1.0 AFFECTED ENVIRONMENT

1.1 ATLANTIC SEA SCALLOP RESOURCE

The Atlantic sea scallop (*Placopetcen magellanicus*) is a bivalve mollusk that is distributed along the continental shelf, typically on sand and gravel bottoms from the Gulf of St. Lawrence to North Carolina (Hart and Chute, 2004). The species generally inhabit waters less than 20^{o} C and depths that range from 30-110 m on Georges Bank, 20-80 m in the Mid-Atlantic, and less than 40 m in the near-shore waters of the Gulf of Maine. Although all sea scallops in the US EEZ are managed as a single stock per Amendment 10, assessments focus on two main parts of the stock and fishery that contain the largest concentrations of sea scallops: Georges Bank and the Mid-Atlantic, which are combined to evaluate the status of the whole stock.

The scallop assessment is a very data rich assessment. The overall biomass and recruitment information are based on results from several surveys including: the NEFSC federal survey; SMAST video survey; VIMS paired tow dredge survey; and towed camera survey conducted by Arnie's Fishery. These data sources are combined in the assessment of the resource and in models used by the Scallop PDT to set fishery allocations.

1.1.1 Benchmark Assessment

The sea scallop resource just had a benchmark assessment in 2014 (SARC59, 2014). Therefore, all of the data and models used to assess the stock were reviewed. The final results from that assessment have been incorporated into this action, including updated reference points for status determination (See Section ???). Overall, a handful of issues were updated as a result of the assessment and are summarized below. The full benchmark assessment and summary report can be found at: http//?>????.

The major highlights from the benchmark assessment include:

1. several changes to the dredge index;
2. use of a separate Habcam index;
3. splitting out GB open and GB closed subareas;
4. several model parameter adjustments (a. increased estimates for natural mortality; b. increased natural mortality for larger scallops; and c. new growth estimates for three different time periods); and
5. new reference points based on these modifications.

Several changes were reviewed and approved related to the dredge survey index: 1) VIMS survey data was integrated for all areas from 2005-2013; 2) tows were standardized to one nautical mile in length instead of using a vessel correlation factor that was used in the last assessment; and 3) marginal areas on GB were dropped from the survey index. Adding the VIMS survey data had modest effects on the index, but improved the overall CV.

Habcam data used as a separate survey index for the first time in this assessment (GB 2011-2013 and MA 2012 and 2013). Previously simple kriging was completed with Habcam data to estimate access area biomass in scallop actions. But this assessment used a more complex a three step model (GAM plus ordinary kriging) to obtain biomass and abundance estimates. A stratified mean was also used as a backup estimate or "sanity check". Paired habcam/dredge tows were used to obtain survey dredge efficiency estimates.

The GB model results were unstable; therefore the region was divided into two sub-regions: GB open and GB closed. Model for GB open performed very well, no retrospective patterns. For GB closed, the model does not believe the large survey years, so underestimates biomass for those years. The assessment panel discussed that density dependence juvenile mortality could be causing this, but that issue was not fully tested in this assessment.

Three model parameters were adjusted: 1) natural mortality increased in all areas, and was increased from 0.12 to 0.16 on GB and from 0.15 to 0.2 in the MA; 2) natural mortality for the plus group was assumed to be 1.5 times that of other size classes (i.e., 0.24 for GB and 0.3 for MA); and 3) different growth estimates used for different time periods. Analyses were completed to support all of these adjustments.

Based on all these changes the assessment approved new reference points for status determination. See a summary of that below (Section 1.1.1.1).

1.1.1.1 Stock status

The scallop stock is considered overfished if F is above Fsmy, and overfishing is occurring if biomass is less than ½ Bmsy. The previous estimate of Fmsy was 0.38 and Bmsy was 125K mt (1/2 Bmsy = 62K mt). SARC59 revised these reference points and increased Fmsy to 0.48 and reduced Bmsy to 96,480 mt (½ Bmsy = 48,240 mt). A comparison of the reference points are described in Table 1.

Table 1 – Summary of old and new reference points

	SARC 50 (2010)	SARC 59 (2014)
OFL	F = 0.38	F = 0.48
ABC/ACL (25% chance of exceeding OFL)	F = 0.32	F = 0.38
ACT for LA fishery (25% chance of exceeding ABC)	F = 0.28	F = 0.34
Bmsy (1/2 Bmsy)	125,358 (62,679)	96,480 (48,240)

Four types of mortality are accounted for in the assessment of the sea scallop resource: natural, discard, incidental, and fishing mortality. The updated stock assessment established new values for natural mortality on both stocks; it was increased from 0.12 to 0.16 on GB and from 0.15 to

0.2 in the MA. In addition, natural mortality for the plus group was assumed to be 1.5 times that of other size classes (i.e., 0.24 for GB and 0.3 for MA).

Discard mortality occurs when scallops are discarded on directed scallop trips because they are too small to be economically profitable to shuck or due to high-grading during access area trips to previously-closed areas. Total discard mortality (including mortality on deck) is uncertain, but was estimated at 20% in this assessment, as well as the previous two assessments.

Incidental mortality is non-landed mortality associated with scallop dredges that likely kill and injure some scallops that are contacted but not caught by crushing their shells, and this source of mortality is highly uncertain. The last benchmark assessment in 2010 used 0.20 on Georges Bank and 0.10 in the Mid-Atlantic (NEFSC, 2010), compared to earlier values of 0.15 on Georges Bank and 0.04 for Mid-Atlantic. There is no new information to modify the values used in 2010, but several studies are in process, and SARC59 did run some sensitivity analyses of this source of mortality. In general, incidental mortality does not have a very large impact on the overall assessment of the stock.

Finally, fishing mortality, the mortality associated with scallop landings on directed scallop trips, is calculated separately for Georges Bank and the Mid-Atlantic because of differences in growth rates. Fishing mortality peaked for both stocks in the early 1990s, but has decreased substantially since then as tighter regulations were put into place including area closures, and biomass levels recovered. shows F and biomass estimates for the combined stock overall through 2013.

SARC 59 included a formal stock status update through FY2013, and the reference points were updated in this benchmark assessment. **<u>The updated estimates for 2013 are: F=0.32 and B=132K, so the stock is not overfished and overfishing is not occurring, under both the old and new reference points</u>** (Figure 1 and Table 2). The main driver for the increase in Fmsy is due to increases in natural mortality and weakening of MA stock recruit relationships. In general Fsmy is uncertain because the Fmsy curve for MA is very flat, uncertain where Fmax is for that region.

Based on these results from the benchmark assessment the reference points for this fishery have been updated and the details are summarized in Section ???.

The Scallop PDT met in August 2014 to review updated survey information for Framework 26. A stock status update for 2014 will not be completed for this action because the 2014 fishing year is not over yet. Instead, the results from SARC59, through 2013, will be used to assess the status of the stock for this action.

Figure 1 - Whole stock estimate of fishing mortality through 2013 (SARC59) Fishing mortality (red line) and biomass estimates (y^{-1}, gray bars) from the CASA model

