North Pacific Fishery Management Council

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REPORT
of the
SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
December 4th – 6th, 2017

The SSC met from December 4–6, 2017 at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair
NOAA Fisheries—AFSC

Amy Bishop
Alaska Sea Life Center

Robert Clark
Alaska Dept. of Fish and Game

Jason Gasper, Acting Vice Chair
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 Game

Seth Macinko
University of Rhode Island

Franz Mueter
University of Alaska Fairbanks

Terry Quinn
University of Alaska Fairbanks

Kate Reedy
Idaho State University Pocatello

Matt Reimer
University of Alaska Anchorage

Ian Stewart
Intl. Pacific Halibut Commission

Alison Whitman
Oregon Dept. of Fish and Wildlife

Members absent were:

Chris Anderson
University of Washington

Sherri Dressel, Vice Chair
Alaska Dept. of Fish and Game

B1 Plan Team Nominations

The SSC reviewed the Plan Team nomination of Kresimir Williams (NMFS-AFSC) to the GOA Groundfish Plan Team, and Katie Palof (Alaska Department of Fish and Game) and Bill Gaeuman (Alaska Department of Fish and Game) to the Crab Plan Team. The SSC finds these nominees to be well qualified, with appropriate expertise that will assist the Plan Teams. The SSC recommends that the Council approve these nominations. The SSC is looking forward to Heather Renner joining the SSC at our February 2018 meeting replacing Lew Coggins. Her expertise in seabirds and ecology will make her an excellent addition.

General Stock Assessment Comments

In an effort to streamline and simplify the SSC report our recommended ABC/OFL's and area apportionments are summarized exclusively in Table 1 and Table 2. Recommendations that differ from Plan Team(s) are marked in **bold.**

Model complexity

The SSC reminds authors of the need to balance the desire to improve model fit with increased risk of model misspecification. This is the topic of the upcoming NMFS National Stock Assessment Workshop that will be held in May 2018.

Response to Joint Plan Teams Request for Clarification on Stock Prioritization

In response to the national stock prioritization effort, NMFS changed the assessment frequency for some stocks in 2017. The SSC reviewed the Assessment Frequency shown on pages 11 and 16 of the BSAI and GOA SAFE documents, respectively, and agrees that the new schedule should be tested.

The Joint Plan Teams requested clarification on SSC advice regarding this topic provided in the February 2017 minutes, which called for the following three actions:

1. Development of a framework for evaluating the costs and benefits of changing the target frequency for the affected stocks and complexes;
2. A more quantitative evaluation of the potential risks of changing the target frequency of GOA flatfish stocks to a four-year cycle; and
3. An evaluation of how projected OFL-to-ABC buffers should increase in the intervening years between full assessments.

With respect to issue 1, the SSC clarifies that our comments were intended to encourage the development of an evaluation framework that can be used for a cost-benefit analysis after a full 4-year assessment cycle is completed. A proper evaluation will need to compare the observed outcomes under the new stock assessment frequencies with what the outcomes would have been had the stock assessment frequencies not been changed. Such an evaluation requires forethought as to what the measurable outcomes (i.e., costs and benefits) will be and the information that should be recorded and gathered in the meantime to facilitate an evaluation.

Examples of indicators of the benefits of the change could include:

1. Substantive improvements to the assessment
2. Substantive improvements to the review and consideration of alternative treatment of the input data
3. Development of environmentally linked assessments based on the ESP
4. Development of methods for tracking the progression of uncertainty

Examples of costs of the changes might include:

1. Number of abrupt changes in the biological reference points due to prolonged periods between assessments.
2. Reductions in annual productivity indices (recruitment) for use in evaluating environmental linkages or global productivity assessments
3. Retrospective realization of overfishing

It should be noted that GOA flatfish stock assessment authors have already benefitted from the staggered cycle for their assessments. The reduced number of assessments for 2017 allowed the authors of the rex sole assessment to more carefully examine the underlying model structure and assumptions leading to the approval of a change in the management category from Tier 5 to Tier 3a. The SSC also noted that the Environmental Socio-economic Profile (ESP) presented in the sablefish assessment is a clear example of a structure for assimilating environmental or socio-economic linkages that could require attention in the assessment. The reduction in the assessment load on flatfish authors should allow more time for the development of these environmentally or socio-economically linked assessments. The SSC has been encouraging the development of a data tracking framework to quantify these tangible benefits (costs) to the NPFMC.

With respect to issue 2 above, the SSC recommends that assessment schedule should be used for a full 4-year cycle and then a cost benefit assessment should be conducted and changes to the system should be considered.

With respect to issue 3 above, the SSC suggests that a framework for evaluating the impacts of increased uncertainty could be developed for the 4-year cycle flatfish assessments that are managed in Tier 3. For example, a representative subset of the authors could estimate how advice would have changed if a full assessment had been conducted on a 2-year cycle. The SSC also recommends that Tier 1 stocks that have been moved to a biennial cycle (e.g., BSAI NRS) could be used to examine how uncertainty increases as the time between assessments increases using MCMC projections. This will clarify whether an increase in the uncertainty buffer is necessary to prevent overfishing and rebuild overfished stocks.

The SSC does not think a workshop involving members (to be named) of the Groundfish Plan Teams, the Social Science Planning Team, and the SSC, along with the GOA flatfish assessment authors is needed, however the SSC is not opposed to participating in a workshop if it occurs. The SSC encourages these advisory bodies to discuss the metrics that could be used to evaluate the costs and benefits of stock prioritization in 2018.

The Joint Plan Teams sought clarification on the following SSC recommendation from the October meeting for the development of indicators of severe stock decline or ecosystem change. The SSC welcomes the opportunity to clarify this issue. The SSC envisions two cases that differ in how they would be addressed in the Council process:

1. Cases when the author's knowledge suggests that stock trends or vital rates have changed to the extent that the preliminary specifications should be changed and/or an early warning to the public is needed for a pending change in harvest specifications. An example for this type of case study was the recent action by the SSC and Council on preliminary specifications for GOA Pacific cod.
2. Cases when the totality of ecosystem indicators suggest that a regime shift has occurred that would lead to long-term or multi-year changes in the carrying capacity of the ecosystem or ecosystem structure. A case study for this type of action was the recent impact of the Pacific Heat Wave on the Gulf of Alaska and Bering Sea ecosystems.

These two circumstances are related but the information requested by the SSC with respect to who should be providing this information differs. In case (a) the responsibility for making this type of determination initially lies with the stock assessment author. The author will be the person in the best position to evaluate how the potential impacts of pronounced changes in the socio-economic or environmental landscape will impact future biological reference points and recommendations on harvest specifications. The authors should strive to remain informed of significant changes in the socio-economic or environmental landscape. The proposed ESPs (see the sablefish example) should serve to link observed changes in the environment or socio-economic landscape to impacts on a particular species or species complex. Specifically, the intent is that the ESPs will help authors to consider carefully whether large residuals in model fit are due to measurement error or to a fundamental change in ecosystem or fishing processes governing their stock or stock complex. These types of changes should be fully vetted through the Plan Teams and SSC.

With respect to case (b), the SSC notes that any evidence of long-term or multi-year changes in the carrying capacity of the ecosystem or changes in ecosystem structure documented in the ecosystem assessments should be used as an early warning to stock assessment authors of a pending change in ecosystem state.

The SSC's response to the Plan Teams' specific questions follow:

- Who will make the determination that some set(s) of environmental and fisheries observations "support the inference of an impending severe decline in stock biomass?"

  The SSC suggests that this would typically start with the author and then follow the existing review process just as it did in the case of GOA Pacific cod. To the extent practicable, documents detailing the declines in abundance should be reviewed by the Plan Teams and SSC in October.

- What form should the "integrated analysis" take?

  The authors should be testing and evaluating how changes in the environmental and socio-economic landscape impact their stock as part of the ESP. In the case of an unexpected change, the information should be provided in the assessment or as a white paper.

- Who should conduct the integrated analysis?

  The stock assessment author should do this with information and data from relevant data providers and analysts.

- Who will make the "thumb up" or "thumb down" determinations with respect to stock assessment status and ecosystem assessment status?

  The SSC recommends that the authors of the Ecosystem Considerations chapter develop the ecosystem status metrics. Thresholds for these ecosystem status metric can be informed by scenarios developed by the Fisheries Ecosystem Plan.

- What criteria will be used to make the "thumb" determinations?

  The elements for making the thumb determinations are already available in the Ecosystem Considerations chapters. The key step is to identify thresholds that would suggest that a long-term or multi-year change in the carrying capacity or ecosystem structure is imminent.

- Is "stock assessment status" supposed to correspond to either of the status determinations that we are required to make under the MSFCMA and, if not, how can readers be made to understand that the same term is being used to refer to two different things?

  Actions regarding the MSFCMA with respect to harvest specifications should follow existing practices where the proposed changes in the harvest specifications are to be developed by the stock assessment author with review by the Plan Teams and the SSC. The SSC recognizes that, in the special case when changes in the ecosystem or socio-economic landscape negatively impact a threatened or endangered species, the relevant specialists dealing with those impacts should be alerted through the existing system leading up to the need for convening a biological review team or Section 7 Consultation.

The SSC does not think that the Plan Team coordinators and co-chairs and FEP Team chairs need to appoint a workgroup for this task. The existing process for scientific review is working and only minor improvements to the system are needed to improve information flow. However, the SSC is not opposed to the development of such a workgroup. If a workgroup is formed, the SSC recommends including SSC members.

C4 BSAI and C-5 GOA specifications and SAFE report

The SSC received a presentation by Grant Thompson (NMFS-AFSC) on the November 2017 Joint and BSAI Plan Team meetings and on recommendations for BSAI groundfish OFLs and ABCs. Jim Ianelli (NMFS-AFSC) presented the EBS pollock stock assessment and the CEATTLE model, and Grant Thompson presented the BS and AI Pacific cod assessments. Jim Ianelli (NMFS-AFSC) gave an overview of the November 2017 GOA Plan Team meeting and on GOA groundfish OFL and ABC recommendations. Steve Barbeaux presented the GOA Pacific cod stock assessment.

