North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE
REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
December 6–8, 2016

The SSC met from December 6th through 8th at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair
NOAA Fisheries—AFSC

Robert Clark, Vice Chair
Alaska Department of Fish and Game

Jennifer Burns
University of Alaska Anchorage

Sherri Dressel
Alaska Department of Fish and Game

Jason Gasper
NOAA Fisheries—Alaska Region

Brad Harris
Alaska Pacific University

Anne Hollowed
NOAA Fisheries—AFSC

George Hunt
University of Washington

Gordon Kruse
University of Alaska Fairbanks

Dayv Lowry
Washington Dept. of Fish and Wildlife

Seth Macinko
University of Rhode Island

Terry Quinn
University of Alaska Fairbanks

Kate Reedy
Idaho State University Pocatello

Ian Stewart
Intl. Pacific Halibut Commission

Alison Whitman
Oregon Dept. of Fish and Wildlife

Members absent were:

Chris Anderson
University of Washington

Lew Coggins
U.S. Fish and Wildlife Service

Franz Mueter
University of Alaska Fairbanks

Matt Reimer
University of Alaska Anchorage

B-1 Bering Sea Fishery Ecosystem Plan Team Nominations

The SSC reviewed the CVs of individuals invited to serve on the Bering Sea Fishery Ecosystem Plan (FEP) Team. We find that all of the candidates for the team possess the scientific and technical expertise necessary to address the needs of the Council in developing the FEP. The SSC recommends that the Council approve these candidates. However, the SSC also recommends that additional expertise be sought to fully address the charge of developing the FEP. Specifically, we would like to see team members with expertise in human dimensions, expertise from ADFG, and additional expertise in oceanography and/or marine ecology be solicited from academia.

C-6 BSAI and C-7 GOA specifications and SAFE report

The SSC received a report from the Joint Groundfish Plan Team given by Diana Stram (NPFMC). The SSC had comments and recommendations on the following topics.

<u>Stock Assessment Prioritization</u>

The SSC was provided with an overview of the goals and objectives of the Plan Team's proposal to hold a two-day workshop in Seattle January 11-12, 2017. The SSC supports this effort and looks forward to receiving input from the PT on options for stock prioritization. The proposed agenda covers all of the major issues identified in the AFSC stock prioritization white paper. The SSC agrees with the plan to use this workshop as a forum for soliciting input on possible changes to assessment frequency, and evaluating the effects of these changes, on a stock-by-stock basis. The SSC and NPFMC will discuss this issue during the February 2017 meeting.

Halibut Report Card
A group of Joint Plan Team, AFSC, and IPHC staff have been working on development of a status summary for Pacific halibut that would mirror the ecosystem report cards presented in the Ecosystem Considerations chapter in the SAFE report. IPHC staff have presented ideas to the group for halibut, including stock status information and potential indicators that may be useful as part of the report card. One consideration is that some of the information (e.g., the IPHC stock assessment) may lag behind one year due to the assessment cycle for Pacific halibut. The group also discussed the potential for reporting along the lines of the Species Profile and Ecosystem Considerations (SPEC) being drafted for individual groundfish stock assessments.

The SSC supports the work of the group in developing a report card for Pacific halibut and looks forward to a report on progress next September.

Halibut DMRs
Jim Armstrong (NPFMC) presented the updated working group report on proposed Pacific halibut discard mortality rates (DMRs) for 2017. The previous approach for DMRs has been in place for many years, is stratified by a target fishery, and uses an average over the previous ten-year period. The revised approach is designed to be consistent with the observer sampling design and with operational causes of variation in DMRs. **The SSC agrees with the Plan Team that this work represents an improvement to previous methods for estimating Pacific halibut DMRs and recommends using the updated methods for specification of DMRs in 2017-2018.**

In an effort to better inform our understanding, the IPHC has prepared a review document of the basis for the underlying survival rates that are used with injury/condition categories assigned by observers to calculate DMRs. The paper will provide a reference for summarizing the various studies that have investigated these rates, the sample sizes and experimental designs, as well as a summary of the relevant results. This document will be available through the IPHC's Report of Assessment and Research Activities distributed for their Annual Meeting to be held in January 2017. **The SSC supports IPHC research proposals that have been submitted to fund research to better inform estimates of halibut discard mortality rate.**

General Stock Assessment Comments
In an effort improve record keeping as assessment authors formulate various stock status evaluation models, the Plan Team has recommended a systematic cataloging convention. Any new model that diverges substantial from the currently accepted model will be marked with the two-digit year and a “0” version designation (e.g., 16.0 for a model from 2016). Variants that incorporate major changes are then distinguished by incremental increases in the version integer (e.g., 16.1 then 16.2), and minor changes are identified by the addition of a letter designation (e.g., 16.1a). **The SSC recommends this method of model naming and notes that it should reduce confusion and simplify issues associated with tracking model development over time.**

General SAFE Comments
The SSC reviewed the SAFE chapters and 2015 OFLs with respect to status determinations for BSAI and GOA groundfish. **The SSC accepts the status determination therein, which indicated that no stocks were subject to overfishing in 2015. Also, in reviewing the status of stocks with reliable biomass reference points (all Tier 3 and above stocks and rex sole), the SSC concurs that these stocks are not overfished or approaching an overfished condition.**

BSAI and GOA specifications

The SSC received a presentation by Grant Thompson (NMFS-AFSC) on Plan Team recommendations for BSAI groundfish OFLs and ABCs. Jim Ianelli (NMFS-AFSC) presented the EBS pollock stock assessment and the CEATTLE model, Grant Thompson presented the BS and AI Pacific cod assessments, and Steve Barbeaux presented the BSAI Greenland turbot stock assessment. GOA Plan Team recommendations were summarized by Jim Ianelli (NMFS-AFSC). Steve Barbeaux presented the GOA Pacific cod stock assessment.

Table 1. SSC recommendations for BSAI groundfish OFLs and ABCs for 2017 and 2018 are shown with the 2016 OFL, ABC, TAC, and catch amounts in metric tons (2016 catches through November 5th from AKR Catch Accounting include CDQ). SSC recommendations in **bold** differed from those of the BSAI Plan Team.

		2016			**2016 Catch**	**2017**		**2018**	
Species	**Area**	**OFL**	**ABC**	**TAC**	**as of 11/5/16**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	EBS	3,910,000	2,090,000	1,340,000	1,349,724	3,640,000	2,800,000	4,360,000	2,979,000
	AI	39,075	32,227	19,000	1,288	43,650	36,061	49,291	40,788
	Bogoslof	31,906	23,850	500	1,005	130,428	**60,800**	130,428	**97,428**
Pacific cod	BS	390,000	255,000	238,680	210,110	284,000	239,000	302,000	255,000
	AI	23,400	17,600	12,839	12,357	28,700	21,500	28,700	21,500
Sablefish	BS	1,304	1,151	1,151	518	**1,499**	1,274	**1,519**	1,291
	AI	1,766	1,557	1,557	349	**2,044**	1,735	**2,072**	1,758
Yellowfin sole	BSAI	228,100	211,700	144,000	128,236	287,000	260,800	276,000	250,800
Greenland turbot	BSAI	4,194	3,462	2,873	2,205	11,615	**6,644**	12,831	10,864
	BS	n/a	2,673	2,673	2,084	n/a	**5,800**	n/a	9,484
	AI	n/a	789	200	121	n/a	**844**	n/a	1,380
Arrowtooth flounder	BSAI	94,035	80,701	14,000	10,346	76,100	65,371	67,023	58,633
Kamchatka flounder	BSAI	11,100	9,500	5,000	4,762	10,360	8,880	10,700	9,200
Northern rock sole	BSAI	165,900	161,000	57,100	44,873	159,700	155,100	147,300	143,100
Flathead sole	BSAI	79,562	66,250	21,000	9,655	81,654	68,278	79,136	66,164
Alaska plaice	BSAI	49,000	41,000	14,500	12,957	42,800	36,000	36,900	32,100
Other flatfish	BSAI	17,414	13,061	2,500	2,810	17,591	13,193	17,591	13,193
Pacific Ocean perch	BSAI	40,529	33,320	31,900	30,408	53,152	43,723	51,950	42,735
	BS	n/a	8,353	8,000	7,186	n/a	**12,199**	n/a	**11,924**
	EAI	n/a	7,916	7,900	7,569	n/a	**10,307**	n/a	**10,074**
	CAI	n/a	7,355	7,000	6,765	n/a	**8,009**	n/a	**7,828**
	WAI	n/a	9,696	9,000	8,888	n/a	**13,208**	n/a	**12,909**
Northern rockfish	BSAI	14,689	11,960	4,500	4,532	16,242	13,264	15,854	12,947
Blackspotted/Rougheye	BSAI	693	561	300	157	612	501	750	614
Rockfish	EBS/EAI	n/a	149	149	65	n/a	**306**	n/a	**374**
	CAI/WAI [a]	n/a	304	200	115	n/a	**195**	n/a	**240**
Shortraker rockfish	BSAI	690	518	200	103	666	499	666	499
Other rockfish	BSAI	1,667	1,250	875	791	1,816	1,362	1,816	1,362
	BS	n/a	695	325	278	n/a	791	n/a	791
	AI	n/a	555	550	513	n/a	571	n/a	571
Atka mackerel	BSAI	104,749	90,340	55,000	54,293	102,700	87,200	99,900	85,000
	EAI/BS	n/a	30,832	28,500	28,168	n/a	34,890	n/a	34,000
	CAI	n/a	27,216	16,000	15,795	n/a	30,330	n/a	29,600
	WAI	n/a	32,292	10,500	10,330	n/a	21,980	n/a	21,400
Skates	BSAI	50,215	42,134	26,000	25,624	49,063	41,144	46,583	39,008
Sculpins	BSAI	52,365	39,725	4,500	4,476	56,582	42,387	56,582	42,387
Sharks	BSAI	1,363	1,022	125	96	689	517	689	517
Squids	BSAI	6,912	5,184	1,500	1,281	6,912	5,184	6,912	5,184
Octopuses	BSAI	3,452	2,589	400	426	4,769	3,576	4,769	3,576
Total	BSAI	5,324,080	3,236,662	2,000,000	1,913,407	**5,110,344**	**4,013,993**	**5,807,962**	**4,214,648**

[a] The SSC recommendation for "maximum subarea species catch" of Blackspotted/Rougheye rockfish in the WAI portion of the CAI/WAI is **29** mt in 2017 and **35** mt in 2018.

Table 2. SSC recommendations for GOA groundfish OFLs and ABCs for 2017 and 2018, shown with 2016 OFL, ABC, TAC, and catch amounts in metric tons (2016 catches through November 5th, 2016 from AKR catch accounting system). Recommendations are marked in **bold** where SSC recommendations differ from those of the GOA Plan Team.

		2016				2017		2018	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	State GHL		6,358	-	-	-	5,094	-	3,937
	W(61)		56,494	56,494	61,222		43,602		33,701
	C(62)		124,927	124,927	46,968		98,652		76,249
	C(63)		57,183	57,183	64,605		48,929		37,818
	WYAK		9,348	9,348	132		7,492		5,791
	Subtotal	322,858	254,310	247,952	172,927	235,807	203,769	182,204	157,496
	EYAK/SEO	13,226	9,920	9,920	-	13,226	9,920	13,226	9,920
	Total	336,084	264,230	257,872	172,927	249,033	213,689	195,430	167,416
Pacific cod	W		40,503	28,352	17,539		36,291		32,565
	C		49,312	36,984	21,939		44,180		39,644
	E		8,785	6,589	66		7,871		7,063
	Total	116,700	98,600	71,925	39,544	105,378	88,342	94,188	79,272
Sablefish	W		1,272	1,272	1,037		1,349		1,367
	C		4,023	4,023	4,147		4,515		4,574
	WYAK		1,475	1,475	1,640		1,605		1,626
	SEO		2,317	2,317	2,457		2,606		2,640
	Total	10,326	9,087	9,087	9,281	**11,885**	10,074	**12,045**	10,207
Shallow-water flatfish	W		20,851	13,250	145		20,921		21,042
	C		19,242	19,242	3,445		19,306		19,418
	WYAK		3,177	3,177	-		3,188		3,206
	EYAK/SEO		1,094	1,094	1		1,099		1,105
	Total	54,520	44,364	36,763	3,591	54,583	44,514	54,893	44,771
Deep-water flatfish	W		186	186	4		256		257
	C		3,495	3,495	161		3,454		3,488
	WYAK		2,997	2,997	9		3,017		3,047
	EYAK/SEO		2,548	2,548	5		2,565		2,590
	Total	11,102	9,226	9,226	179	11,182	9,292	11,290	9,382
Rex sole	W		1,315	1,315	169		1,459		1,478
	C		4,445	4,445	1,492		4,930		4,995
	WYAK		766	766	1		850		861
	EYAK/SEO		967	967	-		1,072		1,087
	Total	9,791	7,493	7,493	1,661	10,860	8,311	11,004	8,421
Arrowtooth flounder	W		28,183	14,500	985		28,100		25,747
	C		107,981	75,000	17,970		107,934		98,895
	WYAK		37,368	6,900	25		37,405		34,273
	EYAK/SEO		12,656	6,900	13		12,654		11,595
	Total	219,430	186,188	103,300	18,993	219,327	186,093	196,635	170,510
Flathead sole	W		11,027	8,650	214		11,098		11,282
	C		20,211	15,400	2,069		20,339		20,677
	WYAK		2,930	2,930	-		2,949		2,998
	EYAK/SEO		852	852	-		857		872
	Total	42,840	35,020	27,832	2,283	43,128	35,243	43,872	35,829

Table 2. *Continued*.

Species	Area	2016 OFL	2016 ABC	2016 TAC	2016 Catch	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Pacific Ocean Perch	W		2,737	2,737	2,627		2,679		2,627
	C		17,033	17,033	17,566		16,671		16,347
	WYAK		2,847	2,847	2,827		2,786		2,733
	W/C/WYAK	26,313	22,617	22,617	23,020	25,753	22,136	25,252	21,707
	SEO	2,118	1,820	1,820	-	2,073	1,782	2,032	1,747
	Total	28,431	24,437	24,437	23,020	27,826	23,918	27,284	23,454
Northern rockfish	W		457	457	115		432		400
	C		3,547	3,547	2,274		3,354		3,108
	E		4	-	-		4		4
	Total	4,783	4,004	4,004	3,389	4,522	3,790	4,175	3,512
Shortraker Rockfish	W		38	38	52		38		38
	C		301	301	395		301		301
	E		947	947	299		947		947
	Total	1,715	1,286	1,286	746	1,715	1,286	1,715	1,286
Dusky Rockfish	W		173	173	91		158		146
	C		4,147	4,147	3,184		3,786		3,499
	WYAK		275	275	7		251		232
	EYAK/SEO		91	91	8		83		77
	Total	5,733	4,686	4,686	3,290	5,233	4,278	4,837	3,954
Rougheye and blackspotted rockfish	W		105	105	40		105		104
	C		707	707	467		706		702
	E		516	516	114		516		512
	Total	1,596	1,328	1,328	621	1,594	1,327	1,583	1,318
Demersal shelf rockfish	GOA-wide	364	231	231	115	357	227	357	227
Thornyhead Rockfish	W		291	291	207		291		291
	C		988	988	663		988		988
	E		682	682	222		682		682
	Total	2,615	1,961	1,961	1,092	2,615	1,961	2,615	1,961
Other rockfish (Other slope)	W/C		1,534	1,534	1,294		1,534		1,534
	WYAK		574	574	48		574		574
	EYAK/SEO		3,665	200	38		3,665		3,665
	Total	7,424	5,773	2,308	1,380	7,424	5,773	7,424	5,773
Atka mackerel	GOA-wide	6,200	4,700	2,000	993	6,200	4,700	6,200	4,700
Big Skate	W		908	908	134		908		908
	C		1,850	1,850	1,874		1,850		1,850
	E		1,056	1,056	44		1,056		1,056
	Total	5,086	3,814	3,814	1,380	5,086	3,814	5,086	3,814
Longnose Skate	W		61	61	131		61		61
	C		2,513	2,513	843		2,513		2,513
	E		632	632	336		632		632
	Total	4,274	3,206	3,206	1,310	4,274	3,206	4,274	3,206
Other skates	GOA-wide	2,558	1,919	1,919	1,568	2,558	1,919	2,558	1,919
Sculpins	GOA-wide	7,338	5,591	5,591	1,293	7,338	5,591	7,338	5,591
Sharks	GOA-wide	6,020	4,514	4,514	1,841	6,020	4,514	6,020	4,514
Squids	GOA-wide	1,530	1,148	1,148	241	1,516	1,137	1,516	1,137
Octopuses	GOA-wide	6,504	4,878	4,878	323	6,504	4,878	6,504	4,878
Total		892,964	727,684	590,809	291,062	**796,158**	667,877	**708,843**	597,052

GOA and BSAI– Sablefish

In this year's assessment the author included in the following new datasets:

- catch - updated catch for 2015, new estimated catch for 2016-2018,
- relative abundance - 2016 longline survey and the 2015 longline fishery,
- ages - 2015 longline survey and the 2015 fixed gear fishery,
- lengths - 2016 longline survey, 2015 fixed gear fishery, and the 2015 trawl fishery.

In response to ongoing research and comments from a CIE review, the authors presented a benchmark assessment in 2016. Eight models were brought forward to address: data issues, variance estimates, and whale depredation. The SSC appreciates the careful analysis that went into the benchmark assessment. The SSC appreciates that the author responded to comments regarding the sequence for model progression and adopted a consistent numbering convention for the eight candidate models.

The author identified a suite of CIE, SSC, and Plan Team recommendations that were not addressed in 2016 but will remain important research topics. These remaining recommendations include: developing a tag-integrated movement model, estimating growth inside the model, considering Canadian catches, and finishing the fishery CPUE index. The SSC agrees that these are important areas of ongoing research that might result in improvements to the assessment.