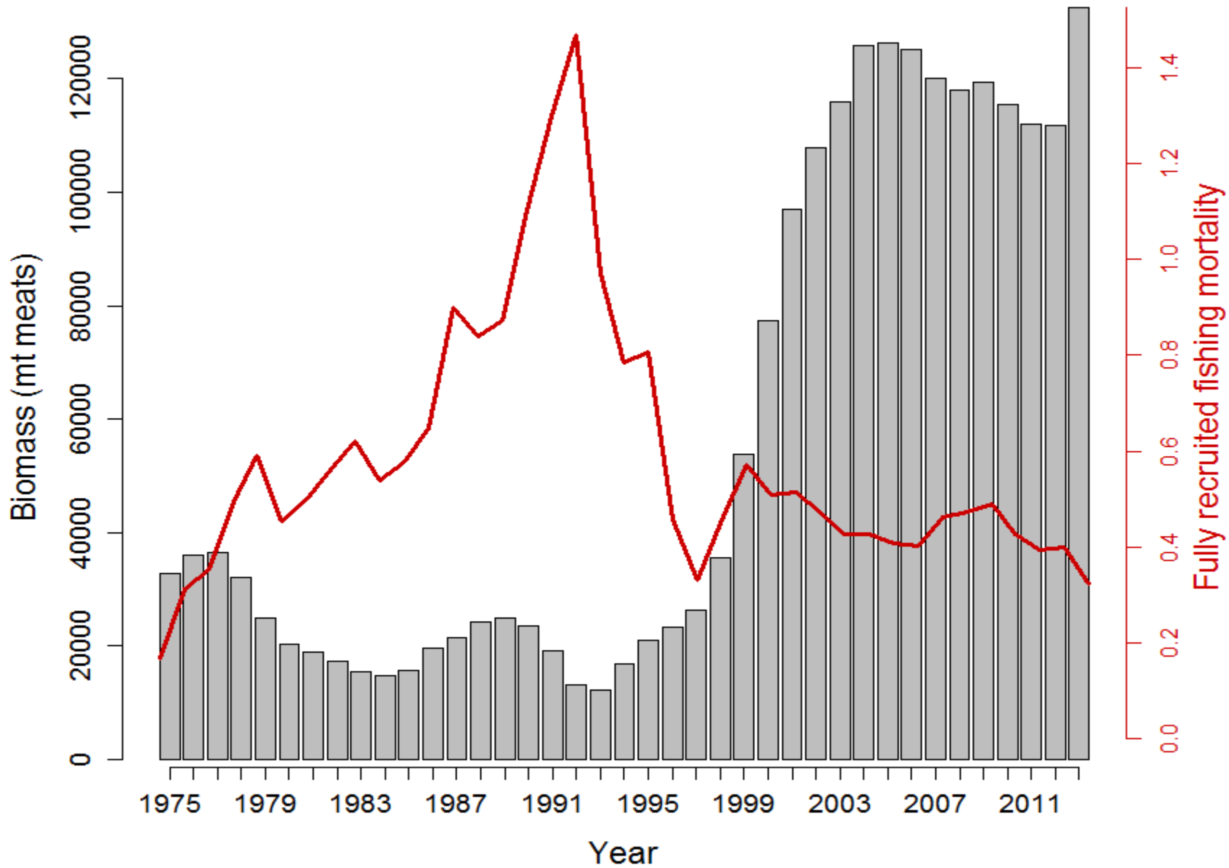


Figure 2 – Fully recruited annual fishing mortality rate for scallops from 1975-2013
Note that trends are different for partially recruited scallops because of changes in commercial size selectivity. SARC59 Fmsy is shown with green dashed line for the most recent period; Fmsy would have been smaller in past years when selectivity was different.

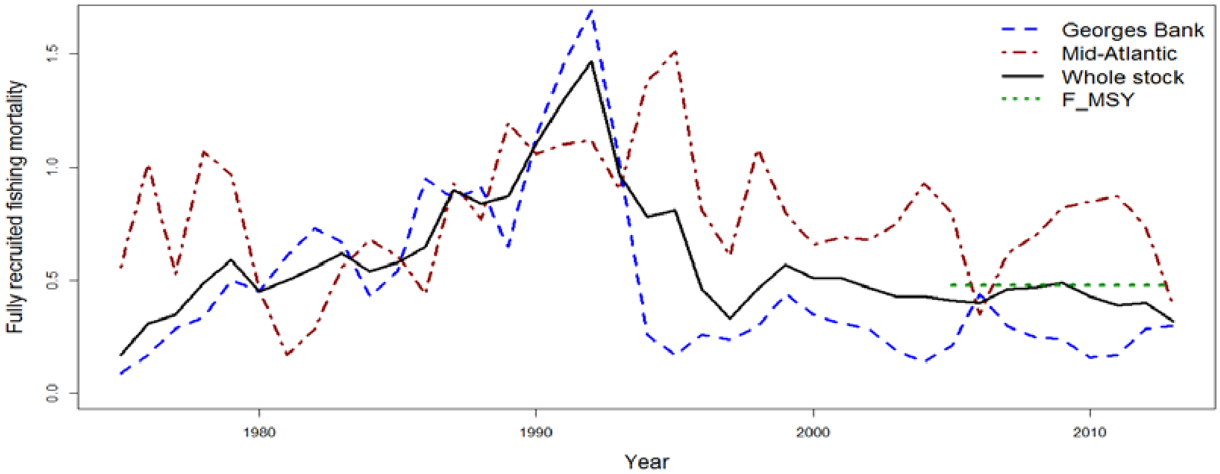


Table 2 – 2013 sea scallop stock status – overfishing is not occurring and the resource is not overfished

	Total 2013 Estimate	Stock Status Reference Points
Biomass (in 1000 mt)	133	½ Bmsy = 48,240
F	0.32	OFL = 0.48

1.1.2 Summary of 2014 surveys

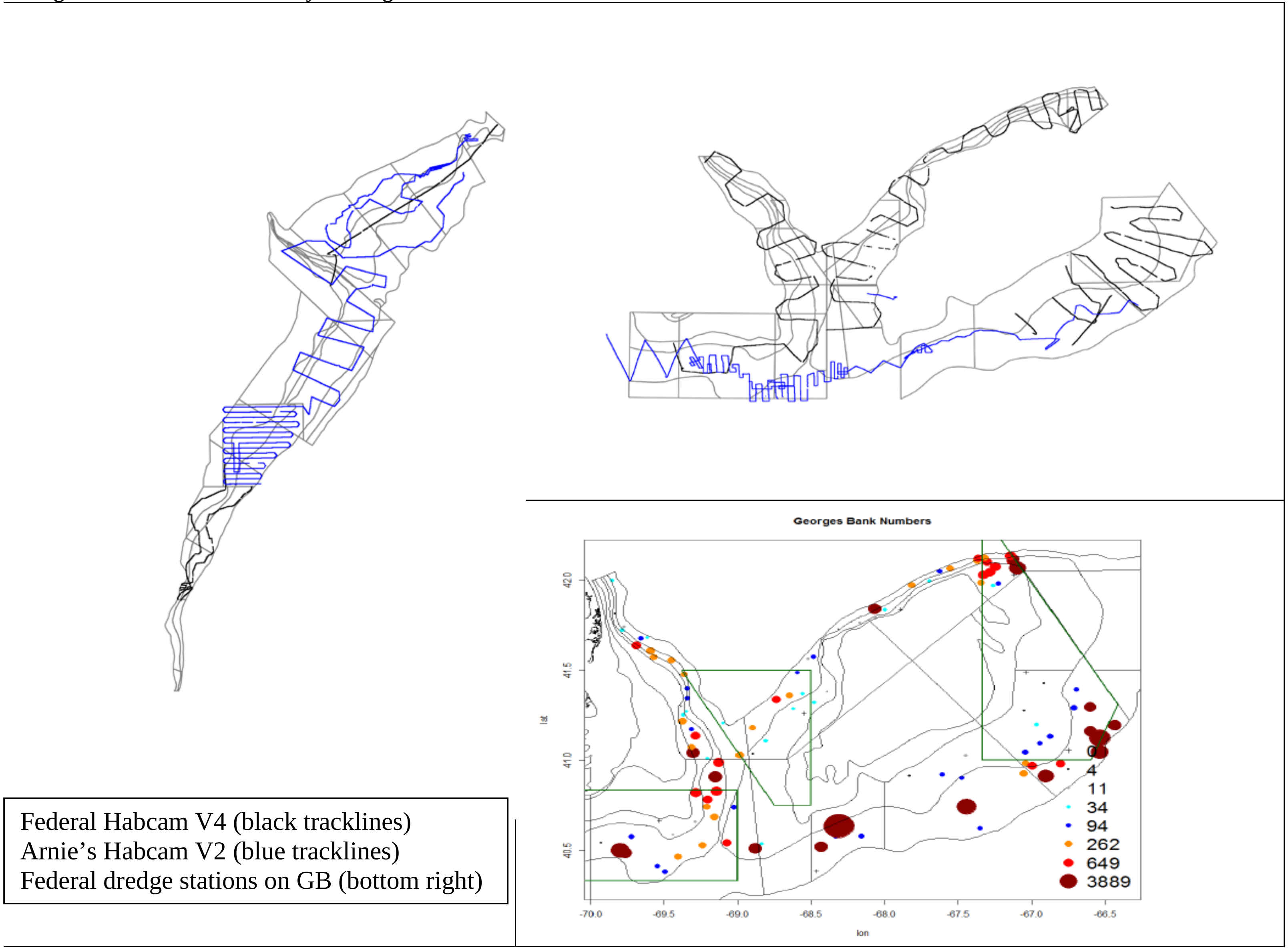
The Scallop FMP is fortunate to have access to several different survey methods. First, the NEFSC has had a dedicated dredge survey since 1977 that has sampled the resource using a stratified random design. More recently, the NEFSC scallop survey has evolved into a combined dredge and optical survey (Habcam Version 4), and is conducted on the R/V Sharp. Ideally, both dredge tows and habcam are used in each stratum, and there are three separate legs of the combined federal scallop survey. In 2014, the federal survey faced some logistical issues, which caused the overall survey to be about ten days shorter than planned and it was completed about two weeks later than scheduled. In the end, a full habcam survey was conducted in both regions (GB and MA), but essentially no federal dredge tows were completed in the MA region and about 120 federal dredge tows were completed in GB (Figure 3).

