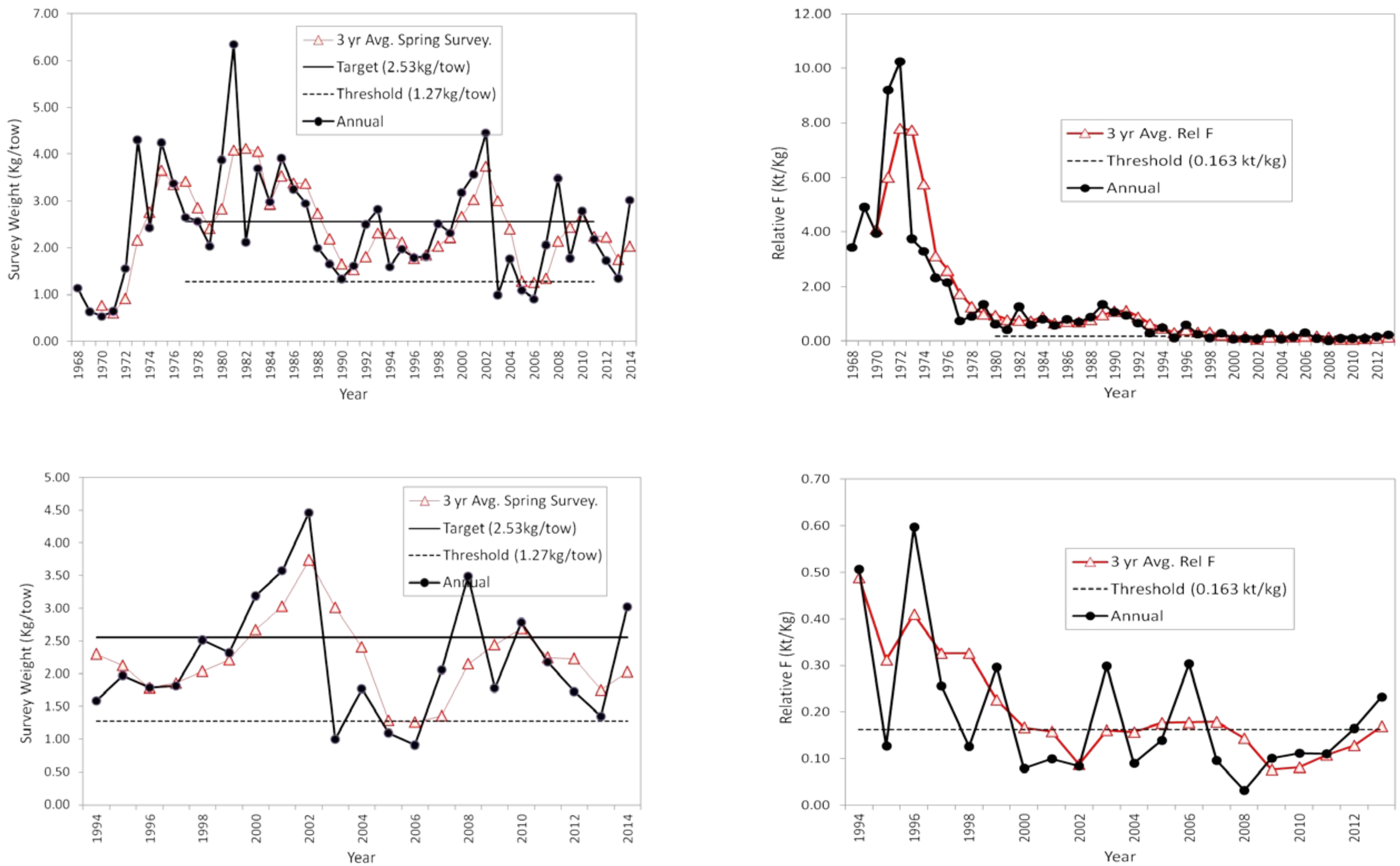
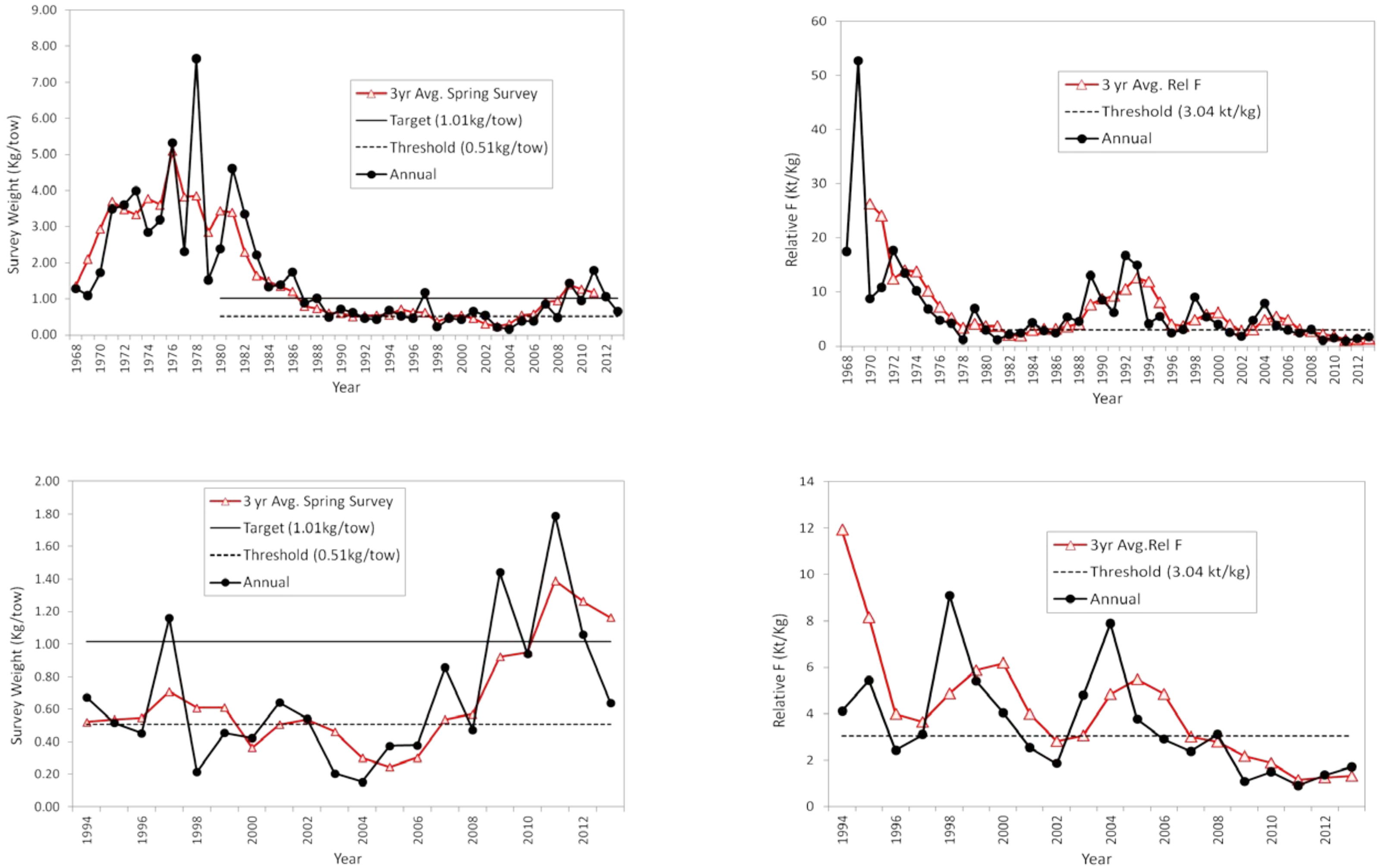
