New England Fishery Management Council
50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
John F. Quinn, J.D., Ph.D., *Chairman* | Thomas A. Nies, *Executive Director*

MEMORANDUM

DATE: **October 6, 2017**

TO: Science and Statistical Committee

FROM: Scallop Plan Development Team (PDT)

SUBJECT: **PDT recommendations for OFL and ABC for Framework 28 (FY2017 and FY2018 default)**

This memorandum addresses the following 2017 SSC terms of reference for Atlantic sea scallops and SSC recommendations from 2016.

2017 SSC Terms of Reference:

1. **OFL and ABC recommendations for fishing years 2018 and 2019 (default).**
2. **Review changes to the growth and meat weight parameters used to estimate and model biomass in portions of the Nantucket Lightship and Elephant Trunk areas, and provide the Council with a recommendation as to whether or not these changes are appropriate.**
3. **Review any changes from benchmark formulation (SARC 59).**

2016 SSC Recommendations requiring follow-up:

4. **Growth data specific to the Nantucket Lightship Area should be used for the present analysis, but additional research and monitoring should be conducted and presented to the SSC before the same approach is used in future specification setting.**
5. **The PDT should continue to investigate alternate weighting scenarios for combining the three surveys used in the projections and report on these analyses during the 2017 specification setting process**

The PDT met on September 25, 2017 to review these estimates and drafted the following consensus statements (in italics) by correspondence. More details will be provided during the presentation of this recommendation at the SSC meeting on October 12, 2017.

By consensus, the Scallop PDT recommends that the model estimates for OFL and ABC for 2018 and 2019 (default) be presented to the SSC (Table 1). *While biomass is expected to increase in 2018, the PDT is concerned that the benchmark configuration of the model may lead to an overestimation of biomass and growth of scallops, particularly in high density areas. The PDT recommends that finer-scale estimates of growth and weight be used in the model this year to account for anomalously slow growth, specifically in portions of the Nantucket Lightship and Elephant Trunk areas. The PDT also notes that if higher than normal natural mortality occurs, the estimates will be overestimated, especially for 2019. The PDT continues to note that dredge efficiency in high density areas may be resulting in lower survey biomass estimates. A* *benchmark assessment is planned for the spring of 2018, and this effort represents an opportunity to address dredge efficiency, as well as growth in high density areas.*

Table 1 – Scallop PDT recommendation for OFL and ABC for Framework 29, Fishing years 2018 and 2019 (default).

Year	ABC-Land	ABC-Disc	ABC-Tot	OFL-Land	OFL-Disc	OFL-Total
2018	45950	14018	59968	55573	16482	72055
2019	45805	12321	58126	55336	14297	69633

Background

There was a benchmark assessment for Atlantic sea scallop in 2014 (SARC 59). Through 2013 the biomass estimate was well above its target, and overfishing was not occurring.

Tracking High Densities of Scallops

Scallop surveys have tracked the size and growth of high densities of animals in the Elephant Trunk and Nantucket Lightship areas for several years. There is additional uncertainty associated with these high density areas, and the PDT has recommended modifications to the benchmark formulation in 2016 and 2017 in an effort to more accurately account for smaller than expected meat weights and slow growth. The net result of the proposed changes is a reduction in the perception of total biomass and exploitable biomass. Even with these adjustments, the 2017 total biomass and exploitable biomass is expected to increase from 2016 levels. A brief description of the PDT's 2015 and 2016 recommendations to the SSC are provided below for context.

2015 PDT Recommendations:

In its 2015 memo to the SSC, the PDT expressed concern that the model may be seriously underestimating natural mortality of juvenile scallops in high density areas based on an earlier experience in 2003 in the Elephant Trunk when a large set of scallops was observed in the area. At the time (2003), the Elephant Trunk area was closed. Despite the absence of fishing, subsequent survey results suggested a rapid decline in biomass.

There were no changes made to natural mortality assumptions in the 2015 model run, and the PDT recommended that out year default measures for 2017 be set equal to the 2016 ABC values. The SSC agreed with this approach, and recommended that the 2017 default specifications be set equal to the 2016 ABC. The PDT noted and discussed the SSC's 2015 recommendations to the Council, and did not pursue changes to natural mortality assumptions last year or this year.

2016 PDT Recommendations:

Last year, the Scallop PDT recommended using finer scale weight estimates (i.e. shell height meat weight parameters) based on data from the 2016 VIMS dredge survey in three areas of the Nantucket Lightship, and reducing the growth and length infinity ($L\infty$) assumptions for animals in high density areas of the Nantucket Lightship to account for anomalous slow growth observed in these areas. These changes represented a departure from the current model configuration, and were expected to result in more conservative estimates of total and exploitable biomass. Changes to the 2016 model included finer scale shell height/meat weight (SH/MW) estimates of areas in the Nantucket Lightship (NLS) based on the 2016 VIMS dredge survey of the area, and reducing the value of the asymptotic maximum length (L∞) in the NLS-S zone to 90 mm.

<u>2017 PDT Recommendations:</u>

Shell Height Meat Weight Parameters:

A recent review of the SARC 59 parameters revealed that ~1-2% of data used were likely invalid due to entry mistakes made at sea (i.e. error in meat weight measurements). The PDT notes that even 1-2% error can distort estimates, especially because the estimation errors between slope and intercept are strongly correlated. The PDT feels that using Hennen and Hart (2012) (SARC 50) SH/MW parameters provide more accurate estimates of biomass, and agreed by consensus to recommend that the peer-reviewed SH/MW parameters from Hennen and Hart (2012, used at SARC 50) be used to generate biomass estimates in this update. The group noted that entry error should not be a concern in the future because VIMS and the NEFSC dredge surveys have integrated automated at-sea sampling equipment which enters meat weight measurements automatically. Shell height meat weight parameters will be discussed at the upcoming 2018 benchmark assessment.

Similar to 2016, the PDT also recommends using finer scale shell height meat weight parameters to estimate biomass within the Nantucket Lightship South (NLS-S) and Nantucket Lightship No Access (NLS-NA) SAMS areas. This year, the PDT recommends using SH/MW parameters based on VIMS data from 2016 and 2017 with no interaction variable (see Appendix I). The SH/MW estimates from the 2016 and 2017 VIMS dredge survey allow for the comparison of meat weights between the NLS SAMS areas. Table 2 shows the relative meat yield in the NLS-S, NLS-NA, and NLS-ext, relative to 100mm animals in the NLS-N. The north area is typically considered to be one of the more productive areas across the resource. The meat weights of animals in the deep portion of the NLS-S are around 24% smaller than 100 mm animals found at the same depth in the NLS-N, while the meats of animals in the NLS-NA to the west are roughly 10% smaller. A 100 mm scallop was chosen as the shell height of evaluation due to the assumption that this may represent a possible L∞ for the southern region, and drawing a comparison with larger animals would result in a larger relative difference. This size is not reflective of the animals in the NLS-S, where the average length was around 77mm in 2017. Table 7 provides a comparison of VIMS dredge survey biomass estimates using SARC 59 and Hennen and Hart (2012) SH/MW parameters. Applying the Hennen and Hart estimates resulted in a 7% increase in dredge survey biomass estimates in the Mid-Atlantic, and a 5% decrease in dredge survey biomass estimates for Closed Area II and surrounds.

Table 3 and Table 4 provide comparisons of VIMS dredge survey estimates using the Hennen and Hart (SARC 50) SH/MW parameters and finer scale data from 2016 and 2017 survey efforts. Table 8 shows the range of SH/MW parameters considered by the PDT, and corresponding estimates using SMAST drop camera data from the NLS.

The PDT also noted that based on observed length frequency obtained from 2016 and 2017 surveys, there are 5-year old animals found in the shallower portions (<70 m) of the NLS-S zone that do not appear to exhibit the same anomalous slow growth as 5-year old animals in the deeper portions (>70 m) of the southern NLS-S zone (Figure 5). The PDT believes that the scallops in the NLS-S are part of the same 2012 cohort. However, length frequencies from 2016 and 2017 presented in Figure 2 suggests that there are some animals in the shallow portion of the NLS-S from the 2012 cohort that are also exhibiting slower than expected growth.