The SSC reviewed these proposed changes in October 2016. In the final assessment eight models were considered:

10.3 This is the model used from 2010-2015

10.3a Model 10.3 with the revision of area sizes used to calculate the domestic longline survey abundance index

10.3b Model 10.3a with the inclusion of analytical annual variance calculations for the domestic longline survey abundance index

16.1 Model 10.3b with domestic longline survey abundance index corrected for sperm whale depredation

16.2 Model 10.3b with additional catch mortality from both sperm and killer whales

16.3 Model 16.1 with additional catch mortality from both sperm and killer whales

16.4 Model 16.3 reweighted so that the standard deviations of the normalized residuals (SDNRs) of the domestic longline survey abundance index equals 1

16.5 Model 16.4 with natural mortality estimated with a prior CV of 10% Model 10.3a used

The proposed methods to correct for whale depredation were reviewed by the CIE and are documented in submissions to the peer-reviewed literature. The authors recommend increasing the survey CPUE at stations where sperm whale depredation occurred, and including fishery whale depredation as catch in the fixed gear fishery. The SSC agrees that these corrections represent a scientifically defensible approach to correct for this problem.

The SSC supports the inclusion of analytical annual variance calculations for the longline survey and supports the author's proposal to re-weight the domestic longline survey abundance by setting the SDNRs for the longline survey to 1 (16.4 & 16.5). The author recommends using Model 16.5 because it propagates the most additional uncertainty, accounts for whale depredation, and has good retrospective behavior. The SSC agrees that Model 16.5 should be used as the base model for 2016 and the values from this model should be used as the foundation for setting the 2017 and 2018 ABC and OFL.

Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points are calculated using recruitments from 1977-2013. The updated point estimates of *B40%*, *F40%*, and *F35%* from this assessment are 105,836 t (combined across the EBS, AI, and GOA), 0.094, and 0.113, respectively. Projected female spawning biomass (combined areas) for 2017 is 91,553 t (87% of *B40%*, or *B36%*), placing sablefish in sub-tier b" of Tier 3. The maximum permissible value of *FABC* under Tier 3b is 0.081, which translates into a 2017 ABC (combined areas) of 13,509 t. The OFL fishing mortality rate is 0.097 which translates into a 2017 OFL (combined areas) of 15,931 t.

The authors recommend that whale depredation should be projected and accounted for in the ABC estimates. The authors note that this decrement is needed in conjunction with typical estimation of mortality to appropriately account for depredation on both the survey and in the fishery. To make this correction the authors recommend multiplying the average of the last three complete catch years (2013-2015) of whale depredation (t) by the amount that the ABC is increasing or decreasing from 2016 to 2017 and 2018. This amount of projected depredation is then deducted from each area ABC to produce new area ABCs for 2017 and 2018. In this case the three-year average depredation is multiplied by 1.145 because the 2017 ABC is recommended to increase 14.5% from 2016. The SSC agrees with the author and Plan Teams that the depredation correction should be made when setting the ABC. The SSC also recommends that the correction is applied to both the ABC and the OFL. **The adjusted 2017 ABC is 13,083 t and the adjusted 2017 OFL is 15,429 t.**

These ABCs are higher than those projected from the previous assessment. Although this is a reasonable outcome given changes to the model, the SSC noted that long-term persistent declines in biomass were estimated from both analyses.

The SSC recommends that the authors carefully consider which years should be used in estimating the average depredation. It was noted that pot gear will be allowed in the GOA in 2018. If a large fraction of the fleet shifts to pot gear, then some adjustment to the three-year average depredation rate used in the adjustment should be considered.

The author recommended no changes be made to the area apportionments until the apportionment scheme is thoroughly re-evaluated and reviewed. The SSC agrees with this approach for 2017, however, they noted that the static apportionments have diverged from biomass-based estimates by as much as 61%, and continue to encourage completion of the analysis of area apportionment options in the near future.

The SSC supports the author's continued efforts to account for uncertainty in the assessment, specifically through addressing data weighting and estimating natural mortality. The SSC notes that if this stock was managed as a Tier 1 stock, this information would be particularly useful. The prior used for natural mortality, with a CV of 10%, was noted by the author to be necessary to ensure convergence. This suggests it may be constraining to the estimated value; the SSC recommends that a formal prior derived from life-history, meta-analyses, or other sources be derived and explored for use in this assessment.

The SSC noted that pending changes to the halibut/sablefish logbooks will provide fishery-reported information on whale interactions. These data may be useful for comparison with, or as supplemented to, observer data in the future.

The SSC reviewed the ecosystem considerations section of the sablefish document and encourages continued work on the SPEC. In particular, the SSC recommends that results of the GOA IERP be included in the Ecosystem section.

Sablefish GOA

Stock/ Assemblage		2017		2018	
	Area	OFL	ABC	OFL	ABC
Sablefish	W		1,349		1,367
	C		4,514		4,574
	WYAK		1,605		1,626
	SEO		2,606		2,640
	Total	11,885	10,074	12,045	10,207

Sablefish BSAI

Stock/ Assemblage	Area	2016 OFL	2016 ABC	2017 OFL	2017 ABC
Sablefish	BS	1,499	1,274	1,519	1,291
	AI	2,044	1,735	2,072	1,758

EBS Walleye Pollock

This is a relatively straightforward update with some methodological changes based on CIE reviews. New data included survey information from the 2016 bottom trawl and acoustic trawl surveys and catch and average weight information from 2015 and 2016. The base Model 15.1 is the model approved by the Plan Team and SSC last year. An incremental process of adding data sources showed that all data sources considered were influential and should be incorporated into the model.

Methodological considerations for modelling included the use of survey biomass instead of survey abundance, data-weighting of length compositions using the Francis method, estimation of annual weight at age (methodology is in Appendix 1A), and capturing the variability in annual recruitment (structural uncertainty) with reference to its effect on biological reference points. The resultant Model 16.1 includes the first three of these considerations and produces good fits to the various data sources. The authors noted that the new data sources were more influential than the model considerations.

With regard to changes in how weight at age is handled, the new analysis has uncovered strong cohort effects in the early part of the time series, which appear to be reduced with strong interannual effects later in the 2000s, which may be related to temperature. The model fits seem to be primarily capturing cohort effects that are then projected forward.

The last consideration of structural uncertainty led to three unnamed model versions: (1) Model 16.1 with standard data weightings (“base-conditioned”); (2) Model 16.1 with reduced influence of the spawner-recruit relationship, or equivalently, increased variability in the spawner-recruit relationship; and (3) an intermediate influence between (1) and (2) (“moderate-conditioned”). In the future, the SSC requests that any model change that produces changes in biological reference points be labeled according to the model-numbering system advocated for by the Plan Team and that the corresponding BRPs be included in the SAFE. In the present assessment, only the BRPs from the moderate-conditioned version were in the SAFE.

The SSC agrees with the Plan Team that the additional data sources and model considerations result in improvements, and so approves Model 16.1 for status determination. Output from this model shows that this stock is in excellent condition with a 2017 estimated spawning biomass of 4.60 million t, much larger than B_{msy} = 2.16 million t and $B_{40\%}$ = 2.63 million t. Use of Model 16.1 places EBS walleye pollock in Tier 1a, which has a corresponding 2017 ABC of 3.12 million t and OFL of 3.64 million t. **The SSC concurs with the Plan Team that it is better to follow recent practice of using BRPs from Tier 3 for additional precaution, which results in a 2017 ABC of 2.80 million t and OFL of 3.64 million t.** The 2018 values are shown in the table below.

There are several reasons that justify taking a precautionary approach when setting the ABC. There is concern over potential consequences for future recruitment due to three unusually warm years in a row (2014-2016) with no expectation of a return to cooler conditions anytime soon. Our current understanding of pollock early life dynamics suggests that recent survival from age-0 to age-1 may be low due to low availability of suitable prey. Combined with increased predation, as suggested by the multi-species model CEATTLE (see below) and other evidence, strength of the 2015 and 2016 year classes is expected to be lower than average. Other items of concern are listed in the SAFE report on page 76. However, energetic condition of young pollock predicts intermediate recruitment of the 2015 cohort. Furthermore, in spite of these concerns related to recent warm conditions and their effects on food, pollock biomass remains high and recent fishing mortality has been relatively low.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Pollock	EBS	3,640,000	2,800,000	4,630,000	2,979,000

SSC Comments to Authors:

- CEATTLE (Climate-Enhanced, Age-based model with Temperature-specific Trophic Linkages and Energetics, Holsman et al.): Ongoing work on a multispecies, age-structured population work is presented in a supplement to the SAFE. It is being developed as a strategic approach to examine trophic linkages and environmental drivers among walleye pollock, Pacific cod, and arrowtooth flounder. It is not meant as an operational replacement for the main single-species models for these stocks, but rather to help explain some of the mechanisms driving the results from the single-species models. Results from CEATTLE agree reasonably well with single-species models and offer additional insights into stock dynamics. For example, the predicted high predation mortality on pollock of the 2015 year class is noteworthy, which is presumably a combination of changes in abundance of the three species and temperature effects on consumption/metabolism. The SSC encourages further work on model development in CEATTLE, including the addition of other species (Pacific halibut, fur seals, Steller sea lions) and investigating its potential use in management strategy evaluation.
- Trawl survey: There seemed to be a much broader distribution of the stock over the shelf in recent warm years, including high densities to the northwest along the edge of the survey region. Might this imply increased predation on young pollock due to increased spatial overlap with adults?

Aleutian Islands Pollock

This assessment is a routine update that includes the 2016 AI bottom trawl survey. There were no changes to the assessment model. Spawning biomass has been increasing since the low point in 1999 due to reduced fishing pressure, not increased recruitment, and projected 2017 spawning biomass is 77,579 t. This stock qualifies for management under Tier 3b, as results from the assessment model indicate that spawning biomass is slightly below the target of $B_{40\%}$ = 81,240 t. **Under Tier 3b, the SSC concurs with the authors' and Plan Team's recommendations for using the 2017 maximum permissible ABC of 36,061 t and the 2017 OFL of 43,650 t.** The 2018 values are shown in the table below.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Pollock	AI	43,650	36,061	49,291	40,788

Bogoslof Pollock

There was a surprising five-fold increase in estimated biomass to about 506,000 t from the March 2016 hydroacoustic survey, which had been languishing at around 100,000 t for a quarter-decade after the huge donut-hole fishery of the 1980s. An interesting question has lingered in the background since that time: Was the donut-hole/Bogoslof group of pollock a self-sustaining stock or was it a just a remnant of the huge 1978 year-class of EBS pollock that moved offshore in search of food, or for some other reason?

As has become a common method for a Tier 5 stock, a random-effects model was used to account for survey measurement error, leading to a 2017 estimate of 434,760 t for stock assessment purposes. Application of the Tier 5 control rule to this estimate results in the 2017 and 2018 maximum-permissible ABC (maxABC) of 97,428 t and the 2017 and 2018 OFL of 130,428 t, which are large increases over past years. The authors and Plan Team accepted these values from the random-effects model.

However, the SSC agrees with the author and Plan Team that it is appropriate to set ABC below the maximum permissible ABC as an added precaution since this event may be ephemeral. **Consistent with past SSC practice, our recommendation is to use a two-year 'stair-step' approach to set ABC, for**

which the Plan Team provided a 2017 ABC of 60,800 t and a 2018 ABC (at maxABC) of 97,428 t. This result is similar to the three-survey average method proposed by the authors and accepted by the Plan Team. The SSC noted that if ship time can be made available, conducting the Bogoslof survey in 2017 would be desirable to help better understand if the aggregation observed in 2016 persists.

Stock/		**2017**		**2018**	
Assemblage	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	Bogoslof	130,428	60,800	130,428	97,428

Pacific Cod
Bering Sea:
Stock assessment results for EBS Pacific cod were presented by the lead author of the assessment, Grant Thompson (AFSC). All of the inputs including catches, indices, and biological data were updated with the most recent years available. Notably, EBS trawl survey estimates of biomass were down 14% from 2015 to 2016, and estimated abundance was down 35%.

Following GPT and SSC recommendations, the author brought forward a new model in September (model 16.1), which is a greatly simplified version of the base model used in recent years (model 11.5). The latter was included for comparison with the expectation that the new model, which performed well during preliminary model runs presented in October, might be adopted as the new base model for this stock. Model 16.1 is a single-gear, single-season model using empirical weight-at-age and time-invariant, asymptotic selectivity with M and Q estimated inside the model. In addition to these two models, the author explored four variants of the new model (models 16.6-16.9) that focused on examining the incremental effects of not including empirical weight-at-age data (16.6) and, in addition, including the NMFS longline survey data (16.7). The other variants of 16.1 (with empirical weight-at-age) allowed for time-varying survey selectivity (16.8), and time-varying fishery selectivity (16.9).

All six of these models estimated increasing spawning biomass trends over the recent period since 2010, with estimated relative biomass (compared with B100%) in 2016 ranging from just below 40% to just under 60%. All six models also used fixed values or produced similar estimates of M, ranging from 0.34 to 0.38. The greatest contrast in results occurred between model 11.5 and 16.1, the two models with the largest difference in complexity. Compared with model 11.5, the new models showed substantial reduction in retrospective bias in estimates of current year spawning biomass. The author summarized that alternative model evaluation metrics (e.g., AIC, retrospective measures) suggested different 'best' models from within the new model set.

The SSC agreed with author and Plan Team recommendations to accept Model 16.6 for harvest specifications. This places the stock in Tier 3a as the estimated spawning biomass is well above $B_{40\%}$ (see tables for numbers). EBS Pacific cod is not estimated to have been subjected to overfishing, is not overfished, and is not approaching an overfished condition.

Stock/		**2017**		**2018**	
Assemblage	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific cod	BS	284,000	239,000	302,000	255,000

The SSC continues to support the spring Pacific cod workshop to review and plan for model development each year, and also supports all of the technical PT recommendations for future model development.
All of the new models (16.*x*) treat the fishery as a single-gear fishery compared to many gear-season combinations in model 11.5 and earlier versions. Because there have been many changes in the fishery, it seems logical to account for these changes by allowing fishery selectivity to vary over time. However, the

results from model 16.8 suggest that using time-varying survey selectivity, rather than fishery selectivity, did a better job improving many aspects of the model fit, including better fits to the survey size and age composition data, a better fit to survey biomass (as expected), and a better fit to fishery size compositions (relative to models 16.1-16.7). **The SSC recommended discarding model 11.5 for future analyses after one or more 16.x models incorporating time-varying selectivity in some reasonable manner (for the survey and/or fishery) are developed to take its place in this set of models.** Depending on staff availability, this could be presented at the spring meeting; however, if that is not possible, it should be brought forward for the September 2017 PT meeting.

The author noted that there are otoliths that have been collected from various sectors of the cod fishery, but have not been aged. These ages could help in assessing ageing bias in the assessment, creating weight-at-age estimates, and reducing uncertainty. **The SSC recommends that including existing fishery ages in the assessment and ageing additional fishery otoliths for this assessment should be priorities**, noting that the AFSC has an ongoing ageing-prioritization analysis which may guide their future efforts. The SSC noted that a recently published analysis investigating aging bias (Kastelle et al. 2017) could be included in this assessment, and that the results of an ongoing NPRB project may also be helpful.

One important issue that has come up repeatedly in the Pacific cod assessment is how to address weight-at-age. Based on earlier recommendations to deal with difficulties fitting length-at-age data, the author developed models using externally estimated weight-at-age data directly in the model (models with empirical weight-at-age data: 16.1, 16.8, and 16.9). However, one concern with the use of these data is that they do not account for aging bias, whereas models that compute weight-at-age internally (Models 11.5, 16.6, and 16.7) estimate the aging bias, which has long been recognized as being potentially important for Pacific cod. The author reported that he addressed an issue with the calculation of weight-at-age after the Plan Team meetings that brought the empirical estimates closer to the model-derived estimates for the 16.x models. **The SSC recommends continued exploration of the treatment of weight-at-age using both internally and externally estimated values.**

The SSC also noted that there are questions remaining regarding the plausibility of dome-shaped selectivity for the trawl survey, and that future research may help in this regard.

The SSC highlighted that between-model variability, even for this refined set of new models, remained high and that status could possibly be better reflected through multi-model inference (model-averaging). The retrospective comparison among prior assessment models (Figure 2.15) clearly illustrates the structural uncertainty in this assessment and continued future change when using only a single model. The SSC noted that choosing a model that is somewhere “in the middle” of the set is not a good approach to model averaging as it ignores within-model uncertainty (by using a naïve average of the point estimates) and discounts information that could be used to weight the models. **The SSC further considering model averaging based on the outcome of the SSC workshop during the February 2017 meeting.**

Public testimony was provided by Chad See and Gerry Merrigan (Freezer Longline Coalition) in support of proposed Model 16.6 for Pacific cod harvest specifications. They also acknowledged the opportunity for public participation and more extensive review provided by the spring meetings for selecting and refining Pacific cod models, and supported continuing this process for 2017/18. They further supported a workshop (by the SSC) on model averaging.

Aleutian Islands:

The Aleutian Islands Pacific cod stock has been assessed separately from eastern Bering Sea cod since 2013, and managed separately since 2014. There has been some effort to develop an age-structured model for a Tier 3 assessment, and a candidate model was evaluated in 2015 (15.7). However, the age-structured model was not accepted and the stock remained in Tier 5. Preliminary fits of several model variants were explored in September 2016 but did not produce satisfactory fits and both the Plan Team and SSC recommended that the author focus efforts on developing the Bering Sea age-structured model instead. Therefore, only Tier 5 considerations were brought forward for specifications, based on a random-effects model.

The estimated survey biomass and abundance increased in 2016 by 15% and 59%, respectively, suggesting an increase in young fish entering the population. The increase is consistent with an increase in the trawl fishery CPUE; however, the longline fishery CPUE decreased slightly. Previous assessments used a natural mortality rate of M=0.34. The author and Plan Team recommend increasing M to 0.36 based on the preferred model (16.6) for the eastern Bering Sea.