The SSC reviewed the SAFE chapters and 2016 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 2016. 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.**

Table 1. SSC recommendations for BSAI groundfish OFLs and ABCs for 2018 and 2019 are shown with the 2017 OFL, ABC, TAC, and catch amounts in metric tons (2017 catches through November 4 from AKR Catch Accounting include CDQ). Recommendations are marked in **bold** where SSC recommendations differ from those of the BSAI Plan Team.

		2017			2017 Catch as of	2018		2019	
Species	**Area**	**OFL**	**ABC**	**TAC**	**11/4/17**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	EBS	3,640,000	2,800,000	1,345,000	1,356,259	4,797,000	2,592,000	4,592,000	2,467,000
	AI	43,650	36,061	19,000	1,492	49,289	40,788	37,431	30,803
	Bogoslof	130,428	60,800	500	186	130,428	60,800	130,428	60,800
Pacific cod	**BS**	284,000	239,000	223,704	196,761	238,000	**201,000**	201,000	170,000
	AI	28,700	21,500	15,695	12,286	28,700	21,500	28,700	21,500
Sablefish	BS	1,499	1,274	1,274	1,150	2,887	1,464	4,576	2,061
	AI	2,044	1,735	1,735	588	3,917	1,988	6,209	2,798
Yellowfin sole	BSAI	287,000	260,800	154,000	125,620	306,700	277,500	295,600	267,500
Greenland turbot	BSAI	11,615	6,644	4,500	2,813	13,148	11,132	13,540	11,473
	BS	n/a	5,800	4,375	2,691	n/a	9,718	n/a	10,016
	AI	n/a	844	125	122	n/a	1,414	n/a	1,457
Arrowtooth flounder	BSAI	76,100	65,371	14,000	6,189	76,757	65,932	75,084	64,494
Kamchatka flounder	BSAI	10,360	8,880	5,000	4,462	11,347	9,737	12,022	10,317
Northern rock sole	BSAI	159,700	155,100	47,100	35,123	147,300	143,100	136,000	132,000
Flathead sole	BSAI	81,654	68,278	14,500	8,879	79,862	66,773	78,036	65,227
Alaska plaice	BSAI	42,800	36,000	13,000	15,549	41,170	34,590	38,800	32,700
Other flatfish	BSAI	17,591	13,193	2,500	4,121	17,591	13,193	17,591	13,193
Pacific Ocean perch	BSAI	53,152	43,723	34,900	32,144	51,675	42,509	50,098	41,212
	BS	n/a	12,199	11,000	8,904	n/a	11,861	n/a	11,499
	EAI	n/a	10,307	7,900	7,486	n/a	10,021	n/a	9,715
	CAI	n/a	8,009	7,000	6,868	n/a	7,787	n/a	7,549
	WAI	n/a	13,208	9,000	8,886	n/a	12,840	n/a	12,449
Northern rockfish	BSAI	16,242	13,264	5,000	4,679	15,888	12,975	15,563	12,710
Blackspotted/ Rougheye	BSAI	612	501	225	197	749	613	829	678
Rockfish	EBS/EAI	n/a	306	100	64	n/a	374	n/a	414
	CAI/WAI	n/a	195	125	133	n/a	239	n/a	264
Shortraker rockfish	BSAI	666	499	125	151	666	499	666	499
Other rockfish	BSAI	1,816	1,362	875	820	1,816	1,362	1,816	1,362
	BS	n/a	791	325	252	n/a	791	n/a	791
	AI	n/a	571	550	568	n/a	571	n/a	571
Atka mackerel	BSAI	102,700	87,200	65,000	63,657	108,600	92,000	97,200	84,400
	EAI/BS	n/a	34,890	34,500	33,475	n/a	36,820	n/a	33,780
	CAI	n/a	30,330	18,000	17,749	n/a	32,000	n/a	29,350
	WAI	n/a	21,980	12,500	12,433	n/a	23,180	n/a	21,270
Skates	BSAI	49,063	41,144	26,000	28,389	46,668	39,082	44,202	36,957
Sculpins	BSAI	56,582	42,387	4,500	5,035	53,201	39,995	53,201	39,995
Sharks	BSAI	689	517	125	178	689	517	689	517
Squids	BSAI	6,912	5,184	1,342	2,099	6,912	5,184	6,912	5,184
Octopuses	BSAI	4,769	3,576	400	208	4,769	3,576	4,769	3,576
Total	BSAI	5,110,344	4,013,993	2,000,000	1,909,035	6,235,731	**3,779,809**	5,954,822	3,578,956

[a] The SSC recommendation for "maximum subarea species catch" of Blackspotted/Rougheye rockfish in the WAI portion of the CAI/WAI is 35 mt in 2018 and 39 mt in 2019.

Table 2. SSC recommendations for GOA groundfish OFLs and ABCs for 2018 and 2019, shown with 2017 OFL, ABC, TAC, and catch amounts in metric tons (2016 catches through November 4, 2017 from AKR catch accounting system). The SSC agreed with the GOA Plan Team in all cases.

		2017				2018		2019	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch as of 11/4/17**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock[a]	State GHL		5,094	0	-		4,037		2,644
	W(61)		43,602	43,602	49,878		30,188		19,921
	C(62)		98,652	98,652	81,565		79,495		52,459
	C(63)		48,929	48,929	52,760		40,939		27,016
	WYAK		7,492	7,492	40		6,833		4,509
	Subtotal	235,807	203,769	198,675	184,243	187,059	161,492	131,170	106,568
	EYAK/SEO	13,226	9,920	9,920	-	11,697	8,773	11,697	8,773
	Total	249,033	213,689	208,595	184,243	198,756	170,265	142,867	115,341
Pacific cod	W		36,291	25,404	17,239		8,082		7,633
	C		44,180	33,135	15,823		8,118		7,667
	E		7,871	5,903	53		1,800		1,700
	Total	105,378	88,342	64,442	33,115	23,565	18,000	21,412	17,000
Sablefish	W		1,349	1,349	1,166		1,544		2,174
	C		4,514	4,514	4,767		5,158		7,260
	WYAK		1,605	1,605	1,667		1,829		2,573
	SEO		2,606	2,606	2,786		2,974		4,187
	Total	11,885	10,074	10,074	10,386	22,703	11,505	35,989	16,194
Shallow-water flatfish	W		20,921	13,250	270		25,206		25,544
	C		19,306	19,306	2,211		25,315		25,655
	WYAK		3,188	3,188	-		2,242		2,272
	EYAK/SEO		1,099	1,099	-		1,925		1,951
	Total	54,583	44,514	36,843	2,481	67,240	54,688	68,114	55,422
Deep-water flatfish	W		256	256	20		413		416
	C		3,454	3,454	211		3,400		3,442
	WYAK		3,017	3,017	8		3,239		3,279
	EYAK/SEO		2,565	2,565	2		2,332		2,361
	Total	11,182	9,292	9,292	241	11,294	9,385	11,431	9,499
Rex sole	W		1,459	1,459	48		3,086		2,909
	C		4,930	4,930	1,360		8,739		8,236
	WYAK		850	850	2		1,737		1,657
	EYAK/SEO		1,072	1,072	-		1,811		1,727
	Total	10,860	8,311	8,311	1,410	18,706	15,373	17,692	14,529
Arrowtooth flounder	W		28,100	14,500	269		37,253		35,844
	C		107,934	75,000	25,692		73,480		70,700
	WYAK		37,405	6,900	32		16,468		15,585
	EYAK/SEO		12,654	6,900	14		23,744		22,845
	Total	219,327	186,093	103,300	26,007	180,697	150,945	173,872	145,234
Flathead sole	W		11,098	8,650	73		12,690		13,222
	C		20,339	15,400	1,802		20,238		21,087
	WYAK		2,949	2,949	-		1,932		2,013
	EYAK/SEO		857	857	-		406		424
	Total	43,128	35,243	27,856	1,875	43,011	35,266	44,822	36,746

[a] W/C/WYAK subarea amounts for pollock are apportionments of subarea ACL that allow for regulatory reapportionment

Table 2. Continued.