Table 2 - Description of the SH/MW changes in Nantucket Lightship SAMS areas from 2016 and 2017 (FW29).

SAMS area	**SH/MW applied in 2016**	**SH/MW applied this year (2017, FW29)**	**Relative meat weight compared to scallops in NLS N in 2017 survey (assuming equal SH and depth)**
NLS-N	SARC 59	SARC 50	-
NLS-S 'Shallow' (>70m)	SARC 59	SARC 50	-
NLS-S 'Deep' (<70m)	VIMS 2016	VIMS 2016/2017 Combined (NLS S)	-23.76
NLS Ext	VIMS 2016	SARC 50	-6.14
NLS NA	VIMS 2016	VIMS 2016/2017 Combined (NLS NA)	-10.46
Estimate of relative meat weight were derived using the following assumptions: Length = 100 mm, mean depth by SAMS area used. Mean depth for NLS-S SAMS area calculated by depth bin. Mean latitude by SAMS area used for SARC 50.			

Table 3 - Comparison of survey biomass estimates for Nantucket Lightship South (NLS-S) using Hennen and Hart (2012) vs. fine-scale 2016/2017 VIMS SH/MW parameters without an interaction variable.

NLS S	Hennen & Hart (SARC 50)	2016/2017 VIMS SHMW without interaction variable
HabCam	92520	77827
DropCam	99104	82984
Dredge	56115	31154
mean	82580	63988
mean (lbs)	182,056,707	141,069,987

Table 4 - Comparison of survey biomass estimates for Nantucket Lightship No Access (NLS-NA) using Hennen and Hart (2012) vs. fine-scale 2016/2017 VIMS SH/MW parameters without an interaction variable.

NLS NA	Hennen & Hart (SARC 50)	2016/2017 VIMS SHMW without interaction variable
HabCam	65,819	56,066
DropCam	52,983	46,250
Dredge	7,577	4,843
mean	42,126	35,720
mean (lbs)	92,872,880	78,748,319

Growth in the Nantucket Lightship SAMS Area

Animals in the deep portion of the NLS (see Figure 9) showed some growth between 2016 and 2017, but are still growing slower than expected relative to other areas of the resource. The PDT investigated how the 2016 growth projection performed relative to observed growth in 2017 in the NLS-S (Figure 3) and found that while growth was underestimated in the model in 2016 (the animals grew faster than projected), observed growth was still slower than normal. With this information in mind, reducing $L\infty$ was again viewed as an appropriate update to the projection model because scaling back $L\infty$ reduces growth (K) proportionally. This year, the PDT recommends setting $L\infty$ to 110 mm in this area (vs. 90 mm $L\infty$ last year) to match observed growth between the 2016 and 2017 surveys. The updated 2016 and 2017 VIMS SH/MW estimates in combination with a lower $L\infty$ value result in reductions to the biomass estimates for the NLS-S.

As noted in 2016, animals from the 2012 cohort in the shallow (<70m depth) portion of the NLS-S appear to be growing at expected rates, and have recruited into the fishery (Figure 2). The 2017, the dredge survey encountered nearly 10x more animals in the shallow portion of the NLS. The reason for this increase could be due to random sampling, and/or higher sampling intensity of the stratum that overlap with this area (seven more tows in stratum 472 in 2017, and 8 more tows in stratum 471). The 2017 dredge survey detected a broader size distribution of animals in the shallow portion, with some animals exhibiting similar slow growth to animals in the deep portion of the area. A review of the 2017 SMAST drop camera data in the shallow and deep portions of the NLS-S (Table 5) showed average scallop size to be larger in the shallow portion (mean SH = 119 mm) of the area compared to the deep portion (mean SH = 71 mm). To address this bimodal growth within the NLS-S, the PDT recommends partitioning survey data by the proportion of biomass observed in the shallow and deep portions. The 2017 model configuration assumes normal growth of animals in the shallow portion, and the reduced $L\infty$ as discussed for the deep portion. The PDT views this as short-term approach to addressing the observed bimodal growth within the NLS-S SAMS area. The PDT suggests that the 2018 benchmark assessment could explore expanding the NLS-N boundary to include the shallow portion of the NLS-S as animals there exhibit similar growth.

Figure 1 - Location of VIMS dredge tows in the Nantucket Lightship in 2016 and 2017.

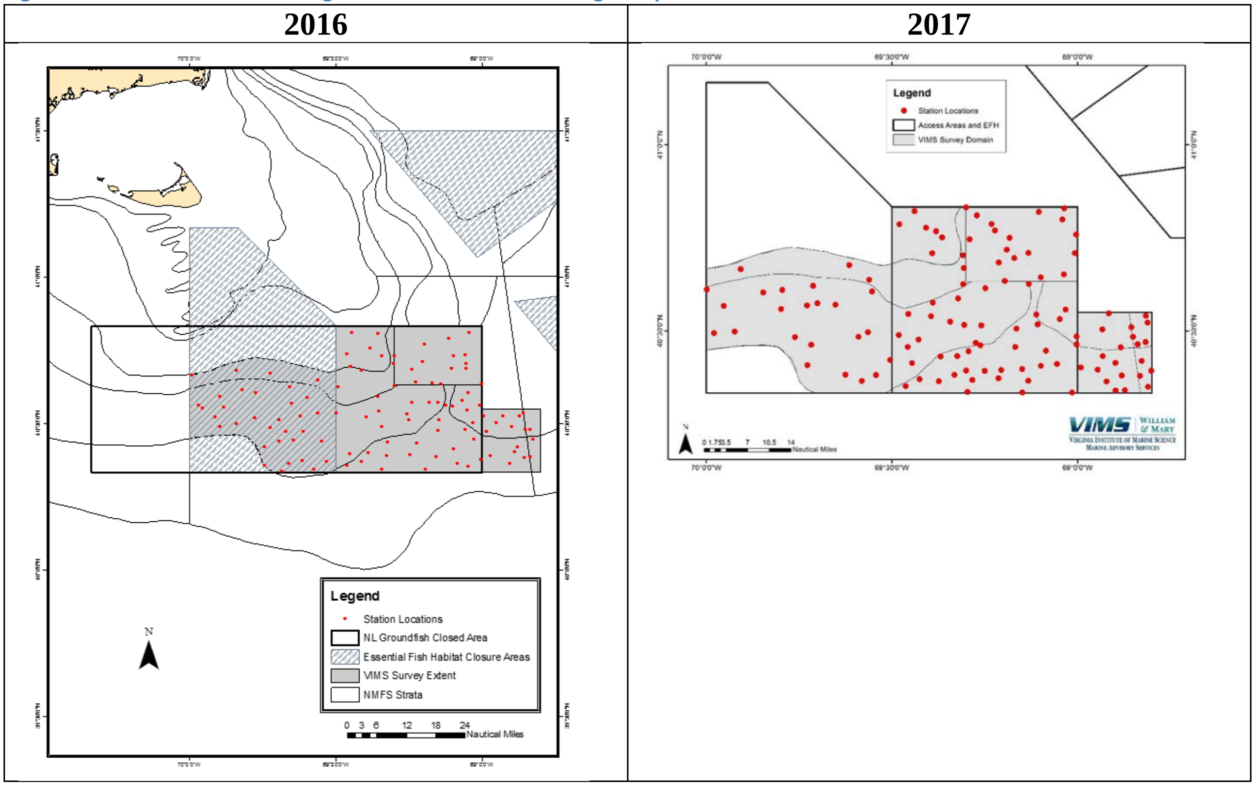


Figure 2 - Length frequency plots of NLS-S shallow (<70m) and deep (>70m) from the 2016 and 2017 VIMS dredge surveys. Note that the total number of animals sampled in the shallow portion increased 10 fold in 2017.