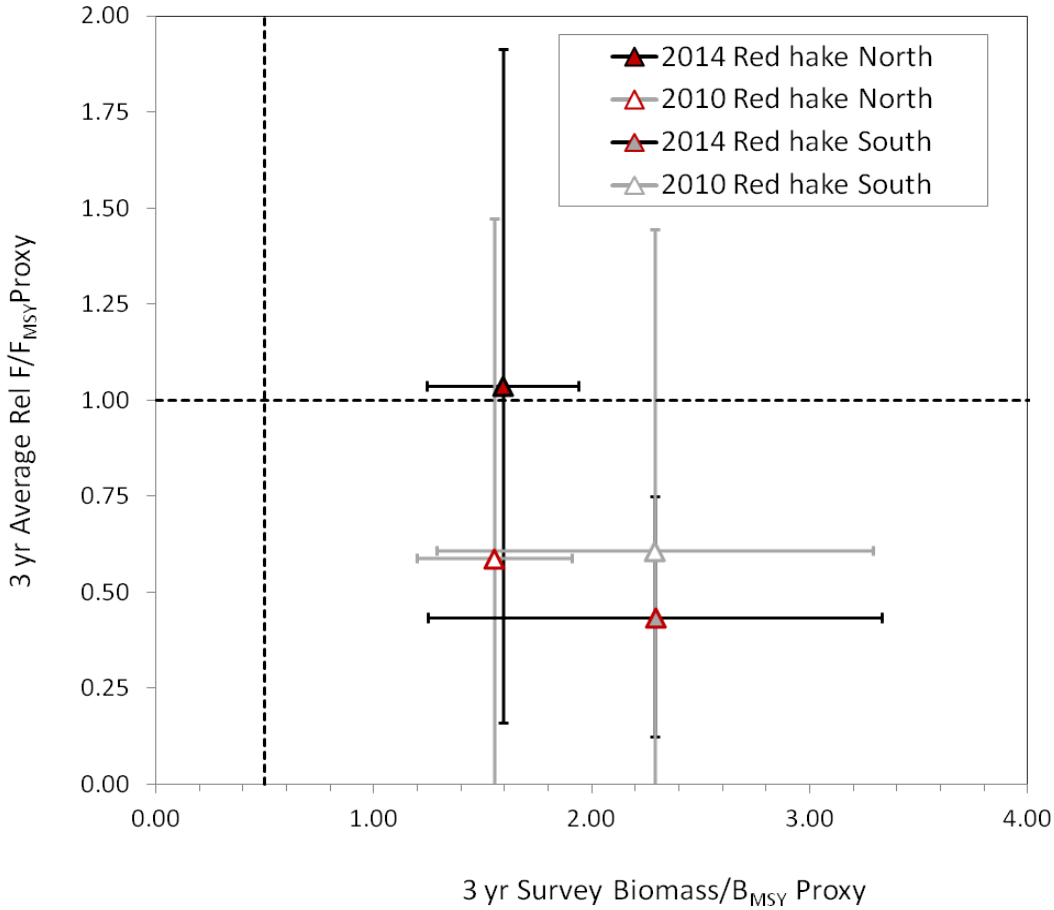