		2017				2018		2019	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific Ocean perch	W		2,679	2,679	2,686		3,312		3,240
	C		16,671	16,671	17,476		20,112		19,678
	WYAK		2,786	2,786	2,757		3,371		3,298
	W/C/WYAK	25,753	22,136	22,136	22,919	31,860	26,795	31,170	26,216
	SEO	2,073	1,782	1,782	-	2,902	2,441	2,840	2,389
	Total	27,826	23,918	23,918	22,919	34,762	29,236	34,010	28,605
Northern rockfish[b]	W		432	432	232		420		382
	C		3,354	3,354	1,547		3,261		2,965
	E		4	0	-		4		3
	Total	4,522	3,790	3,786	1,779	4,380	3,685	3,984	3,350
Shortraker rockfish	W		38	38	43		44		44
	C		301	301	229		305		305
	E		947	947	275		515		515
	Total	1,715	1,286	1,286	547	1,151	863	1,151	863
Dusky rockfish	W		158	158	123		146		135
	C		3,786	3,786	2,437		3,502		3,246
	WYAK		251	251	22		232		215
	EYAK/SEO		83	83	5		77		72
	Total	5,233	4,278	4,278	2,587	4,841	3,957	4,488	3,668
Rougheye and blackspotted rockfish	W		105	105	34		176		174
	C		706	706	328		556		550
	E		516	516	174		712		703
	Total	1,594	1,327	1,327	536	1,735	1,444	1,715	1,427
Demersal shelf rockfish	Total	357	227	227	124	394	250	394	250
Thornyhead rockfish	W		291	291	151		344		344
	C		988	988	612		921		921
	E		682	682	249		773		773
	Total	2,615	1,961	1,961	1,012	2,717	2,038	2,717	2,038
Other rockfish (Other slope)[b]	W/C		1,534	1,534	986		1,737		1,737
	WYAK		574	574	42		368		368
	EYAK/SEO		3,665	200	31		3,489		3,488
	Total	7,424	5,773	2,308	1,059	7,356	5,594	7,356	5,593
Atka mackerel	Total	6,200	4,700	3,000	1,048	6,200	4,700	6,200	4,700
Big skate	W		908	908	163		504		504
	C		1,850	1,850	1,298		1,774		1,774
	E		1,056	1,056	104		570		570
	Total	5,086	3,814	3,814	1,565	3,797	2,848	3,797	2,848
Longnose skate	W		61	61	167		149		149
	C		2,513	2,513	685		2,804		2,804
	E		632	632	267		619		619
	Total	4,274	3,206	3,206	1,119	4,763	3,572	4,763	3,572
Other skates	Total	2,558	1,919	1,919	1,472	1,845	1,384	1,845	1,384
Sculpins	GOA-wide	7,338	5,591	5,591	1,284	6,958	5,301	6,958	5,301
Sharks	GOA-wide	6,020	4,514	4,514	1,505	6,020	4,514	6,020	4,514
Squids	GOA-wide	1,516	1,137	1,137	44	1,516	1,137	1,516	1,137
Octopuses	GOA-wide	6,504	4,878	4,878	180	1,300	875	1,300	975
Total		796,158	667,877	535,863	298,538	655,707	536,825	604,413	480,190

[*] Note that the 4 mt of EGOA northern rockfish is excluded from that stock's total as it is managed as part of the EGOA "other rockfish" category.

GOA – BSAI Sablefish
Jim Ianelli (AFSC, GOA Plan Team chair) summarized the 2017 sablefish assessment. There was no public testimony.

A full stock assessment was developed for sablefish. This assessment incorporated new data from a variety of sources. There were no structural changes to the 2016 assessment model. The main features of Model 16.5 include:

> *"1) New area sizes for the domestic longline survey abundance (Echave et al. 2013)*
> *2) Inclusion of annual variance calculations including uncertainty of whale observations in the domestic longline survey index*
> *3) Additional catch mortality in the longline fisheries from sperm and killer whales*
> *4) Natural mortality is estimated."*

The SSC noted that Model 16.5 continues to show a poor fit to the younger size modes in the trawl survey. The SSC encourages the author to explore potential mechanisms underlying this lack of fit (e.g., mis-specified growth). **The SSC approved the addition of updated data and the use of Model 16.5 for this year's assessment.**

The new longline survey data provided evidence of a large 2014 year class. The model estimate of this year class was 10 times the long-term average. The author noted that the presence of 2 year-olds in the age compositions was positively related with eventual year-class strength, however the magnitude of the year class has been uncertain. In addition, there was a strong lack of fit to the recent trawl survey indices related to the magnitude of this year class. Given this uncertainty, the author recommended replacing the magnitude of this year-class with the next largest year-class on record (1977) in the projections. The SSC agreed with this approach for setting the 2017 ABC. The SSC recognizes that, in 2018, this year class will likely be used in the assessment and inclusion of this information will impact the estimates of biological reference points for management.

As was done in 2017, the SSC agreed that survey CPUE and fixed gear fishery catches should be corrected to account for whale depredation.

The SSC approved the authors and Joint Plan Team's recommendations for Tier, ABC and OFL. These recommendations include adjustments for the magnitude of the 2014 year-class and whale depredation. The authors and the JPT agreed that the fixed area apportionments used in 2016 should be applied again this year. The author noted that the CIE reviewers concluded that continued use of the fixed area approach did not appear to pose a conservation concern. The SSC notes that the authors have indicated that a complete review of the method to be used for spatial allocation will be forthcoming. The SSC requests conduct of this analysis in 2018.

As in previous years, the authors employed an alternative projection method based on MCMC. Use of this method is desirable in that it incorporates multiple sources of uncertainty in the projection. The SSC encourages assessment authors to explore this type of alternative to the current use of the projection model.

The authors noted that "*recent genetic work by Jasonowicz et al. (2017) found no population sub-structure throughout their range along the US West Coast to Alaska, and suggested that observed differences in growth and maturation rates may be due to phenotypic plasticity or are environmentally driven."* The SSC notes that there may well be other reasons to delineate separate stock units, but suggests that the assessment authors should consider the merits of a single coastwide assessment in light of these recent findings.

The assessment authors noted that sablefish exhibit skip spawning at ages at which less than 100% of the fish are mature; the rate of skip spawning is variable and decreases with age. The SSC encourages continued exploration of methods to incorporate new maturity data into the stock assessment.

The SSC welcomes a fully developed Environmental Socio-economic Profile (ESP) for sablefish. This document holds great promise as an "on-ramp" for the introduction and testing of environmentally or socio-economically linked assessments. In the case of sablefish, the ESP-type process has already succeeded. The whale depredation methods appeared as an appendix to the SAFE chapter for several years and it has now transitioned to formal use in the estimation of biological reference points. This type of testing and formal transition, serves as a test case for the ESP. Another case study is the incorporation of the CEATTLE model as an appendix to the EBS pollock chapter.

The SSC notes that the current version of the ESP contains a considerable amount of background information that is redundant to text already included in the assessment. This background information detracts from the utility of the ESP as a clear testing ground for the implementation of environmentally or socioeconomically linked assessments.

The SSC also notes that the conceptual model and the literature review are not particularly useful for the process of developing environmentally or socio-economically linked assessments. The assessment authors certainly should be aware of the life history and potential environmental and socio-economic linkages impacting their stock. This type of conceptual information should be moved to the Ecosystem Considerations Chapter.

To be useful in informing the status determination process, the ESP must shift from a collection of references about sablefish to a suite of core indicators that would be updated every year in September.

The SSC recommends that, if future ESPs are developed for other species, they should be developed in conjunction with the lead author. If the ESPs are developed without inclusion of the lead author, the likelihood that the document will be used as an on-ramp to environmentally or socio-economically linked assessments will be diminished. If the ESP identifies promising environmental or socio-economic linkages, it should be incumbent on the author to strive to include models that incorporate the stated relationship to explore its contribution to addressing process error.

The SSC had the following comments with respect to the specific content in the ESP for sablefish. The author should examine what the predicted year-class strength in 2014 would have been based on current knowledge of environmental linkages listed in the ESP. This prediction should be presented in the 2018 SAFE document to assess the process error surrounding the stock-recruit curve and an evaluation of whether the information contributed by the ESP is sufficient to change the management of this stock to tier 1.

The SSC also suggests that the next assessment include further investigation of the lack of fit to the plus group in recent fishery age compositions, and development of a prior for natural mortality.

C4 BSAI SAFE and Harvest Specifications for 2018/19

EBS Walleye Pollock

Public testimony was provided by Ruth Christianson (UCB), who questioned the reduction from maximum permissible ABC using Tier 1 calculations to an ABC based on Tier 3 calculations. This assessment is a straightforward update with no changes in the assessment model, Model 16.1. Bottom trawl and acoustic survey, catch, age composition, and average weight-at age information were updated.

Work continued on the random-effects model for annual weight-at-age-estimates. The methodology to estimate survey biomass was changed to a density-dependent approach from a design-based estimation method for improved accuracy. For the first time, hydroacoustic survey estimates included the lower parts of the water column from 0.5 – 3 m off-bottom.

Harvesters encountered good fishing conditions in 2017, as evidenced by an analysis of fishing effort. The stock assessment using Model 16.1 estimates strong 2012 and 2013 year classes and the female spawning biomass estimates (3.87 million t in 2017, 3.68 million t in 2018) are well above B_{msy} (2.04 million t). There were no retrospective patterns of concern in estimated biomass.

The SSC previously determined that EBS pollock should be placed in Tier 1. The authors and Plan Team used Model 16.1 to determine maximum permissible ABCs of 3.60 million t in 2018 and 3.44 million t in 2019 based on the standard Tier 1a approach. **Subject to the concerns described below, the SSC concurs with the authors and Plan Team to follow recent practice of using BRPs from Tier 3 for additional precaution, which results in a 2018 ABC of 2.59 million t and OFL of 4.80 million t.** The 2019 values are shown in the table below.

The authors listed seven reasons for reducing ABC from the maximum permissible. The Team mentioned some of these in their report and SAFE Introduction.

1. There may be lower larval and juvenile survival due to the warm conditions during 2014-2016.
2. There were few age-1 pollock in 2016 and 2017.
3. The abundance of older pollock (ages 10 and above) is relatively low (although this has been expected due to small year-classes before 2012).
4. Warm temperatures may have provided a corridor to allow some EBS pollock to move north into the northern Bering Sea, where they will not be routinely assessed and cannot be harvested under the current management plan. Whether these fish will return to their normal range is a concern.
5. The multi-species CEATTLE model produces a much different estimate of B_{msy} than the single-species assessment model (3.6 million t versus 2.04 million t estimated in the current assessment).
6. As pollock is a key prey species for many predator species, a northward movement of pollock may have detrimental effects on these species.
7. Projections suggest declines in abundance in the future, except at low catch levels. In addition, greater amounts of fishing effort would be required.

The SSC notes that the reduction in 2018 ABC from 3.60 million t (the maximum permissible) to 2.59 million t, a 28% reduction, is the second largest reduction of any BSAI stock (Bogoslof pollock being the largest). There are only four stocks with any reductions, and the reductions for the other two are less than 6%. Consequently, it is imperative that a strong, plausible rationale be given for the large reduction for EBS pollock. The SSC recommends that the authors and Plan Team elaborate on the rationale associated with the seven points above and provide better quantitative and qualitative support. Statements suggesting that the max ABC level is "clearly risky" and that a "stable catch system" requires the reduction are too subjective.