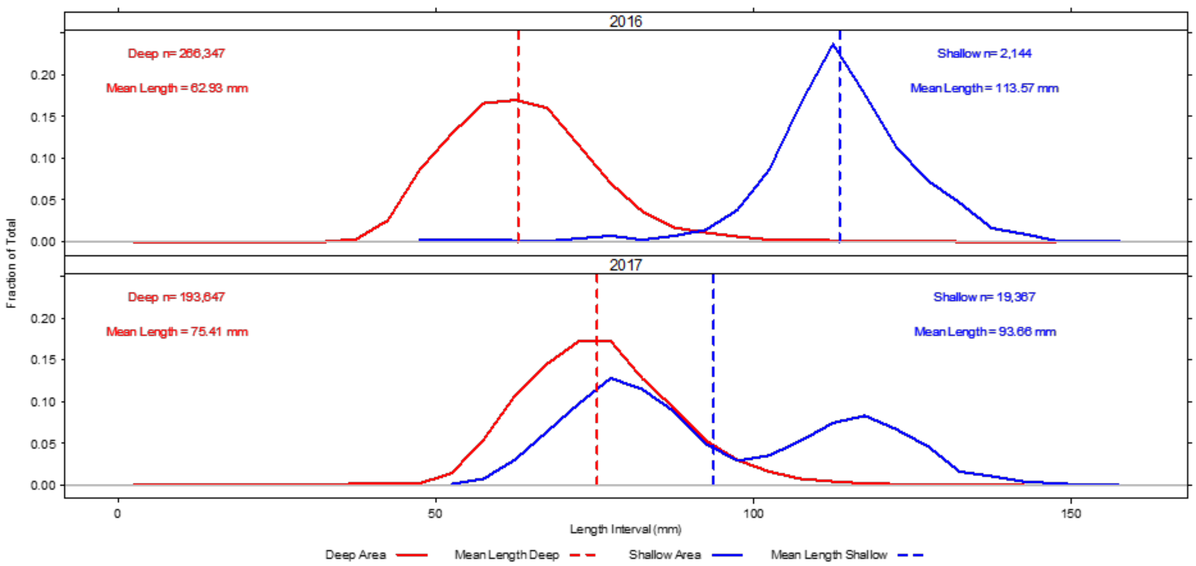


Figure 3 - Comparison of 2016 and 2017 dredge survey observations in the NLS-S, including the 2017 projected growth of these animals (red dashed line).

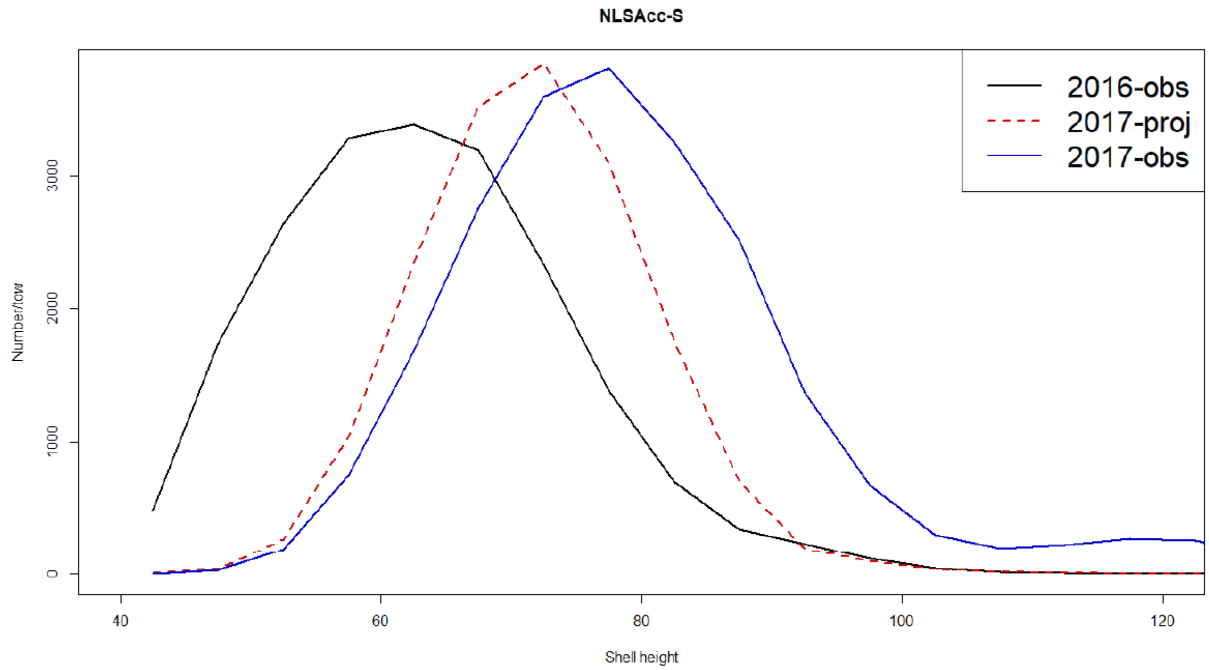


Figure 4 - Comparison of 2016 and 2017 dredge survey observations in the NLS-NA, including the 2017 projected growth of these animals (red dashed line).

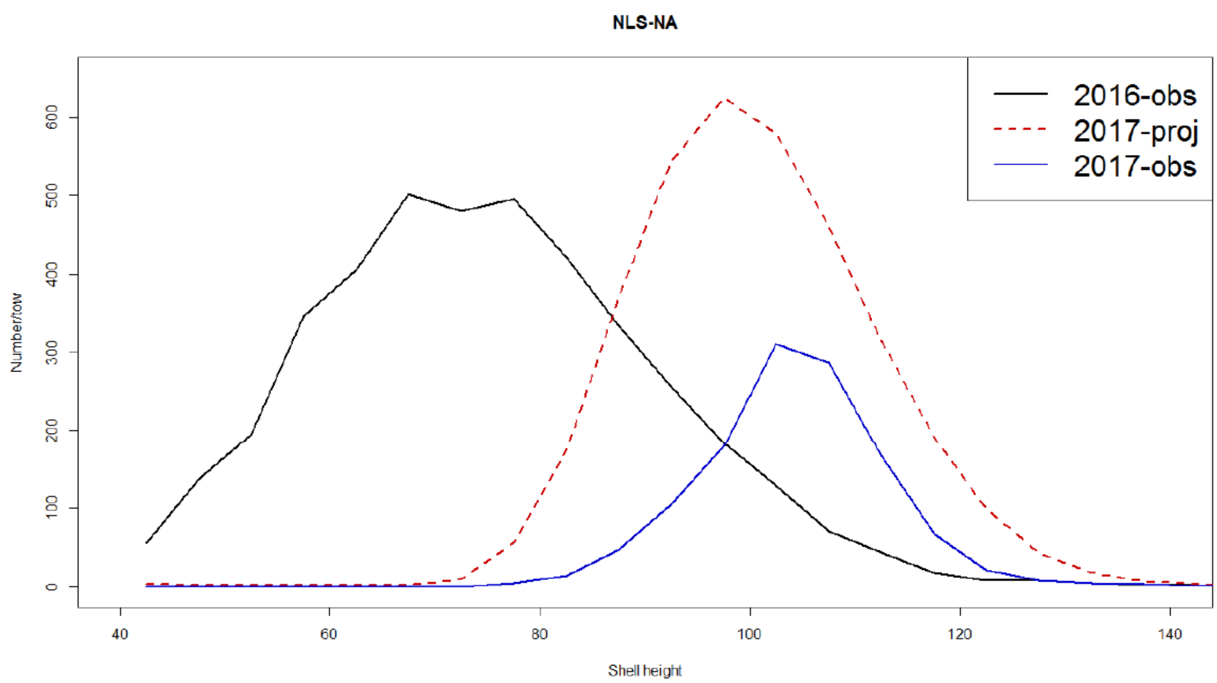


Table 5 - Comparison of SMAST survey data and estimates for the shallow and deep areas of NLS-S.