Figure 19 - ***Southern red hake*** spring survey biomass in kg/tow (LEFT) and relative exploitation ratios (RIGHT) of the total catch to the spring survey indices in kt/kg and associated 3-yr moving averages (red lines). The horizontal dash lines represent the biomass and overfishing thresholds and the solid line is the biomass target. The BOTTOM panels reflect the most recent 20 years of the entire time series



.

Figure 20 - Red hake biomass and fishing stock status plots for specification years 2012-2014 (labeled as 2010) and 2015-2017 (labeled as 2014) and associated 95% confidence intervals. The triangle and circle symbols are points estimates derived from the ratio of the most recent 3yr average index to proxy reference points while the 95% CI were calculated from the 5th and 95th percentile of the cumulative distribution of the recent 3year index of biomass and Relative F.



6.2 Overfishing Limit (OFL) and Allowable Biological Catch (ACL)

The overfishing limit (OFL) as adopted in amendment 19 is an annual limit derived as the product of current population biomass and fishing rate that will produce the long-term sustainable maximum yield, after taking into account the variance for each factor.

Uncertainty in the silver hake OFL was estimated as a joint product of the probability distribution between the F_{MSY} proxy and the most recent 3-year average of the fall survey biomass (2011-2013) while red hake used the 3-year average spring survey biomass (2012-2014 in the north and 2011-2013) from bottom trawl survey applied to F_{MSY} proxy. It should be noted that the variance for the survey indices explicitly incorporates the Bigelow conversion coefficients and associated standard errors from the calibration experiment (**Miller et al. 2010**) for years 2011-2013 to approximate the Albatross variance equivalent based on the following relationship:

$$V(I_{survey}) = \left[\frac{V\left[\frac{I_{HBB}^{yr1}}{\rho}\right] + V\left[\frac{I_{HBB}^{yr2}}{\rho}\right] + V\left[\frac{I_{HBB}^{yr3}}{\rho}\right]}{3} \right]$$

The variance for the observed indices for each year and vessel was estimated from the expected values $E(I_{vessel}^{yr})$ of the stratified mean weight (kg/tow) and the observed coefficient of variance (CV) as:

$$V(I_{vessel}^{yr}) = (CV * E(I))^2$$

The variances for the Henry B. Bigelow survey indices, calibrated to Albatross IV units (Miller et al 2010) by applying the conversion coefficient (ρ), were estimated using Taylor series expansion in the following relationship:

$$V(I_{HBB \to ALB}^{yr1-yr3}) = \left(\frac{I_{HB}^{yr}}{\rho}\right)^2 \times \left[\frac{V(I_{HB}^{yr})}{(I_{HB}^{yr})^2} + \frac{V(\rho)}{\rho^2}\right]$$

Although survey mean weights were estimated from a length-based based model, the standard errors were derived from the constant model as a proxy for the length-based estimates due to unavailable variance estimates for the length-based calibration approach. A comparison of the aggregated survey mean weights between the length-based and constant model approach showed minimal differences, therefore, the application of the variance from the constant model was assumed to be a reasonable approximation for the length-based model.

Silver hake probability distributions for F_{msy} proxy were derived from a lognormal distribution of the mean and variance for year 1973-1982. Preliminary attempts assumed a normal distribution of the mean FMSY proxy, however the distribution was deemed less desirable due to the high variability of silver hake catches dominated by the distant-water fleets during the period used to define FMSY proxy. Consequently, this resulted in negative catches in the OFL distribution, and was not considered in this assessment update.

Although red hake does not have an accepted analytical model from the previous benchmark assessment, the SARC agreed to use the relative F (RelF) from the AIM analysis strictly as a proxy F_{msy} For red hake (**NEFSC, 2011**). The probability distribution for F_{msy} proxy was obtained from the AIM bootstrap distribution. For each bootstrap calculation, the saved predicted values of the Ln (replacement ratio) and random residuals from the initial regression of the replacement ratio and the RelF estimates are passed to a regression routine, and the α and β values saved to obtain 1,000 realizations of the replacement F (-α/β).

ABC is the level of catch that accounts for scientific uncertainty in the estimate of the OFL and any other scientific uncertainty. The National Standard 1 guidelines prescribe that "the determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing." ABC's for specification years 2015-2017 were updated for each stock of red and silver hake. However, the southern silver hake ABC was adjusted by 4 percent to account for the average amount of offshore hake catches in southern silver hake trips.

Using proxy values for FMSY approved by the 51st SAW (NEFSC 2011a) and estimates of scientific uncertainty for the reference point and for the three year moving average for NMFS trawl survey biomass, ABCs were updated for red and silver hake were updated by stock area per the current specification in Amendment 19. The small-mesh multispecies ABCs are expressed as a percentile of the overfishing level (OFL) distribution that estimates quantifiable scientific uncertainty, with the 50th percentile being risk neutral. Described below are the current ABC specifications for red and silver hake:

- Northern and southern red hake ABCs based on the 40th percentile of the stochastic estimate of OFL.

- Northern and southern silver hake ABCs based on the 25th percentile of the stochastic estimate of OFL. In the southern stock area, the ABC is increased by 4% to account for the customary estimated catches of offshore hake.

Estimated OFL for both red and silver hake are summarized in Table 28Table 29 and Figure 21Figure 22 based on the median value of the OFL distribution. The resulting OFL estimates for northern silver hake stock was 43,608 mt (95% Confidence interval of 10,000 – 248,000 mt) and 60,148 mt (95% Confidence interval of 12,000 – 336,000 mt) for the southern silver hake. Northern red hake OFL estimate was 331 mt (95% confidence interval of 77 – 543 mt) and 3,534 mt (95% confidence interval of 2,077 – 5,041 mt) for the southern red hake stock.

The recommended 2015-2017 ABC for red and silver hake are also provided in Table 28Table 29 and Figure 21Figure 22**.**

Silver hake 2015 – 2017 ABC set at 25th percentile to account for scientific uncertainty:

- 24,383 mt (53% of OFL; 1504% of 2013 catch) north
- 32,424 mt (54% of OFL; 598% of 2013 catch) southern whiting

Red hake 2015 – 2017 ABC set at 40th percentile to account for scientific uncertainty:

- 287 mt (89% of OFL; 92% of 2013 catch) north
- 3,179 mt (93% of OFL; 290% of 2013 catch) south

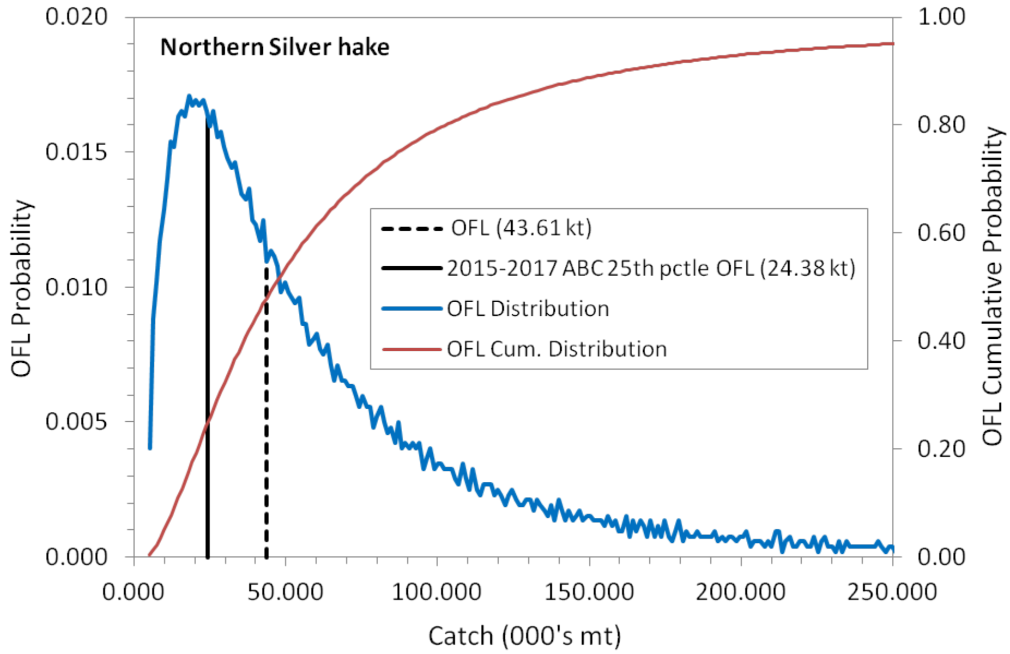
Table 28 - Summary stock status and Overfishing limit (OFL) for specification year 2015-2017 for both northern and southern ***silver hake*** stocks. Allowable Biological Catch (ABC) estimate, defined as the 25th percentile of OFL distribution and associated risk of exceeding FMSY proxy are provided.