The SSC concurs with the Plan Team recommendation to use the random-effects estimate of biomass with M=0.36 for the 2016 harvest specifications under Tier 5.

Lacking area-specific estimates of M, the SSC concurs with the use of M=0.36 in this analysis. All three cod assessments could benefit from a formal prior on M based on the variety of studies referenced in each. **The SSC recommends that a prior for use in all cod assessments be developed for 2017.** The SSC also supports the PT recommendation to continue development of an age-structured model for the next assessment cycle in an effort to move the stock to Tier 3.

The SSC supports the author's observation that ageing bias needs to be further investigated for cod, with results potentially applicable to all three assessments.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Pacific cod	AI	28,700	21,500	28,700	21,500

BSAI Atka Mackerel

A full assessment was presented for BSAI Atka mackerel this year. Changes to last year's Atka mackerel assessment include both updates to datasets and a change in methodology. The AI bottom trawl survey time series was updated with the 2016 estimate (down 38% from the 2014 estimate, but up 161% from 2012), 2015 fishery age composition data were added, total 2015 year-end catch was updated, and the projected total catch for 2016 was set equal to the 2016 TAC.

Models presented for Atka mackerel in 2016 included:

1. Model 14.1, the selected model configuration used for ABC setting since 2014, which was updated with new data (each updated data source was identified with a separate submodel so the effects of each addition could be assessed),
2. Model 16.0, which is Model 14.1 with input sample sizes for compositional data scaled to have the same mean as in Model 14.1 (*N*=100), but varied relative to the number of hauls sampled rather than the number of fish sampled.

Additional methodological changes included:

1. The selectivity schedule used for projections was equal to the average of the most recent five years for which model estimates are available, rather than the most recent five years (with the current year set equal to the previous year, effectively double-weighting this value).
2. Catches for 2017 and 2018 were assumed to equal 62% of the BSAI-wide ABC, based on an analysis of the effect of the revised Steller Sea Lion Reasonable and Prudent Alternatives that were implemented in 2015, rather than the 80% rate that was used in last year's assessment.

The author and Plan Team recommended Model 16.0 and the SSC concurs. According to this model, spawning biomass reached an all-time high in 2005, then decreased continuously through 2016 (a decline of 56%), and is projected to decrease further through at least 2018. The 1998-2001 year classes were all very strong, but since then only the 2006 and 2007 year classes were above the long-term average. In particular, the 2011 year class, which was estimated to be above average in last year's assessment, is now estimated to be below average. The projected female spawning biomass for 2017 (145,258 t) is down 13% and 2% from last year's projections for 2016 and 2017, respectively, but still above $B_{40\%}$ (125,288 t). The stock is projected to remain above $B_{40\%}$ through the next several years. Estimates of biomass reference points ($B_{100\%}$, $B_{40\%}$, $B_{35\%}$) are all 8% lower than last year's respective estimates.

As spawning biomass is projected to be above $B_{40\%}$ in 2017, Atka mackerel qualifies for Tier 3a. The SSC supports the author- and PT-recommended OFLs and ABCs for 2017 and 2018. The random effects model for allocation was first used in 2015 and the SSC supports its use for this assessment.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Atka mackerel	EAI/BS		34,890		34,000
	CAI		30,330		29,600
	WAI		21,980		21,400
	Total	102,700	87,200	99,900	85,000

While the authors did a very good job of recounting the management history relative to the Steller sea lion BIOP and RPAs, the ecosystem considerations section of the document provided very limited information on interactions between Atka mackerel and both marine mammal and seabird predators. The SSC recommends that the authors include information on how recent trends in Steller sea lion pup production correlate with Atka mackerel biomass and closure areas in the AI, and notes that the high biomass and low exploitation rates reported in areas 541 and 542 correspond with areas where Steller sea lion populations appear to be recovering, while the Steller sea lion population in area 543, which was recently reopened to fishing, continues to decline.

Similarly, Atka mackerel are also found in the diet of northern fur seals. Currently northern fur seals are listed as depleted, and the population on the Pribilof Islands continues to decline. While there is limited overlap between Atka mackerel fishery and Pribilof Islands northern fur seals foraging areas, should protections for northern fur seals increase this may have an impact on the fishery, particularly in the region near the northern fur seals colony on Bogoslof Island.

As noted in the SSC December 2014 minutes, the AI bottom trawl survey provides highly variable estimates of trends and this contributes to the sensitivity of the assessment results to assumptions about M, Q, and effective sample size of the composition data. The SSC appreciates the responses from authors on previous SSC comments and supports the continued comprehensive analysis of fishery and survey time-varying selectivity and estimation of M and Q. Additional explanation of why dome-shaped selectivity is appropriate for Atka mackerel would be helpful.

For next year's assessment, the SSC supports the following Plan Team recommendations:

1. Tuning compositional data sample sizes to the harmonic mean effective sample size, or using the "Francis method."
2. Turning off time-varying fishery selectivity.
3. Statistical estimation of the amount of time variability in selectivity.
4. Use of time blocks for fishery selectivity, in consultation with industry.

The SSC also supports continued work to calculate catchability with respect to information provided by previous survey trawl performance studies and fish temperature relationships and continued exploration of using spatial analysis and covariates to extract additional information from trawl surveys.

BSAI Flatfish

Yellowfin Sole

Changes to last year's yellowfin sole assessment include updates to datasets on fishery and survey age composition, trawl survey biomass, and estimated discards and total catch in the fisheries. The model was unchanged, except for the way that weight-at-age is handled. Past assessments of yellowfin sole have used sex-specific, time-invariant growth based on the average length-at-age and weight-at-length relationships from the time-series of survey observations summed for all years. To incorporate time-varying (year effect on growth) and temperature-dependent growth functions into the age-structured stock assessment model, the authors used the annual observed population mean weight-at-age from the trawl survey.

The yellowfin sole stock assessment has set an example for its inclusion of ecosystem factors in the assessment. Temperature was found to be related to survey catchability and growth. Interestingly, after conducting a field experiment to further examine relationships between temperature and catchability, it was found that survey biomass is more strongly correlated to wave height than temperature, which is in turn confounded with temperature. The SSC supports the approach outlined in the SAFE to further elucidate the effects of sea state and/or bottom temperature on q, noting that these covariates may act on the assessment in different ways (i.e., availability versus gear efficiency). If an effect of wave height on catchability is confirmed, implying that rougher seas adversely affect the ability of the trawl to tend the seafloor, then this would beg the question whether other assessed species are similarly affected. So, the outcome of this work has the potential for important, far-reaching implications.

One ongoing issue with the yellowfin sole assessment is a strong retrospective pattern illustrated by Figure 4.21 in the SAFE document. More recent assessments tend to yield higher estimates of female spawning biomass. Attempts to determine the cause have been unsuccessful so far. The PT suggested that the author consider examining the potential effects of q and M on the retrospective patterns. The SSC encourages ongoing efforts to understand this phenomenon so that appropriate model adjustments can be made. The SSC also recommends updating weight-at-age with each assessment as new data become available annually. Finally, the SSC looks forward to the use of the adopted model naming convention in next year's yellowfin sole assessment.

Although total biomass has been slowly declining over three decades, the projected female spawning biomass estimate increased 11% from last year's estimate. The authors suggested that this was due primarily to a 48% increase in the 2016 survey biomass over the 2015 estimate and changes in fishery weight-at-age.

The BSAI yellowfin sole stock assessment remains in Tier 1a. The SSC supports the recommendations made by the authors and PT for the OFLs and ABCs for 2017 and 2018.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Yellowfin sole	BSAI	287,000	260,800	276,000	250,800

Greenland Turbot

Steve Barbeaux presented the Greenland turbot stock assessment. Four new models were introduced this year, in addition to last year's accepted model. There were no changes made to the base model, which has the same configuration as model 15.1 from 2015, except for the addition of updated catch and size composition data from longline and trawl fisheries, as well as survey biomass and size composition data from the 2016 slope trawl survey. Model 16.1 is the same as Model 15.1 except that size bins smaller than 50 cm were combined for both sexes. Model 16.3 is the same as Model 16.1 except it includes an additional time block (2011 – 2016) in the slope survey to account for an apparent density-dependent change in migration. Changes were also made to the slope survey selectivity curve (now double normal constrained to be asymptotic) and longline fishery selectivity (now allowed to be dome-shaped). Model 16.4 is the same configuration as Model 16.3, except that size compositions from the Auke Bay Laboratory longline survey are excluded (because fish sex is not determined in this survey). Finally, Model 16.6 is the same as Model 16.4, except that R_0 is conditioned using bottom temperatures to recognize the observation that good recruitment seems to occur in cold years. **The authors and PT recommended the use of Model 16.4 owing to its good fit and retrospective pattern, and the SSC concurs.**

The assessment projects a 63% increase in the 2017 female spawning biomass compared to the 2016 estimate, with a further increase in 2018. On the other hand, abundance is declining. This is attributed to incoming 2007-2009 year classes, which are relatively strong. As these cohorts age, they decline in abundance but increase in biomass owing to growth in body size.

As the stock is projected to be well above $B_{40\%}$ for 2017, it is managed under Tier 3a (compared to Tier 3b last year). The authors and PT agreed on the resultant specifications of OFL for 2017 and 2018. However, they disagreed on the ABC specifications. The authors' preferred approach is to set catch at 7,000 t or the maximum ABC, whichever is least. As precedent for their approach, the authors pointed out that over 1990-1995 the Council set the ABCs (and TACs) at 7,000 t as an added conservation measure citing concerns about recruitment and warmer ocean conditions, which was further explored in the experimental model 16.6. In support of this more conservative approach, the authors cited the general long-term decline in female spawning biomass since at least the mid-1970s, the modest recent increase as a result of a few good year classes associated with cold temperatures in 2002, and the likelihood that this stock will continue to have poor recruitment for the foreseeable future owing to warm ocean temperatures.

The PT disagreed with the author's ABC choice and gave the rationale that it was subjective and not supported by the model. Instead, the PT recommended use of the maximum permissible ABCs for 2017 and 2018 and further suggested that downward adjustments could be made by the Council during the TAC-setting process. The SSC had considerable discussion about ABCs. In the end, the SSC believes there are a myriad of reasons not to set ABC at maximum permissible levels. The SSC reiterates the reasons offered by the authors and also notes the modest recent increase in female spawning biomass after more than four decades of steady, large declines. In addition, the SSC notes uncertainties in the assessment associated with the pulsed nature of recent recruitment and large-scale migration of the stock to the south and to deeper waters with age.

The SSC supports management under Tier 3a and the authors' and PT's recommended OFLs for 2017 and 2018. As has been the SSC's practice in the past to address conservation concerns and uncertainties, the SSC recommends a stair-stepped approach to maxABC over the next two years. **For 2017, the SSC recommends stepping halfway from the ABC (3,462 t) for 2016 and the maxABC (9,825 t) for 2017. This results in an ABC of 6,644 t for 2017 and 10,864 t (unchanged maxABC) for 2018.** The SSC supports the authors' and PT's approach toward apportionment of ABCs for the BS and AI. The apportionment is based on unweighted averages of EBS slope and AI survey biomass estimates from the four most recent years. **For 2017, the SSC calculated the area apportionments by applying the percentages (87.3% and 12.7%) from the PT times 6,644 t. Thus, the SSC's recommended apportionment of the 2017 and 2018 ABCs are 5,800 t and 9,484 t for the EBS and 844 t and 1,380 t for the AI, respectively. Finally, the SSC agrees with the authors and PT and does not recommend area apportionment of OFLs.**

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
	BS		5,800		9,484

Greenland turbot	AI		844		1,380
	Total	11,615	6,644	12,831	10,864

The SSC supports the PT recommendations for the assessment authors to:

1. Explore the consistency of time blocks across surveys,
2. Complete a stock structure template,
3. Explore the use of age composition data in the model, and
4. Contact Auke Bay Laboratory survey staff about getting sex-specific lengths collected during future surveys.

Arrowtooth Flounder

As 2015 was an "off year" for the BSAI arrowtooth flounder, the current assessment is an update to the 2014 assessment. Updated data include: (1) biomass estimates and size compositions from the 2015 and 2016 eastern Bering Sea shelf surveys, 2016 eastern Bering Sea slope survey, and 2016 Aleutian Islands survey, (2) fishery size compositions for 2015 and 2016, (3) estimates of catch through October 26, 2016, and (4) age data from the 1993, 1994, 2012, 2014, and 2015 eastern Bering Sea shelf and 2014 Aleutian Islands surveys, as well as the 2012 eastern Bering Sea slope survey. Five models were proposed based on modifications of the 2014 model (now named 15.0). Model 15.0a incorporates new weighting to the three survey indices only, whereas Model 15.0b includes the new data without the new weighting. Model 15.1 includes the new data and added the new likelihood component. Model 15.1a is the same as Model 15.1 with the new age-length conversion matrix. Finally, Model 15.1b adds the new weighting to 15.1a. The authors' and PT's preferred model was Model 15.1b, because of its improved fit to the survey biomass time series.

Some addition work is indicated for the preferred model for next year's assessment. For instance, the authors were concerned that some selectivity parameters may be at or near their boundaries. They suggested investigating this by considering alternatives for the degree of dome-shaped selectivity curves for the EBS survey. In addition, the PT recommended that the authors consider smoothing the age-length conversion matrix. The SSC supports these explorations.

Some interesting changes have occurred in the biomass and distribution of arrowtooth flounder throughout the BSAI area. It was noted that survey biomass estimates on the Bering Sea shelf have generally increased over the last three decades but levelled off during recent years, whereas biomass estimates for the Bering Sea slope and the Aleutian Islands are lower and relatively constant (±20%) over this period. The authors found evidence that some of the annual variability in survey biomass estimates on the Bering Sea shelf co-vary positively with bottom temperature, similar to findings for yellowfin sole and northern rock sole. In recent years, arrowtooth flounder have been distributed more broadly on the shelf, likely due to warmer shelf temperatures.

Spawning biomass is projected to be above $B_{40\%}$ in 2017, thus arrowtooth qualify for Tier 3a. The SSC supports the authors' and PT's recommended OFLs and ABCs for 2017 and 2018. Arrowtooth flounder are a largely unexploited resource in the BSAI.

Stock/ Assemblage	**Area**	**2017 OFL**	**2017 ABC**	**2018 OFL**	**2018 ABC**
Arrowtooth flounder	BSAI	76,100	65,371	67,023	58,633

Kamchatka Flounder

As 2015 was an "off year" for the BSAI Kamchatka flounder assessment, this year's assessment represents a full update to the 2014 assessment. Data updates include estimates of recent catches, as well as biomass estimates and length compositions from recent slope, shelf, and Aleutian Islands surveys. No changes were made to the assessment methods.

Estimated total and female biomass of Kamchatka flounder steadily increased from 1991 to 2009, declined slightly until 2011, and further increased through 2016. The stock appears to have benefitted from many above average and several strong year classes since 2000.

The SSC appreciates the examination of retrospective patterns of female spawning biomass estimates shown in Figure 7.20. Models fit in more recent years seem to provide higher estimates of female spawning biomass. The author suggested that survey biomass increases are likely affecting the retrospective trends. The SSC recommends attempts to examine the causal relationship by which increasing survey biomass would generate this pattern. Assumptions about the survey (or fishery) selectivity may be worth examining. The authors noted that fishery selectivity is poorly determined (presumably due to the low sample sizes). If the gears used in the surveys or fisheries are actually less selective for smaller fish than assumed, the abundances of young recruiting fish may be underestimated in the model as young fish recruit to the gear. The SSC supports the suggested sampling priority to collect more length data in commercial fisheries targeting Kamchatka flounder as a means to improve estimates of fishery selectivity.

As spawning biomass is projected to remain above $B_{40\%}$ in 2017, Kamchatka flounder qualify for Tier 3a. The SSC supports the authors' and PT's recommended OFLs and ABCs for 2017 and 2018.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Kamchatka flounder	BSAI	10,360	8,880	10,700	9,200

Northern Rock Sole

The most recent full assessment was in 2015; this assessment includes updated catch, trawl survey biomass and fishery and survey age compositions from 2015 and 2016. In 2015, the best model 15.1 had fixed Q = 1.5. Alternative models included Models 16.2-16.6 that explore estimation of Q and/or M, and Model 16.7 that explores temperature dependence in catchability. The SSC agrees with the Plan Team that Models 16.2-16.6 do not offer any improvement over 15.1, which remains the best model. Also, it agrees that the exploration of both wave height and temperature effects on catchability needs further work in conjunction with RACE personnel with expertise in herding by the gear.

Northern rock sole has been placed in Tier 1a, with 2017 projected biomass of 539,500 t, well above the MS level. The fishery is stable (B80%) and exploits the stock lightly because of PSC concerns and the OY cap. The population is projected to decline slowly. Consequently, the ABCs and OFLs for 2017 and 2018 are slightly lower than those for 2016.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Northern rock sole	BSAI	159,700	155,100	147,300	143,100

Flathead Sole

The most recent full assessment was in 2014; this assessment includes updated catch data from 2015 and 2016, trawl survey biomass and bottom temperature from the EBS shelf and Aleutian Islands in 2015-2016, and survey and fishery age and length compositions from 2014 – 2016. A new survey biomass index was added to the assessment spanning 1982-2016. Also time series of length-age, length-weight, weight-age relationships, and length-age transition matrices spanning the period from 2001-2015 were developed for inclusion in the stock assessment model.

The base model from 2014 updated with data through 2016 is labeled 14.1. The authors considered three alternative models: 14.1a, harmonic mean weighting of sample size; 14.1b, inclusion of the growth time series, and 14.1c, the combination of 14.1a and 14.1b. The SSC agreed with the Plan Team and authors that Model 14.1c was best. The SSC views the inclusion of the growth time series as a major improvement and recommends labeling Models 14.1b and 14.1c as Models 16.1a and 16.1b, respectively.