In addition, SMAST has conducted video surveys of various parts of the resource area. In most years since 2003, including 2014, SMAST completed a broadscale video survey of most of the resource area. In addition to a broadscale survey of most of the resource area, SMAST also completed a more intensive survey of the sliver north of the scallop access area within CA1. The 2014 SMAST season included about 2,000 stations on seven separate cruises (Figure 4).

Third, VIMS conducts a grid design survey towing two dredges, one commercial dredge and one survey dredge, in various areas that tend to vary from year to year. In 2014 VIMS completed 565 stations on three separate research cruises (Figure 4).

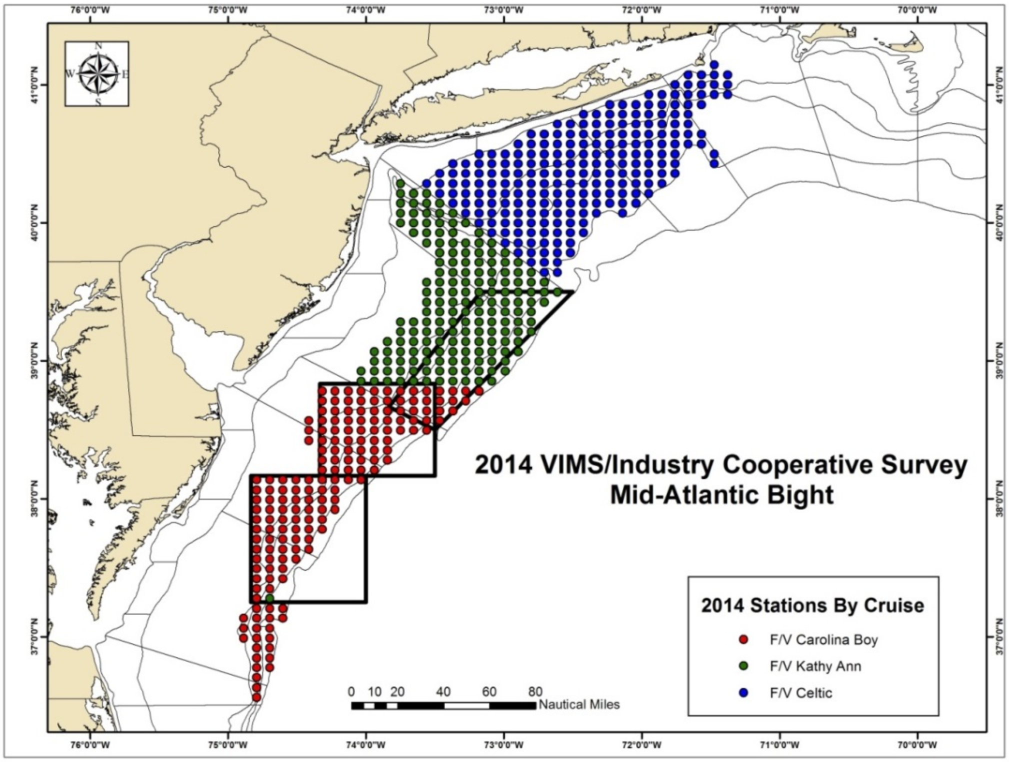
Finally, Arnie's Fisheries has completed very intensive optical surveys of discrete areas using Habcam Version 2. The areas vary from year to year, and in 2014 the areas covered were Elephant Trunk, areas with high concentrations of small scallops in and around NL and south of Long Island, as well as areas on the southern flank of GB and from Hudson Canyon proper to Elephant Trunk (Figure 3).

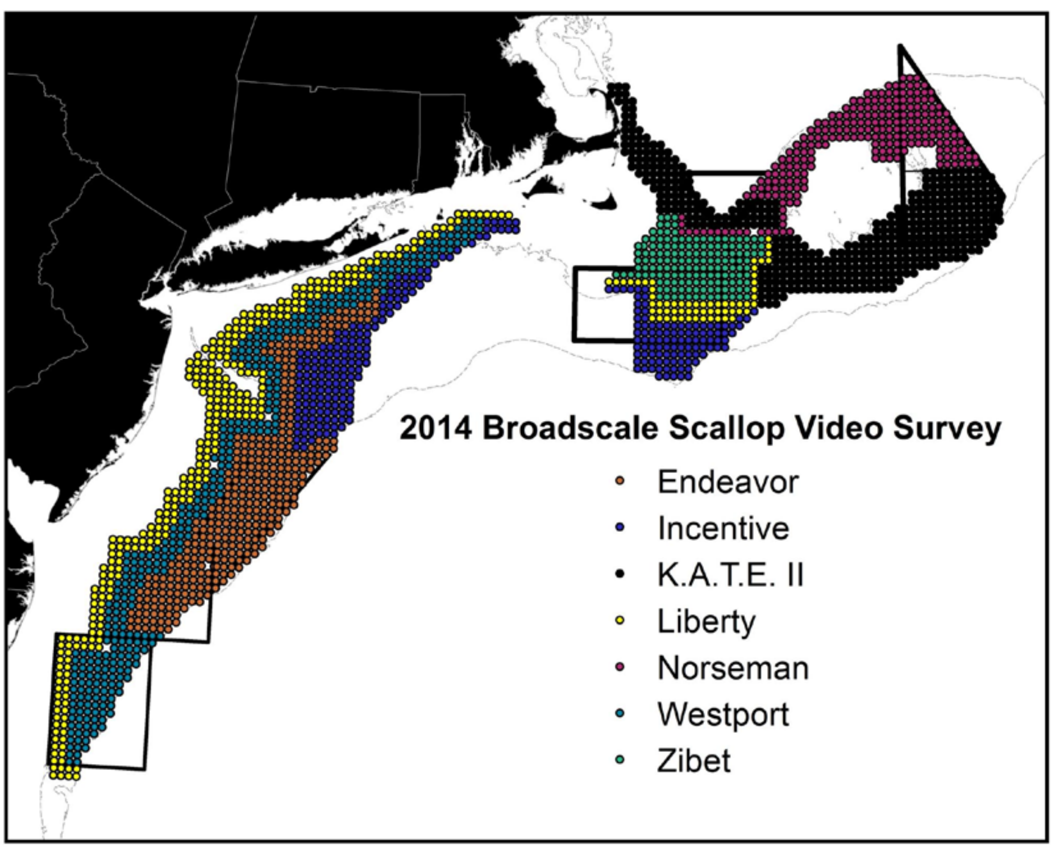
Figure 3 – 2014 NEFSC survey coverage



Federal Habcam V4 (black tracklines)
Arnie’s Habcam V2 (blue tracklines)
Federal dredge stations on GB (bottom right)

Figure 4 – 2014 survey stations for VIMS (top) and SMAST (bottom)





The Scallop PDT combines the results from all available surveys to estimate sea scallop biomass and recruitment on an annual basis. The PDT met on August 26, 2014 and reviewed results from all the surveys described above.

1.1.3 Updated estimates of scallop biomass and recruitment

1.1.3.1 Georges Bank

The scallop abundance and biomass on Georges Bank increased from 1995-2000 after implementing closures and effort reduction measures. Biomass and abundance then declined from 2006-2008 because of poor recruitment and the reopening of portions of groundfish closed areas. Biomass increased on Georges Bank in both 2009 and 2010, mainly due to increased growth rates and strong recruitment in the Great South Channel, along with continuing concentrations on the Northern Edge and in the central portion of Closed Area I, especially just south of the “sliver” access area.