	North	**South**
3-year Average Fall Index 2011-2013 (kg/tow)	15.72	1.70
BMSY Proxy Threshold (kg/tow)	3.21	0.83
Ratio of 3-year average Fall index (2011-2013) to BMSY Proxy	**4.90**	**2.05**
3-Year Average Relative Exploitation Index 2011-2013 (kt/kg)	0.14	3.86
FMSY Proxy 1973-1982 (kt/kg)	2.78	34.18
Ratio of 3-year average Exploitation index (2011-2013) to FMSY Proxy	**0.05**	**0.11**
OFL (000's mt) based on point estimate	43.61	60.15
ABC (000's mt) does not include 4% Adj for offshore hake	24.38	31.18
ABC/OFL	0.56	0.52
Pr (F > FMSY)	0%	0%

Table 29 - Summary stock status and Overfishing limit (OFL) for specification year 2015-2017 for both northern and southern red hake stocks. Allowable Biological Catch (ABC) estimate, defined as the 40th percentile of OFL distribution and associated risk of exceeding FMSY proxy are provided.

	North	South
3-year Average Spr. Index 2012-2014 (kg/tow)	2.03	NA
3-year Average Spr. Index 2011-2013 (kg/tow)	NA	1.16
BMSY Proxy Threshold (kg/tow)	1.27	0.51
Biomass Stock Status - Ratio of recent 3-year average Spr. index to BMSY Proxy	**1.61**	**2.30**
3-Year Average Relative Exploitation Index 2011-2013 (kt/kg)	0.17	1.32
FMSY Proxy 1982-2010 (kt/kg)	0.16	3.04
Overfishing Stock Ststus - ratio of 3-year average Exploitation index (2011-2013) to FMSY Proxy	**1.04**	**0.43**
OFL (000's mt) based on point estimate	0.33	3.53
ABC (000's mt)	0.29	3.18
ABC/OFL	0.88	0.90
Pr (F > FMSY)	6%	29%

Figure 21 - 2014 updated OFL frequency distribution for the northern (TOP) and southern (BOTTOM) stock of silver hake derived as a cross product of the fall survey and relative exploitation probability distributions. The fall survey probability distributions were derived from the most recent 3-yr mean and variance and assuming a normal error structure while distribution of relative exploitation was calculated as the average of the ratios of catch to the fall survey biomass from 1973-1982 with a lognormal error structure.



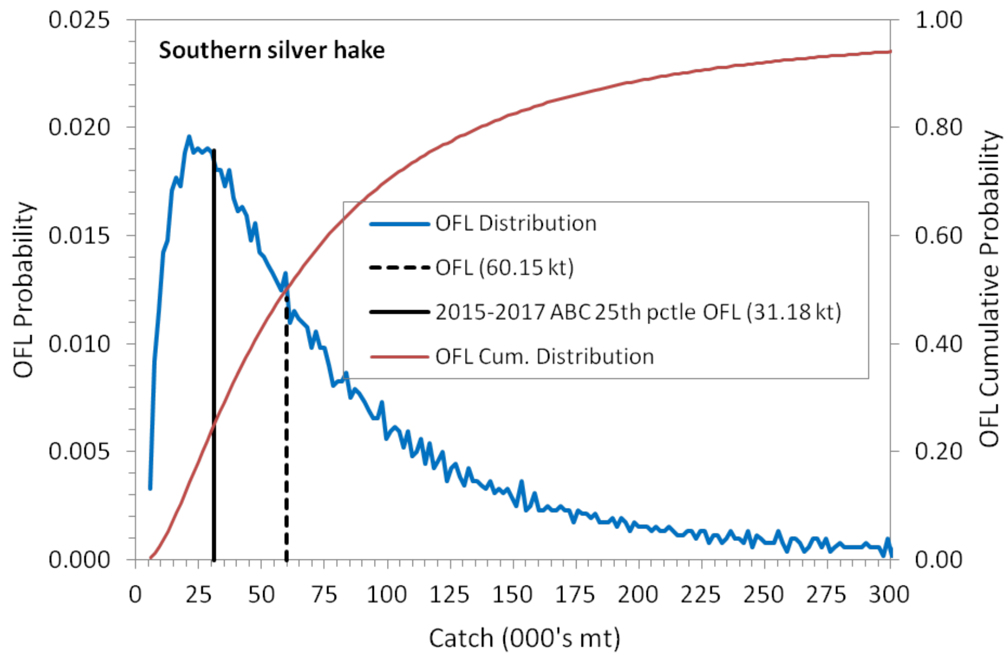
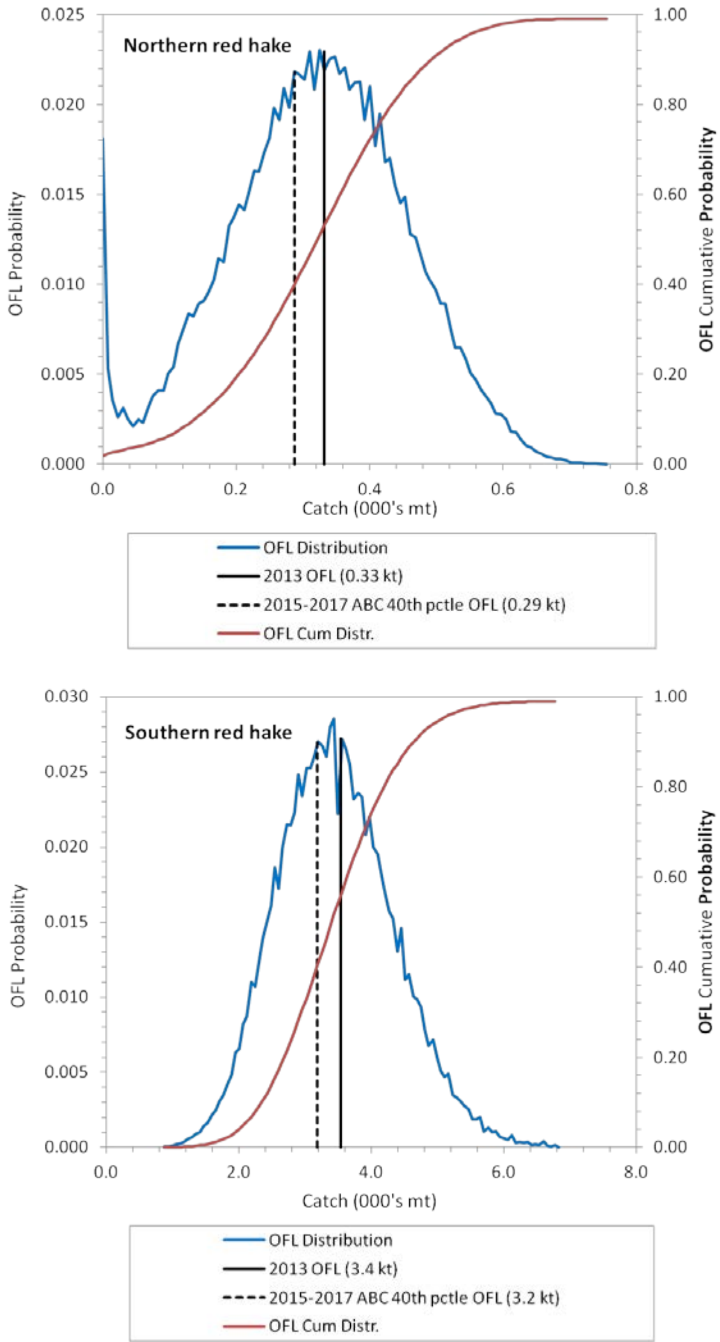