The recommended Model 16.1b shows that OFL and ABC have been relatively stable. Spawning biomass has also been rather stable at ~$B_{70\%}$. Flathead sole qualifies for assessment under Tier 3a.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Flathead sole	BSAI	81,654	68,278	79,136	66,164

Alaska Plaice

The most recent full assessment was in 2014; this assessment includes updated catch data from 2015 and 2016 and new information on trawl survey biomass and age and length compositions from 2013 – 2016. There were no modifications to the assessment methodology.

Biomass for 2016 was 20% higher than that in 2015 (the lowest on record) but down 6% from 2014, and overall the trend in survey biomass continues downward. Biomass is supported by a 1998/1999 cohort that is aging, with more recent cohorts all ≤110% of the long-term average. The 2017 total (3+) biomass estimate for the EBS is 412,000t, a 3.2% reduction relative to the 2016 estimate of 425,217t. Alaska plaice biomass is still high relative to B40%, and is lightly exploited (mortality estimate 0.04). Modelling efforts indicate that Alaska plaice is not subject to overfishing, is not overfished, and is not approaching an overfished condition.

The authors' recommendation for the ABC in 2017 is a 14% decrease from the 2016 ABC, and 8% lower than the 2015 prediction for 2017. Projections are slowly declining, but above *B40%*. The SSC recommends adopting the authors' and PT's recommendations for continued management of the Alaska plaice stock under Tier 3a. **The SSC agrees with the authors' and PT's recommended ABCs and OFLs for 2017 and 2018.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Alaska plaice	BSAI	42,800	36,000	36,900	32,100

Other Flatfish

This is a Tier 5 stock complex consisting of 15 species of flatfish for which survey data are provided from regional bottom trawl surveys. The last full assessment was in 2012. This assessment includes updated catch data from 2015 and 2016 and new information on trawl survey biomass from 2016. There were no modifications to the assessment methodology.

Biomass for 2016 was up 7% across all geographic areas since the last full assessment. Biomass is at approximately $B_{95\%}$ for 2017. The Other Flatfish complex is not currently being subjected to overfishing, however concerns were raised about butter sole, for which the estimated exploitation rate from 2014-2016 has averaged 43%. Consequently, the SSC recommends that the authors complete the stock structure template, especially for butter sole.

The authors' recommendation for OFL and ABC are the same in 2017 and 2018, and up 25% over 2016. **The SSC agrees with the authors' and PT's recommended ABCs and OFLs for 2017 and 2018.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Other flatfish	BSAI	17,591	13,193	17,591	13,193

The SSC discussed impacts to one species in the complex, butter sole, for which half the estimated biomass was harvested in 2016. This may be of concern in future years, though it was also noted that harvest occurs at the fringes of the known range for this species.

BSAI Rockfish

Pacific Ocean Perch (POP)

This year's analysis represents a full assessment, following an "off-year" executive summary in 2015. All previously included data sources were updated with recent year's information and two changes were made: 1) adding the EBS slope survey data, and 2) removing the historical fishery CPUE series. Catches were updated through 2015 and projected for 2016.

The model recommended by the author (16.3) uses a revised approach to weighting of compositional data based on the harmonic mean method. This choice was based on better fit to the data than other candidate models, and potentially better performance of the data-weighting method for very short time series. The model results suggest that the stock is decreasing after a long period of increase from the early 1980s, although estimates of management quantities are higher than the previous assessment.

The SSC agrees with the author's and Plan Team's BSAI total OFL and ABCs, but recommends using the *unadjusted* apportioned values for area-specific ABCs. The SSC did not think that the approach for 'correcting' the survey estimates for use in apportionment by using model-based catchability and selectivity was appropriate for management use. Based on current status, this stock qualifies for management under Tier 3a and the 2017 and 2018 ABCs and OFLs are below in metric tons.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Pacific Ocean perch	EBS		12,199		11,924
	EAI		10,307		10,074
	CAI		8,009		7,828
	WAI		13,208		12,909
BSAI	Total	53,152	43,723	51,950	42,735

The SSC appreciates the work addressing several SSC comments from the December 2014 minutes and looks forward to continued work on several of these topics including:

- Continued investigation into the large and problematic retrospective pattern observed for this model.
- Further examine the evidence supporting the survey selectivity changes in the most recent years in the model.
- Explore estimates of biological parameters like maturity to see if there are trends in these estimates.
- Continue work on empirical studies of rockfish densities on trawlable and untrawlable grounds to help inform *a prior* distribution for survey catchability.
- The Plan Team's recommendation to further investigate the poor residual pattern observed in the fit to the AI survey index.

The SSC also recommends continued investigation into the estimation of natural mortality and the apparently constraining effect of the current prior.

Northern Rockfish

This year's analysis represents a full assessment, following an "off-year" executive summary in 2015. All previously included data sources were updated with recent year's information, and catches were updated through 2015 and projected for 2016.

The model recommended by the author (16.1) uses a revised approach to weighting of compositional data based on the harmonic mean method. This choice was based on better fit to the data than other candidate models, and potentially better performance of the data-weighting method for very short time series. The model results suggest that the stock has been relatively flat in recent years.

The SSC supports the authors' and Plan Team's recommended OFLs and ABCs. This stock qualifies for management under Tier 3a and the 2017 and 2018 ABCs and OFLs are below in metric tons.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Northern rockfish	BSAI	16,242	13,264	15,854	12,947

The SSC supports the two Plan Team recommendations to: 1) present plots of the predicted mean age and length compared to the observed age and length means over time (with confidence intervals); and 2) examine the residual pattern in the fit to the AI survey to see if there was a substantial change in the survey design or potential model misspecification that would explain the change in sign of the residuals between 2006 and 2010.

The SSC further recommends continued investigation into the poor retrospective pattern in this model.

Shortraker Rockfish

The 2017 estimated shortraker rockfish biomass is 22,191 t, which is approximately 4% smaller than the last full assessment (2014). According to the random effects model, total biomass (AI and EBS slope combined) from 2002-2016 has been very stable, ranging from a low of 21,214 t in 2006 to a high of 23,990 t in 2002.

The SSC has previously determined that reliable estimates of only biomass and natural mortality exist for shortraker rockfish, qualifying the species for management under Tier 5. **The SSC agrees with the Plan Team's recommendation for basing the biomass estimate on the random effects model and setting F_{ABC} at the maximum permissible level under Tier 5, which is 75 percent of M. The SSC accepts the ABC and OFL estimates for 2017 and 2018 (in mt) below:**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Shortraker rockfish	BSAI	666	499	666	499

The SSC agrees with the Plan Team's recommendation to exclude years prior to 1991 in the AI survey, due to changes in survey methodology, to be consistent with other AI stock assessments.

Blackspotted and Rougheye Rockfish Complex

This year's analysis represents a full assessment, following an "off-year" executive summary in 2015. All previously included data sources were routinely updated with recent year's information, with the important change that the EBS slope trawl survey biomass and age-composition data were included for the first time.

Length-at-age, weight-at-length and age-to-length conversion matrices were recalculated based on data from the AI trawl survey from 1991 onward. Catches were updated through 2015 and projected for 2016.

The model recommended by the author (16.5) uses a revised approach to weighting of compositional data based on the harmonic mean method. This choice was based on better fit to the data than other candidate models, and potentially better performance of the data-weighting method for very short time series. The model results suggest that the stock is increasing, although estimates of management quantities are lower than the previous assessment due to model changes. The latter result was noted as particularly important with regard to sub-area considerations.

The SSC agrees with the authors' and Plan Team's recommended BSAI total OFL and ABCs, but recommends using the *unadjusted* apportioned values for area-specific ABCs. The SSC did not think that the approach for 'correcting' the survey estimates for use in apportionment using model-based catchability and selectivity was appropriate for management use. Based on current status, this stock qualifies for management under Tier 3b and the 2017 and 2018 ABCs and OFLs are below in metric tons.

Stock/		**2017**		**2018**	
Assemblage	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Blackspotted/	EBS/EAI		306		374
rougheye	CAI/WAI		195		240
BSAI	Total	612	501	750	614

Based on the apportioned ABCs, the WAI Maximum Subarea Species Catch (MSSC) for 2017 is 29 t, and the CAI MSSC for 2017 is 166 t. For 2018, the WAI MSSC is 35 t, and the CAI MSSC is 204 t.

The SSC had some concern that the authors' choice of years over which to compute reference points (1977-2000) differed from the period recommended by the Recruitment Working Group (1977-2002). The SSC noted that if the 2002 year-class is included in future calculations, the status determination could change. The SSC recommends that the Plan Teams formally adopt the Recruitment Working Group's recommended period of years and request that authors provide supporting analysis where they advocate deviating from these recommendations.

The SSC noted the very large retrospective pattern observed in this assessment and recommends continued investigation to try to reduce or at least better understand this problem.

Although the use of a single model for the whole area (AI and BS) was recommended this year by the SSC, it may not represent the best approach. The SSC recommends that this choice be reevaluated, with particular investigation into which aspects of adding the EBS data, and how treatment of these data in a combined analysis, are most influencing the model results.

The SSC also supports the additional Plan Team recommendations for this assessment, that the author explore the interplay of catchabilities with availabilities in the incorporation of the slope survey into the model and that catch continue to be monitored relative to the MSSC.

The SSC had substantial discussion regarding the use and achievement of recent and future MSSCs. The **SSC recommends further analyses on two topics in preparation for the 2017 PT and SSC process: 1) the biological basis for dividing the species catch, and for using the specific current management line between the WAI and CAI; and 2) the relative merits of MSSCs versus alternative management tools.**

The SSC received public testimony from Chad See and Gerry Merrigan (Freezer Longline Coalition). Their presentation highlighted the apparent inconsistency that survey indices are up in 2016 (except in CAI and

WAI), but assessment results and, importantly, the WAI MSSC is down. Recent catches have been higher than projected MSSCs for 2017-2018 in the WAI. They stated that, with more target abundance (POP, Pacific cod), the fishery may have a harder time achieving the lower MSSC for 2017, suggesting a transition (e.g., stair-step or average) rather than moving directly to the new MSSC. They noted that there are few management tools to 'slow down' this fishery in-season with regard to RE/BS bycatch. The SSC also received testimony from Todd Loomis (F/V Seafisher, F/V Ocean Peace), who reported concern that the low WAI MSSC was being influenced by increases in other areas. Mr. Loomis stated that bycatch rates are currently low relative to historical fishery behavior. He further noted that some of the fishing occurs along the management boundary between the WAI and CAI, and questioned the necessity of such a large differential between limits for proximate fishing areas.

Other Rockfish Complex

The 2016 assessment reported that survey biomass of Other Rockfish was somewhat lower than the historic high seen in the 2014 AI survey, but was at a historic high in the EBS slope survey.

New data in the 2016 assessment included updated catch and fishery lengths for 2016. Biomass estimates, CPUE, and length frequency compositions were also included from the 2016 Aleutian Island trawl survey and the 2016 eastern Bering Sea slope survey. Biomass estimates were also added from the 2015 and 2016 Bering Sea shelf survey.

The SSC agrees with the Plan Team's recommended approach of setting F_{ABC} at the maximum allowable under Tier 5 ($F_{ABC} = 0.75M$). The accepted values of M for species in this complex are 0.03 for shortspine thornyheads and 0.09 for all other species. Multiplying these rates by the best biomass estimates of shortspine thornyhead,and other rockfish species in the "other rockfish" category yields the 2017 and 2018 OFL and ABCs, which are accepted by the SSC and tabulated below (in mt).

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Other rockfish	EBS		791		791
	AI		571		571
	Total	1,816	1,362	1,667	1,250

The SSC agrees with the Plan Team's recommendation that the author explain the discrepancy between the estimate of M used in the assessment (0.03) and what is stated as preferred by the author in the SAFE document (0.038).

BSAI Sharks

A full assessment for the BSAI shark complex was presented. This complex is in Tier 6, with the OFL specified based on the maximum historical catch from the period 1997-2007. There are not reliable estimates of BSAI shark biomass from the surveys, and trends are difficult to identify because sharks are unavailable to the trawl gear.

In 2014, the SSC and Plan Team recommended re-evaluating model options at the next full assessment (2016), the reasoning being a few years of data would have been collected under the restructured observer program.

In response to this request, the authors presented differing years for assessing catch and compared these with the status quo harvest specification period. The years evaluated included:

1) 1997-2007 (status quo period)
2) 2003-2015 (authors preferred period)
3) 2013 -2015 (post-restructuring period)

For each period, the authors evaluated setting the OFL to the average or the maximum of the catch. The author and Plan Team's preferred model uses the maximum catch from 2003-2015 for setting harvest specifications.

Public testimony was provided by Chad See and Gerry Merrigan (Freezer Longline Coalition), who expressed their concerns about the authors' and Plan Team's recommended model. There was a strong concern that the ABC and OFL would have been exceeded in the past under the authors' and Plan Team's preferred specification time period. They advocated for maintaining status quo. Concern was also expressed that water temperature may increase catch rates of sharks, based on warm water occurring in the late 1990s and early 2000s coinciding with high shark catch. SSC discussion pointed out that that catch has remained low during recent periods of warm water.

SSC discussion was focused on high shark catch in 2002 (1,363 tons). The 2002 estimate is an outlier when compared to all other years (1997 – 2015; approximately twice as high as the maximum catch 2003-2015). Investigation of these data found the catch was high due to a single, large basking shark observed as bycatch on a longline vessel. The sampled basking shark was estimated to weigh 5 tons (since it could not be weighed), which was extrapolated to two sharks for a total haul weight of approximately 10 tons. The large size of that single animal (recorded beyond known maximum weight for the species) extrapolated out to a large estimated catch that, when used in the pseudo-blend catch estimation procedure, resulted in extrapolation to unobserved vessels and a large total catch for the "other" sharks group in 2002. However, removing the 2002 data point results in OFLs and ABCs that are similar to those for the 2003-2015 time series. Basking sharks are clearly a rare event, with two recorded catches since 1997- one in longline and one in trawl (2015). **Given the 2002 estimate appears to be biased high due to an inaccurate weight estimate, the SSC recommended not using the 2002 estimated catch for setting the shark complex harvest specifications.**

Further, the 2003-2015 period represents the best available information due to new data collection and estimation methods, including estimation in the catch accounting system; improvements to species identification and observer protocols; and inclusion of years under the restructured observer program (which placed CPs in full coverage). For this time period, the OFL is equal to the maximum catch in 2006, and assessment catch table (table 20.4) shows the new ABC would not have been exceeded in the last 10 years. **The SSC concurred with the authors' and Plan Team's recommended time period and resultant harvest specifications.**

The SSC recommends that the authors bring forward, in the next full assessment, harvest specification options discussed in the Plan Team (using the 2003-2015 time period), with a discussion of the tradeoffs between the methods and the management and conservation of BSAI sharks. The SSC supports the Plan Team request to provide catch of sleeper sharks in numbers to better evaluate average weight and catch trends.

The SSC also requests the following for future assessments:

- Investigate the relationship between bottom temperature and catch trends, and
- follow the model numbering format

The SSC also encourages further investigations to age sleeper sharks, which has not been possible to date. The author recommended several potential new methods for investigation.

Stock/ Assemblage	**Area**	**2017 OFL**	**2017 ABC**	**2018 OFL**	**2018 ABC**
Shark	BSAI	689	517	689	517

BSAI Skates

A full assessment was presented for BSAI skates in 2016. The skate complex is managed as a single unit for the BSAI and consists of two models, one for Alaska skate and one for all other skates (14 species). Within the complex, Alaska skate are assessed as a Tier 3 stock and the remaining skate species ('other skates') are managed as Tier 5 due to a lack of reliable age-specific information.

Total skate survey biomass has increased for the EBS shelf and EBS slope, and declined for the Aleutian Islands. The EBS shelf survey accounts for approximately 80% of the overall skate biomass among the areas, and is almost entirely composed of Alaska skates. Biomass trends for the predominant species were stable or increasing. However, the SSC noted the declining trend in leopard skate biomass in the AI survey, which has declined 67% from its 2010 survey biomass estimate (12,958 t to 4,220 t in 2016). This decline highlights the need for species-specific catch estimation of skates, and for life history information for this species and the other endemic AI skate, the butterfly skate. Overall, catch is stable and historically high the last few years, with most catch occurring in the longline fisheries.

Alaska skate

Three models were presented for Alaska skate: the previously accepted model (14.2); a model with asymptotic selectivity for the trawl and longline fisheries (14.3); and a version of model 14.2 started in 1977 rather than 1977. **Results among models were similar and the SSC recommends the author's and Plan Team recommended model 14.2. The species remains in Tier 3a.**

In addition to supporting the Plan Team's recommendations, the SSC has the following recommendations:

- Re-evaluate the use of trawl survey data to apportion longline. The assessment uses trawl survey species composition to apportion Alaska skate from other skates caught in the longline fishery. Trawl species composition from a survey maybe quite different from species composition in the longline fishery. Speciation in the observer data has improved since the Ormseth and Matta (2007] paper referenced in the assessment. The author should compare the observer data from the longline fishery to the trawl survey catch to evaluate this assumption.
- The assessment should incorporate relevant information pertaining to the relationship between water temperature and recruitment. Development time for some skate species is influenced by water temperature (i.e., warmer water results in shorter development periods). This may functionally affect recruitment trends and variability.
- The stock structure section for Alaska skates has conflicting and inaccurate information regarding national standard guidelines. This section needs to be updated.

Other Skates

A random effects model is used for the harvest specifications for the remaining skate species in the complex, which are primarily whiteblotched skates. **The SSC recommends the Plan Team's and authors' recommended model.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Skate	BSAI	49,063	41,144	46,583	39,008

As possible, future assessments should include information on the distribution and abundance of endemic skate species (such as the leopard skate), spatial information on fishery catch, and available biological information. Fishery impacts to rare species managed as part of a complex can be extreme in the face of limited population-level information.