In 2012, GB biomass was primarily concentrated in NL, the Channel, and cod HAPC within CA2. In 2013, GB biomass declined in all areas, especially the Channel. In 2014 abundance was very high on GB, but mostly from small scallops observed throughout most of the resource area. In particular, large settlement areas were observed along the southern flank of GB, and in some cases in areas that do not typically have high densities of scallops. Figure 5 - Figure 10 show the survey results for scallop biomass and abundance for GB from various surveys of the area. Note in Figure 5 that 2014 is displaying scallop numbers and 2013 results are in terms of biomass, so they are not comparable. Overall, GB biomass has been increasing since 2010 (Figure 10 and Figure 15). However, exploitable biomass has been declining on GB since 2005. It is expected to increase over the next few years if smaller scallops grow and survive on GB.

Table 3 summarizes the biomass estimates per area based on 2014 surveys.

Figure 5 - Total scallop biomass (g/tow) on GB from the 2014 NEFSC dredge tows (TOP) compared to 2013 biomass from both VIMS and NEFSC dredge tows combined (BOTTOM)

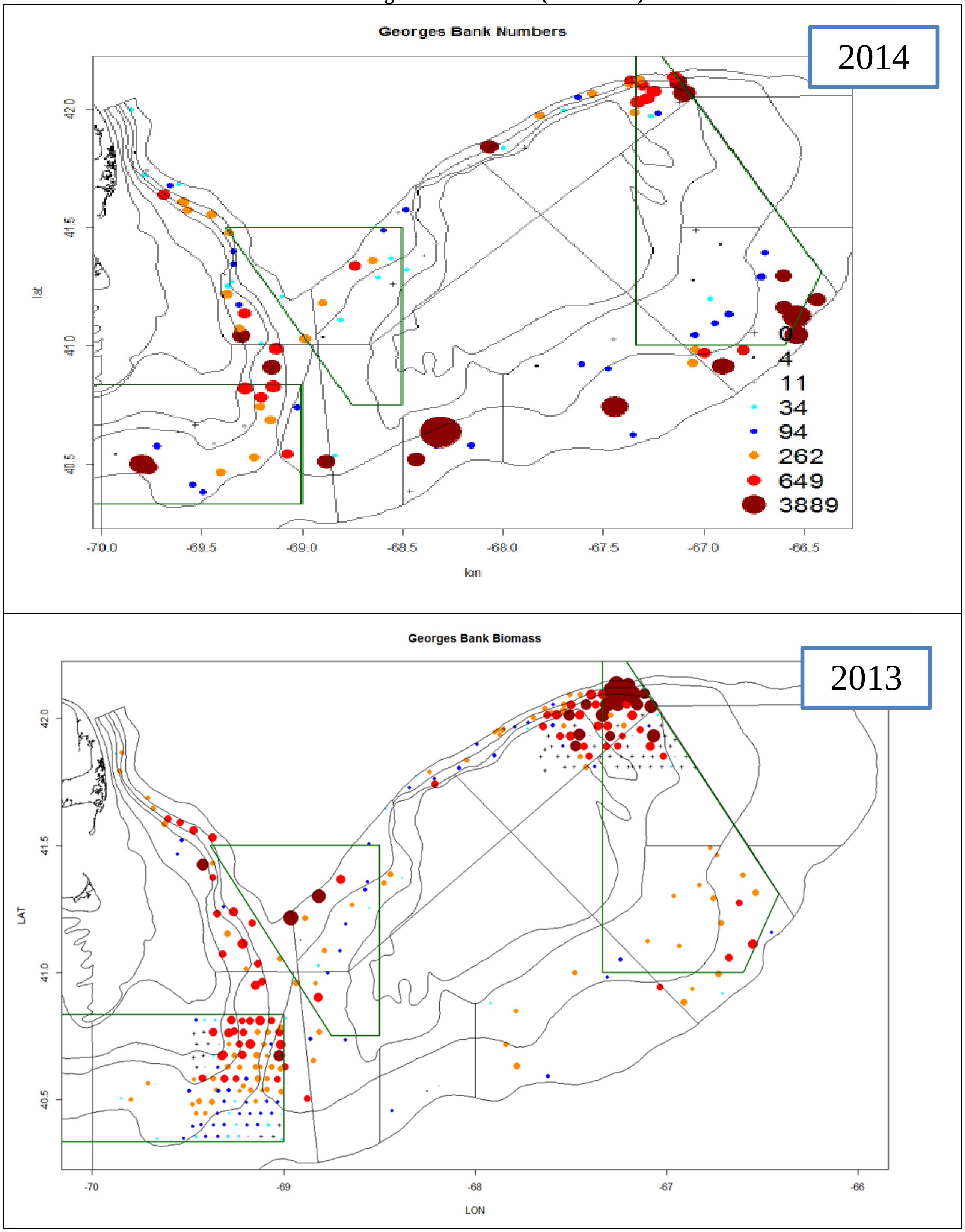


Figure 6 - Total scallop abundance (numbers per station) on GB (2014 SMAST video survey)

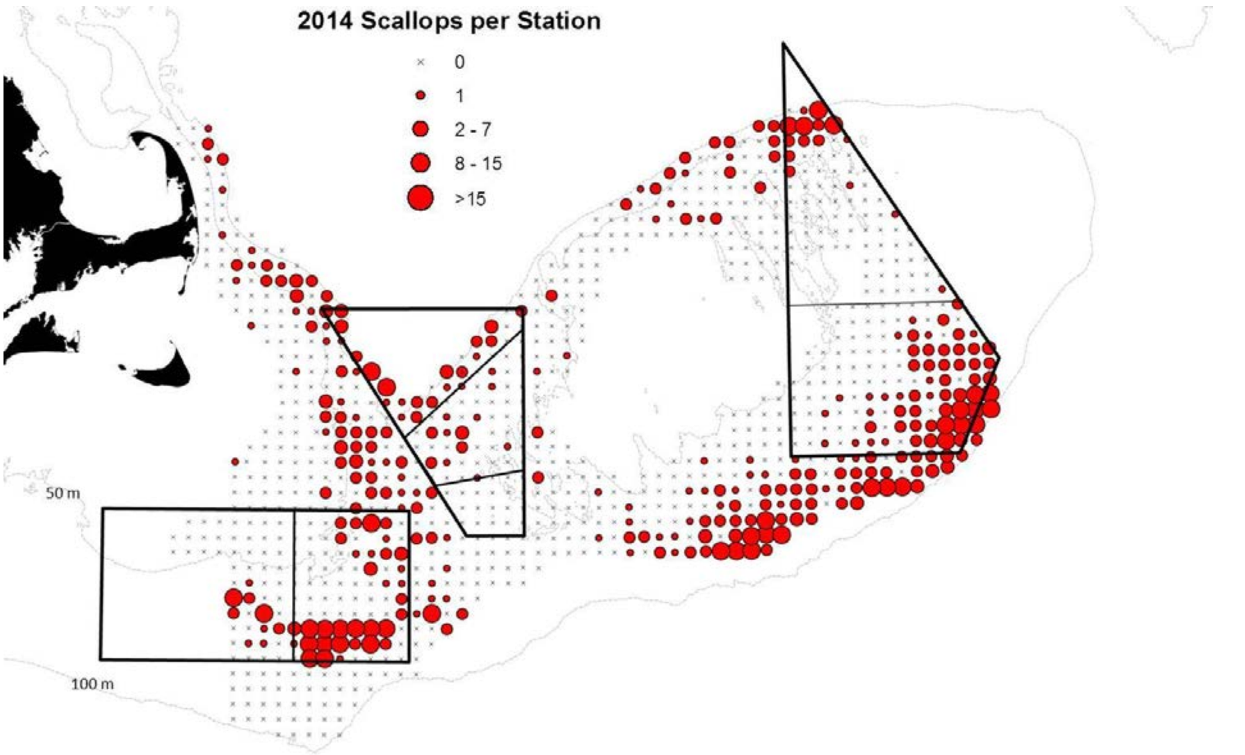


Figure 7 - Total scallop abundance (numbers per station) for recruits (less than 75mm) in the GB region from the 2014 SMAST video survey