The assessment authors would like to undertake research on genetics to better understand the stock structure in the northern Bering Sea. Also, further work is anticipated on the random effects model for average weight-at-age. The authors will also be investigating projections and reference points for the multi-species CEATTLE model. The intent is not to replace the single-species model but rather to strategically explore predator-prey interactions and the effects of environmental factors.

The Plan Team had four recommendations for the authors. The SSC endorses the first two recommendations, which involve further exploration of the prior for steepness and reporting a year-class diversity index. Lacking adequate explanation, the SSC is unsure of the value of the latter two recommendations, which involve a comparison of fishery and survey CPUE and additional projections using fixed catch.

Bogoslof Walleye Pollock
There is no new information, so OFLs and ABCs are rollovers.

AI Walleye Pollock
This is "partial" assessment in which projections are rerun with updated catch information. **The SSC concurs with the updated OFLs and ABCs.**

EBS Pacific Cod
Stock assessment results and a summary of the Plan Team recommendations for EBS cod were presented by Grant Thompson, the lead author of the assessment. The SSC commends the author on his extremely thorough response to the numerous and varied Plan Team and SSC comments from previous meetings. The breadth of analyses and options provided to both the Plan Teams and the SSC fostered evaluation of many aspects of the data and models.

Public testimony was provided by Chad See and Gerry Merrigan (Freezer Longline Coalition), who provided a presentation summarizing some aspects of the biological, fishery, and assessment information. They highlighted the questions regarding cod distribution and potential movement to the northern Bering Sea (NBS) in 2017 as a partial explanation for the observed decline in the EBS trawl survey. They supported the Plan Team's choice of model 16.6, but not the reduction from the maximum ABC. Shaun Andrew (vessel captain), provided personal and fleet observations of consistent catches and generally good fishing, with 2017 activity occurring farther north than has been common. He further observed that, based on current late-season fishing, some southward movement of cod aggregations may now be occurring. He observed that some fishing in the 1990s had also extended to northerly areas in the Bering Sea (as far north as 61 degrees). Richard Thummel (Alaska Leader fisheries) expressed concern that fishery observations indicated that 2017 appeared to be an average year, but the survey results looked much worse. He expressed concern that the proposed reduction from the maximum ABC could have consequences for his operating plan, particularly with regard to crew employment and vessel participation. Craig Lowenberg (Self), provided the observation that additional fishing for Pacific cod as bait during the crab fishery was unnecessary, due to high incidental encounter rates.

Following Plan Team and SSC recommendations, the author brought forward six models updated with 2017 (and some 2016) data:

- Model 16.6 - representing last year's accepted base model.
- Model 17.1 - making a number of recommended changes to 16.6 including adjusting fishery and survey timing, using haul-based input sample sizes and week x gear x area catch-weighted size compositions, removing older fishery age data, adding recent 2013-2016 age data, including a prior for natural mortality based on previous estimates, adjusting the selectivity parameterization, and allowing time-varying selectivity for the fishery and survey.
- Model 17.2 - starting from 17.1, but using the harmonic mean weighting of composition data, and removing time-varying selectivity for the survey.
- Model 17.3 - - starting from 17.1, but using the harmonic mean weighting of composition data, and estimating the survey index standard error internally
- Model 17.6 - starting from 17.1, but using the harmonic mean weighting of composition data, and allowing time-varying length at age 1.5.

- Model 17.7 - Identical to 17.6, but limiting composition data multipliers to a maximum value of 1.0.

The Plan Team reported extensive discussions regarding which model or models to select for determining stock status and management recommendations for 2018-2019. They concluded that, although models 17.x did address previous concerns in some aspects of the assessment and treatment of the data, the author's preferred model 17.2 did not reflect a clear and obvious improvement over model 16.6. The SSC agreed, but noted that many of the improvements made in the 17.x models are strong candidates for future inclusion into modelling efforts, and the decision to endorse model 16.6 was difficult. The SSC noted that, although there is considerable interest in continued future use of the simpler model represented by model 16.6, there is a considerable list of improvements that are still needed. These improvements include: addressing ageing bias, adding the 2013-2016 age data, continued investigation into time-varying selectivity (fishery and possibly survey) and data weighting. The SSC recognized that the EBS and GOA Pacific cod assessments have diverged to some degree in 2017, with additional complexity (particularly with regard to time-varying processes including fisheries selectivity) included in the adopted model for the GOA and not for the EBS. Improved coordination between the basic approaches may be desirable in the future. Further, model 16.6 continues to show a poor retrospective pattern. All of the models considered for 2017 show the result that, in hindsight, there appears to have been a long period of heavy exploitation, with very high estimated fishing mortality rates. Although this may be possible, this result continues to give pause in light of a lack of clear demographic data indicating such high levels of fishing mortality. None of the models considered for 2017 could adequately accommodate a possible shift in biomass from the EBS to the NBS, one likely contributor to the trends observed in both areas.

The SSC has encouraged the additional work on model averaging conducted during 2017, and the author and Plan Teams have made good progress on the topic, even if neither are ready to move forward with it. Remaining concerns include clearly identifying criteria for including models in an ensemble, specifically delineating between alternative plausible hypotheses and sensitivity analyses (which should not be included), as well as continued exploration of specific methods for calculating averaged results. **The SSC supports the Plan Team's recommendation to conduct a spring workshop to address these and other issues which would not be limited to just Pacific cod.**

Therefore, the SSC agrees with the Plan Team to use model 16.6 as the basis for this year's status determination and setting of management quantities. After considerable discussion, the SSC concluded that there were not compelling reasons to set the 2018 ABC below the maximum permissible value. Ecosystem and population information provided a mixed signal: recent low recruitment estimates are concerning, there was high age-1 mortality estimated from the multi-species model, there was contradictory information on Pacific cod body condition in recent years. An expected return to cooler conditions in the near future may alleviate some of these concerns. The results of the NBS survey from 2017 indicated a substantial amount of cod north of the area included in the stock assessment, associated with warmer bottom temperatures over much of the shelf. The size composition of fish in the NBS is similar to that in the standard survey area, consistent with the hypothesis that they are part of the same population. **Unlike the Plan Team, the SSC recommends setting the 2018 ABC at the maximum permissible level of 201,000 t because there is not unequivocal information justifying a further reduction. The SSC endorses the Plan Team's recommended 2019 ABC of 170,000 t, which is the maximum permissible.** The SSC does note that biomass is expected to decline in the near term due to recent low recruitments.

In addition, the SSC had several recommendations for the next assessment cycle:

- Discontinue work on development of empirical weight at age; analysis to date suggests that this may not be a fruitful avenue given data available.

- Report a consistent metric (or set of metrics) to describe fish condition among assessments and ecosystem documents where possible.
- **The SSC disagreed with the Plan Team's recommendation to drop the first 5 years of EBS trawl data** in order to use the NW strata. Instead it encourages treatment of these data by allowing catchability to change after the first 5 years of the EBS survey in the model, or through geostatistical modelling approaches, perhaps similar to those proposed by Dr. Stan Kotwicki in a separate presentation.
- **The SSC strongly supports the proposal for renewed genetics work to investigate the degree to which the cod observed in the NBS represent a separate genetic pool from those observed in the EBS.** However, the SSC was concerned that mixing samples collected over several decades, and the apparent lack of samples from the EBS shelf could be problematic. They encourage the PIs of this study to consider the sample distribution over time and space and work with fishery or other sources to provide the clearest test possible of this very specific question concerning Bering Sea cod.
- Projections in this and other assessments clearly illustrate the lack of uncertainty propagation in the 'proj' program used by assessment authors. The SSC encourages authors to investigate alternative methods for projection that incorporate uncertainty in model parameters in addition to recruitment deviations. Further, the SSC noted that projections made on the basis of fishing mortality rates (Fs) only will tend to underestimate the uncertainty (and perhaps introduce bias if the population distribution is skewed). Instead, a two-stage approach that first includes a projection using F to find the catch associated with that F and then a second projection using that fixed catch may produce differing results that may warrant consideration.

Aleutian Islands Pacific Cod
The Aleutian Island Pacific cod stock has been assessed separately from eastern Bering Sea cod since 2013 and has been managed separately since 2014. The stock remains in Tier 5 for assessment and management using a simple random effects model of the trawl survey biomass time series; however, there were no new trawl survey data available for 2017. Catches were updated from 1991-2016 and projected for 2017. **The SSC supports the Plan Team's recommendations for the OFL and ABC.** The estimate of natural mortality from the EBS Pacific cod model 16.6 (0.36) was used, resulting in a maximum ABC of 21,500 t. The percentages for area allocation remain unchanged from last year.

BSAI Atka Mackerel
A full assessment was presented for BSAI Atka mackerel. Changes to last year's Atka mackerel assessment include both fishery data updates (catch and age composition) and an evaluation of the trade-offs between effective sample size and the degree to which selectivity is allowed to vary. An Aleutian Islands survey did not occur in 2017, thus an update of the survey biomass data series did not occur. Age composition data were tuned using the Francis method, as was the time-varying fishery selectivity variance term. Additionally, the projected total catch for 2017 was set nearly equal the TAC (64,500 t), estimated annual selectivity from 2012-16 was used for projections, and an assumption that 75% of the BSAI-wide ABC is likely to be taken under revised Steller Sea Lion Reasonable and Prudent Alternatives was applied to 2018 and 2019 maxABCs.