BSAI Sculpins

The BSAI sculpin complex is managed as a Tier 5 stock and is assessed biennially with a full assessment in 2016. New data in this this year's assessment included updated catch; biomass and length estimates from the 2016 EBS slope survey, 2015 and 2016 EBS shelf survey, and the 2016 AI survey. A standard random effects model was used to provide estimates of ABC and OFL for 2016 and 2017.

Models are separated by region (Aleutian Islands, Bering Shelf, and Bering Sea slope), and estimated separately for the 6 most common sculpin species, and for all other sculpins combined. The random effects models appeared to fit the survey data well (Figure 9). Natural mortality is calculated as the survey biomass-weighted average of the instantaneous natural mortality rate for the six most abundant species. The estimate of natural mortality decreased from 0.290 to 0.283, and biomass increased from 194,783 t to 199,937 t.

The SSC concurs with the authors' and Plan Team's recommended specifications, based on the random effects modeling approach. The SSC also encourages the assessment author to work with AKRO/AKFIN staff to insure commercial catch is accurately queried from the Catch Accounting System. Small discrepancies between catch tables within the current assessment and past assessments were noted.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Sculpin	BSAI	56,582	42,387	56,582	42,387

The SSC appreciates the recent life history information that has been developed for the most common sculpin species, but both the author and SSC note the need for additional age validation studies.

BSAI Squid

A full assessment was presented for squid this year. Squids are managed under Tier 6 because the groundfish bottom trawl surveys do not provide reliable biomass estimates. Harvest recommendations for the Bering Sea and Aleutian Islands (BSAI) squid complex are currently made based on historical catch. Until the 2015 assessment cycle, the overfishing level (OFL) was set equivalent to the average historical catch during 1978-1995. In 2014 and 2015, squid catches increased and the current specifications acted as a constraint on the directed pollock fishery, where most squid are captured. As a result the Plan Teams and the SSC requested that the assessment author revisit the analytic approach and develop a set of harvest recommendations that better reflect a sustainable level of squid removals. A number of alternative approaches were examined, and the author, Plan Team, and SSC were in agreement that setting OFL as the average catch during the earliest part of the catch history (1977-1981) was the best alternative. The advantages of using this earlier time period are: (1) the fishery is consistent during this period (i.e., all fishing was by foreign fleets); and (2) catches during this era are more likely to reflect sustainable catches, either because there was targeting of squid or because there was greater overlap between the fisheries and squid.

The assessment inputs were updated but there were no changes to the assessment methods. Catch data were updated through October 16, 2016. Survey biomass estimates were updated to include the 2015 and 2016 EBS shelf survey, the 2016 EBS slope survey, and the 2016 AI trawl survey.

In 2015, the SSC and the Plan Team recommended that the author examine the cause behind the dramatic decline in catch in the early 1980s for the 2016 assessment, and that the author consider whether certain environmental conditions may be correlated with squid catch and abundance in the surveys. The report now includes an exploration of how CPUE and effort varied during the early part of the historical catch time series (1977-1990). In addition, the author provides limited discussion regarding how squid populations may respond to environmental change, particularly increased ocean temperature. The Plan Team minutes note that the author presented an analysis (not in the assessment) relating mean July mantle length in the fishery with May SST anomalies to investigate the relationship between temperature and mean smaller lengths observed. The Team recommends that the author continue to evaluate this and include temperature data available from the survey (of continuous temperature sampling as well as bottom temperature data) and its relationship to mantle length. The Team also recommends considering a spatial analysis of mantle length and temperature. These analyses were not included in the SAFE report and were not presented to the SSC. The SSC supports the Plan Team's recommendation for further work on this topic and requests that these analyses be included in the next full squid assessment.

The Plan Team's and the authors' recommend OFL should continue to be based on the average catch from 1977-1981 time period. The SSC concurs and supports the authors' and Plan Team's recommended ABC and OFL.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Squids	BSAI	6,912	5,184	6,912	5,184

The squid complex is not being subjected to overfishing. It is not possible to determine whether this species complex is overfished or whether it is approaching an overfished condition because it is managed under Tier 6.

BSAI Octopus

A full assessment was presented for octopus this year. There are seven species of octopuses managed under the BSAI octopus complex, but the giant Pacific octopus dominates the incidental catches from commercial fisheries. Since 2013, BSAI octopus harvest specifications have been based on the consumption of octopus by Pacific cod. The geometric mean of all annual estimates of predation mortality by Bering Sea Pacific cod on octopus is used as an estimate of total natural mortality (N), and is combined with the general logistic fisheries model to set OFL=N and ABC=0.75*OFL.

There were no changes to this Tier 6 alternative consumption method. The new data included in this analysis included additional Pacific cod stomach data through 2015 (about 9,000 new samples), 2016 ESB slope and shelf survey data, the 2016 AI survey data, and the 2015 and 2016 (preliminary) catch data. Increases in both Pacific cod and percentage of octopus in Pacific cod diet increased the annual consumption estimates from 2009-2015. All of the 2016 survey biomass estimates were similar to or higher than all the previous estimates. There was a substantial increase in octopus biomass in 2015 and 2016 in the Gulf of Alaska as well. Species composition and size frequencies from the surveys were similar to previous years. The 2014 - 2016 catch rates are stable at about 430 t (well below the ABC) with retention at about 17%.

The authors and the Plan Team continue to recommend the use of this alternative Tier 6 method for the 2016 and 2017 harvest specifications. T**he SSC agrees with this approach and supports the Plan Team's ABC and OFL recommendations.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Octopus	BSAI	4,769	3,576	4,769	3,576

The octopus complex is not being subjected to overfishing. It is not possible to determine whether the octopus complex is overfished or whether it is approaching an overfished condition because it is managed under Tier 6.

The SSC commends the analysts on the substantial work involved in producing the new data for this assessment (9000 additional stomach samples) and looks forward to completion of the 2012 and 2013 Pacific cod diet data analysis for inclusion in the assessment.

The SSC noted that the octopus beak to weight analysis in the report indicates that the largest octopus in the cod diet data corresponds to the smallest in the commercial samples. The SSC recommends that the author and Plan Team examine the implications of this on the assessment. In addition, the SSC expressed interest in the potential for beaks to be used to apportion the stomach content data to species and recommends that the authors pursue efforts to evaluate the plausibility of this approach.

BSAI Forage Fish

There was no update to the BSAI Forage Fish chapter, as this is an off year, but Diana Stram (Council Staff) provided a brief overview of materials contained in the C6 Supplemental Herring PSC Management document.

The SSC appreciated the update and expressed concern over the loss of State of Alaska surveys for BSAI herring due to budget cuts. The SSC noted that analyses have been conducted since Amendment 16A was adopted as part of the Bering Sea/Aleutians Islands Groundfish Fishery Management Plan, indicating a change in the BSAI herring distributions since 1991 and recommending a review of the Herring Savings Areas implemented through Amendment 16A (Tojo et al., 2007). The 2015 BSAI Forage Fish Chapter presented a geographic distribution map of the 2010–2014 herring PSC that supports the change in herring distribution identified in Tojo et al. (2007), indicating that herring distributions continue to differ from those upon which Amendment 16A was based.

Therefore, the SSC recommends that the Herring Savings Areas established by Amendment 16A be reviewed and revised, as appropriate. The SSC also recommends that the Forage Fish Chapter not be moved into the Ecosystem Chapter (see minutes in the GOA Forage Fish section below) due to the different purposes of the two chapters and to prevent the potential loss of details pertinent to the status of this species complex.

<u>Citation:</u> Tojo N., G.H. Kruse, F.C. Funk (2007) Migration dynamics of Pacific herring (*Clupea pallasii*) and response to spring environmental variability in the southeastern Bering Sea. *Deep Sea Research Part II* 54: 2832-2848.

GOA Walleye Pollock

Last year's approved model (Model 15.1a.) was used as the base model. Several relatively minor modifications to Model 15.1a focused on changes to model inputs as recommended by the Plan Team last year: 1) Model 16.1: a change in how weight-at-age for 2016 and 2017 is computed, which was prompted by concerns over a sharp decline in observed weight-at-age in 2015; 2) Model 16.2: a change in the estimator used for ADF&G trawl survey biomass (delta-GLM approach); 3) Model 16.3: revised estimates of net selectivity in the Shelikof Strait acoustic survey; and 4) Model 16.4: using a GLMM estimator for NMFS bottom trawl survey biomass.

Biomass estimates in both the 2015 and 2016 ADF&G surveys were very low, resulting in a poor fit to these data. Using a delta-GLM model (16.2) resulted in larger CVs for these two survey data points and a corresponding decrease in their influence on model results. The delta-GLM approach was an improvement over the previous area-swept method with an assumed fixed CV across surveys. Further modifications of the model (16.3, 16.4) were postponed, pending further exploration of the selectivity issues and the geospatial approach. Model 16.2 fitted the various data sources reasonably well. The spawning stock is estimated to be at 54.5% of the unfished level, up from a low of 25% in 2003 and from a level of 33% in 2016.

The SSC agrees with the author and Plan Team to accept model 16.2 for harvest specifications. The stock is in Tier 3a as female spawning biomass is well above $B_{40\%}$. (East Yakutat and Southeastern Alaska are actually Tier 5 calculations involving a random effects model applied to bottom trawl survey data.) **The SSC recommends adopting the authors' and PT's recommendations for OFL and ABC (see table below).**

Area apportionments are based on the most recent data available within each season (Appendix C, GOA pollock chapter). The NMFS bottom trawl survey had been considered the most appropriate survey for apportioning TAC during the summer C and D seasons. But last year, the Plan Team recommended that the average of the annual summer acoustic survey estimate and the estimate from the random effects model of bottom-trawl survey be used instead, so this averaging approach is now the default. The resulting area apportionments, reduced by 2.5% of the ABC for the State of Alaska managed pollock fishery in Prince William Sound, are in the overall summary table.

Stock/		2017		2018	
Assemblage	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	State GHL		5,094		3,937
	W (61)		43,602		33,701
	C (62)		98,652		76,249
	C (63)		48,929		37,818
	WYAK		7,492		5,791
	Subtotal	235,807	203,769	182,204	157,496
	EYAK/SEO	13,226	9,920	13,226	9,920
	Total	249,033	213,689	195,430	167,416

SSC recommendations to the authors:

- A number of assessments are adopting the geostatistical approach for estimating survey biomass and its uncertainty. The approach is well documented and often results in improved estimates; hence the SSC encourages further exploration of a geostatistical biomass estimate, as in Model 16.4.
- The SSC looks forward to suggestions for model improvement during the CIE review in 2017.

GOA Pacific cod

The stock assessment for GOA Pacific cod was presented to the SSC by its new lead author, Dr. Steve Barbeaux (AFSC) and Plan Team recommendations were summarized by GOA Plan Team Co-Chair Dr. Jim Ianelli (AFSC).

For this assessment, all previously included data sources were updated with recent year's information, and a number of important changes were made, particularly the inclusion of the AFSC longline survey index and length data, and aggregation of fishery data that had previously been partitioned into seasons into just three gear types (trawl, longline, and pot). The GOA bottom trawl survey index declined from a very large and uncertain estimate in 2009 through the most recent survey in 2015. The AFSC longline survey index was down slightly in 2016, but above a recent low observed in 2013, with a different trend than the bottom trawl survey. Of note was the observation that the mean size for all fisheries appears to be in decline for recent years.

The author provided a summary of the history of the GOA Pacific cod models, including some evaluation of the relevant biological and fishery features that had been included. The author broadly described the modelling effort transitioning from the previous assessment (model 15.3) to the new models. The author presented a set of models to the Plan Teams in September, and added features that could be evaluated both sequentially and in parallel. Specific changes to the September base model (model 16.6) included addressing the SSC's recommendation regarding extending the plus group, using conditional age-at-length in place of marginal ages, and adding an R1 offset to the initial conditions. From that effort, alternative models adding the estimation of natural mortality (M), treatment of trawl survey catchability, and treatment of fishery and survey selectivity (i.e., dome-shaped, time-varying) were developed for this assessment. These efforts resulted in 11 new models, the set reflecting a broad degree of uncertainty regarding absolute stock size and some difference in recent biomass trends.

The model recommended for management use this year (model 16.08.25) represents a substantially different view of Pacific cod biology and population dynamics than both historical and recent assessments. The new model suggests a much higher rate of natural mortality, a much smaller absolute stock size, and a higher degree of productivity. Despite these differences, the absolute change in recommended OFLs and ABCs was relatively small due to increased productivity. The recommended model estimates a relatively large 2012 year class, and much lower recruitments since then.

The SSC concurs with the Plan Team's recommendations on setting OFL and area-specific ABCs using the random effects approach for area apportionments, which results in the values summarized below. Based on current status, this stock qualifies for management under Tier 3a and the 2017 and 2018 ABCs and OFLs are below in metric tons.

Stock/ Assemblage	**Area**	**2017 OFL**	**2017 ABC**	**2018 OFL**	**2018 ABC**
Pacific cod	W		36,291		32,565
	C		44,180		39,644
	E		7,871		7,063
	Total	105,378	88,342	94,188	79,272

In addition to supporting the Plan Team's recommendation for future work, the SSC has the following recommendations:

- The SSC noted that the estimated value for M in the author's preferred model was 0.47, using a prior with a mean of 0.38 and a CV of 0.1. A number of studies were referenced suggesting a range of M that is potentially broader than implied by the current prior. All three Pacific cod assessments could benefit from a consistent formal prior on M based on the variety of studies referenced in each. The SSC recommends that a prior for use in all Pacific cod assessments be developed for 2017 and explored for use in the GOA Pacific model.
- Investigation of whether the fishery is accessing older cod. The author noted that there are otoliths that have been collected from the cod fishery, but have not been aged. Given the result in this year's model that there are far fewer old Pacific cod in the stock than in recent assessments, the SSC recommends that ageing additional fishery otoliths for this assessment be a priority, noting that the AFSC has an ongoing ageing-prioritization analysis which may guide their future efforts, and the author has recommended working with the age and growth lab on this project. Along these lines, ages underlying the study defining current maturity schedules (Stark, 2007) should be re-aged, and the data re-analyzed in light of recent information regarding ageing bias (i.e., Kastelle et al., 2017).
- Aging bias should be explicitly included in the next assessment.
- The author presented qualitative tagging results suggesting some transfer between the Unimak Pass area of the GOA and the Bering Sea. The SSC recommends further exploration of this information on stock boundaries and comparison with genetic and other studies.
- In light of the breadth of hypotheses used in historical assessments and reflected in the retrospective comparison of previous spawning biomass trends (Figure 2.15), the SSC noted that structural uncertainty in this assessment is large (a similar situation to EBS Pacific cod). The outcome from the planned modeling workshop will be informative for assessing structural uncertainty in this assessment.

GOA Atka Mackerel

An executive summary was provided this year for the Gulf of Alaska (GOA) Atka mackerel stock assessment. GOA Atka mackerel are managed as a Tier 6 stock. The OFL and ABC recommended for this Tier 6 stock were unchanged as the reference period was unchanged. The SSC endorses the OFL and ABC levels (in mt) recommended by the author and the Plan Team.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Atka mackerel	GOA-wide	6,200	4,700	6,200	4,700

GOA Flatfish
This is a non-survey year for GOA flatfish species and only executive summaries were provided by authors.

Shallow-water Flatfish Complex
The assessment included revised 2015 catch and the partial 2016 catch as well as 2016 catch projections for northern and southern rock sole. Projected catch to the end of 2016 is calculated as the average fraction of catch to October 13 from the last 10 years (83.4%). The projected 2017 catch is set equal to the projected 2016 catch. This is a change from previous assessments, which assumed maximum permissible ABC as the catch for the upcoming year. The random effects model was used to estimate 2015 biomass for the Tier 5 calculations.

Northern and southern rock sole are in Tier 3a while the other species in the complex are in Tier 5.

For the shallow water flatfish complex, ABC and OFL for southern and northern rock sole are combined with the ABC and OFL values for the rest of the shallow water flatfish complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern. The recommended apportionment for the 2017 ABC are estimated using the random effects model estimates of biomass for the shallow water flatfish complex by management areas.

The SSC supports the authors' and Plan Team's recommendations for ABC and OFL in 2017 and 2018 and area apportionments using combined Tier 3 and Tier 5 calculations for this stock complex (see table at end of flatfish section).

Deepwater Flatfish Complex
The deepwater flatfish complex is composed of Dover sole, Greenland turbot, and deepsea sole. This complex is assessed on a biennial schedule to coincide with the timing of survey data. New information available to update the Dover sole projection model consisted of updated 2015 catch and catch estimates for 2016 and 2017.

Dover sole is a Tier 3 stock which is assessed using an age-structured model. A single species projection model was run using parameter values from the accepted 2015 Dover sole assessment model. Both Greenland turbot and deepsea sole are in Tier 6. Dover sole comprises approximately 98% of the deepwater flatfish complex and is the main component for determining the status of this stock complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern.

Apportionment for the deepwater flatfish complex was done using the random effects model to fill in depth and area gaps in the survey biomass by area for Dover sole. The resulting proportion of predicted survey biomass in each area formed the basis for apportionment of the Dover sole portion of the deepwater complex. The Greenland turbot and deepsea sole portion was based on the proportion of survey biomass for each species in each area, averaged over the years 2005-2015. The ABC by area for the deepwater flatfish complex is then the sum of the species-specific portions of the ABC. **The SSC supports the authors' and Plan Team's recommendations for ABC and OFL for 2017 and 2018 and area apportionments for the GOA deepwater flatfish assemblage.**

Rex Sole

The projection model was run using updated 2015 catch and new/estimated catches for 2016-2017.