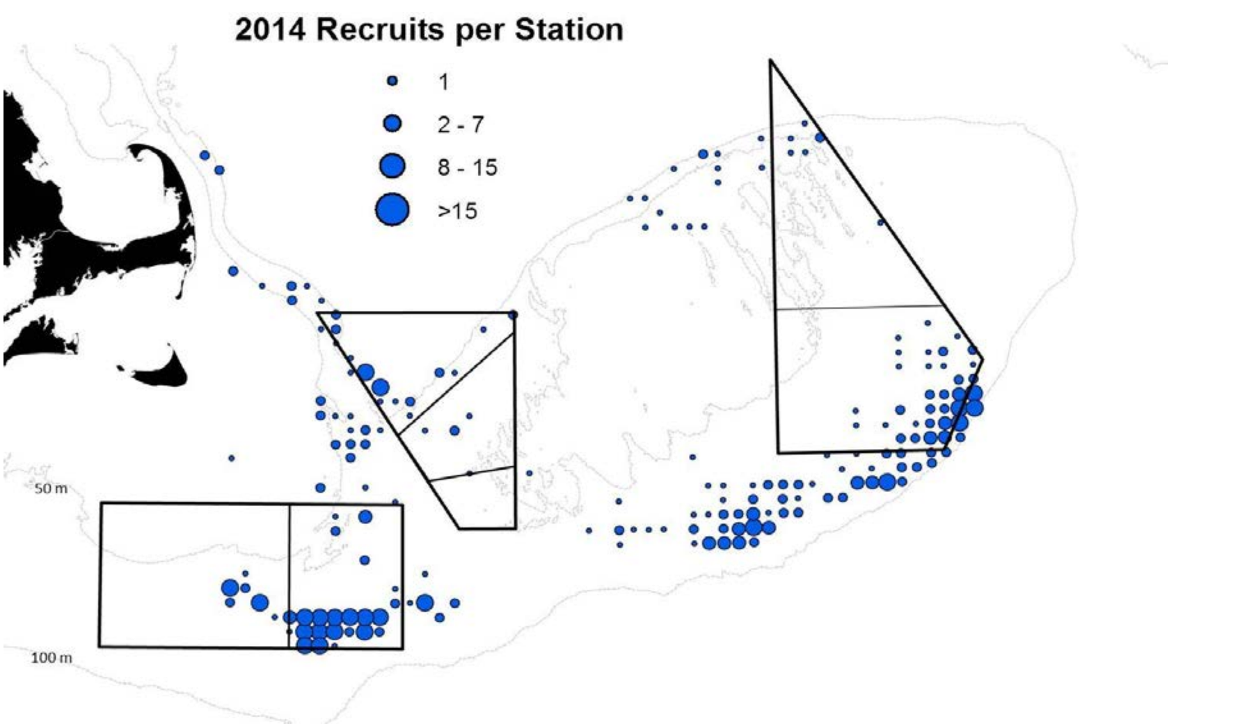


Figure 8 - Total scallop biomass in areas on GB combining optical survey results from 2014 NEFSC Habcam Version 4 and Arnie's Fishery Habcam Version 2

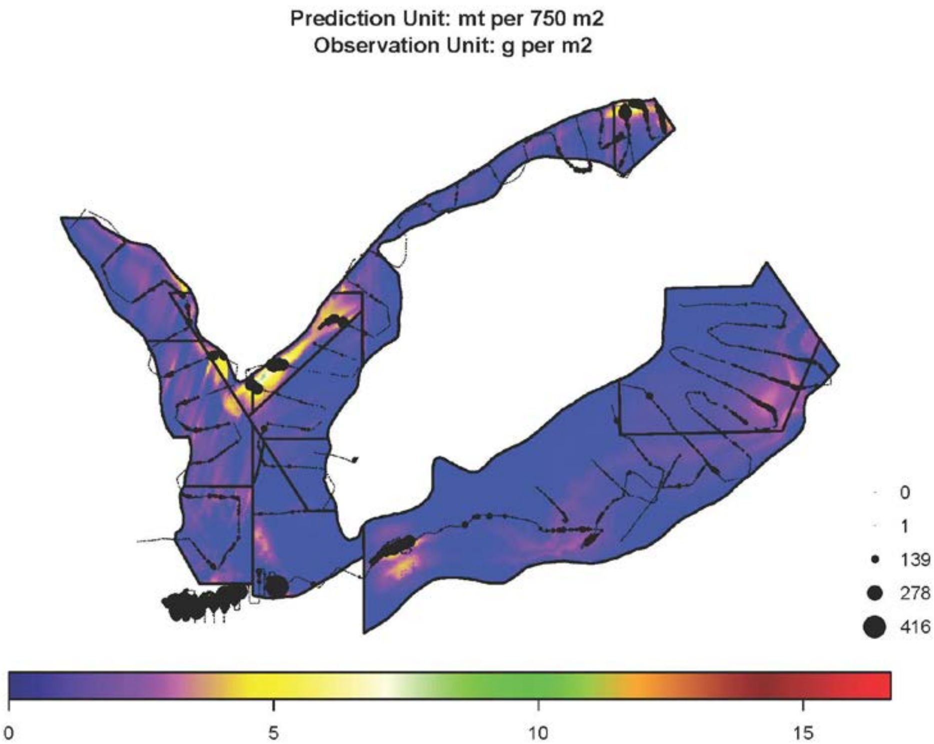


Figure 9 – Distribution of scallops by shell height from 2014 Arnie's Fishery Habcam Version 2

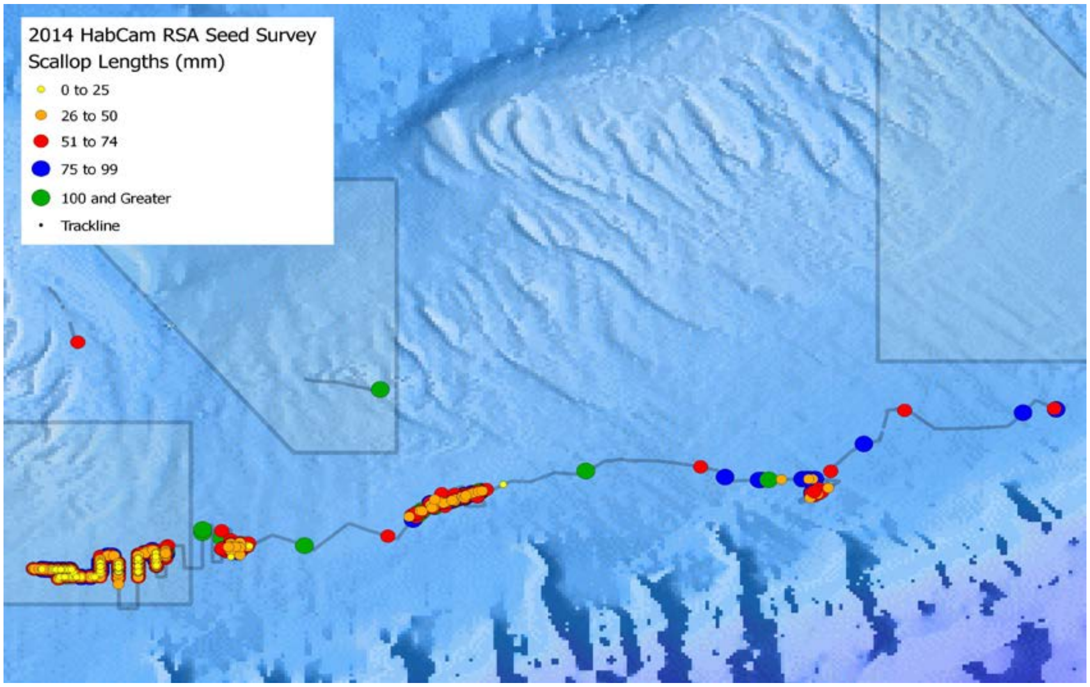
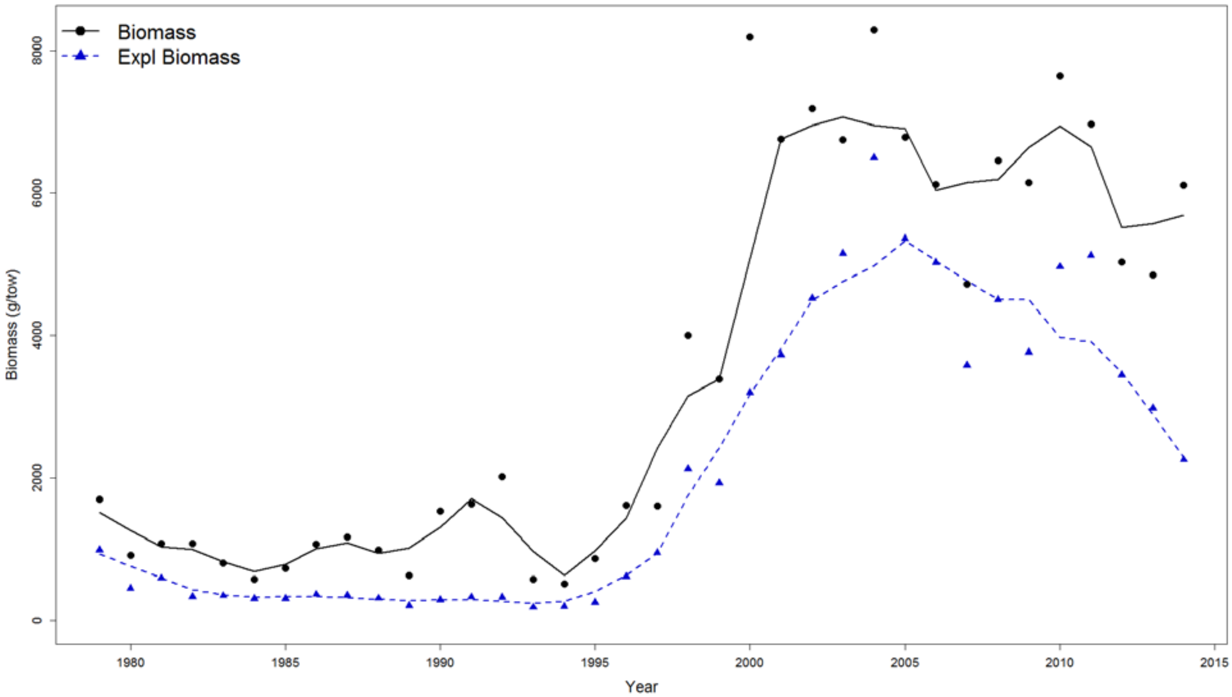