Models presented for Atka mackerel in 2017 included:

1. Model 16.0, the base model with the variance of fishery selectivity allowed to vary as in the 2016 assessment, time-varying fishery selectivity, and both fishery and survey sample size allowed to vary with the number of hauls.
2. Model 16.0a, a modification of 16.0 where the variance of fishery selectivity was tuned using Francis weighting

3. Model 16.0b, a modification of 16.0a where survey sample size was also tuned using Francis weighting
4. Model 16.0c, where fishery selectivity was calculated for time blocks and both fishery and survey sample size were tuned using Francis weighting

While model 16.0c showed promise, using time blocks for fishery selectivity caused significant recruitment events to be obscured and resulted in a poor fit to fishery age composition data. **As a result, the authors and Plan Team recommended Model 16.0b, and the SSC concurs**. According to this model, spawning biomass reached an all-time high in 2004, then decreased through 2017 (a decline of 48%), and is projected to decrease further through 2018. The 1999-2001 year classes were all very strong, but since then only the 2006, 2007, and 2012 year classes were above the long-term average. The addition of new survey age composition data caused the estimated biomass of the 2011 and 2012 year classes to increase 14 and 32%, respectively. The projected female spawning biomass for 2018 (139,297 t) is down from last year's projections for 2017, but still above $B_{40\%}$ (122,860 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 2% lower than last year's estimated values.

As spawning biomass is projected to be above $B_{40\%}$ in 2018, Atka mackerel falls into Tier 3a. The SSC supports the author's and Plan Team's recommended OFLs and ABCs for 2018 and 2019. The random effects model for regional allocation has been used since 2015 and the SSC supports its use for this assessment.

This year the authors not only thoroughly recounted the management history of Atka mackerel relative to the Steller sea lion BIOP and RPAs, but also provided a detailed description of ecosystem considerations including prey availability and diet, interactions between Atka mackerel and predators such as marine mammal and seabirds, and changes in habitat quality and distribution. They also described known impacts of the targeted fishery on the biology of Atka mackerel and benthic habitat. The SSC thanks the authors for their dedicated work to put the species and fishery into a broader ecological context that promotes deeper understanding of factors influencing diverse parameters used in the assessment.

As noted in the SSC December 2014 and 2016 minutes, the AI bottom trawl survey provides highly variable estimates of trends and this contributes to the sensitivity of 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 in this assessment.

For subsequent assessments, the SSC supports the following Plan Team recommendations:

1. Investigate which parameters are changing in retrospective peels
2. Consider dropping the 1986 age composition data from the analysis
3. Improve documentation for the process of using Francis weights to tune the constraint governing the extent of time variability in fishery selectivity.
4. Continue to investigate fishery selectivity time blocks, based on changes in the fishery.
5. Evaluate sensitivity of model results to an assumed average sample size of 100 for fishery age composition data, or find a way to tune sample size and the constraint governing the extent of time variability in fishery selectivity simultaneously.
6. Investigate whether a larger number of otoliths can be collected in a representative fashion.
7. Continue investigation of age-dependent natural mortality.
8. Continue to include (and update) Figure 17.5, which shows annual temperature anomalies calculated from Aleutian Island trawl survey data.

The SSC also supports continued work to explore spatial covariates that affect the abundance and distribution of Atka mackerel, and efforts to evaluate how changes in trawl tow duration after 2001 may have affected encounter rate and estimated biomass, age composition, etc.

BSAI Flatfish

Yellowfin Sole

There were no changes in the model for this assessment. Updated data included estimates of discards and retained portions of the 2015 fishery catch, survey and fishery age composition for 2016, estimates of trawl survey biomass and standard error for 2017, and estimates of total catch through the end of 2017.

This assessment is exemplary for its inclusion of environmental factors in the estimation of survey catchability, stock-recruit relationships, and fish growth. Sea state has a larger effect on yellowfin sole trawl efficiency than temperature. Biomass is correlated to wave height, which is also correlated with temperature. A paper was submitted on the effects of wave-induced vessel motion on the geometry of a bottom survey trawl and the herding of yellowfin sole. The SSC compliments the authors for these efforts.

Two stock-recruit models were evaluated: model 14-2 – full time series (1955-2012) - and model 14-1 – post-regime shift (1978-2012). For the former, some large recruitments occurred at low stock sizes, suggesting a more productive stock. Fits to the latter result in a higher estimate of Bmsy and a lower estimate of Fmsy. Given the uncertainty of the productivity of yellowfin sole at low spawning stock sizes, and given general practice to use the post-1977 regime shift values unless there is a compelling reason to do otherwise, the productivity of yellowfin sole was estimated by fitting the 1977-2012 spawner-recruit data in the model (Model 14-1).

Spawning biomass has been slowly declining for the past 22 years, but remains large (1.9 times Bmsy). Average to above average recruitments from 2006 to 2009 are expected to maintain the abundance of yellowfin sole at a level above Bmsy in the near future. Annual exploitation rates of yellowfin sole since 1977 are low, averaging 4% (range 3-7%) of total biomass.

One ongoing concern with the assessment is a strong retrospective pattern in female spawning biomass, whereby more recent assessments tend to yield higher biomass estimates (Figure 4.21). Pursuant to requests by the Plan Team and SSC, the authors explored the effects of M and q on these patterns. Lower values of q and M resulted in better retrospective patterns and lower Mohn's test statistics. The SSC supports the Plan Team's recommendation to select a parameterization (e.g., M=0.09 and q=1.0) that reduces the retrospective pattern and to determine whether spawning biomass projections from this parameterization fall within the uncertainty of the base model or if it describes different population trends. The SSC also endorses the Plan Team's recommendation to continue to explore effects of M and q on the retrospective patterns in biomass.

The SSC notes that potential improved performance of the model with lower values of M are interesting, given that M appears to have been well specified both outside the model (based on multiple methods of estimation, including analysis of old Japanese pair trawl effort data) as well as inside the model (profile of M over a range of values). A natural mortality value of 0.12 is used for both sexes in the base model. Pending the outcome of efforts to explore effects of M and q on the retrospective pattern, the SSC recommends that the authors reexamine alternative methods and data available to estimate M independent of the model in attempts to independently "validate" the plausibility of the results.

The SSC notes that there appears to be a strong time trend in the proportion of fish in the final age bin (age 17+) in the fishery catch at age data for both males and females (Table 4.4). Prior to 1980, there were no fish in this category. This proportion has generally increased from the mid-1980s to a maximum of 19% for males in 2004 and 23% for females in 1999, and fluctuated at relatively high levels through 2016. Such a pattern could be consistent with time-varying M, although there may be other explanations. For next year's assessment, the SSC recommends that the assessment authors consider the evidence for time-varying M and evaluate the ability of time-varying M to address the retrospective biomass pattern in an alternative model.

The SSC agrees with the authors' and PT's recommendations for ABC and OFL under Tier 1a.

Alaska Plaice

A full assessment was conducted for Alaska plaice. The model was unchanged from the 2016 assessment. Updated data included estimates of catch and discards for 2016 and 2017; shelf trawl survey biomass estimates, standard errors, and survey length composition for 2017; and survey age composition and fishery length composition for 2016.

Alaska plaice are primarily taken incidental to flatfish fisheries targeting yellowfin sole and northern rock sole. Model estimates indicate an increase in female spawning biomass from the mid-1970s to the mid-1980s, and a general slow decline since then. Projections suggest that this decline may continue for another 5 years, as only the 2001 and 2002 year classes were above average since 1993.

Unlike some other flatfish species that demonstrate a positive correlation between survey catchability and temperature, there is no apparent relationship between temperature and survey catchability of Alaska plaice. A comparison between the residuals from fitting the trawl survey biomass and average annual bottom temperature anomalies revealed no correlation. Alaska plaice have an antifreeze protein that allows them to thrive in cold waters. Surveys conducted in 2017 indicate that 40% of the plaice biomass exists in the northern Bering Sea. Because the northern Bering Sea is closed to fishing, biomass estimates from only the EBS standard survey are used in this assessment. As with a number of other species, there is a poor understanding of the relationship between Alaska plaice in the eastern Bering Sea to those in the northern Bering Sea.

A retrospective analysis of female spawning biomass estimates does not suggest any serious issues with model misspecification. Likewise, fits to survey biomass, survey ages and lengths, and to fishery ages and lengths seem reasonable.

The SSC agrees with the authors' and Plan Team's ABC and OFL recommendations under this Tier 3a assessment.

BSAI Forage Fish

The SSC received a report on the status of forage species in the Bering Sea and Aleutian Islands (BSAI) region. The purpose of the report is to monitor potential impacts of bycatch on forage fish by (1) investigating trends in forage fish abundance and distribution, and (2) describing interactions between federal fisheries and forage species. BSAI forage fish information is also reported in the Ecosystem Considerations report. In response to the SSC's request (Dec 2016 Report), the author continued to produce this biennial analysis in the SAFE report. The forage fish information report in the BSAI SAFE uses bottom trawl surveys in the BSAI and acoustic-survey results where applicable. The Ecosystem Considerations report is based on the surface-trawl surveys conducted by the Ecosystem Monitoring and Assessment program, uses euphausiid abundance information from acoustic surveys and includes indirect indicators of forage species abundance and prey availability (e.g. seabird breeding success and groundfish predator diets).

The SSC appreciates the author's effort to reduce duplication and confusion between this report and the Ecosystem chapter. The inclusion of an ecosystem chapter forage fish information summary and cross-referenced information in the report were useful and should be maintained. The SSC appreciates the author's examination of temperature and forage fish trends**. The SSC supports the Team's recommendation to remove the "warm" and "cold" stratification in the temperature analyses and instead plot mean annual CPUE as a function of annual temperature to explore the temperature – CPUE relationship.**

Further work could certainly be done on spatial analysis to better inform changes in forage fish distribution. This may provide useful information from the standpoint of where PSC is encountered relative to fishery activity. Along these lines, in our December 2016 report, the SSC noted that 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. **The SSC concurs with the Plan Team recommendation that the assessment author should examine catch inside and outside of the current herring protection areas, and whether core areas of high forage fish (specifically herring) abundance and catch have changed over time.**

EBS/GOA Ecosystem Chapters

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

Comments applicable to the Ecosystem Considerations Chapters for both the Eastern Bering Sea and the Gulf of Alaska.