Figure 22 - 2014 OFL frequency distribution for the northern (TOP) and southern (BOTTOM) stock of red hake derived as a cross product of the fall survey and relative exploitation probability distributions. The spring survey probability distributions were derived from the most recent 3-yr mean and variance and assuming a normal error structure while distribution of relative exploitation was calculated as the average of the ratios of catch to the spring survey biomass from 1982-2010 with a normal error structure.



6.3 Risk Analyses (Probability of Overfishing)

The probability of fishing mortality exceeding F_{MSY} proxy was estimated for a range of 2013 catches at the median of F_{MSY} for red and silver hake (Table 30-Table 33and Figure 23Figure 24). Relative exploitation was calculated at each realization of the survey biomass distribution (from the normal distribution as described above). The probability that a catch exceeded a percentile of F_{msy} was estimated as the sum of the products of the probability of each relative F exceeding that catch (1 or 0) and the probability of each survey realization.

Fishing at the proposed ABC's for both stocks of silver hake results in a 0% risk of exceeding the overfishing limit. However for red hake, there is a low risk (6%) and a moderate risk (29%) risk of exceeding the overfishing limit for the northern and southern stocks respectively at the proposed updated ABC levels.

Table 30 - Risk of exceeding F_{MSY} proxy over a range of catches (ABC and OFL estimate from the probability distribution in Bold) for ***northern silver hake*** stocks. Relative F probabilities were calculated from realizations of the three average fall survey distribution and the OFL estimate. ***Note that the median OFL from the distribution as reported in table below is slightly different from the point estimate due to skewness in the distribution***

Pctile of OFL	Catch (kt)	% of OFL_50th Pctile (45.87 kt)	% of 2013 Catch	Prob. (F > $FMSY_{Proxy}$)
5	9.96	22%	576%	0%
10	13.83	30%	799%	0%
20	20.85	45%	1205%	0%
25	**24.38**	**53%**	**1409%**	**0%**
30	28.05	61%	1621%	0%
40	36.19	79%	2092%	4%
45	40.79	89%	2358%	25%
50	**45.87**	**100%**	**2652%**	**68%**
60	58.33	127%	3372%	99%
70	75.43	164%	4360%	99%
80	102.58	224%	5929%	99%

Table 31 - Risk of exceeding F_{MSY} proxy over a range of catches (ABC and OFL estimate from the distribution in Bold) for and ***southern silver hake*** stocks. Relative F probabilities were calculated from realizations of the three average fall survey distribution and the OFL estimate. ***Note that the median OFL from the distribution as reported in table below is slightly different from the point estimate due to skewness in the distribution***

Pctile of OFL	Catch (kt)	% of OFL_50th Pctile (59.69 kt)	% of 2013 Catch	Prob. (F > $FMSY_{Proxy}$)
5	12.34	21%	215%	0%
10	17.39	29%	302%	0%
20	26.55	44%	462%	0%
25	**31.18**	52%	542%	**0%**
30	36.05	60%	627%	0%
40	46.81	78%	814%	4%
45	52.97	89%	921%	27%
50	**59.69**	100%	1038%	**56%**
60	76.23	128%	1326%	97%
70	99.47	167%	1730%	99%
80	136.27	228%	2370%	99%