Zone	NLS-S-Deep 3 nmi 2016_17 VIMS SH-MWT No Interaction	NLS-S-Shallow 3 nmi SARC 50
QuadratArea	2.51	2.67
meanSH	71.18	119.05
NumberMeasured	2635	83
ScallopDensity	13.66	0.79
StationCount	27	12
SE	4.28	0.31
CV	31.30	38.90
ScallopAbundance	11,387,653,821	292,411,246
WeightedLatitude	40.42	40.48
WeightedDepth	77.75	65.51
meanMTWT	6.55	34.28
TotalBiomassMillLbs	164.4	22.1
TotalBiomassMT	74,557	10,023
SEofTotalBiomassMT	23,339	3,899
ExploitablemeanMTWT	10.47	37.77
ExploitableBiomassMillLbs	27.5	18.5
ExploitableBiomassMT	12,461	8,396
SEofExploitableBiomassMT	3,901	3,266

Growth in the Elephant Trunk "Flex" SAMS Area

VIMS shell height data from 2015 – 2017 surveys were used to investigate growth trends in the high-density area of Elephant Trunk "Flex" SAMS area (ET-Flex). A comparison of length-frequencies in ET-Flex vs. ET-open suggested that the 2013 year-class was growing slower than expected in ET-Flex between 2015-2017. Further analysis suggested that scallops in the highest density portion of ET-Flex, described as "The Blob" in related figures, were growing slower than those in the rest of ET-Flex. The majority of animals sampled by the VIMS survey in 2017 were in the high density "Blob" area, and while some animals appeared to be growing normally, the mean length from dredge surveys of the area increased less than 5 mm between 2016 and 2017. This is far below the projected growth for this area (Figure 8). When considering observed length frequencies, it should be noted that the ET-Flex opened to fishing in late March of 2017, and that the ET-Open has been open to the fishery for the past few years. The PDT suggests that the different growth rates observed within a relatively small portion of the ET-Flex SAMS area could likely be a result of several oceanographic and biotic conditions (i.e. depth, hydrography, density). The benchmark configuration of the SAMS model projects growth of scallops in the ET-Flex to be faster than other nearby areas. To account for the observed slow growth in the ET-Flex, the PDT recommends reducing L_∞ to 110 mm for the ET-Flex SAMS area in the short term (vs. L_∞ of 140 mm), and notes that this issue will likely be taken up at the 2018 benchmark. The PDT notes that slow growth in the ET has been observed before, the 2001 year class that settled in this area exhibited almost no growth between 2005 and 2006. However, expected growth was observed in this area the following year (2007).

Figure 5 - Relative length frequency of the ET Flex and ET Open areas by year for the VIMS survey dredge

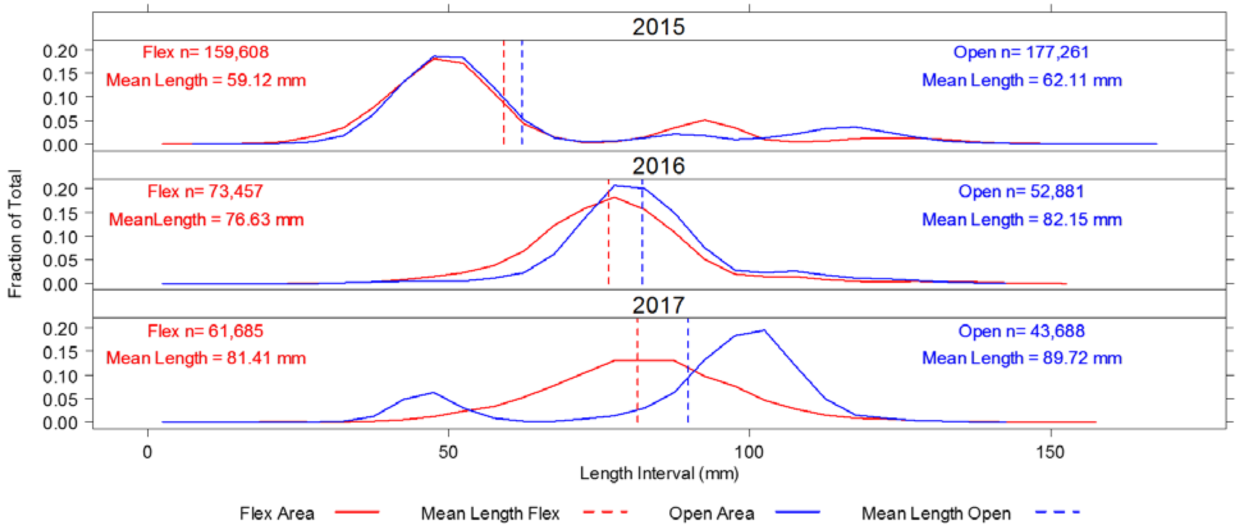


Figure 6- Location of VIMS dredge tows within the Elephant Trunk "Flex" SAMS area.

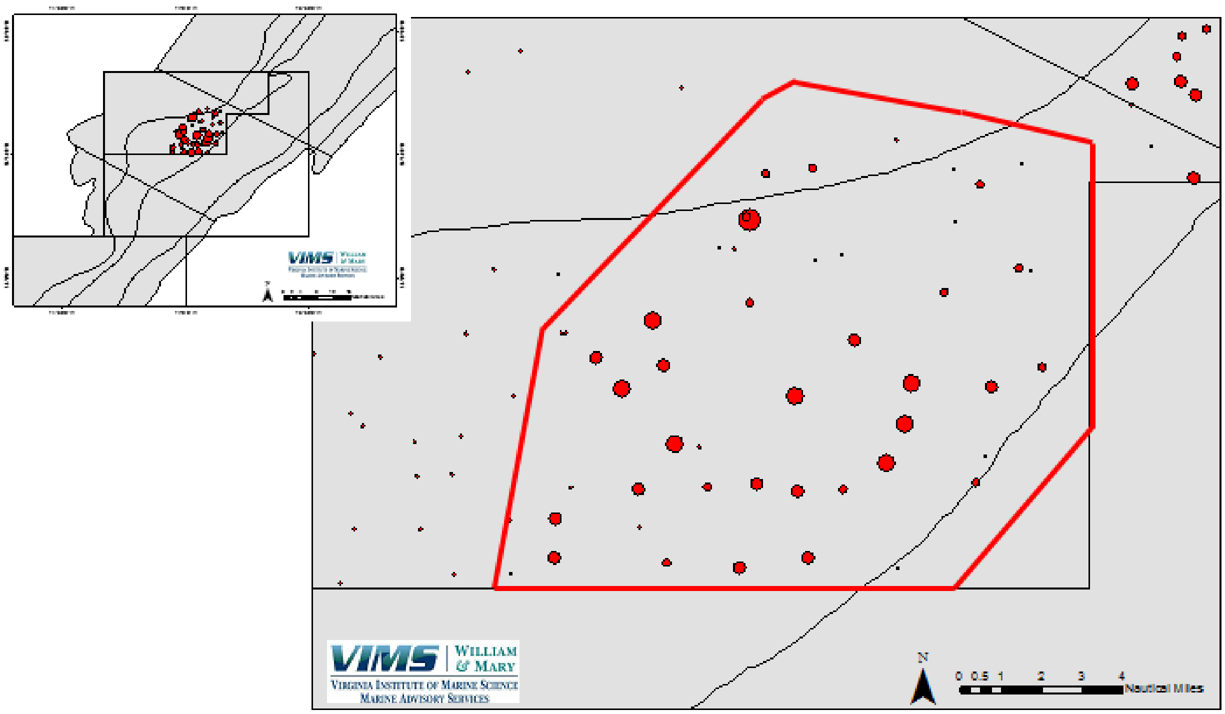


Figure 7 - Relative length frequency distributions for the ET Blob (high density area) and the rest of the ET Flex area by year for the VIMS survey dredge.