Figure 10 – GB dredge survey biomass and exploitable biomass time series (1979-2014)



1.1.3.2 Mid-Atlantic

In general, Mid-Atlantic biomass was declining since 2009, and has been steadily increasing as smaller scallops grow (Figure 14). The decline in exploitable biomass from 2006-2014 was primarily from depletion of the large biomass in Elephant Trunk and several years of poor recruitment in that area (2009-2011). However, stronger recruitment has been observed in 2012 and 2013. Once these scallops grow larger biomass in the Mid-Atlantic is expected to increase. Figure 11 through Figure 13 show 2014 survey results from various surveys of the area. The large number of small scallops observed in 2012 in all three MA access areas seems to have survived, and some of these animals will be ready for harvest in FY2015. Note that another set of smaller scallops was observed in several surveys in more shallow areas within the MA access areas. Overall MA scallop biomass is increasing as smaller scallops continue to grow in this area (Figure 15).

Table 3 summarizes the biomass estimates per area based on 2014 surveys.

Figure 11 - Total scallop abundance for the Mid-Atlantic from the 2014 VIMS dredge tows for smaller scallops (LEFT) and larger scallops (RIGHT)

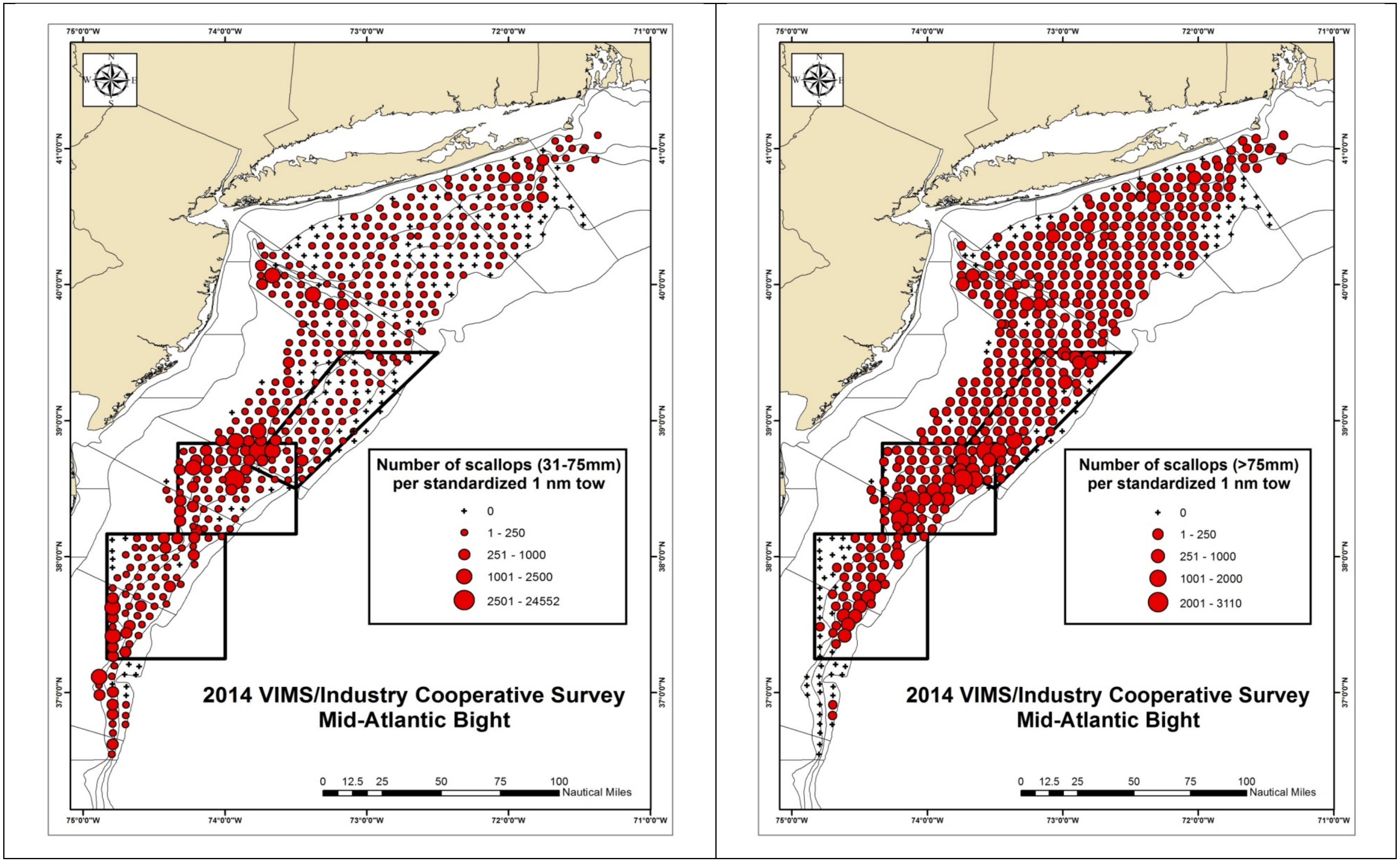


Figure 12 - Total scallop abundance (numbers per station) for MA region from the 2014 SMAST video survey (LEFT) and abundance of small scallops less than 75mm (RIGHT)