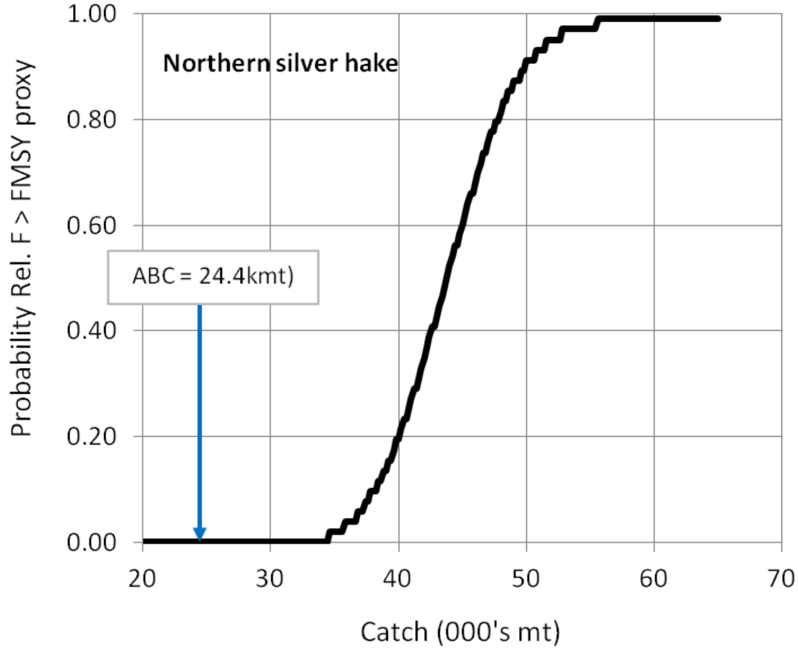
Table 32 - Risk of exceeding F_{MSY} proxy over a range of catches (ABC and OFL estimate from the probability distribution in Bold) for ***northern red hake*** stocks. Relative F probabilities were calculated from realizations of the three average fall survey distribution and the OFL estimate. ***Note that the median OFL from the distribution as reported in table below is slightly different from the point estimate due to skewness in the distribution***

Pctile of OFL	Catch (kt)	% of OFL_50th Pctile (0.322 kt)	% of 2013 Catch (0.364 kt)	Prob. (F > $FMSY_{Proxy}$)
5	0.077	24%	21%	0%
10	0.137	43%	38%	0%
20	0.204	63%	56%	0%
25	0.228	71%	63%	0%
30	0.250	78%	69%	0%
35	0.269	84%	74%	0%
40	**0.287**	**89%**	**79%**	**6%**
45	0.305	95%	84%	17%
50	**0.322**	**100%**	**88%**	**37%**
60	0.356	111%	98%	78%
70	0.392	122%	108%	95%
80	0.433	135%	119%	99%

Table 33 - Risk of exceeding F_{MSY} proxy over a range of catches (ABC and OFL estimate from the distribution in Bold) for and ***southern red hake*** stocks. Relative F probabilities were calculated from realizations of the three average fall survey distribution and the OFL estimate. ***Note that the OFL from the distribution as reported in the table below is slightly different from the point estimate due to skewness in the distribution***

Pctile of OFL	Catch (kt)	% of OFL_50th Pctile (3.40 kt)	% of 2013 Catch (1.10 kt)	Prob. (F > $FMSY_{Proxy}$)
5	2.08	61%	189%	0%
10	2.34	69%	213%	0%
20	2.68	79%	244%	10%
25	2.82	83%	257%	14%
30	2.95	87%	268%	17%
35	3.07	90%	279%	23%
40	**3.18**	**93%**	**289%**	**29%**
45	3.29	97%	299%	35%
50	**3.40**	**100%**	**309%**	**41%**
60	3.63	107%	330%	54%
70	3.88	114%	353%	68%
80	4.19	123%	381%	82%

Figure 23 - Probability of exceeding FMSY proxy for the northern (TOP) and southern (BOTTOM) ***silver hake*** stocks based on the updated 2014 OFL. The risk of overfishing is a product of the probability of Rel.F > FMSY proxy for each survey realizations and the survey probability distributions.



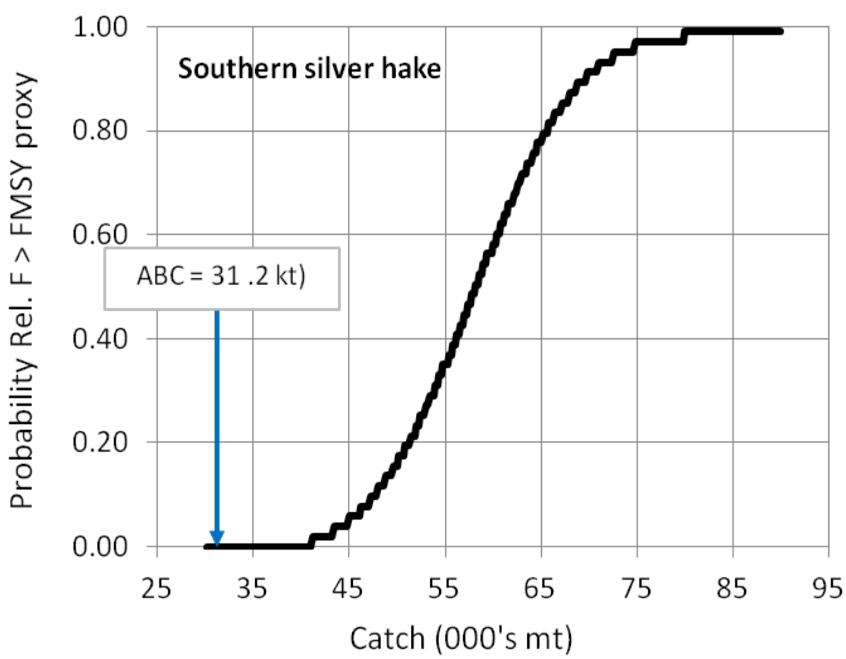
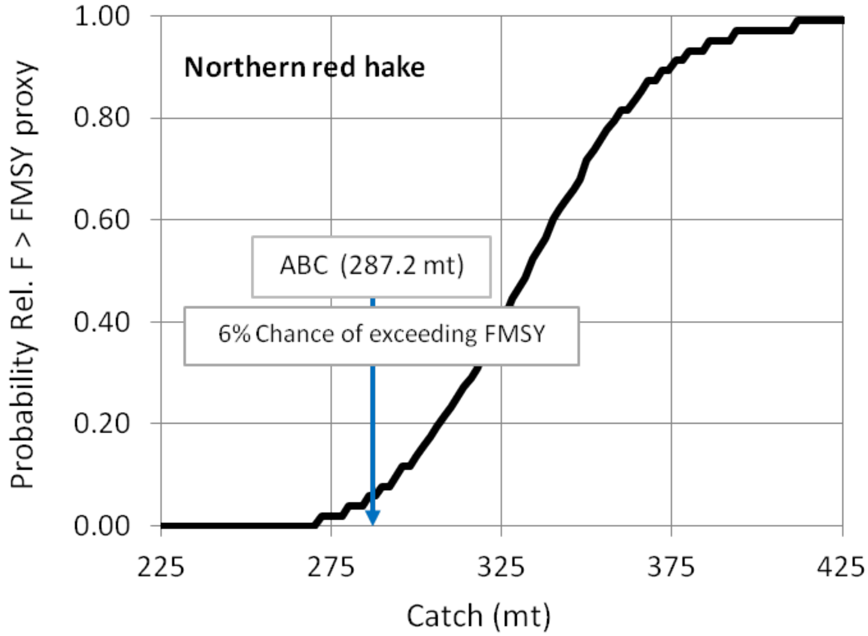
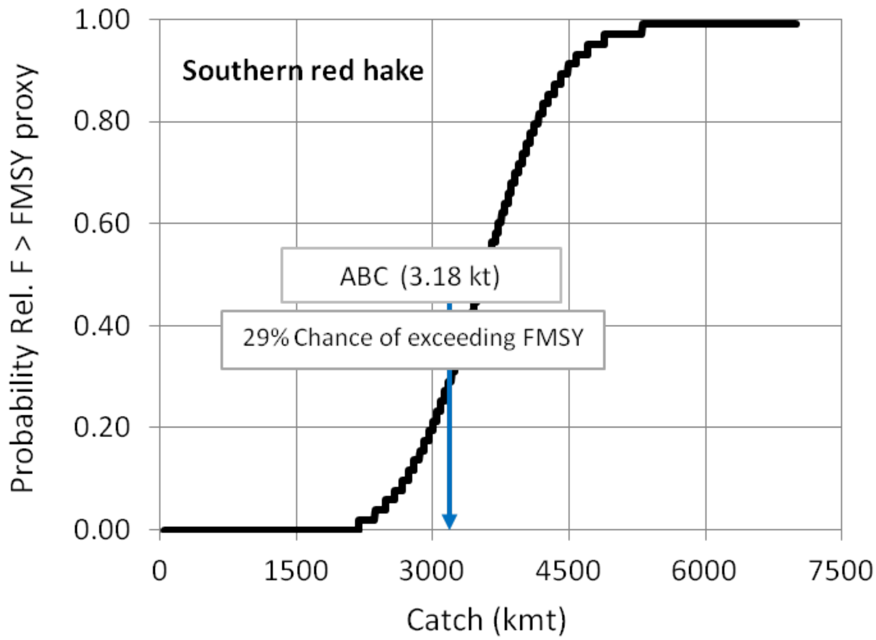