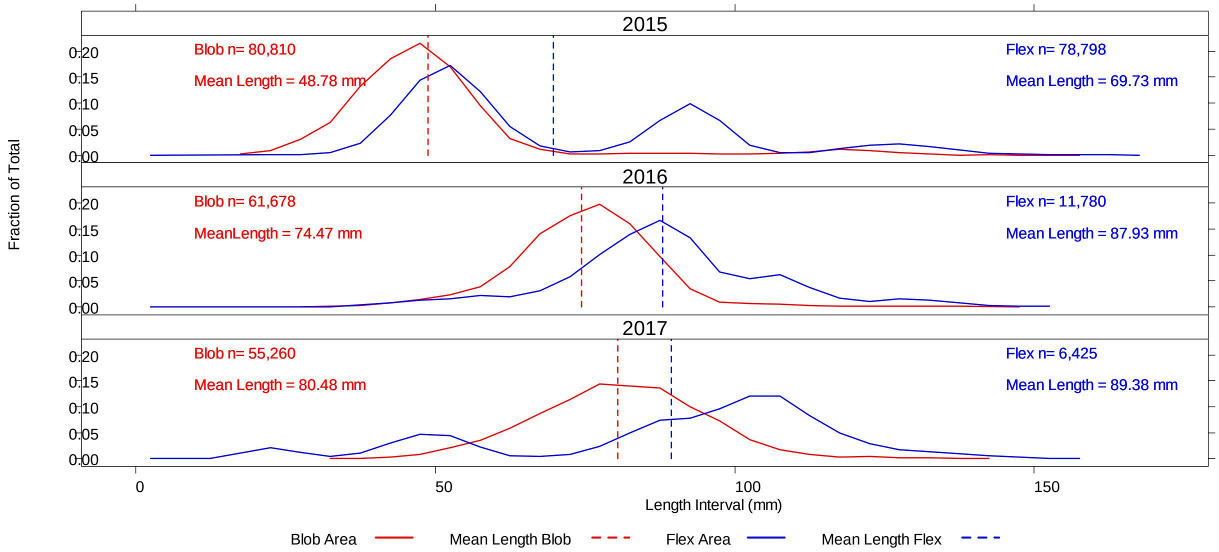
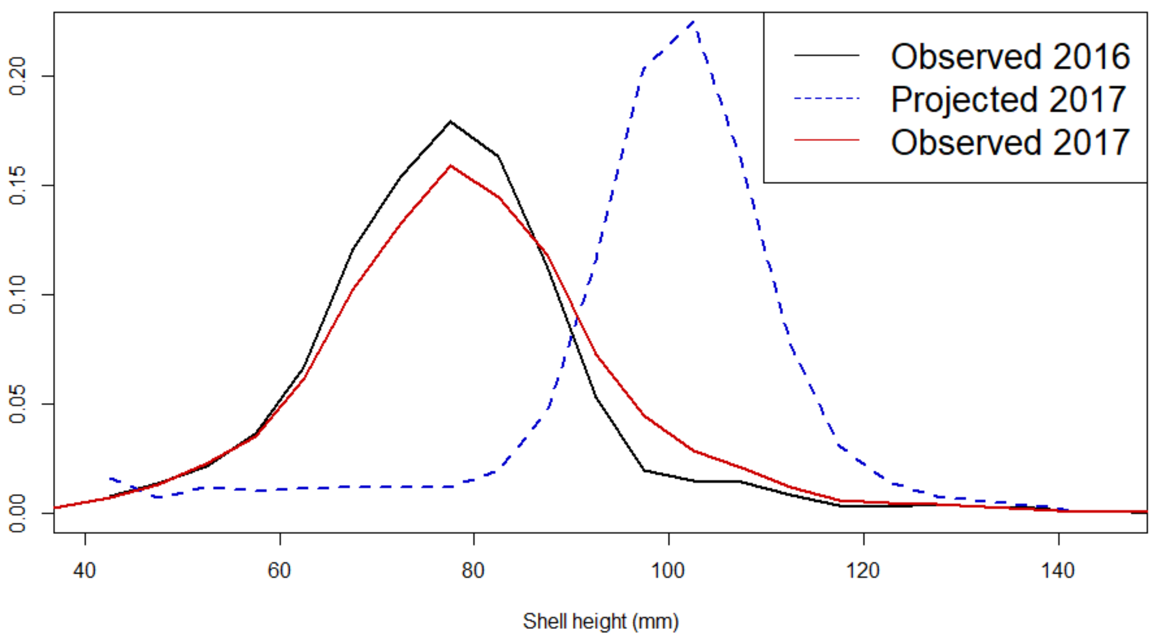


Figure 8 - Compariosn of observed and projected growth in the ET-Flex area in 2017.



Other Sources of Uncertainty – Dredge Efficiency in High Density Areas

In addition to uncertainty related to the assumptions of natural mortality and anomalous growth, there is also uncertainty related to the estimates of biomass. In 2017, there were large differences between the individual survey estimates of biomass in portions of the Nantucket Lightship area and Elephant Trunk area where high densities of animals have been observed by previous surveys. In three instances, the optical (Habcam and drop camera) survey estimates of biomass were very similar, but several times larger than the dredge survey estimates. There is uncertainty in the survey biomass estimates where in some cases, variation between dredge and optical estimates is considerable. Some variation in survey biomass estimates can be expected because survey methods and coverage levels vary by area. As was the case in 2016, the PDT noted dredge efficiency could be a causative factor in explaining the divergence of the dredge and optical estimates in high density areas in 2017. When the PDT compared survey estimates from all other (non-high density) areas, there was general agreement in total biomass estimates across dredge, drop camera, and Habcam results. Though exploratory analyses were completed on this issue in 2016 and 2017, the PDT did not recommend any changes to how the dredge data was combined with other survey estimates this year. One reason for not deviating from the benchmark on this issue is that there is ongoing research funded through the scallop RSA that is examining this issue, and it will be investigated further through the 2018 benchmark assessment. The status quo approach is anticipated to result in conservative biomass estimates.

Other deviations from SARC 59 – Scaling to CASA

The 2017 iteration of the SAMS model was not scaled to the CASA model. At SARC 59, the initial conditions for the SAMS model were scaled to CASA, but these runs were intended to be example projections, not part of the benchmark formulation. If the PDT were to use the CASA model to initialize the SAMS model, it would have to be initialized with the previous year (e.g., 2016) because current year landings and other commercial data are not yet available. This is another issue that can be addressed at the 2018 benchmark assessment.

SSC Recommendation #4 from 2016: The PDT should continue to investigate alternate weighting scenarios for combining the three surveys used in the projections and report on these analyses during the 2017 specification setting process.

The PDT and a PDT sub-group, which was formed to follow-up on the 2015 scallop survey peer-review, discussed alternative methods for combining the results of the three survey methods. This year (consistent with prior years), the PDT developed total biomass estimates by averaging the results of the three surveys by SAMS area (Table 6). An alternative approached that has been raised is to use geostatistical methods to develop total biomass estimates. This would entail adding all data sets (dredge, drop camera, and HabCam) to the geostatistical model (GAM + Ordinary Kriging) to derive a total biomass estimate. At present, the geostatistical approach is only used to generate biomass estimates for HabCam data. The PDT sub-group discussed comparing the results of a simple mean of the three surveys and a single model co-kriging approach over several years.

<u>References:</u>

Hennen, D.R. and Hart, D.R. Shell Height-to-Weight Relationships for Atlantic Sea Scallops (Placopecten magellanicus) in Offshore U.S. Water. Journal of Shellfish Research, 31(4):1133-1144. 2012.

NEFSC. 2014. 59th Northeast Regional Stock Assessment Workshop (59th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-09; 782 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Table 6 - Combined survey estimates for 2017 by SAMS area.