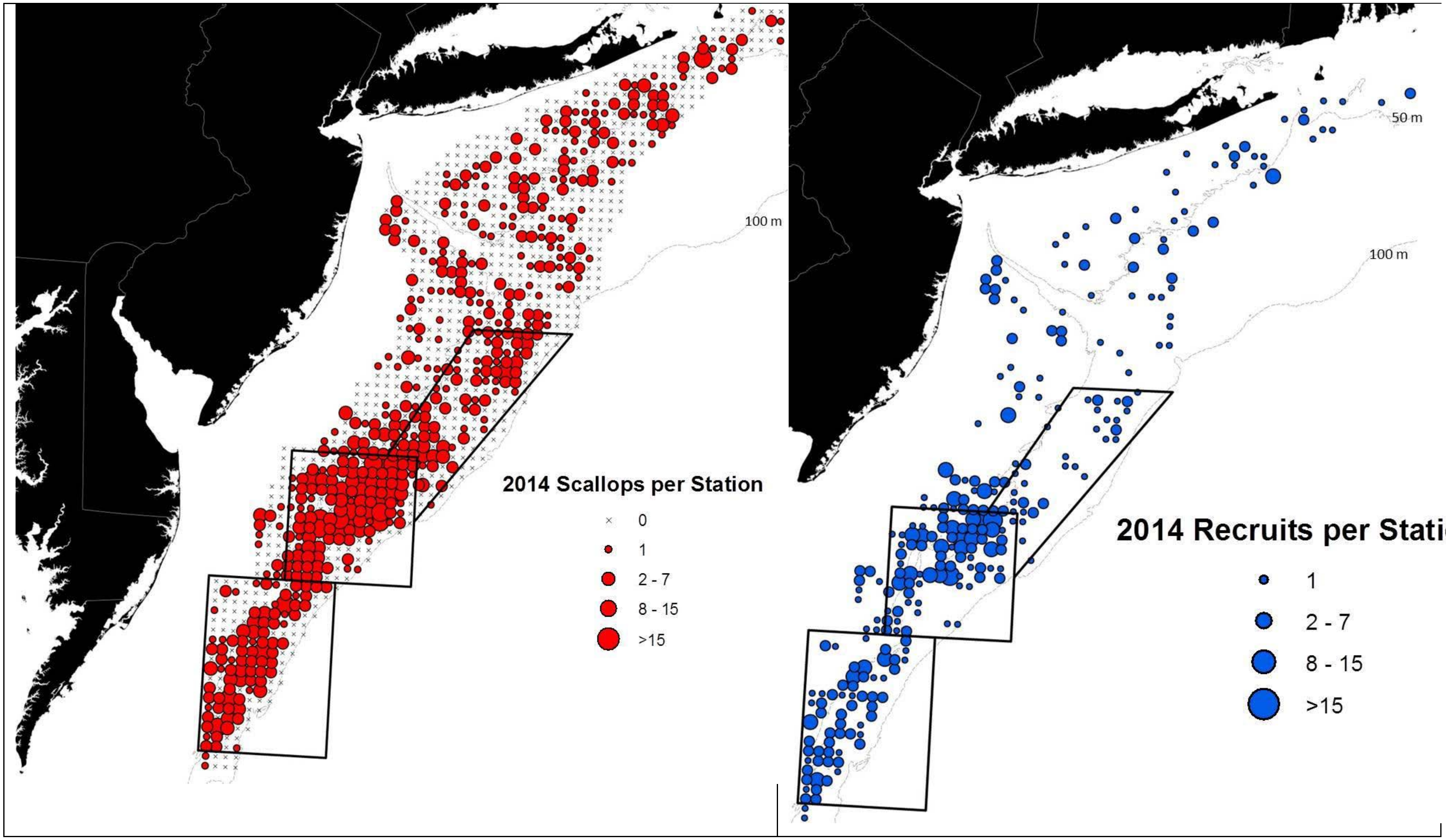


Figure 13 - Total scallop biomass for the Mid-Atlantic from the 2013 NEFSC optical survey (Seahorse)

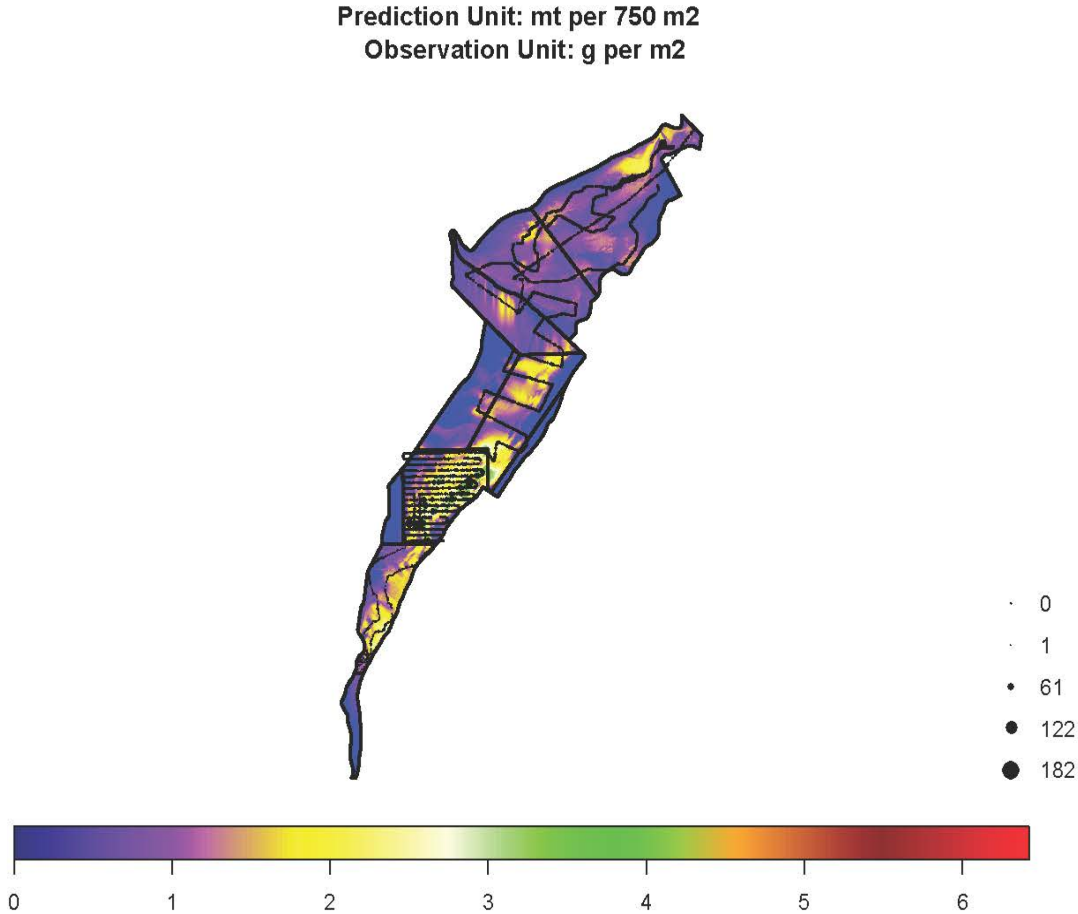


Figure 14 – MA dredge survey biomass and exploitable biomass time series (1979-2014)

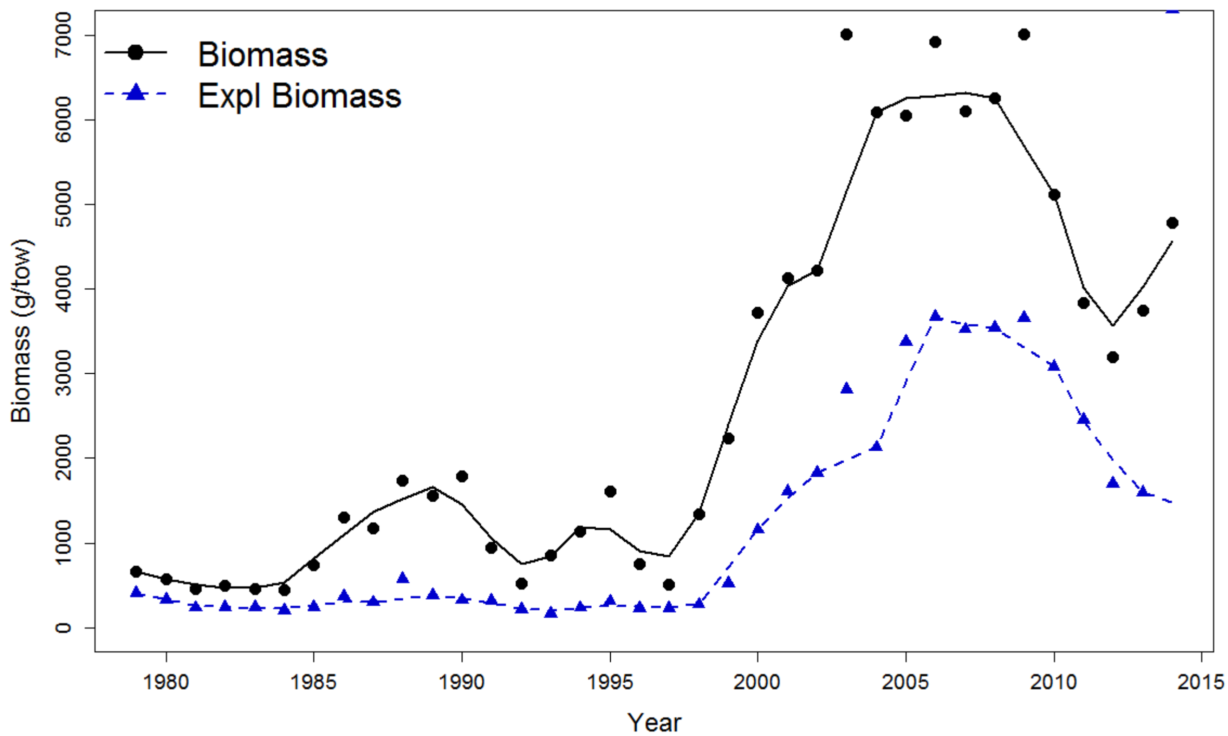


Figure 15 – NEFSC biomass survey indices (through 2014)