A Tier 5 approach (using model estimated adult biomass) is used for rex sole ABC recommendations due to unreliable estimates of *F40%* and *F*35%. ABCs and OFLs are calculated using the catch equation applied to beginning year biomass values estimated by the age structured model. Area apportionments of rex sole ABCs for 2017 and 2018 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. **The SSC supports the authors' and Plan Team's recommendations for ABC and OFL and area apportionments for 2017 and 2018.**

Arrowtooth Flounder

Parameter values from the previous year's assessment model, projected catch for 2016, and updated 2015 catch were used to make projections for ABC and OFL estimates. Arrowtooth flounder biomass estimates are very similar to those estimated in the last full assessment in 2015. The projection model estimate of total (age 1+) biomass shows a slight decrease to 2,103,090 t in 2017. Female spawning biomass in 2017 was estimated at 1,174,400 t, which is above *B40%*, and is essentially equivalent (0.5% decrease) to the 2016 estimate in last year's assessment. Arrowtooth flounder is estimated to be in Tier 3a. **The SSC supports the authors' and Plan Team's recommendations for ABC and OFL and area apportionments for 2017 and 2018.**

Flathead Sole

The projection model was run using updated 2015 catch and new estimated total year catches for 2016-2017. The 2017 spawning biomass estimate (82,819 t) is above *B40%* (36,866 t) and projected to be stable through 2018. Total biomass (3+) for 2017 is 269,638 t and is projected to slightly increase in 2018.

Flathead sole are determined to be in Tier 3a. Area apportionments of flathead sole ABCs for 2017 and 2018 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. As this is an off-cycle year, only an executive summary was provided. **The SSC supports the authors' and Plan Team's recommendations for ABC and OFL and area apportionments for 2017 and 2018.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Shallow-water flatfish	W		20,921		21,042
	C		19,306		19,418
	WYAK		3,188		3,206
	EYAK/SEO		1,099		1,105
	Total	54,583	44,514	54,893	44,771
Deep-water flatfish	W		256		257
	C		3,454		3,488
	WYAK		3,017		3,047
	EYAK/SEO		2,565		2,590
	Total	11,182	9,292	11,290	9,382
Rex sole	W		1,459		1,478
	C		4,930		4,995
	WYAK		850		861
	EYAK/SEO		1,072		1,087
	Total	10,860	8,311	11,004	8,421
Arrowtooth flounder	W		28,100		25,747
	C		107,934		98,895
	WYAK		37,405		34,273
	EYAK/SEO		12,654		11,595
	Total	219,327	186,093	196,635	170,510
Flathead sole	W		11,098		11,282
	C		20,339		20,677
	WYAK		2,949		2,998
	EYAK/SEO		857		872
	Total	43,128	35,243	43,872	35,829

GOA Rockfish

Pacific Ocean Perch

New data added to the projection model included updated 2015 catch and new projected total year catches for 2016-2018. The 2017 spawning biomass estimate (156,563 t) is above $B_{40\%}$ (114,131 t). The projected 2018 spawning stock biomass estimate is 156,444 t. The GOA Pacific ocean perch stock was determined to be in Tier 3a. The apportionment of ABCs is based on the random effects model applied to the subarea biomass indices from the GOA trawl survey.

The SSC accepts the OFL and ABC recommendations of the Plan Team and the assessment authors. The SSC also accepts Plan Team area apportionment of ABCs among GOA areas and continue using the upper 95% confidence interval of the ratio in biomass to apportion catch between WYAK and EYAK/SEO following the previous assessments.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Pacific ocean perch	W		2,679		2,627
	C		16,671		16,347
	WYAK		2,786		2,733
	W/C/WYAK	25,753	22,136	25,252	21,707
	SEO	2,073	1,782	2,032	1,747
	Total	27,826	23,918	27,284	23,454

Northern Rockfish

New data added to the projection model included updated 2015 catch and projected total year catches for 2016-2018. The 2017 spawning biomass estimate (29,198 t) is above $B_{40\%}$(27,983 t) and projected to decrease to 27,344 t in 2018. Total biomass (2+) for 2017 is 75,028 t and is projected to decrease to 73,248 in 2018. Northern rockfish are estimated to be in Tier 3a in 2017 and 3b in 2018. Area apportionments of northern rockfish ABC's for 2017 and 2018 are based on the random effects model applied to GOA bottom trawl survey biomass for the Western, Central, and Eastern Gulf of Alaska. The small northern rockfish ABC apportionments from the Eastern Gulf are combined with other rockfish for management purposes.

The SSC supports the ABCs and OFLs, and apportionments, recommended by the authors and Plan Team.

Stock/		2017		2018	
Assemblage	Area	OFL	ABC	OFL	ABC
Northern rockfish	W		432		400
	C		3,354		3,108
	E		4		4
	Total	4,522	3,790	4,175	3,512

Shortraker Rockfish

Shortraker rockfish are a Tier 5 species for specifications where F_{ABC} = 0.75, M = 0.0225, and F_{OFL} = 0.03. ABCs and OFLs are based on the random effects model using an estimated survey biomass that remains stable.

The apportionment percentages are the same as in the 2015 assessment (for the 2016 fishery). Authors note that catches in the Western GOA have exceeded this apportionment in 2015 (47 t) and 2016 (52 t as of Nov 5th 2016) and in the Central GOA in 2016 (395 t as of Nov 5th, 2016). **The SSC accepts the Plan Team's and authors' recommendations for ABC and OFL. as well as the area apportionments.**

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Shortraker rockfish	W		38		38
	C		301		301
	E		947		947
	Total	1,715	1,286	1,715	1,286

<u>Other Rockfish (Combination of Slope Rockfish and Pelagic Shelf Complex Species)</u>
The estimated biomass of 104,826 t is based on the random effects model applied to survey biomass for the Tier 4 and 5 species in the complex. Surveys indicate stability for this complex. Area apportionment is based on the sum of random effects model biomass (Tier 4/5 species) and catch history (Tier 6 species) by region. As in previous recent assessment, a single ABC for the combined WGOA and CGOA areas is used to address concerns about the ability to manage smaller ABCs in the WGOA. The SSC agrees with the Plan Team's and authors' ABCs, OFLs, and area apportionments (including the 4 t from the northern rockfish category). Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Assemblage /Stock	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Other rockfish	W/C		1,534		1,534
	WYAK		574		574
	EYAK/SEO		3,665		3,665
	Total	7,424	5,773	7,424	5,773

<u>Dusky Rockfish</u>
New data added to the projection model included updated 2015 catch and new projected catches for 2016-2018. The 2017 projected spawning biomass estimate (23,178 t) is above $B_{40\%}$ (19,707 t) and projected to decrease to 21,554 t in 2018. The dusky rockfish stock is in Tier 3. **The SSC concurs with the Plan Team's and the authors' ABCs and OFLs.**

Assemblage /Stock	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Dusky rockfish	W		158		146
	C		3,786		3,499
	WYAK		251		232
	EYAK/SEO		83		77
	Total	5,233	4,278	4,837	3,954

Rougheye and Blackspotted Rockfish

New data added to the projection model included updated 2015 catch and new projected total year catches for 2016-2018. Female spawning biomass (13,754 t) is above $B_{40\%}$ (8,226 t) and projected to remain stable. The rougheye/blackspotted complex qualifies as a Tier 3a stock. Apportionment of the 2017 and 2018 ABC is based on the same method used last year (3 survey weighted average). **The SSC accepts the Plan Team's and authors' recommended ABCs and OFLs, and apportionments.**

Assemblage /Stock	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Rougheye/blackspotted Rockfish	W		105		104
	C		706		702
	E		516		512
	Total	1,594	1,327	1,583	1,318

Demersal Shelf Rockfish (DSR)

Catch information and average weights for yelloweye rockfish catch from the commercial fishery were updated for 2016. For 2016, 2017, and 2018 the non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. Non-yelloweye Tier 6 ABCs and OFLs are added to the Tier 4 yelloweye ABCs and OFLs for total DSR values. Overall density estimates have declined in all management areas in recent years. CSEO exhibited the biggest downward trend. In SSEO trends increased through 2003, and then declined. The EYKT density estimates are more variable and relatively stable through the survey time series.

The Plan Team and authors recommend an *F=M* harvest rate lower than the maximum permissible and the SSC agrees. Due to updated average body weight based on fishery data, updated biomass projections, and Tier 6 calculations for non-yelloweye rockfish,DSR is down slightly from that recommended for 2016.

Results from the statistical age-structured model for yelloweye rockfish in southeast outside Alaska waters was presented as an appendix.

The SSC was encouraged by the development of the statistical age-structured model for yelloweye rockfish in southeast outside Alaska waters and looks forward to reviewing preliminary model results in October2017.

Stock/ Assemblage	Area	2017 OFL	2017 ABC	2018 OFL	2018 ABC
Demersal rockfish	Total	357	227	357	227

Shortspine Thornyhead

New catch information includes updated 2015 and estimated 2016 catch. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern. Apportionment is based on random effects estimation of biomass by region, fit to 1984-2015 trawl survey biomass estimates. **The SSC agrees with Plan Team's and authors' recommendations for ABCs, OFLs, and area apportionments.**

Stock/ Assemblage	**Area**	**2017 OFL**	**2017 ABC**	**2018 OFL**	**2018 ABC**
Shortspine Thornyhead	W		291		291
	C		988		988
	E		682		682
	Total	2,615	1,961	2,615	1,961

GOA Sharks
In this off-cycle year, estimates from the 2015 full assessment are rolled over for the next two years. New information includes updated 2015 and estimated 2016 catch. The GOA shark complex includes spiny dogfish, Pacific sleeper shark, salmon shark, and other/unidentified sharks. Reliable total biomass estimates for the shark complex are unavailable, and little is known about spawning biomass or stock status trends. Sharks are caught incidentally in other target fisheries. Catches of sharks from 1992 through 2016 have been well below the ABC first established for the shark complex in 2011. There are insufficient data to determine if the shark complex is in an overfished condition and the complex is managed Gulf-wide.

Plan Team ABC/OFL recommendations based on a Tier 5 approach (termed a modified Tier 6 or Tier 6*) were used for the spiny dogfish component of the complex, while other components were treated as a single Tier 6 "species." The SSC concurrs with the Plan Team's recommendation to continue with this approach.

Stock/ Assemblage	**Area**	**2017 OFL**	**2017 ABC**	**2018 OFL**	**2018 ABC**
Sharks	GOA-wide	6,020	4,514	6,020	4,514

GOA Skates
The survey biomass trend was mixed between the species . Big skate biomass increased, other skates decreased, and longnose skates were stable. Catch as currently estimated did not exceed any Gulf-wide OFLs and it is not possible to determine the status of stocks in Tier 5 with respect to overfished status. The SSC concurred with the Plan Team's ABCs, OFLs and use of the random effects model for estimating proportions by area. Big and longnose skates have area-specific ABCs and Gulf-wide OFLs; other skates have a Gulf-wide ABC and OFL.

Stock/ Assemblage		2017		2018	
	Area	OFL	ABC	OFL	ABC
Big Skate	W		908		908
	C		1,850		1,850
	E		1,056		1,056
	Total	5,086	3,814	5,086	3,814
Longnose Skate	W		61		61
	C		2,513		2,513
	E		632		632
	Total	4,274	3,206	4,274	3,206
Other skates	GOA-wide	2,558	1,919	2,558	1,919

GOA Sculpins

There were no changes to the Tier 5 approach used in 2015 and new information includes updated 2015 and 2016 catch data. The stock complex trend overall appears to be stable based on survey data. However, the author noted that some stocks (e.g., bigmouth sculpin) had survey biomass estimates that indicated declines. Recent catches of sculpins have been well below the ABC first established for the sculpin complex in 2011. GOA sculpins are managed Gulf-wide. **The SSC agrees with the Plan Team's ABCs, OFLs, and Tier 5 approach with species-specific natural mortality and biomass estimates based on the random effects model.**

Stock/ Assemblage		2017		2018	
	Area	OFL	ABC	OFL	ABC
Sculpins	GOA-wide	7,338	5,591	7,338	5,591

GOA Squid

In the 2015 full assessment, the author and the Plan Team recommended a modified Tier 5 approach using survey biomass. However, the SSC was not supportive of that proposal so Tier 6 was used. For this update, the analyst presented the status quo Tier 6 recommendations for OFL and ABC, which come from maximum 1997-2007 catch.

Although the same year range was used for the 2016 assessment as the 2015 assessment, the maximum historical catch, which occurred in 2006, was recently adjusted by the Region from 1,530 t to 1,516 t so the OFL and ABC changed slightly from last year. The Plan Team agreed that the adjustments to OFL and ABC should be made, and noted that other authors needed to be aware that changes had been made and adjust their assessments accordingly.

The SSC supports the authors' and Plan Team's recommended ABC and OFL for this Tier 6 stock complex that reflects the updated maximum catch from the catch history (1,516 t).

Stock/ Assemblage	2016			2017	
	Area	OFL	ABC	OFL	ABC
Squid	GOA-wide	1,530	1,148	1,530	1,148

GOA Octopus
This is a Tier 6 assessment with an alternative method approved by the Plan Team and SSC. A minimum biomass estimate based on trawl survey data and a conservative rate of natural mortality were used to set OFL and ABC, as in previous years. There are no new data for the octopus species complex this year. The Plan Team expressed concern that the Random Effects model that was applied to survey data appeared to follow the data too tightly given the error. The SSC supports their recommendation that the author examine this.

The SSC supports the authors' and Plan Team's recommendations for ABC and OFL.

Stock/ Assemblage	2016			2017	
	Area	OFL	ABC	OFL	ABC
Octopus	GOA-wide	6,504	4,878	6,504	4,878

GOA Forage Fish
The SSC received a brief report on the Forage Fish chapter and again noted that we appreciated the information contained in these reports, which are completed on even years. The 2014 report focused on the distribution of forage species and this year's report focuses on 1) summarizing catch information, 2) GOA assessment survey results, and 3) a GOA IERP research summary.

The Plan Team discussed the value of having the information included in the Forage Fish chapter moved into the Ecosystem chapter. They suggested that greater meaning could be gained from looking at the information in both chapters together and recommended including bycatch rate information, bycatch amount, and frequency of occurrence information from the surveys with density information in the Ecosystem chapter.

The SSC acknowledges the Plan Team's concern that forage fish information is contained in two places (the Forage Fish chapter and the Ecosystem chapter), but **recommends that the Forage fish chapter be retained as a separate chapter due to (1) the different purposes of the two chapters and (2) concern over losing information if it is incorporated into the Ecosystem chapter (due to the brevity necessary for the Ecosystem chapter).**

There are different purposes for the Forage Fish chapter as an appendix to the SAFE and Forage Fish as a component of the Ecosystem Chapter.

1. The SAFE chapter provides an accounting of biomass, catch, spatial distribution, and size composition of individual species, as well as an assessment of stock status and continued sustainability of the member species.
    a. With a high turn-over species (a characteristic of many forage fish), it is important to continue to track individual species trends (e.g., avoid a listing for eulachon as occurred along the west coast). This might include movement from the "ecosystem component" to "in the fishery" even if a directed fishery is not occurring.

    b. Although forage fish are managed as an “ecosystem component,” the NPFMC must still monitor the forage fish complex to ensure that management in this category is appropriate.
    c. The summer acoustic survey is now providing quantitative biomass estimates for capelin, which will inform the chapter. Over time we expect that this chapter will evolve to include random effects models of biomass, as well as an assessment of alternative management implications (e.g., to split species or not to split).

2. The Ecosystem chapter provides information that is useful for evaluating time trends in prey for top trophic level consumers and time trends in the abundance of pelagic planktivores.

3. A clear tie between the two chapters would be improved estimates of forage fish consumption rates from ecosystem models (reported in Ecosystem chapter) that will inform forage fish mortality estimates in the Forage fish chapter.

The SSC also expressed concern over losing information if the Forage fish chapter were to be incorporated into the Ecosystem Chapter. As noted in the 2014 SSC minutes, the SSC believes that the distribution of forage species catches in various surveys provides some of the most helpful information on the distributions of these species and some of the only information on the distribution of these species when they are not near shore. Similarly, distributions of incidental and prohibited species catches and summaries of related programs and studies that have been included in the Forage Fish chapter are an important and unique gathering of information. This amount of information would certainly have to be reduced if forage fishes were moved into the Ecosystem chapter.

Recognizing that forage fish contributions are included in more than one SAFE document, the SSC recommends that authors state the types of information that are contained in each at the start of the chapter (e.g., this chapter includes distribution, abundance and catch information for forage fishes, this chapter includes summaries of interactions of forage fishes with other members of the ecosystem) and cross-list where other contributions are located. This would help make readers aware that there are several efforts to assess interannual forage fish information.

Groundfish SAFE Appendices

BSAI/ GOA Grenadiers

Grenadiers are an Ecosystem Component species so a stock assessment is not required and there is no official ABC or OFL. An abbreviated BSAI and GOA combined SAFE report is produced in even years for the purpose of tracking trends in abundance and catch. This year’s abbreviated assessment updated catch in both FMPs through October 2016, updated the survey biomass estimates for the Aleutian Islands (AI) and eastern Bering Sea (EBS) slope trawl surveys through 2016 and the Gulf of Alaska (GOA) trawl survey through 2015, and updated the AFSC longline survey RPNs through 2016. There were no changes to the assessment methodology from the previous abbreviated assessment presented. The new data were included in this year’s assessment included updated catch data through 2016, updated 2016 AI biomass, NMFS longline survey Relative Population Weights (RPWs) for 2015 and 2016, updated GOA biomass time series, and EBS slope biomass for 2016.

GOA grenadier biomass is estimated using a random effects model. In the AI and EBS biomass estimates for giant grenadier are calculated based on the average of the three most recent deep-water trawl surveys that sampled down to 1,000 or 1,200 m. In the EBS, these are now the 2010, 2012, and 2016 surveys. In the AI a method described fully in the 2012 SAFE (Appendix 1A) was used to calculate biomass down to 1,000 m, even when trawl surveys sampled only to 500 m. Estimates of AI biomass used to calculate ABC and OFL are based on biomass estimates from 2012, 2014, and 2016.