	Dredge				Drop Camera (Digital)				Habcam				Means					
Georges Bank	**NumMill**	**BmsMT**	**SE**	**MeanWt**	**NumMil**	**BmsMT**	**SE**	**MeanWt**	**NumMill**	**BmsMT**	**SE**	**MeanWt**	**NumMill**	**BmsMT**	**SE**	**MeanWt**	**IVWMBms**	**SE**
CL1ACC	45	1602	671	35.6	66	1647	358	24.9	66	883	6	13.3	59	1377	761	23.3	883	6
CL1NA	457	9588	4560	21.0	761	13904	4106	18.3	565	12829	604	22.7	594	12107	6165	20.4	12797	593
CL-2(N)	442	7407	2947	16.8	214	3187	1488	14.9	190	6122	118	32.2	282	5572	3304	19.8	6106	118
CL-2(S)	406	11218	656	27.6	465	7361	684	15.8	314	8979	129	28.6	395	9186	957	23.3	9006	124
CL2Ext	396	6721	538	17.0	545	5153	439	9.5	300	5354	46	17.9	414	5743	696	13.9	5362	45
NLSAccN	132	6428	510	48.5	260	8888	3393	34.2	222	10083	300	45.4	205	8466	3444	41.3	9143	258
NLSAccS	3152	31154	2380	9.9	11676	82984	25271	6.8	9315	77827	3174	8.4	8048	63988	25580	8.0	48146	1899
NLSNA	221	4843	1718	21.9	2597	46250	18029	16.7	2906	56066	1831	19.3	1908	35720	18203	18.7	28915	1250
NLSExt	15	674	145	45.8	967	16175	15043	16.1	171	7164	1176	42.0	384	8004	15090	20.8	773	144
NF	274	3355	954	12.2	39	636	261	16.2	78	1289	1037	16.5	131	1760	1433	13.5	851	245
SCH	459	8485	3596	18.5	631	6590	1256	10.5	339	6857	167	20.2	476	7311	3812	15.4	6856	165
SF	296	3588	1082	12.1	747	6799	1080	9.1	282	6061	59	21.5	442	5482	1530	12.4	6056	58
Total Rotational	*4146*	*57797*	*2612*	*13.9*	*13979*	*122208*	*29615*	*8.7*	*10388*	*110289*	*3401*	*10.6*	*9504*	*96764*	*29923*	*10.2*	*77279*	*2072*
Total EFH Closures	*1120*	*21838*	*5695*	*19.5*	*3572*	*63341*	*18550*	*17.7*	*3661*	*75017*	*1932*	*20.5*	*2784*	*53399*	*19501*	*19.2*	*69530*	*1829*
Total Open	*1029*	*15428*	*3874*	*15.0*	*1417*	*14025*	*1677*	*9.9*	*700*	*14207*	*1052*	*20.3*	*1049*	*14553*	*4350*	*13.9*	*14291*	*1015*
TOTAL	**6295**	**95062**	**8409**	**11.6**	**18968**	**199574**	**8409**	**11.6**	**14748**	**199513**	**4050**	**13.5**	**13337**	**164716**	**35988**	**12.4**	**179844**	**3649**
MidAtlantic																		
Block Island	122	1864	29	15.3	115	1267	495	11.0	113.8	1819.7	7.7	16.0	117	1650	496	14.1	1822	7
Long Island	597	14728	681	24.7	1168	20278	2889	17.4	731	18899	502	25.9	832	17968	3010	21.6	17486	400
NYB	628	13148	1344	20.9	34	463	70	13.7	336	8432	200	25.1	333	7348	1360	22.1	1361	66
MA inshore	100	1001	106	10.0	174	1558	358	8.9	75	537	2	7.1	117	1032	373	8.8	537	2
HCSAA	1275	22358	1312	17.5	801	10562	1671	13.2	957	18449	2662	19.3	1011	17123	3406	16.9	17938	962
ET Open	1214	21708	1034	17.9	2341	22023	2153	9.4	1588	19233	545	12.1	1715	20988	2450	12.2	19879	470
ET Flex	742	10618	1071	14.3	3620	48108	9963	13.3	2608	45232	3012	17.3	2324	34653	10463	14.9	14841	1004
DMV	257	2476	285	9.6	438	5010	636	11.4	253	3569	780	14.1	316	3685	1046	11.7	2967	247
Virginia	23	49	11	2.2									23	49	11	2.2	49	11
Total Access	*2747*	*46542*	*2004*	*16.9*	*3580*	*37595*	*10349*	*10.5*	*2797*	*41251*	*4131*	*14.7*	*3041*	*76449*	*11321*	*25.1*	*45534*	*1803*
Total Open	*1470*	*30789*	*1511*	*20.9*	*1491*	*23566*	*2954*	*15.8*	*1256*	*29687*	*540*	*23.6*	*1421*	*28047*	*3361*	*19.7*	*29812*	*509*
TOTAL	**4959**	**87949**	**2510**	**17.7**	**8691**	**109269**	**10762**	**12.6**	**6661**	**116170**	**4166**	**17.4**	**6786**	**104495**	**11810**	**15.4**	**95464**	**2150**
Total w/o ETF, NLSNA & S		*136397*				*131501*				*136559*								
OVERALL TOTAL	**11254**	**183011**	**8775**	**16.3**	**27659**	**308843**	**13657**	**11.2**	**21410**	**315683**	**5810**	**14.7**	**20123**	**269212**	**37876**	**13.4**	**275248**	**4845**

12-Sep-17

PRELIMINARY ESTIMATES FOR PDT DISCUSSION PURPOSES ONLY

DO NOT CIRCULATE OR CITE

Figure 9 - Depth contours within the Nantucket Lightship zones, as configured in FW29. Note that the 70 m depth contour makes the split between the Nantucket Lightship access South "Shallow" and the Nantucket Lightship access South "Deep" zones.

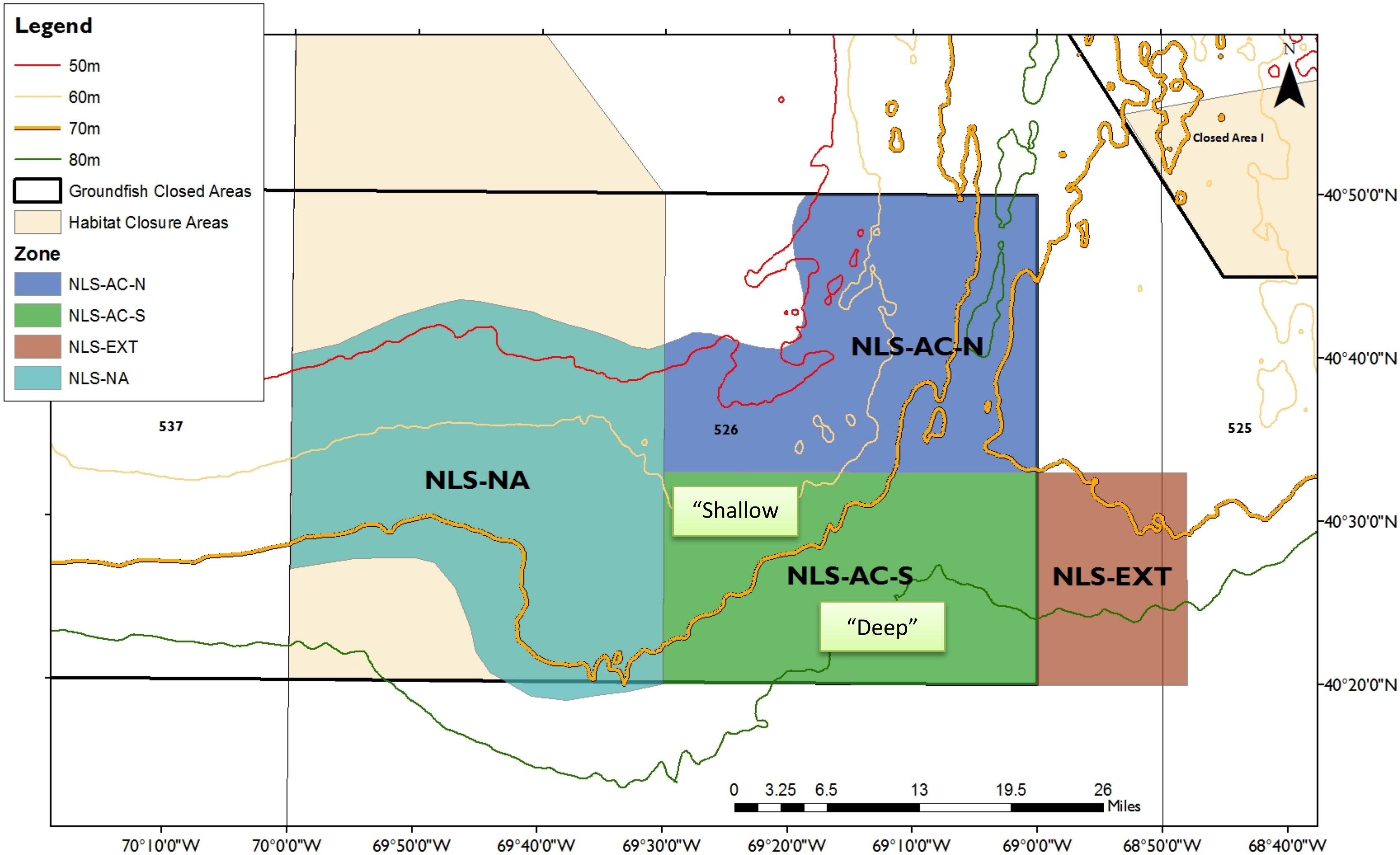


Table 7 - Comparison of VIMS dredge biomass estimates using SHMW parameters from SARC 59 and Hennen and Hart.