This year, as in the past, the Ecosystem Considerations Reports are insightful, well written and well edited. Both chapters were 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 been very responsive to the comments and suggestions provided by the SSC in 2016. Last year the SSC raised the question as to whether sufficient resources were being devoted to the compilation and editing of the Ecosystem Considerations chapters. The SSC recognizes that this year NOAA provided additional staff resources to sustain the improvement of these documents, and that these additional resources allowed for more in-depth analyses of recent environmental changes, such as the examination of the sudden decline in Pacific cod in the Gulf of Alaska.

The SSC was pleased to see the addition of the rapid zooplankton assessments included for both EBS and GOA Ecosystem reports. As requested by the SSC, these data are shown with historical context for small and large copepods, and euphausiids. Additionally, this indicator now estimates abundance rather than proportional catches, which aids in interpretation.

There are expanded analyses of abundance and distribution shifts of groundfish and jellyfish from AFSC bottom trawl surveys. New indicators for groundfish from these surveys (mean length, lifespan and total biomass) have remained relatively stable over the time series. The SSC appreciates the inclusion of these new indicators, but suggests that even small changes could have far reaching implications as these are relatively gross-scale indicators. The SSC requests further development of these indicators as anomalies to better discern long-term trends. The SSC looks forward to the eventual inclusion of comparisons of events in the different LMEs, and how events in one LME may affect another LME.

The editors present a new “Groundfish Recruitment Predictions” section, which includes a new indicator for Pacific cod and five new indicators for walleye pollock. The SSC supports the development of these predictions based on ecosystem indicators that are firmly grounded in mechanistic relationships. Effort should be directed toward the eventual incorporation of these recruitment indicators in the assessment models. **The SSC recommends that these species-specific predictions are transitioned to the ESPs (Ecosystem Socio-economic Profile) to ensure that they are considered by the stock assessment authors.**

The SSC commends the ongoing efforts to expand the treatment of the Human Dimensions portion of the Ecosystem Considerations chapters. In particular, a number of new indicators have been incorporated. The SSC notes that development of indicators on the “health” of fishing communities lags behind that of indicators for the health of the fish stocks and that the latter were developed and refined over a long time period. The SSC encourages the continued development of this section and, in particular, the development of indicators on which the Council might be able to act in the advent of evidence of a problem. Specific to the human population indicators, regional characterizations mask rural trends relative to urban centers. The SSC recommends the inclusion of maps demonstrating finer scale shifts in population trends as well as school enrollment trends, both of which are strong indicators of community stability or vulnerability.

The influences on the economic and social life in Alaska’s coastal communities are many and the SSC cautions against facile causal interpretations. At the same time, it would be a mistake to dismiss the indicators presented in the chapter as being disconnected from and unrelated to the Council’s sphere of influence. The policy choices made by the Council and the US Congress directly influence the possibilities presented to the communities of the North Pacific. The SSC suggests that the Human Dimensions ecosystem indicators be a topic for discussion by the newly formed Social Science Planning Team.

The LEO Network is a potentially valuable resource for ecosystem considerations that invites community members to record unusual observations which are then vetted by scientific consultants before being published on the network. **The SSC recommends the exploration of projects within this tool that ask specific questions to solicit relevant observations from communities**. It is not clear how this network is publicized or the level of community awareness and involvement. Specific to the northern Bering Sea, the SSC endorses the Plan Team recommendation for continued evaluation of approaches to incorporate local ecological knowledge into the Ecosystems Considerations chapters. In addition, the SSC encourages exploration of other more active approaches to gathering and engaging citizen science/LTK from communities.

Last year the SSC raised the issue of how well report authors have managed to address the implications of their indicator findings for the current year. One of the important reasons for the existence of the Ecosystem Considerations chapters is to provide the Council with information that may be relevant for adjusting the coming year’s harvest specifications or biological reference points. Thus, the indices and their implications that are most valuable will be those that provide information that inform Council decisions. The Implications Sections that merely state that an indicator might be important for management are not particularly helpful. The SSC recognizes that the editors are planning to revise the instructions to authors to clarify this issue, and looks forward to improvements in this area.

The editors raised the question as to the possibility of a change in the organization of the Ecosystem Considerations chapters. Currently, the report is organized by trophic level, reflecting the flow of energy and material to fish stocks and the fishing community within each LME. The editors are considering reformatting by ecosystem-scale management objectives created by Congress (see Table 1 in each of the chapters). The SSC questions the utility of the proposed change from a document focused on understanding of relevant portions of the marine ecosystem in which fishing is occurring to one that focuses more on fisheries management objectives. This organization could be appropriate for the fishing and human dimensions indicators, but not the physical and ecological indicators in the Ecosystem Indicators section. The SSC has been on record for many years in requesting that the Ecosystem Considerations chapters and their components follow an organization scheme based on trophic level.

Bering Sea Chapter:

In the EBS Chapter, the “Hot Topics” section included an excellent discussion of large biomasses of Pacific cod and walleye pollock in the northern Bering Sea. The presence of these fish in large numbers that far north raises important questions about their persistence there and their relationship to the stocks in the eastern Bering Sea. Although in 2017 there may have been a wider pathway north in the inner shelf than usual, an important question is now whether the fish observed in the north are a separate stock and, if they are not a separate stock, will the population return south prior to winter. Likewise, high numbers of age-0 pollock were observed in the northern Bering Sea. It is not known what proportion of these fish will return to the southeastern Bering Sea.

Our best information is that both walleye pollock and Pacific cod lack the antifreeze proteins needed to prevent tissues from freezing at the sub-zero water column temperatures almost certain to occur over the shelf in the coming winter. Observations around Norton Sound of the presence of cod and pollock and their condition this winter could be most helpful in evaluating the implications of this new distribution pattern. It would be of interest to survey local communities in the northern Bering Sea to obtain information about their past experiences with groundfish in these waters, and when they have been observed to arrive and depart. Specifically, the authors should investigate whether data from the Norton Sound winter king crab fishery is useful. With regard to Pacific cod in particular, results from the 2017 northern Bering Sea survey, in concert with the observed decline in biomass from the EBS bottom trawl survey, suggest that we might need to be adaptive not only in our management, but also in our surveying of commercial fish stocks. The SSC strongly supports conducting additional surveys in the northern Bering Sea.

In the EBS chapter, the suite of contributions showing the relationships among the availability of large, lipid-rich zooplankton, diets of age-0 pollock, the lipid content of these juvenile fish and their survival to age-3 is remarkable. The demonstrated predictive ability suggests that we are making progress toward having the understanding and data available for input to the pollock assessment model that may improve predictions of year-class strength. Additional information shows that year-class strengths of cod and pollock are strongly correlated and suggests that prediction of Pacific cod year-class strength may also become possible.

The SSC expressed interest in having information on the status and trends of marine mammals in addition to northern fur seals. Two species that may be of particular interest in the EBS are walrus and harbor seals. Diet studies indicate walrus are still primarily benthic foragers, but also utilize fish resources. Recent reports from communities indicate that harbor seal populations in Bristol Bay are increasing. As harbor seal diets include forage fish and groundfish, monitoring their populations may contribute to ecosystem status and pattern interpretation. Changes in ice seal distribution or abundance may help in assessing changes in commercially important stocks, or the prey on which they depend.

A few notable trends in the EBS

<u>Groundfish</u>

Groundfish condition declined from 2016 – 2017 for all species, except for age-1 pollock and Alaska plaice, e.g., length-weight residuals for adult walleye pollock and Pacific cod were both negative. The SSC requests that the authors consult with the stock assessment authors and select a common index of fish condition. Poor condition may compromise overwinter survival. Also, based on the CEATTLE model, estimated mortality for age-1 pollock, Pacific cod and arrowtooth flounder remained elevated in

2017, and predictions based on the relationship between the North Pacific Index and Pacific cod recruitment deviations suggest that poor cod recruitment is likely. The results from these three indicators in concert (poor condition, increased mortality and negative recruitment deviations) may signal an upcoming period of poor Pacific cod recruitment. On a more positive note, cooler temperatures are forecast for 2018, which should lead to increased large zooplankton, and better survival of juvenile pollock and cod.

Flatfish
Springtime drift patterns were consistent with below average flatfish recruitment for winter spawners. There have been very few years with drift patterns that indicate strong recruitment for flatfish over the last decade, and, this relationship may be weakening for certain species. The extended period of poor flatfish recruitment should be monitored.

Crab and motile epifauna
Commercial crab biomass decreased in 2017 again, whereas brittle stars and sand dollars continue to increase. The SSC raised the possibility that a restructuring of this part of the ecosystem is occurring, or has already occurred, and recognizes the continued depression of commercial crab stocks.

Salmon
Canadian-origin Yukon River juvenile Chinook abundance in the northern Bering Sea was below the long-term average, and there is a potential need for reduced bycatch caps three to four years from now. It could be useful to summarize data on the availability of zooplankton and forage fish to salmon as they enter the ocean.

Gulf of Alaska Chapter
The Ecosystem Considerations Chapter for the Gulf of Alaska is still expanding and developing, and the SSC wishes to recognize the hard work of the editors and the contributors in developing this valuable management product. The SSC looks forward to further development of the GOA chapter, including the development of additional indicators. The need remains to finalize indicators for the regional report cards and to make progress in the development of predictive capacity as in the EBS Ecosystem report. The division of the GOA into eastern and western sub regions emphasizes data gaps, such as the lack of forage fish indicators in both regions, and the role of freshwater input.