The main grenadier species taken in the BSAI or GOA fisheries are giant grenadiers. The estimated biomass in the GOA increased from 1984 through 2005 and has remained relatively stable since. Both the Aleutian Islands trawl survey biomass and Eastern Bering Sea slope trawl survey biomass are relatively stable over the time series. Recent catch levels have been well below ABC.

The tier 5 definitions for OFL and ABC were used to calculate the unofficial OFLs and ABCs for grenadiers (listed below in mt).

	Unofficial	
Area	**OFL**	**ABC**
EBS	44,053	33,040
AI	49,322	36,991
BSAI total	*93,375*	*70,031*
GOA	39,615	29,711
Grand total	*132,990*	*99,742*

The SSC appreciated the efforts of the author and the Plan Team to provide the abbreviated assessment. The SSC supports the unofficial ABC and OFL values recommended by the author and the Plan Team.

Ecosystem Considerations

The SSC heard presentations by Stephani Zador (NOAA AFSC) on the Ecosystem Considerations Chapters for the eastern Bering Sea, the Aleutian Islands, and the Gulf of Alaska. There was no public testimony.

This year, as in the past, the Ecosystem Considerations chapters are thoughtful, well done, and most helpful in providing a context within which to assess the stocks of commercially harvested fish in Federal waters off Alaska. The editors and authors have also been most responsive to the comments and suggestions provided by the SSC in 2015. The most striking change this year has been to split the Ecosystem Considerations chapter into four Large Marine Ecosystem (LME) chapters, one each for the Arctic (not yet available), the eastern Bering Sea, the Aleutian Islands, and the Gulf of Alaska. Moreover, the chapter on the Aleutian Islands recognizes three distinct ecoregions, and the Gulf of Alaska report is split into two regions. The SSC strongly supports, and deeply appreciates the effort associated with, these changes. The high quality of the figures was noteworthy, as was the consistent inclusion of error bars, where appropriate.

The SSC was also pleased to see the inclusion of human communities as ecosystem components, the new approach for assessing trawl impacts, and the various new forage fish indices in the chapters, among other changes. All of these additions represent important improvements to the document. The SSC further encourages the continued development of predictive capacity, and commends the efforts in this direction to date. Although more of the indicator reports mention the management implications of the findings than has been the case in the past, some of these discussions of implications are rather cursory, and the SSC recommends that authors continue to expand these sections.

As we obtain more and better data for the Aleutian Islands and the Gulf of Alaska, it is likely that the Ecosystem Consideration documents will grow substantially. The annual production of the Ecosystem Considerations chapters is a heroic accomplishment, but it also brings to mind a question: If the Ecosystem Considerations are as important as the SSC thinks they are, are there sufficient resources being devoted to their compilation and editing? Synthesis across the indicators is a critical component of this effort, but is somewhat limited, likely due to time constraints. The SSC suggests that it may be appropriate to provide additional staff resources to sustain the improvement of these documents.

Given the length and breadth of the 2016 Ecosystem Considerations chapters, it is not practical to review and evaluate all elements and issues that might be addressed. Thus, this SSC report deals only with some of the most critical issues. These include the new structure of the documents, major issues in the environment that may impact commercially important stocks, and issues pertaining to the need for additional information.

<u>Splitting the Ecosystem Considerations Chapter into Large Marine Ecosystems</u>
The SSC sees the new format of the Ecosystem Considerations chapters as a very positive step toward integrating the various topics within a region. Particularly in the chapter on the eastern Bering Sea, there was improved coherence within topic areas (e.g., zooplankton), and improved cross-referencing between issues of relevance to each other. Cross-referencing between regions (GOA vs. EBS) still remains a challenge, but the loss of between-region comparisons is more than offset by improved integration within regions, including an increased awareness of potential data gaps. The SSC also appreciates the efforts of the authors to examine ecological issues at spatial scales below those of the regions, thereby reflecting differences in sub-regional ecosystems. The split of the three ecoregions of the Aleutian Islands and the split between the eastern and western Gulf of Alaska seem most appropriate. As suggested on page 45 of the eastern Bering Sea Chapter, it may be appropriate to examine selected indicators by the Inner, Middle, and Outer Shelf Domains in the Bering Sea.

<u>Cross-cutting issues that may be of importance to management</u>
Selection and/or development of Ecosystem Indicators included in the Report Cards:
The SSC appreciates the authors' efforts to identify regionally relevant ecosystem indicators to include in each of the report cards. As new indicators are identified and/or prior indicators replaced within each region, we request that the rationale behind indicator selection be provided.

<u>Continuation of aberrantly warm conditions</u>
With the possible exception of the western Aleutian Islands, all regions managed by the NPFMC have experienced unusually warm conditions for the past three years. Forecasts suggest that these warm conditions may persist at least for the coming winter and spring. The last time we had four warm years in a row (2001- 2005), there was a strong reduction in pollock recruitment in the eastern Bering Sea, among other impacts. The Ecosystem Considerations chapters provide a useful heads-up that commercially valuable fish stocks may be adversely impacted by the continuing warm anomaly.

<u>Bottom-up impacts on commercially important stocks</u>
There is accumulating evidence from the Bering Sea, the Aleutians, and the Gulf of Alaska that bottom-up issues may be affecting recruitment and fish weight-at-length or -age. Changes in the size composition of copepod zooplankton associated with warming waters have now been identified in the eastern Bering Sea and the Gulf of Alaska. In the eastern Bering Sea, changes in the timing of sea ice retreat appear to affect the recruitment of both large calanoid copepods and shelf species of euphausiids, with a demonstrated impact on the survival of age-0 pollock. We need to know what other species of commercially important fish are similarly affected. In the Aleutians, there is evidence of fish being underweight (negative length-weight residuals for most species in 2014 and 2016), but the direct mechanisms have not been identified. There are some old zooplankton data of Coyle and Hunt from the western Aleutians (Kiska and Buldir waters) that have not been published. Comparison of these historic (1990s) data with present-day conditions might be very valuable. In the Gulf of Alaska, shifts in copepod size distribution may be negatively affecting the availability of forage fish, which in turn affects predatory fish of all kinds.

The Rapid Assessments of Zooplankton are a valuable addition to the tools with which we assess environmental change, and the SSC appreciates the requested expansion of these data in all LMEs. It is hoped that the full work-ups of the samples will become the basis for future in-depth reports. In the meantime, it would be good if the authors could provide an indication of the abundance of large copepods as well as their relative abundance with respect to small copepods, as opposed to simply reporting on composition of zooplankton catches.

There is a current lack of information on the lower trophic levels in the central and western Aleutian Islands, and to a lesser extent, in the Gulf of Alaska. These lower trophic-level-processes are potentially vulnerable to the impacts of climate warming and to ocean acidification. We lack sufficient information about the lower trophic levels in these region to be able to anticipate how warming, acidification, and harmful algal blooms might impact the lower trophic levels and, through them, the stocks of commercial interest. Obtaining the necessary information should be a high priority for research.

Forage fish and groundfish trends across LMEs

There are some indications across LMEs that forage fishes and groundfishes may be impacted by aberrant environmental conditions, resulting in impacts to foraging behavior and efficiency. Drift patterns in the eastern Bering Sea in 2016 are consistent with below-average recruitment for winter-spawning flatfishes (northern rock sole, arrowtooth flounder, and flathead sole). There are several seabird-based indicators that suggest that foraging conditions were extremely poor in the EBS as well. In the GOA, the apparent recruitment failure of multiple groundfish stocks in 2015, including pollock, Pacific cod and several flatfishes, and the predicted below average recruitment for sablefish are additional potential examples. The SSC continues to strongly endorse investigations into the mechanisms behind these potential impacts across all LMEs.

The status and ecology of marine mammals

The chapters on the eastern Bering Sea and Aleutian Islands say relatively little about the status and ecology of Northern Fur Seals and Steller Sea Lions. There is a report that fur seals are declining steadily, particularly on St Paul Island, but there is little information on progress that may have been made in determining when and where in their life cycle threats to fur seal survival and successful reproduction are occurring. Likewise, we are told little about the status and ecology of sea lions in the Central and Western Aleutians. Declines in Steller Sea Lions have impacted fisheries in the Aleutian Islands, and on-going declines in Northern Fur Seals have the potential to impact the pollock fishery over a large portion of the eastern Bering Sea. If the Council and the National Marine Fisheries Service are to manage fisheries to protect these marine mammal species, then the Marine Mammal Laboratory will have to become more proactive in providing information and in collaborating with the Council in the management and protection of these marine mammal stocks. A useful starting place would be for the Marine Mammal Laboratory to contribute more fulsomely to the relevant annual Ecosystem Considerations chapters; for instance, by providing the biennial pup counts in time for inclusion in this document.

There is virtually no information presented on the impacts of increasing numbers of baleen whales in any of the regions. It would be useful to know something about the numbers of whales likely present in the various regions, their diets, and their potential prey consumption. There are data on whales in Prince William Sound that could be used as an example. Modeling of some what-if scenarios could be useful for understanding the potential for whales to impact fisheries through either consumption of young of commercially valuable species or their prey.

Humans as part of ecosystems

With reference to human communities, the SSC requests consistency across the documents in the use of key indicators. The use of school enrollment data in the AI document, for example, should be repeated for the other ecoregions as this is an established indicator of community health in areas where commercial fishing is a significant economic driver. The analyses of population changes reference decline and urban consolidation, among many trends; spatial data to accompany these population shifts would demonstrate sub-regional trends more effectively and is consistent with the ways non-human species are presented in the documents. The SSC recommends that the authors use their own subheading, "Humans as a Part of Ecosystems," that is, humans are members of ecosystems as apex predators, as the framework for inclusion of future indicators and to discard the notion that humans are "impacted by" or "impacting" the ecosystem, as was presented to the SSC. The latter is a Western and Euro-American philosophy that places humans outside of nature, is in conflict with Alaskan Natives' relationship with the environment, and does not capture the integral role and complexity of human communities and stakeholders in the AI, EBS, and GOA. Additional indices, such as use of subsistence food from the sea, would be welcome.

The SSC had the following specific comments for the authors.

<u>Eastern Bering Sea</u>

BASIS Survey (p. 25):

The Editor acknowledges the importance of the BASIS survey, and notes that these surveys will now be biennial surveys in the future. The SSC continues to be concerned by this loss, and recommends a continued search for funding this as an annual survey.

New index on herring in the eastern Bering Sea:

The SSC appreciates the development of the new Bering Sea herring index based on the BASIS survey data. Both the abundance and the distribution of herring indicated by the index differ greatly from other studies of herring in the eastern Bering Sea, such as ADF&G surveys of mature herring during spawning and literature studies of the herring monthly distributions and migration based on herring bycatch (Barton and Wespestad, 1980) and Prohibited Species Catch (Tojo et al., 2007). As a result, background information to help interpret the results of the index and put it in context with other studies would be particularly valuable. For instance, to understand how and why this index differs from other Bering Sea herring studies, it would be helpful to include (1) what age classes are sampled, (2) what age classes, maturity classifications (mature fish, immature fish), and Bering Sea areas do the biomass estimates represent, and (3) how effective do authors expect the survey is for estimating population biomass and distribution of the age classes captured by the survey, including any suggestions the authors may have on what factors may have negatively affected the survey's or index's effectiveness.

Multivariate Index of Climate Forcing (p. 44):

For several years, the issue of the development of a multivariate index of climate forcing has been mentioned, but apparently little progress has been made. Is this index important? If so, it would be good to see it to completion.

Index of Primary Production (p. 44):

What may be more important than an estimate of the amount of primary production is an index of the timing of the spring blooms and the availability of phytoplankton to herbivorous zooplankton in spring and early summer. Also, the composition of the phytoplankton is important in so far as diatoms are more nutritious than the smaller celled dinoflagellates.

Index of cold pool species (p. 45):

The SSC supports the development of an index of species that particularly depend on the presence, location and/or timing of the cold pool. This information will be of particular importance if the cold pool shrinks and shifts northward in the future.

Index of Fishery Performance (p. 45):

The SSC notes that development of a fishery performance index based on attainment of TAC may not be informative for fisheries that are more bycatch limited, and recommends consulting with industry or the Advisory Panel for appropriate performance indices for these fisheries.

Structural Epifauna and Bottom temperatures (p. 74):
Bottom temperatures have been greatly elevated in the past year, particularly in the shallower portions of the Middle and Inner Shelf domains. What do we know about the potential impact of elevated temperatures on the survival of benthos, in particular the structural epifauna? Are there data on lethal temperatures?

Spatial Distributions of fish (e.g., Fig. 54, 58, 59, 93):
The data on distribution shifts is most interesting and presages possible shifts with continued warming. It would of value to relate these shifts to variables such as bottom temperatures, ice cover, and depth. This might help stimulate examinations of mechanisms behind the observed shifts.

Eastern Bering Sea Slope Surveys (p. 76):
For the shelf and upper slope surveys, catches of anemones were reported, but not for the slope surveys. It would be of interest to know if they also declined in this deeper habitat that is presumably more protected from rapid environmental change.

Yukon Chinook Salmon (p.118):
It appears that there is good news concerning the abundance of Yukon River juvenile Chinook salmon of Canadian origin. If there is a substantial increase in the salmon in the Bering Sea, then there are likely to be an increase in salmon PSC in the eastern Bering Sea pollock fishery, for which there is a hard cap on the number of PSC salmon allowed.

Condition of fish (139):
The author raises the question of whether it would be more useful to report the condition of juvenile fish separately from that of fish that have recruited to the fishery. This seems like a useful addition, as one may predict survival to recruitment, whereas the other provides an index for converting numbers of fish to biomass of fish.

Aleutian Islands
The new organizational structure served to highlight the lack of information for the Aleutian Islands in particular and would like to encourage continued investigation into additional sources of data for this LME, particularly in the Western Aleutians, as patterns there appear to frequently diverge from that of the Central and Eastern subregions.

Continuous plankton recorder (p. 62):
It would be useful to provide the names of at least the most important (by biomass and by number) of the zooplankton species (in all regions). Large and small categories, especially from places that are not often or well-studied, do not tell us whether we are dealing with the same species in the southern Bering as on the eastern Bering Sea shelf.

Weight at length of groundfish (p. 69):
The reduced weight at length of many groundfish species suggests either that there are too many fish, or that the prey of the fish has declined. Another implication is that the nutritional quality of the fish taken by Steller Sea Lions in the western Aleutians may of low quality, an issue that other research has shown to be particularly problematic for juvenile sea lions.

Mean weighted distributions of rockfish (p. 69):
It appears that the increased temperatures encountered by the fish did not lead to a deepening of their distributions. Could this indicate that the temperatures encountered so far are not stressing the fish?

Socio-economics of the Pribilof Islands (p.100):

The Pribilof Islands communities might be best considered in the Eastern Bering Sea chapter. They perhaps should have a discussion of their own particular situation, as they are isolated from other communities and are very dependent on fisheries and fisheries management decisions.

<u>Gulf of Alaska</u>
The GOA Ecosystem Considerations chapter has undergone considerable improvement in recent years, though the Editor and the SSC acknowledge that it is still a work in progress. As mentioned previously, the GOA report card has now been split into two regions (western and eastern) based on feedback from a workshop with the GOA IERP principal investigators. The SSC notes that the ecology of the two sub-regions is quite different, and supports this division, which is already recognized in some groundfish assessments. Some indicators have not yet been finalized for the eastern GOA report card. The SSC looks forward to continued development of these region-specific indicators.

Capelin abundance (Report card):
This suggests that capelin were more abundant in the cold years. Did their numbers change that quickly, or did they change their distribution, making them less available to the birds?

Zooplankton Indices:
It would be of value to examine the relationships between the abundance of large and small zooplankton, and whether there is a tie to water temperature. What are the ecological mechanisms behind the observed dynamics?

Salp abundance increased again (p. 29):
This is an important observation that might portend a new food web structure inimical to commercially important fish. Is there information on how nutritious salps are?

Capelin indicators (P.31):
It might be useful to present the data from the seabird diets and the fish diets separately so that one can understand if the index shifts whether the shift is primarily in capelin availability in surface waters or at depth.

Ocean Station PAPA (p. 39):
This report, while excellent, seems too detailed and too retrospective. A shorter report focused on the current situation and its relationship to the time series might be more appropriate. Coloring the modeled tracks for warm and cold years could be of value for understanding the implications of the trajectories.

Figures 12 and 13 (p. 53, 54):
It would be useful to have some indication of the variances around the means.

Herring (p. 73):
This is a very nice, helpful summary.

Human population declines in the GOA (p. 134):
The statement that the declines are due to declining fish stocks seems problematic. This is not what the stock assessments show. Is this population decline really driven by increases in efficiency, and thus the availability of fewer jobs, or changes in product mix?

C-8 RKC Savings Area EFP
The SSC received a presentation on a proposed Exempted Fishing Permit (EFP) submitted by John Gauvin of the Alaska Seafood Cooperative (AKSC) to conduct experimental trawling in areas currently closed to non-pelagic trawling in the southeastern Bering Sea. Public testimony was provided by Leah Sloan (student, University of Alaska Fairbanks), Molly Zaleski (Oceana), Scott Goodman (BSFRF), and Bob Hezel

(captain, Fisherman's Finest) and Dennis Moran (resident, Fisherman's Finest). Written comments were provided by Scott Goodman and Doug Wells, (Executive Director and President, of BSFRF respectively), Tyson Fick, (Executive Director of the Alaska Bering Sea Crabbers, ABSC), and Susan Murray, (Deputy Vice President, Pacific, Oceana). Leah Sloan presented preliminary results from her hotspot analysis of daily fishing logs from the red king crab fishery in Bristol Bay during 2005-2015. Ms. Sloan suggested that the aggregations of legal male red king crabs varied widely each year and that different patterns were apparent in warm versus cold years. BSFRF, ABSC and Oceana expressed shared concerns that trawling in the RKCSA would put depressed crab stocks at risk. Bob Hezel explained the close cooperation among vessels in his Amendment 80 sector to share fishing information to reduce bycatch during the flatfish trawl fisheries in the eastern Bering Sea.