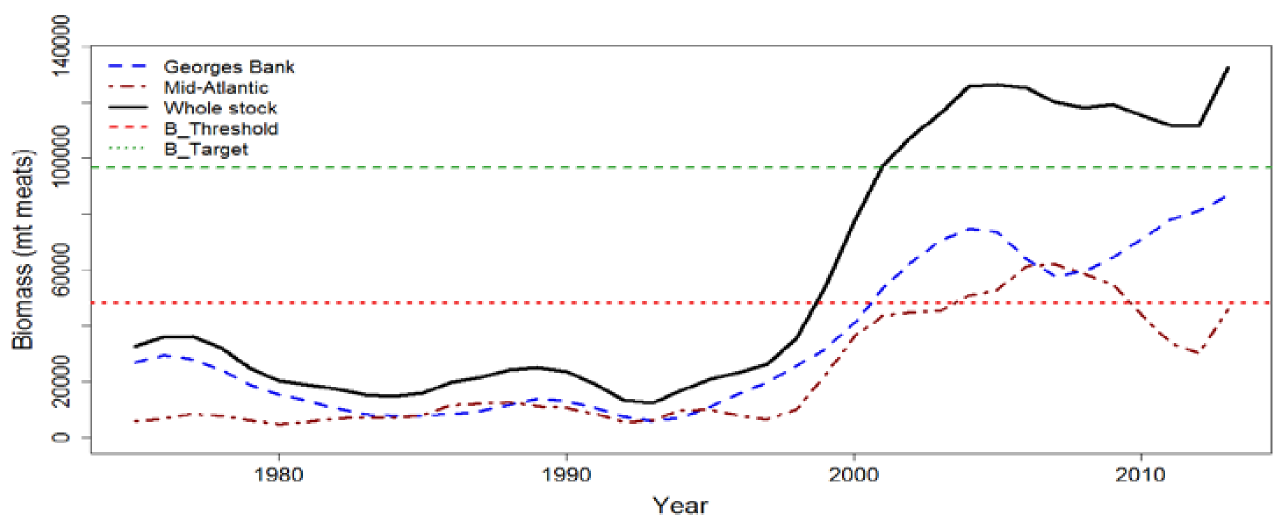


Table 3 – Summary of biomass estimates by SAMS area (2014 surveys)

	DREDGE			SMAST			Habcam		Totals		
Area	Bms	SE	Ebms	Bms	SE	Ebms	Bms	SE	Bms	SE	Ebms
Delmarva	4707	778	2080	9626	1093	3935	10598	2526	8310	1651	3008
Elephant Trunk	16392	3426	8067	24799	2909	12938	36154	14729	25782	8891	10503
HCS	5805	1206	3044	7381	1021	3143	18041	6752	10409	4004	3094
Virginia	279	79	3	NS	NS	NS			279	79	3
NYB	6822	1656	4140	6900	867	2119	12756	6082	9415	3674	3130
Long Island	11966	816	8438	10269	950	6402	14305	11131	12950	6467	7420
NYB Ext	1766	332	757	*	*	4013	*		*		2385
Block Island	939	206	535	1372	671	521	*		*		528
Mid-Atlantic Total	**48676**	**4167**	**27064**	**60347**	**3612**	**33071**	**91854**	**20577**	**67145**	**12374**	**30069**
CL-I NA	2163	649	1854	5115	3004	3091	21378	4510	9984	3151	2473
CL-1 Acc	333	59	246	962	375	190	*		*	219	218
CL-2 NA	8989	3190	7061	5550	2054	4191	7087	1486	7209	2353	5626
CL-2 Acc	7848	2462	3642	8197	2570	929	9835	3681	8627	2956	2286
NLS-NA	2240	1142	675	5211	4650	677			3726	2765	676
NLS-Acc	1637	327	854	30052	6534	3091	3231	626	11640	3794	1973
GSch	17689	1875	9485	11134	7849	4949	15994	3825	14939	5156	7217
SEP	15434	9833	2862	7026	1359	2476	16038	4019	12833	6183	2669
NEP	7752	9302	3837	5863	1483	2259	4330	861	5982	5461	3048
Georges Bank Total	**64085**	**14311**	**30516**	**79110**	**12246**	**21853**	**77893**	**19008**	**74938**	**11446**	**26185**
TOTALS	**112761**	**14906**	**57580**	**143066**	**12767**	**54924**	**159149**	**28013**	**142083**	**16856**	**56253**

* Included in other areas

Table 4 – Summary of biomass estimates by SAMS area (2013 surveys)

Mid-Atlantic Bight	Dredge	SE	Habcam	SE	SMAST	SE	Mean	SE
Hudson Canyon South	7839	1126	7528	1097			7684	786
Delmarva	4559	605	6067	655	6249	803	5625	400
Elephant Trunk	14317	1758	19063	1993			16690	1329
Inshore of ET	109	421	868	825			489	463
Virginia Beach	1208	605	395	388			802	359
NYB/LI (includes str 21)	20662	2468	29816	2485			25239	1751
Block Island	N/S	N/S	1655	364			1655	364
Total MA Rotational	26715	2173	32658	2367			29687	1607
Total MA Open	21979	2575	31079	2647			26529	1847
Total MidAtlantic	**48694**	**3370**	**63737**	**3551**			**56216**	**2338**
Georges Bank								
Closed Area I Acc	494	108	3340	401			1917	208
Closed Area I NA	16940	5750	4553	747			10747	2899
Closed Area II Acc	5552	1042	9845	1221	5148	1049	6848	639
Closed Area II NA	9041	1220	8497	765			8769	720
NLS Acc	3271	342	4098	584			3685	338
NLS NA	90	28	N/S	N/S			90	28
S Channel	11711	2842	13496	1130			12603	1529
Southern Flank	5704	1197	11445	1946			8575	1142
Northern Edge	4425	580	3160	537			3793	395
Total GB Clsd/Acc	35389	5980	30333	1771			32861	3119
Total GB Open	21840	3138	28101	2313			24970	1949
Total Georges Bank	**57229**	**6754**	**58434**	**2913**			**57027**	**7899**
TOTAL	**105923**	**7548**	**122171**	**4593**			**113242**	**8238**

1.1.4 Northern Gulf of Maine

The PDT has updated results but they have not been incorporated in this document yet.

- SARC59 updated NGOM biomass estimates
- State of ME sent biomass estimates of state waters
- MA and ME state water fishery trends

1.1.5 Performance of ACL management

In the first under ACL management, fishery allocations essentially kept landings right below ACL (landings 98% of ACL). In 2012 and 2013 landings were closer to 90% of the ACL. This is not surprising since fishery allocations are actually set at ACT, a substantially lower level to account for management uncertainty. For example, in 2014 the ACT for the LA fishery was 15,567mt and the LA ACL was 18,885, about a 3,000mt buffer. FY2014 is not over yet, but preliminary estimates suggest that landings will be below ACL, and potentially closer to 80% of ACL. This is probably driven by a handful of reasons: LPUE may be lower in open areas than projected, in the past projections of catch per day were underestimated by the model used by the PDT and it may be possible that the model is getting closer to realized catch levels, carryover measures may have been utilized more than average trends, etc.

Table 5 – Summary of landings compared to ACL/ABC

	OFL	ABC (including discards)	Discards	ABC available to fishery = ACL (after discards removed)	Actual Landings	% of ACL (landings/ACL)	Total Catch (landings plus assumed discards)	% of ABC (including discards)
	A	B	C	A-C = D	E	E/D	E+C=F	F/B
2011	32,387	31,279	4,009	27,269	26,795	98.30%	30,804	98.50%
2012	34,382	33,234	4,266	28,961	26,160	90.30%	30,426	91.60%
2013	31,555	27,370	6,366	21,004	18,303	87.14%	24,669	90.13%
2014	30,419	26,240	5,458	20,782	16,500 (17,447)	79.4% (84.0%)	21,958 (22,905)	83.7% (87.3%)
2015 (default)	34,247	29,683	5,701	23,982				
2015 proposed	39127	32119	6240	25879				
2016 proposed	48489	39836	5964	33872				

- 2014 Actual landings is a projection only – the fishing year is only half over.
- PDT estimated catch using trends from NMFS Monitoring website (and second estimate in parentheses is the projected catch from FW25).