	Hennen and Hart		SARC 59			Difference in Biomass	Change in SE
SAMS Area	Total Biomass (mt)	SE (mt)	Total Biomass (mt)	SE (mt)		HH - SARC 59	HH - SARC 59
BI	1,863.63	217.16	1,969.62	226.1058849		-105.99	-8.95
DMV	2,476.02	285.06	2,306.38	264.0633935		169.64	21
ET_Close	10,617.64	1,070.52	9,255.26	943.4438283		1,362.38	127.08
ET_Open	21,708.29	1,034.19	18,128.67	845.5272761		3,579.62	188.66
HCS	22,358.18	1,311.62	21,405.69	1259.058815		952.49	52.56
LI	14,727.92	681.26	15,104.66	697.5731618		-376.74	-16.31
NYB	13,147.86	1,343.62	12,876.97	1320.810196		270.89	22.81
NYB_Inshore	1,000.58	106.14	990.57	102.1007242		10.01	4.04
VIR	48.73	10.78	51.41	11.60769783		-2.68	-0.83
	87,948.85		82,089.21				
mt difference	5,859.64						
Change (%)	107						
	Hennen and Hart		SARC 59			Difference in	Change in SE
SAMS Area	Total Biomass (mt)	SE Biomass	Total Biomass (mt)	SE Biomass (mt)		HH - SARC 59	HH - SARC 59
CAII_S AC	10,659.84	621.44	11,217.67	656.46		-557.83	-35.02
CAII_S_ext	6,459.45	502.87	6,720.86	537.52		-261.41	-34.65
	17,119.29		17,938.53				
mt difference	819.24						
Change (%)	95						

Table 8 - Comparison of SMAST Nantucket Lightship biomass estimates using a range of SH-MW parameters. The PDT recommends using the 2016/2017 VIMS SH-MW parameters with no interaction variable.

Area	meanMTV	TotalBiom	TotalBiom	SEofTotalI	Exploitabl	Exploitabl	Exploitabl	SEofExploitableBior
NLS-EXT 3 nmi 2016 VIMS SH-MWT	16.15	34.4	15,609	15,043	18.48	15.8	7,169	6,909
NLS-EXT 3 nmi 2016_17 VIMS SH-MWT	18.77	40.0	18,141	17,484	21.69	18.5	8,413	8,108
NLS-EXT 3 nmi	16.73	35.7	16,175	15,589	19.54	16.7	7,579	7,305
NLS-EXT 3 nmi 2016_17 VIMS SH-MWT No Interaction	15.02	32.0	14,520	13,994	17.41	14.9	6,753	6,508
NLS-AC-S 3 nmi 2016 VIMS SH-MWT	6.79	174.8	79,271	25,271	12.10	38.8	17,602	5,611
NLS-AC-S 3 nmi 2016_17 VIMS SH-MWT	8.92	229.6	104,136	33,199	16.77	53.8	24,388	7,775
NLS-AC-S 3 nmi	8.49	218.5	99,104	31,594	16.88	54.1	24,558	7,829
NLS-AC-S 3 nmi 2016_17 VIMS SH-MWT No Interaction	7.11	183.0	82,984	26,455	13.58	43.5	19,751	6,297
NLS-NA 3 nmi 2016 VIMS SH-MWT	16.68	95.5	43,320	18,029	20.17	54.4	24,672	10,268
NLS-NA 3 nmi 2016_17 VIMS SH-MWT	22.25	127.4	57,781	24,048	27.08	73.0	33,130	13,788
NLS-NA 3 nmi	20.40	116.8	52,983	22,051	25.13	67.8	30,748	12,797
NLS-NA 3 nmi 2016_17 VIMS SH-MWT No Interaction	17.81	102.0	46,250	19,248	21.72	58.6	26,567	11,057

Figure 10 - 2017 Georges Bank SAMS Areas

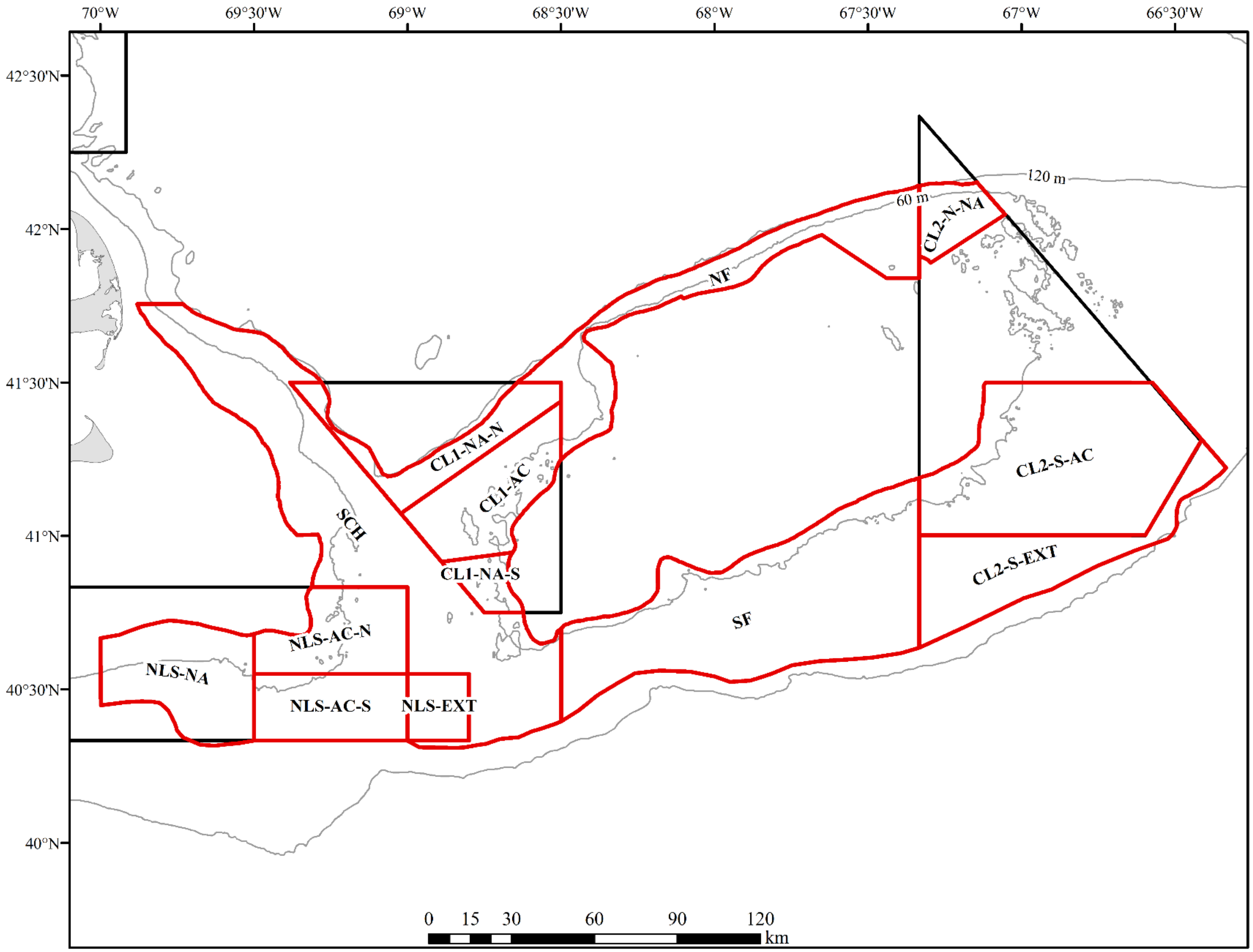
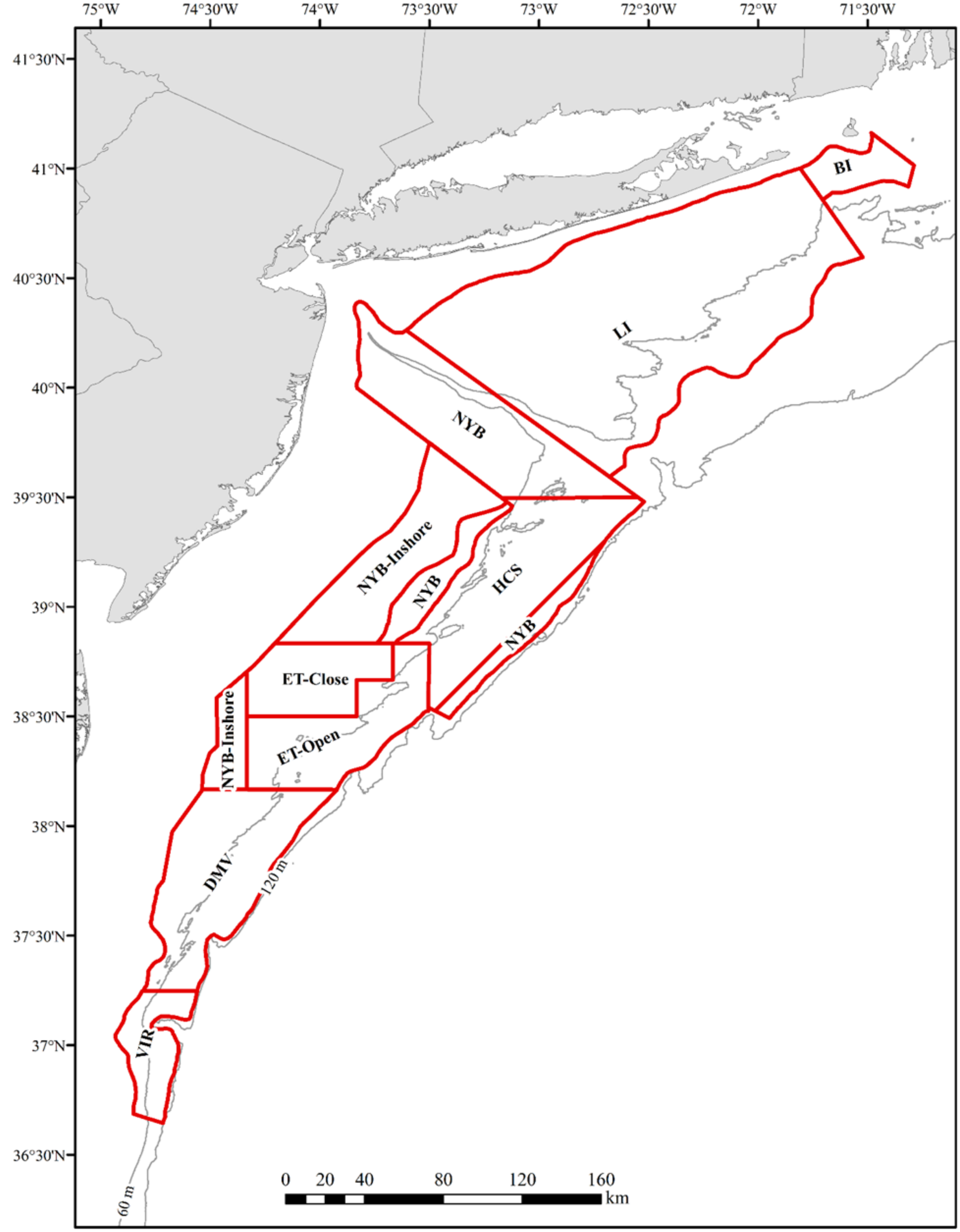