The Exempted Fishing Permit (EFP) application reflects a revision of an earlier EFP that was submitted in October 2015, reviewed by the SSC in December 2015, and withdrawn shortly thereafter. Approval of the EFP would allow up to 10 vessels to participate – up to five vessels would be allowed to conduct experimental fishing in two subareas of the Bering Sea that are closed to fishing with trawl gear and five additional vessels that would conduct fishing in areas adjacent to the closed areas with identical data collection methods to facilitate comparisons. Specifically, approval of the permit would allow non-pelagic trawl gear to fish in Area 516 of Zone 1, which is otherwise closed to all trawl gear, and the RKCSA, which is otherwise closed to non-pelagic trawl gear. The overall goal of the EFP is to investigate whether the RKC bycatch performance of the Bering Sea winter/spring flatfish fishery across Zone 1 is improved by allowing vessel operators to pursue high CPUE groundfish fishing inside the RKCSA and Area 516 closures.

The SSC greatly appreciates the initiative of the Alaska Seafood Cooperative (AKSC) to develop a proposal that aims to increase the efficiency of the Amendment 80 fleet while maintaining or improving bycatch protection of red king crabs in the southeastern eastern Bering Sea. As we noted in 2015, the Bristol Bay trawl closures for red king crab have been in place since the 1990s, so an investigation into the efficacy of these closures is overdue. The SSC is very supportive of efforts to investigate the efficacy of these closures for RKC and feels that given the importance of their conclusions for evaluation of management alternatives such studies should be scientifically credible. The SSC carefully reviewed the EFP with respect to each of the concerns and recommended steps that the SSC provided on the earlier version (see pages 44-48 of the SSC's report of its December 2015 meeting). In overview, the SSC found the revised EFP to be much more clearly written and commends the author for his efforts to address the concerns raised in our 2015 minutes. Specifically, the roles of the onboard observers and sea samplers has been clarified, improved descriptions were provided for data collection methods and statistical tests, and a statistical power analysis was conducted. The SSC notes that in their letter to the NPFMC the NMFS Alaska Regional Office indicated that the work proposed in the EFP was not expected to result in significant effect on the human environment, and that it would qualify for a Categorical Exclusion under section 5.05b and 6.03d.4 because it is a minor change and indistinguishable from 2017 and 2018 Amendment 80 groundfish fisheries with no new effects on the environment and for which any cumulative effects are negligible.

The SSC had a lengthy and wide-ranging discussion on number of issues including:

- The potential for progress to be make towards the main goal of this study using existing data and new information collected outside the closure areas. For instance:
    - Attainment of the flatfish TACs is not constrained by RKC PSCs. Thus, the sector's interest to access existing trawl closure areas relates to their interest to catch the TACs with reduced fishing effort and lower RKC bycatch. The underlying premise of the EFP is that areas of high flatfish CPUE are associated with low crab densities. Two types of retrospective analyses were suggested to evaluate this claim:
        - First, monthly distributions of yellowfin sole catch in 2015 could be examined to see if high CPUE rates get interrupted by the closure areas.

- Second, existing observer data could be analyzed to demonstrate that tows with high flatfish CPUE have low crab PSC rates. In response, the applicant stated that it would be difficult to demonstrate this relationship given the preponderance of tows with zero bycatch of RKC. However, the SSC notes that, if that is true, then it may be difficult to demonstrate this relationship with new observations collected under the EFP.

During this discussion, the SSC noted that 1) achieving reduced fishing effort with no reduction in RKC bycatch could result in less fishing and thereby reduced seabed disturbance, and 2) the validity of the suggested analyses depends heavily on the observer data-derived PSC rates which have not been compared to whole hauls (which the EFP proposes to do). In addition, some of the effort in the '10-minute strip' would likely be displaced into the closure area, and overall PSC limits would remain unchanged.

- Some of the proposed experimental fishing could be conducted outside of the closure areas. For instance, new data could be collected and analyzed on fishery CPUE and crab PSC rates in areas outside of the trawl closure areas. The whole-haul sampling could be done outside the closure areas by deploying sea samplers to allow comparisons between whole-haul and observer samples, including estimation of variances of PSC catch rates. In response to this suggestion by the SSC, it was indicated that the Amendment 80 sector was unwilling to bear this expense. During this discussion, the SSC noted that any comparison of fishery CPUE and crab PSC in the open areas would be impacted by the requirement to fish around the closures and thus would not address the same objectives as the EFP.

- It was not possible for the SSC to evaluate how many crabs would be saved by allowing fishing in the trawl closure areas. It was indicated that the sector currently takes an estimated 25,000 RKC annually. Given changing crab distributions, success avoiding crab bycatch likely varies year-by-year and may depend on whether it is a warm or cold year. Thus, it will not be possible to generalize the results from one or two years of experimental fishing in the closed areas. During the discussion, the SSC noted that the crab PSC estimate for this sector is based on very few actual crab observations (e.g. 88 crab in 2013 and 192 crab in 2014) and the true crab savings associated with this EFP was likely not knowable without the whole haul sampling as proposed.

- The SSC appreciates the statistical power analysis provided in the EFP. Based on the assumptions and data used in the power analysis, minimum sample sizes needed varied widely based on the high degree of zero inflation in the data. For example, a one-sided t-test would require 599 tows and 3,929 tows for scenarios A and B, respectively. Alternatively, a binomial proportion test would require minimum sample size of >10,000 or 200 tows for scenarios A and B, respectively (Table 2 in EFP). The EFP indicated that 425 hauls were expected, using an assumption that 50% of hauls for the five boat closure-access group, would occur inside the closure to detect a haul-level average bycatch rate difference of 0.16 crabs/ton or more between inside and outside (90% power, 5% Type-I error level). The SSC noted that the power analysis was appropriate and difficult to undertake owing to the lack of observations inside the closed areas. In an attempt to address this the EFP used catches in the "10-minute strip" portion of the RKCSA "as a proxy for what might be found in the RKCSA in comparison to the remainder of Zone 1" (stated on p.7 and also stated on p. 10 and 15 of the EFP). In Ms.Sloan's public testimony she suggested that crab catches in the 10-minute strip and catches in the RKCSA during the October fishery might not be related. She suggested that, in warm years, crab catches appeared to be low in the 10-minute strip but high in the RKCSA. The two scenarios evaluated in the power analysis used RKC bycatch rates that were lower inside the closed areas than outside. The SSC noted that there are several other reasons to think the opposite might be true. First, approximately 25% of the NMFS summer survey catch of RKC comes from the RKCSA, whereas the RKCSA accounts for only about 10% of the total survey area (C. Siddon, ADF&G). Second, during her public testimony, Ms. Sloan indicated that during the October fishery logbook data showed that just 29% of commercial catch of legal red king crab came from areas open to trawling over 2005-2015. Rather, 71% came from trawl closure areas, including 30% from the RKCSA, 8% from the RKCSA subarea (10-minute strip), and 33% from the nearshore closure area. During discussion, the SSC noted the preliminary analysis presented in Ms. Sloan's public testimony. The SSC commended Ms. Sloan's efforts on her report, but noted that several important aspects of the hotspot analysis required revisions, which could change the size, shape and locations of the predicted hotspots and the p-values used to define the hotspots may not be properly estimated or require additional interpretation.

- The timing of proposed experimental trawling in protected RKC habitats is not ideal, given low crab stock status. Alternatively, the EFP aims to reduce crab PSC which, if achieved, will have a positive effect on crab stock status. Abundances of red king, Tanner and snow crab have declined even further in 2016. A long-term declining trend in RKC has been associated with generally poor recruitment since 1985. This year, ADF&G closed the Tanner crab fishery due to low abundance. Moreover, mature male biomass of snow crab declined to an all-time low this year. During this discussion, the SSC also noted that low crab abundance posed a challenge to the statistical analysis owing to the difficulty of detecting meaningful differences in zero-inflated datasets. This is not likely to change in the near term and impacts analyses of fishery CPUE and crab PSC whether it occurs in or outside of the closed areas.

- The revised EFP attempts to accommodate molt timing of RKC. As originally proposed, the EFP was requested for February 1 to May 15, 2016 and January 20 to May 15, 2016. The new EFP is requested for January 20 to April 30 in both 2017 and 2018, and noted that "molting is currently thought to occur mostly in May-July when fishing for rock sole and yellowfin in the eastern part of Zone 1 is generally completed." However, as pointed out in the SSC's meeting minutes from December 2015, these molting dates pertain to mature female RKC. Males molt in late winter/early spring so that they are in hardshell condition by May-June for mating with softshell females. A comprehensive review of survey and fishery data for the eastern Bering Sea found "Various size-sex-maturity groups that have been vulnerable to trawling or other commercial fishing gear have been found in the process of molting or in a soft shell condition from the last week of January to the end of June" (for more details, see EA/RIR/FRFA, Amendment 37 to BSAI Groundfish FMP, p. 11)." The EFP indicates that fishing vessels will move voluntarily if and when molting RKC are encountered. This is why it is important that the training of sea samplers includes expertise to correctly identify pre-molt and molting (softshell) crab. During this discussion, the SSC noted that these aspects of RKC molt timing are relevant to trawl-crab interactions in general and are not specific to the closed areas in the EFP. Depending on the spatiotemporal distribution of crab the ability to target flatfish in the closures could reduce trawl-crab interactions.

- The SSC noted that, while there were no habitat analyses underpinning to location, size or shape of the RKC closures, the effects of trawling on benthic habitat features remains a concern. Do the closed areas have habitat features that would be compromised by trawling? Amendment 37 to the BSAI Groundfish FMP was enacted to provide for "increased protection of adult red king crab and their habitat". King crabs are often closely associated with structure-forming invertebrates (e.g., sea whips, anemones), which are vulnerable to bottom trawling. Dr. Brad Harris indicated that he has a master's student beginning to develop a project on this topic. He noted that a preliminary analysis examining structure-forming invertebrates detected in the NMFS summer trawl surveys outside and inside trawl closure areas yielded little information as these features were rarely detected outside or inside the closures areas. In a similar study conducted in another protected area of Bristol Bay, McConnaughey et al. 2000 (ICES J. Mar. Sci. 57: 1377-1388) found that sedentary macrofauna (e.g., anemones, soft corals, sponges, whelk eggs, bryozoans, ascidians), neptunid whelks, and empty shells were more abundant in the untrawled area. Dr. Harris indicated that new data are likely needed to address this issue and that if the EFP is conducted he and his student will work with the applicant to collect benthic habitat data.

- If the EFP is approved, the SSC recommends that some consideration be given to potential increases in discard mortality rates (DMRs) associated with the extended handling times expected due to whole haul crab accounting. Further, molting crab are expected to have very high DMRs. Discard mortality rates should be adjusted to account for higher mortality under these circumstances.

As the SSC pointed out in its report from December 2015, it is important to bear in mind that a successful test fishery executed under an EFP could provide important information, but, as was noted by the applicant, the EFP will not produce sufficiently robust data to inform management decisions (e.g., the efficacy of the closures). Given the lack of a formal sampling design and the limitations in the data available to construct a power analysis it is not possible to make inferences beyond the actual hauls that are observed. That is, the EFP will not estimate and compare crab densities, habitat attributes, or other features inside and outside the closure areas that may be critical to potential management actions that would open existing closed areas to routine trawling.

During public testimony, the BSFRF indicated interest in working with the Amendment 80 sector toward a collaborative survey effort conducted in the late winter 2018 (January – April 2018) before any Amendment 80 EFP fishing inside the RKCSA. The BSFRF also indicated that such efforts to plan a collaborative approach would include a close review of current bycatch information and an assessment of what is currently known about the habitat within the RKCSA.

Scientific information on the distribution and densities of crabs and flatfish in open versus closed areas during the flatfish fishing season, such as could be obtained from a survey, coupled to habitat information, would be critical to potential management actions that would open existing closed areas to routine trawling. Issues raised by the EFP emphasize the need for thorough re-evaluation of existing bycatch management measures for crab and other PSC species. The SSC is intrigued by the possibility that analyses of red king crab distributions experienced during fall commercial fisheries (e.g., those presented by Ms. Sloan) could be used to inform future spatiotemporal bycatch avoidance measures for the winter/spring flatfish fishery. Comparisons of crab distributions in fall versus winter/spring are necessary to evaluate the potential for using such a dynamic approach to bycatch management.

D-1 EFH Fishing Effects
Steve McClean (NPFMC) provided an overview of revisions to the methods for assessing the impacts of habitat disturbance on fish and crab stocks. Jonathan Warrenchuk (Oceana) provided public testimony.

The EFH regulations instruct the Council to act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects habitats that are necessary for spawning, breeding, feeding or growth to maturity in a manner that is more than minimal and not temporary in nature. The SSC formed an EFH sub-committee responsible for guiding the EFH (AKRO & AKPU) workgroup by assisting in the development of an analytical approach to impact assessment. The SSC workgroup reviewed past recommendations from CIE reviews and recommended revisions.

The workgroup recognized that the new Fishing Effects (FE) database is a marked improvement over the past Long-term Effect Index (LEI) model in that it provides time trends in habitat impacts that can be quantitatively compared to spawning location, breeding success, feeding, and growth to maturity. This facilitates a more formal impact review. The Fishing Effects subcommittee formed by the SSC recommends a three-tiered method to evaluate whether there are adverse effects of fishing on EFH. The key elements of the proposed revised assessment approach will take into account stock status, proportion of EFH for a given stock that is disturbed, and patterns of habitat disturbance and the suite of available indicators for spawning location, breeding success, feeding, and growth to maturity. The proposed approach was reviewed by the Plan Teams and SSC earlier this year.

In response to comments from the SSC and Plan Teams, the EFH (AKRO-AKPU) workgroup added a new deep-water strata. This strata includes cobble and boulder habitats deeper than 300 m. The workgroup added a new "Long-Lived Species" habitat feature (recovery score of "4") that corresponded to a recovery time of 10-50 years. The 50-year upper limit of recovery time was calculated with a decay function that yielded an expectation that 5% chance that long-lived species would require 150 years to recover. The SSC appreciates the addition of this information to the analysis, but felt that labeling the habitat feature with a recovery time of 10-50 years when actual recovery could take as much as 150 years was misleading.

The revised proposal clarifies that the p-values included in the 3-tiered approach are being used to guide the stock assessment authors in their evaluation of the severity of impacts. The SSC appreciates the difficulty facing the analytical team in balancing the need to comprehensively evaluate potential risks of habitat disturbance while minimizing the potential for spurious correlation. The proposed methods maintain the threshold for bringing potential concerns to the Plan Teams and SSC while providing the analyst with the flexibility to bring forward weaker relationships (p values < 0.25) if the author considers the finding to be compelling.

The SSC discussed the proposed use of the upper 50% threshold for defining the core area for assessment of whether or not more than 10% of the EFH was experiencing disturbance. This cut-off was accepted by the SSC as it provided consistency across species.

The SSC notes that time trends in percent reduction in habitat may not be a normally distributed variable and recommended that, after the stock assessment authors have completed their assessments, the outcomes be evaluated. The SSC discussed the possibility of developing a dataset with known properties to evaluate how often the proposed approach detected the number of false positives and false negatives that are likely to occur.

The SSC discussed the importance of considering non-fishing impacts that might impact recovery rates. In particular, the SSC noted that ocean acidification could impact recovery rates of some species. The SSC noted that there is a separate ongoing analysis of non-fishing impacts on EFH.

In conclusion, the SSC commends the EFH (AKRO-AKPU) workgroup for developing an analytical framework that facilitates the impact assessments discussed here. The proposed impact assessment method should identify potential relationships that require additional processed-oriented research, which would help science centers and funding agencies to target habitat research projects on the most pressing EFH issues.

The SSC notes that a CIE review of the analytical approach and its outcome is planned for 2018. This review should serve as a guide for future EFH assessments.

D-2 EFH Non-Fishing Effects

The SSC reviewed the report on Impacts to Essential Fish Habitat from Non-fishing Activities in Alaska. The SSC found this report to be a comprehensive evaluation of the range of possible non-fishing impacts to habitat. The SSC recommends providing this document to the FEP team.

With respect to the climate change section, the SSC recommends that the authors contact Dr. Paul Spencer who is leading the rapid vulnerability assessment for fish and crab resources in the Bering Sea. The SSC also recommends that the workgroup consider the information provided in the Bering Sea Regional Action Plan, which is NMFS regional response to the NMFS Climate Science Strategy. In addition, the workgroup may want to contact analysts involved in the JISAO/SAFS/AFSC Alaska Climate Integrated Modeling (ACLIM) study. This project provides projections of future ocean conditions under various climate change scenarios. These scenarios could be considered in the report.

The SSC also notes that several of the citations for the Aleutian Islands region are outdated. In addition, the SSC encourages the authors to cite the original literature rather than synthesis reports to the extent practicable.

With respect to the overall document, the SSC recommends an attempt to quantify the spatial scale and intensity of the impacts in a manner similar to the effects of fishing analysis. A synthesis (even a qualitative evaluation) would be quite valuable in interpreting the potential contribution of the effects on marine fisheries.

The SSC noted that some of these impacts (such as OA) could impact the recovery rates of living structure. In cases where this type of impact is possible, the report should attempt to document the spatial footprint and intensity of the impact.

The SSC noted that it is not clear where the cumulative effects of fishing and non-fishing impacts will be considered. The value of the non-fishing impact report lies in its contribution to the cumulative effects analysis.