An exceptionally valuable addition this year is a thoughtful examination of the impact that the warm “blob” that arrived in late 2013 had on the dynamics of Pacific cod in the Gulf of Alaska. This exposition provides not only a way to understand what happened and why, but also provides the tools for rethinking how we might have detected the decline of cod two to three years before it happened. It would be valuable to develop a protocol for how to detect and respond to a potent ecosystem change in the future that could negatively, or positively, affect harvest specifications (See above discussion).

The SSC welcomes new contributions including: multiple oceanographic indicators, forage fish from Middleton Island auklet and kittiwake diets (which show a lack of capelin in their diets during heat wave years), ADFG herring biomass in EGOA, spring larval pollock from the EcoFOCI survey in western GOA, humpback whales in Glacier Bay, and the new suite of socio-economic indicators. The disease ecology indicators may prove particularly important. The SSC expects to see prevalence of these factors shift with changes in environment, e.g., emerging novel pathogens, or expansion of distribution with changes in the environment, such as an increase in Vibrio in warming waters.

The report on the station Papa trajectory index was interesting and the SSC appreciated having the full retrospective dataset for comparison to the southward trajectory in 2017. It would be useful to explore how variations in this index translate into changes in zooplankton abundance or species composition.

A unique feature of the GOA is the number of tidewater glaciers in Kenai Fjords, Prince William Sound and SE Alaska that contribute freshwater to the marine environment. How are these inputs changing, and what are the potential impacts on the productivity of the GOA?

The SSC suggests that results from the AFSC GOA bottom trawl survey be further investigated as a strong data source. Biomass estimates for the apex predator and the motile epifauna guilds are included in the report cards for the subregions, but more detail on these results included in the executive summaries and the current state sections would be useful. As shown by the editor in the presentation to the SSC, there were differences in what drove recent changes in the apex predator biomass by subregion, in this case, the large increase in the eastern GOA in 2015 was driven by arrowtooth flounder. It would also be useful to have data on acidification (pH) as an additional indicator to complement temperature and salinity. The SSC noted that Qiong Yang (PMEL/JISAO, NPRB 1509) has developed a new index of fish distribution by size, which should be considered for the 2018 report.

A few notable trends in the GOA

As noted in the Hot Topics section, pyrosomes were noted in the GOA for the first time in 2017. It appears that they were quite widespread and abundant, but it is not clear what their presence means for commercially important fish stocks. To the extent possible, their potential role in the ecosystem and potential impact on fish in the GOA needs to be addressed.

<u>Zooplankton/jellyfish</u>
The shift in the size of zooplankton from large (*Calanus*, *Neocalanus*) to smaller species, and the scarcity of the larger species is an important observation. This shift may reflect changes in the advection of large species from the south and/or onto the shelf or an ecosystem response to the recent warming events.

The size distribution of jellyfish species has shifted toward smaller species; it would be interesting to determine whether this shift is a reflection of the size spectrum of zooplankton available.

<u>Groundfish</u>
The arrowtooth flounder stock has declined recently, potentially indicating a response to the marine heat wave similar to Pacific cod. Presumably, this would result in decreased predation pressure on pollock, as well.

Larval walleye pollock at-sea rough counts were above average in the WGOA EcoFOCI survey throughout grid, in contrast to 2015, when the survey encountered lots of zero stations and low rough counts. Larval pollock abundances were also high in late summer during the Oscar Dyson survey. The SSC requests that this survey be further investigated to evaluate its utility for other groundfish species.

In 2017, all groundfish species excepting Pacific cod had below average condition. The lack of a consistent temporal and spatial trend might be indicative of highly dynamic productivity with local hotspots that influence condition. The SSC requests these data be split out into juvenile and adult samples, as suggested by the contributors to evaluate further spatial and temporal patterns.

Based on 2016 environmental data, model-based predictions are for an above average abundance of age-2 sablefish (68 million) in 2018 (2016 year-class). However, based on 2017 environmental data, there may be below average abundance of age-2 sablefish in 2017 (2015 year-class). Recruitment is modeled from chlorophyll a, sea temperatures and pink salmon returns in Southeast Alaska. The large 2018 prediction appears to be primarily driven by a high chlorophyll a value, and the author notes the relatively high error associated with this estimate. These data are from the Southeast Coastal Monitoring survey. This raises the question whether there are other data that could be available from this survey.

Salmon

Estimated biomass of juvenile salmon present on the EGOA shelf decreased in 2017. Abundances were low for Chinook, coho, and pink salmon, and moderate for chum salmon. This implies a decline in marine conditions encountered for growth and survival of salmon from Southeast Alaska, British Columbia, and the Pacific Northwest stocks.

Marine mammals

Preliminary non-pup counts of Steller sea lions declined 12% in 2017 compared to 2015. Both the eastern and western population were on an upward trajectory through 2015. It will be important for management to see if the latest decline was a short-term response to the heat wave or if it becomes a persistent trend.

Given the marked changes observed in the Gulf of Alaska in response to the marine heat wave, the SSC encourages the ecosystem considerations authors to examine methods to estimate the carrying capacity of the Gulf of Alaska. The SSC recognizes that some consideration of ecoregions (perhaps nearshore, banks and troughs) and zoogeography (perhaps an eastern and western/central spilt) may be needed.

C5 GOA SAFE and Harvest Specifications for 2018/19

GOA Walleye Pollock

W/C/WYAK Gulf of Alaska

This year's assessment is based on several sources of new information from 2016 and 2017. The commonly observed conflict between the hydroacoustic and bottom trawl survey trends was amplified in 2017, with the trend in the hydroacoustic survey being positive and the trend in the bottom trawl survey being negative. Pollock at older ages appeared to be skinnier than normal. An interesting observation is that there was an unusually skewed sex-ratio (40% females) in the winter fishery, the cause of which is unknown. One possibility may be differential maturity curves for males and females and the dominance of the large 2012 year class. Table 1.15 shows wide variability in the estimated proportion mature for age 5 females, ranging from 0.086 in 2014 to 0.953 in 2017. Similar information on male maturity was not reported.

Four alternative models were evaluated in addition to last year's approved model (Model 16.2). Model 17.1 uses the data weighting approach of Francis, as is common in several other assessments. Model 17.2 uses time-varying random walks for the bottom trawl and hydroacoustic survey catchabilities, in light of information suggesting changes of pollock in the water column. Model 17.3 is the same as Model 17.2 but with a smaller penalty on deviations, which allows more variability in catchability over time. Model 17.4 is the same as Model 17.2 but allows natural mortality to be different for the 2012 year-class.

While Model 17.1 had the desired effect of reducing effective sample sizes, there were no appreciable effects on model results compared to Model 16.2. Models 17.2 and 17.3 were more plausible than 16.2, because survey catchability does seem to vary over time. Model 17.2 was preferred over Model 17.3, because the latter was perceived to overfit the data. Model 17.4 did not improve model fit. Thus, the authors and Plan Team selected Model 17.2 as the preferred model, and the SSC concurs. The SSC recommends that the authors either provide better justification for the penalties used in Models 17.3 and 17.4 or develop a more quantitative approach to selecting penalty terms.

Results from the stock assessment show a moderate decline in female spawning biomass from 213,689 t in 2017 to 170,265 t in 2018. Consequently, there were moderate declines in ABC and OFL as well. On the positive side, the 2012 year-class appears to be very strong and is the largest in over 30 years. The stock is in Tier 3a as female spawning biomass is above B40%. **The SSC agrees with the authors' and PT's recommendations for OFL and ABC (see Table 2 above).**

East Yakutat/ Southeastern Alaska
For East Yakutat and Southeastern Alaska Tier 5 calculations are done with the random effects model applied to bottom trawl survey data.

Area apportionments
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. Since 2015, the Plan Team and SSC have 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 Table 2 above.

Recommendations
The SSC agrees with the four recommendations made by the Plan Team:
1. Examine trawl catchability in relation to the age-structure of the population.
2. Continue to investigate alternative data weighting procedures.
3. Attempt to construct a weighted availability index by depth.
4. Explore environmental covariates in the delta-GLMM analysis of survey abundance.

GOA Pacific cod
Steve Barbeaux (AFSC) presented results from the 2018 Pacific cod stock assessment, a preliminary version of which was presented in October. The SSC appreciates the thorough discussion of model development and model results in the face of an apparent substantial decline in Pacific cod biomass in the Gulf of Alaska. The SSC also notes the contributions of the ecosystem assessment group in supporting and justifying the development of a model that accounts for poor feeding conditions associated with the 2014-2016 warm anomaly in the Northeast Pacific. Public testimony was provided by Julie Bonney (Alaska Groundfish Data Bank) and Chris Woodley (Groundfish Forum). They indicated support for reducing the ABC in an attempt to help keep the stock above the SB20% level in the near future.

The Pacific cod stock in the Gulf of Alaska experienced a drastic decline in biomass and abundance since 2015, as first reported in October following the 2017 bottom trawl survey. As detailed in the ecosystem status report, the Gulf of Alaska experienced anomalous warm conditions throughout the water column starting in 2014 through at least 2016 (a warm event known as 'The Blob'). This unusual warm event apparently affected the entire ecosystem and, in particular, affected prey availability for upper trophic level predators as was evident in a number of ecosystem indicators (groundfish condition, seabird die-offs and other unusual mortality events), including the poor condition of Pacific cod in recent years (negative weight-at-length anomalies).

The decline was most obvious in a sharp reduction in the 2017 bottom trawl survey biomass, which had a very tight confidence interval because Pacific cod were consistently encountered in very low abundances throughout the survey region. Low densities in much of the survey region were corroborated by reduced catch rates in the fishery in 2017. The observed decline in biomass was not captured by last year's accepted model (16.08.25), when updated with new data. Therefore, model explorations this year focused on model features that might help explain this large and unexpected decline, in addition to other improvements. The new models developed for 2017 (17.09.x series) incorporate some relatively minor data changes that did not have a strong effect on results and vary primarily in their treatment of natural mortality and survey catchability, as well as changes to the periods over which selectivity was allowed to vary.