Figure 24 - Probability of exceeding FMSY proxy for the northern (TOP) and southern (BOTTOM) ***red hake*** stocks based on the updated 2014 OFL. The risk of overfishing is a product of the probability of Rel.F > FMSY proxy for each survey realizations and the survey probability distributions.





6.4 Summary

The updated stock assessment for the small multi-species groundfish was completed by adding catch and indices through 2014 to the previous 1955-2009 assessment to develop recommendations for the 2015-2017 ABC. Catch information consisted of commercial landings, discards and recreational catch for red hake. Catch data was combined with fisheries independent survey data from the fall and spring Northeast Fisheries Science Center trawl survey in a simple Index-based approach that utilizes a three year moving average of the fall and spring biomass index and relative exploitation ratio of catch to survey. Uncertainty in the Overfishing Limits was re-estimated to determine current ABC levels based on the current definition in Amendment 19.

Results of the assessment update show that both stocks of silver hake are not overfished and overfishing is not occurring. The three year average fall biomass index (15.72kg/tow in the north vs 1.70kg/tow in the south) are both well above the overfished management threshold (3.21 kg/tow in the north vs 0.83kg/tow in the south), influenced by the recent observed increases in the fall survey trends. The exploitation index measured as the ratio of catch to survey has remained consistently low since the previous benchmark assessment and well below (0.14 kt/kg in the north vs 3.86 kt/kg in the south) the management overfishing definition thresholds (2.78 kt/kg in the north vs 34.17 kt/kg in the south). Conversely, the red hake assessment update indicates that both stocks are not overfished. However, overfishing is occurring in the northern stock while overfishing is not occurring in the southern stock of red hake. The recent three year arithmetic mean biomass index based on the NEFSC spring bottom trawl survey for the northern stock (2012-2014 = 2.03 kg/tow) and southern stock (2011-2013 = 2.42 kg/tow) were both above the proposed management threshold (1.27 kg/tow in the north vs 0.51 kg/tow in the south). The recent three year average exploitation index (0.170 kt/kg) was just above the management threshold in the north (0.163 kt/kg) and below (1.320 kt/kg) the management threshold in the south (3.038 kt/kg).

The proposed ABC recommendations for Silver hake 2015 – 2017 ABC set at 25th percentile to account for scientific uncertainty was estimated at 24,383 mt in the north and 31,177 mt in the south. Both ABC's were approximately above 50% of the OFL with zero risk of exceeding the overfishing limit. Red hake proposed ABC recommendations for 2015 – 2017 set at 40th percentile of the OFL resulted in 287 mt in the north (89% of OFL) and 3,179 mt in the south (93% of OFL), with a low (6%) and moderate (29%) risks of exceeding the overfishing limit in the north and the south respectively.

Stock status for both northern and southern stock of silver hake continues to improve with increasing trends in population biomass and relatively stable catches in the recent years. The proposed OFL estimates suggest that both stocks can withstand higher levels of catch with very little to no risk of exceeding the overfishing limit. Nevertheless, catch remains a major source of uncertainty in the overfishing reference points as implied in the OFL uncertainty estimates. The range of years (1973-1982) adopted in the previous 2010 benchmark assessments for deriving the overfishing definition reference points remain as a source of uncertainty because it does not incorporate contemporary measures of stock productivity. The transition from the 1970's to the 1980's highlight a period of high and low productivity with respect to the stock dynamics. Recognizing the potential for non-stationary productivity in the stock dynamics and the implications on estimates of the OFL, a precautionary basis for ABC should be maintained to account for the level of uncertainty in the OFL . Other sources of uncertainty in the assessment include: truncation in the age structure, estimates of predatory consumption, and catch estimates relative to mixed landings in the fishery (NEFSC, 2011).