Figure 11 – 2017 Mid-Atlantic Bight SAMS Areas



Appendix I: VIMS Survey SH/MW Calculations for NLS

2016 Approach:
Parameter estimates for shell height meat weight relationships for the NLCA derived from 2016 VIMS dredge survey data using the updated region/zone designations. log = ln

Equation:
Meatweight= intercept+(B1* logsh)+(B2*logdepth)+(B3*(logsh*logdepth)) + SAMS_zone_2016

Parameter	Parameter Estimate
Intercept	-25.7615
B1 logsh	6.7540
B2 logdepth	4.1120
B3 logsh:logdepth	-1.0054
SAMS_zone_2016NLS_AC_S	-0.4917
SAMS_zone_2016NLS_EXT	-0.2214
SAMS_zone_2016NLS_NA	-0.3743
SAMS_zone_2016VIMS_45	-0.2198

2017 Approach:
Parameter estimates for shell height meat weight relationships for the NLCA derived from 2016 and 2017 VIMS dredge survey data without an interaction variable.

Parameter	Parameter Estimate
Intercept	-8.46
logsh	2.67
logdepth	-0.17
Southern Area	-0.39
Extension	-0.29
NA Area	-0.27
VIMS 45 Area	0.02

Appendix II: 2017 SAMS Runs Outputs and Assumptions

Run 1:

1. Model configured the same as FW28, with 8 areas in MA and 13 in GB.
2. L∞ in the ET Flex was reduced to match that in ET Open
3. L∞ in deep portion of NLS-S was increased from 90 mm to 110 mm to match observed growth.
4. ACL: F=0.38, OFL: F=0.48

Table 9 - 2017 SAMS Run #1: 2018/2019 projected exploitable biomass by SAMS area, including ABC and OLF estimates.

MA	ExBms18	ACL18	ACL19	OFL18	OFL29
HCS	7296	2702	2675	3288	3233
Virginia	4	15	84	19	103
ETOp	11605	4087	4314	4946	5210
ETFlex	19486	7096	7151	8596	8666
Dmv	1732	962	1867	1173	2245
NYB	4651	1736	1876	2094	2259
LI	8994	2943	2557	3545	3065
Inshore	1872	685	840	826	1009
TotalMA	**55640**	**20226**	**21364**	**24487**	**25790**
C1NA	9016	2664	2230	3209	2676
C1Acc	1044	267	205	320	246
C2NA	2962	952	1045	1152	1263
C2Acc	3344	1143	1187	1386	1428
NLSNA	23114	8449	7863	10213	9441
NLSAccN	4735	1320	1052	1585	1262
NLSACCS-shal	6965	2173	1945	2623	1341
NLSACCS-deep	23051	6290	6997	7662	8502
C2Ext	4234	1374	1239	1650	1480
NLSExt	7371	1852	1252	2213	1495
Sch	5000	1540	2265	1848	2682
NF	1002	334	382	402	459
SF	3831	1278	1261	1535	1508
Total GB	**95669**	**29636**	**28923**	**35798**	**33783**
TOTAL	**151309**	**49862**	**50287**	**60285**	**59573**

Run 2:

1. Same configuration as Run 1, except L∞ in ET-Flex set at 110 mm.

Table 10 - Comparison of the meat weigh and growth parameters used in recent SAMS configurations, including a comparison of OFL and ABC estimates for two SAMS runs in 2017.

	2015	2016	2017 (Run 1)	2017 (Run 2)
Meat weight	SARC 59	SARC 59, with changes to SHMW parameters using VIMS 2016 data (NLS-S, NLS-NA, NLS-ext)	SARC 50, with changes to SHMW parameters in NLS using VIMS 2016 & 2017 data (NLS-S, NLS-NA).	Same as 2017 Run 1
Growth	SARC 59	SARC 59, with reductions to growth in NLS	SARC 59, with reductios to growth in NLS-S deep (>70m) based on observed growth between 2016 and 2017. Reduction to growth in ET-Flex using ET-Open L infinity	Same as 2017 Run 1, change ET-Flex L infinity to 110 mm based on observed growth in 2016 and 2017. This adjustment results in a roughly 8.6 million lb reduction from 2017 Run 1, but is still higher than the 2017 ACL.
2018 OFL/ABC (mt)			OFL=60,285 ABC=49,862	OFL=55,573 ABC=45,950
2019 OFL/ABC (mt)			OFL=59,537 ABC=50,287	OFL=55,336 ABC=45,805