Catches of red hake in the north continues to increase, dominated by discarding in the fishery due to very little market demand. Although northern red hake population biomass increased in 2014, there has been a declining trend in survey estimates in prior years with 2013 survey estimate second lowest in the recent decade. This resulted in a change in overfishing status from being below reference threshold to slightly above the threshold.   The proposed ABC for 2014 suggest a low risk of exceeding the overfishing limit, should the population biomass and catches remaining at the current level. Catches have been at or above ABC with poor recruitment in the last three years which may partly explain the lack of response to population growth. However, with the relatively strong incoming year class observed in 2014 and the assumption that current environmental and fishing conditions will prevail, there is potential for population growth in the subsequent years. It should be noted that It will be premature to assert with certainty, the faith of this incoming year class until subsequent years of observations are made from additional years of sampling.

In the south, red hake population biomass has been declining in the recent three years, with catches remaining relatively stable, but has also been dominated by discards in the fishery.   The decline in the population biomass is accompanied by a slight increase in the relative exploitation index but without a change in fishery and population status relative to the reference thresholds. Recruitment has been poor over the last two decades. Although the biomass threshold is above the target and threshold, the population biomass will likely continue to decline if recruitment remains poor at current catch levels.

7.0 Whiting PDT Membership

The Whiting Plan Development Team includes:

1. Andy Applegate
2. Larry Alade
3. Colleen Giannini
4. Moira Kelly
5. Jerome Hermsen
6. Brian Hooper
7. Tammy Murphy
8. David Thomas

8.0 References

Almeida, F. 1987. Stock definition of silver hake in the New England-Middle Atlantic area. N. Am. J. Fish. Mgt. 7: 169-186.

Anderson , E.D. , F.E. Lux, and F.P Almeida. 1980. The Silver Hake Stocks and Fishery off the Northeastern United States. Marine Fisheries Review 4(1): 12-20.

Bolles, K.L., and G.A. Begg. 2000. Distinction between silver hake (*Merluccius bilinearis*) stocks in U.S. waters of the Northwest Atlantic based on whole otolith morphometrics. Fish. Bull. 98: 451-462.

Bowman, R.E., C.E. Stillwell, W.L. Michaels, and M.D. Grosslein. 2000. Food of Northwest Atlantic fishes and two common species of squid. NOAA Tech. Memo. NMFS-F/NE-155, 138 pp.

Brodziak, J.K.T., E.M. Holmes, K.A. Sosebee, and R.K. Mayo. 2001. Assessment of the Silver Hake Resource in the Northwest Atlantic in 2000. *Northeast Fish. Sci. Cent. Ref. Doc. 01-03.*

Collette, B.B. and G. Klein-MacPhee, eds. 2002. Bigelow and Schroeder's fishes of the Gulf of Maine. Washington D.C.: Smithsonian Institute Press; 252-256.

Colton, J.B., Jr., and R.F. Temple. 1961. The enigma of Georges Bank spawning. Limnol. Oceanogr. 6: 280-291.

GARM (Groundfish Assessment Review Meeting). 2007. Report of the Groundfish Assessment Review Meeting (GARM) Part 1. Data Methods. R. O'Boyle [chair]. Available at http://www.nefsc.noaa.gov/nefsc/saw/

Grosslein, M.D. and T.R. Azarovitz. 1982. Fish distribution. MESA New York Bight Atlas Monogr. No. 15, 182 pp.

Northeast Fisheries Science Center. 2011. 51st Northeast Regional Stock Assessment Workshop (51st SAW) Assessment Report. US Dept Commer., Northeast Fish Sci. Cent. Ref Doc. 11-02; 856 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at: http://www.nefsc.noaa.gov/nefsc/publications/

Legault C.M., M. Palmer, and S. Wigley. 2008b. Uncertainty in Landings Allocation Algorithm at Stock Level is Insignificant. GARM III Biological Reference Points Meeting. WP 4.6.

Lock, M.C. and D.B. Packer. 2004. Essential Fish Habitat Source Document: Silver Hake, *Merluccius bilinearis*, Life History and Habitat Characteristics, Second Edition. *NOAA Technical Memorandum NMFS-NE-186.*

Miller TJ, Das C, Politis PJ, Miller AS, Lucey SM, Legault CM, Brown RW, Rago PJ. 2010. Estimation of Albatross IV to Henry B. Bigelow calibration factors. NMFS NEFSC Ref. Doc. 10-05. 233 p.

Musick, J.A. 1967. Designation of the hakes, Urophycis chuss and Urophycis tenuis, in ICNAF statistics. Int. Comm. Northw. Atl. Fish. Res. Doc. No. 67/76.

Northeast Fisheries Science Center. 2011. 51st Northeast Regional Stock Assessment Workshop (51st SAW) Assessment Report. US Dept Commer., Northeast Fish Sci. Cent. Ref Doc. 11-02; 856 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at: http://www.nefsc.noaa.gov/nefsc/publications/

NMFS (National Marine Fisheries Service). 2012. MRFSS/MRIP Calibration Workshop Ad-hoc Working Group Report. May 16, 2012. 12 p.

O'Brien, L., J. Burnett, and R. K. Mayo. 1993. Maturation of nineteen species of finfish off the northeast coast of the United States, 1985-1990. NOAA Tech. Report. NMFS 113, 22-25 p.

Palmer, M. 2008. A method to apportion landings with unknown area, month and unspecified market categories among landings with similar region and fleet characteristics. GARM III Biological Reference Points Meeting. WP 4.4. 9 p.

Palmer MC, Hersey P, Marotta H, Shield GR, Cierpich SB. 2013. The design, implementation and performance of an observer pre-trip notification system (PTNS) for the northeast United States groundfish fishery. NMFS NEFSC Ref. Doc. 13-21. 82 p.

Roundtree, R.A. 1999. Nov. Diets of NW Atlantic fishes and squid. http://fishecology.org Accessed 17 Aug. 2000. Steiner et al. 1982

Steiner, W.W., J.J. Luczkovich, and B.L. Olla. 1982. Activity, shelter usage, growth and recruitment of juvenile red hake *Urophycis chuss*. Mar. Ecol. Prog. Ser. 7:125-135.

Wigley S.E., P. Hersey, and J.E. Palmer. 2007a. A description of the allocation procedure applied to the 1994 to present commercial landings data. GARM III Data Meeting. WP A.1

Wigley SE, Rago PJ, Sosebee KA, Palka DL. 2007b. The Analytic Component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: Sampling Design, and Estimation of Precision and Accuracy (2nd Edition). NMFS NEFSC Ref. Doc. 07-09. 156 p.