Last year's accepted model (16.08.25) represents both a simplification and a substantially different view of the dynamics of Pacific cod compared to the previously accepted model. While there is still a lot of uncertainty about the appropriate model structure, as in the EBS cod assessment, there is evidence that the higher rate of natural mortality, smaller absolute stock size, and higher productivity implied by the new model are very plausible. Some evidence in support of the model structure cited by the author include recent studies suggesting fewer old cod in the population (both currently and historically) than was previously believed and the fact that the estimated population trajectory is more consistent with documented historical trends, specifically the 'gadid outburst' in the Gulf of Alaska in the late 1970s and early 1980s.

The SSC briefly reviews model development and selection for the record.

- Last year's model, as well as a modified model using a log-normal prior for M (17.09.25), estimated a very large 2012 year class, which is supported by many sources of data. However, the model had very poor retrospective performance with regard to recruitment estimates. When updated with 2017 data, the models estimate much lower recruitment for the 2012 year-class in order to account for the observed large drop in biomass in 2017. Therefore, other model variants based on preliminary models developed in September, as supported by Plan Team and SSC recommendations, allowed for a higher natural mortality rate on the strong 2012 year class once they recruit to the fishery.
- Model 17.09.26 makes two changes: (1) allowing natural mortality in 2015 and 2016 to differ from mortality in other years to account for a possible mortality event during those years associated with the warm anomaly and (2) allowing annual variation in trawl and longline selectivity in 1977-1989. Both of these changes, when introduced individually, improved the model fit substantially. The selectivity changes improved likelihoods for length and age compositions, as expected, while a higher estimate of M in 2015/2016 improved the fit to the survey data substantially due to a much better fit to the recent decrease in survey biomass. In combination, these changes improved likelihood components as well as retrospective patterns (Mohn's rho values < 0.005) considerably over model 17.09.25.
- Model 17.09.31 added a temperature-dependent catchability in the longline survey, as well as a tighter prior distribution for M to avoid what the author felt was an unrealistically high mortality estimate. This model greatly improved fits to the longline survey data and suggested higher catchability in the longline survey during warm years, consistent with the observed tendency for Pacific cod to move into deeper waters, where the longline survey takes place, when temperatures increase.
- Model 17.09.35 in addition introduced a relatively minor change in longline and trawl fishery selectivity in 2005 and 2006 to account for the shortened season in those years, which resulted in larger sizes of fish caught on average. This modification improved model fit to both the longline and trawl length compositions, primarily due to a better fit to the 2005/2006 lengths, but had little effect on other results.
- Retuning multinomial sample sizes for the fishery length composition data using a model that was otherwise identical (17.09.36) had minimal impacts on model results.
- The final model (17.09.37) used a different parameterization of natural mortality that includes both a decrease in M with age, as well as temperature dependent mortalities over time. In addition, it still allowed for a further increase in M during 2015/16. The SSC appreciates this exploration of environmentally-dependent mortality. The model fit improved considerably (with a drop in AIC of 36, in large part a result of improved fits to survey biomass data) and results

suggest that M increases substantially with temperature. However, the author considered this model exploratory at this stage and it clearly needs further work.

The author and Plan Team recommended Model 17.08.35 and the SSC concurs with this recommendation. This model fit the data well without obvious bias or apparent overfitting and had a reasonable retrospective pattern. The most influential modification over last year's model was the extra time block for natural mortality in 2015/2016. The SSC accepts this adjustment to natural mortality to achieve a better model fit because of the strong rationale presented by the author and the ecosystem group in support of higher mortalities for the period 2015/2016. Evidence in support of this modification include:

- Low condition (weights-at-length) across numerous groundfish species observed in 2015
- Low potential growth for Pacific cod in recent years based on mean relative foraging rates reported in Holsman and Aydin (2015; top panel of Fig 2.99 in the assessment)
- Unusually high metabolic demands in 2015 based on bioenergetics considerations (Fig. 2.99, bottom panel)
- Below average diet energy density (lowest since 2007) based on diet composition of survey collected stomach samples (Fig. 2.101)
- Reports in 2015-2016 of widespread mortality events from starvation for seabird and marine mammal predators that share prey with Pacific cod.
- Apparent decline of capelin, an important prey item for Pacific cod, in the diets of Pacific cod from 2015 (Fig. 2.101).
- Overall lower mean stomach fullness for fish in 2015.

In combination, these observations suggest that the persistent warm conditions associated with the 2014-2016 warm anomaly in the Gulf of Alaska resulted in reduced prey availability and may have contributed to high mortality of juvenile and adult Pacific cod in 2015 and 2016. The SSC notes that short-term adjustments to M associated with unusual mortality events are occasionally used in stock assessments. Examples include Bristol Bay red king crab, St. Matthew Island blue king crab, and Prince William Sound herring. Mass mortalities are also commonplace in other stocks, such as scallop stocks around the world.

The author and Plan Team further reduced the ABC from maxABC because projections based on the maximum ABC suggested that the biomass could drop below $B_{20\%}$ by 2020. **The SSC supports this (minimal) reduction in ABC and highlights the substantial risk implied in these projections that Pacific cod biomass could drop below $B_{20\%}$ in the near future.**

The SSC also supports the area apportionment based on a random effects model fit to trawl survey biomass estimates through 2017, which resulted in a split of 44.9% (Western GOA), 45.1% (Central) and 10.0% (Eastern).

The SSC offers the following additional recommendations, which in part reflect previous Plan Team and SSC recommendations:

- The author should further explore a model variant that includes the IPHC survey, which is as a broad-scale, annual survey that could provide valuable information during off years for the bottom trawl survey.
- The current prior on natural mortality includes estimate from Thomson (2007), which is to a large extent based on the same data as other estimates, thus 'double counting' these data. To be consistent with the EBS assessment, the SSC suggests dropping this estimate from the prior distribution for M.

- The SSC appreciates the expansion of the section reviewing Pacific cod life history, but this section needs to be edited to more clearly describe the relationships between temperature conditions and the growth and survival of larval and juvenile Pacific cod.
- The SSC encourages further explorations of model 17.09.37 with the idea that including an environmentally (temperature)-dependent increase in M should account for the apparent increase in M in 2015/2016 without also including an additional step change. Perhaps this can be achieved by letting M increase non-linearly with temperature (e.g. exponential increase in M with temperature or including a temperature threshold, if supported by bioenergetic considerations). As the author pointed out, if a model of this form were adopted, it also raises questions about how to specify temperatures for projections and may require an updated approach for projections.
- The SSC re-iterates last year's recommendation that aging bias should be explicitly included in the assessment and the author stated that this was elevated to a high priority for next year.
- The SSC reiterates its desire that authors follow guidance on naming models. In particular, major model versions should reflect the year in which they were first developed.
- Some of the age data are fit twice in the model (as marginal and conditional age-at-length). This issue should be corrected next year.
- Model 17.09.31 included a change that constrains M in 2015/2016 beyond the recommended prior. This change was motivated by the desire to avoid a considerably higher M in 2015/2016 that the author felt was unrealistic and may be overfitting the data. The SSC requests that the author provide a stronger rationale for this ad-hoc adjustment.
- Going forward, the author outlined ambitious plans for future improvements to the model that include environmental effects on various parameters and other changes. The SSC encourages these explorations but cautions against major changes before gaining additional experience with what is already a very complex model. One area for further explorations that the SSC has supported in the past is an assessment of the implications of observed movements of Pacific cod between the EBS and GOA in the area of Unimak Pass.
- Sample sizes for age composition data are fixed at 100 and a maximum of 200 for the survey and fishery, respectively. The SSC encourages the author to consider a less arbitrary approach based on the number of hauls in both cases, similar to changes considered in the EBS cod model, and continued exploration of iterative reweighting to generate internal consistency with model fit.
- The SSC is concerned about the limitations of the current projection model and encourages the author to explore projections within the assessment model to better characterize uncertainty in biomass trajectories. This becomes especially important as the stock is close to a crucial management threshold ($B_{20\%}$) and improved estimates of the probability of dropping below this threshold in the future could better inform the Council's decisions. The SSC is not suggesting a change to the standard projection model at this point, but a comparison of the standard projections with those generated within the model.
- The SSC is encouraged to learn of efforts underway at the AFSC to develop a multispecies model (CEATTLE) for the Gulf of Alaska, which would provide an ideal platform for exploring temperature effects within a multispecies context.

Finally, the SSC highlights the value and the extensive use of ecosystem information in both the EBS and GOA Pacific cod assessments and in our deliberations. In the GOA, ecosystem information was essential in informing model development, in particular in supporting a model that includes elevated mortality in two years based on the strong evidence for poor prey availability associated with an unusual warm event. In the EBS, ecosystem considerations were essential in setting the ABC.

Minor comments to the author:

- Table 2.10 duplicates Table 2.8

- Figs. 2.10/2.11 and 2.20/2.21 provide useful comparisons of fishing depths and CPUE among recent years by gear, but the figures are difficult to read. Comparisons among years would be much easier if years were shown in columns and the x-axis range were standardized across panels by gear type.
- Figure 2.26: The condition index in 1992 for the 40-50 cm size range appears erroneous.

GOA Atka mackerel

This was a full assessment with catch and survey biomass updated through 2017 in this Tier 6 assessment. 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. **The SSC agrees with Plan Team's and authors' recommendations for ABCs, OFLs, and area apportionments.**

GOA Flatfish

<u>Shallow-water Flatfish</u>

A full assessment for shallow water flatfish was presented. The shallow water complex is comprised of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole and Alaska plaice. The two rock sole species are assessed by age-structured assessment models under a Tier 3 assessment, whereas a random effects model is used for the other species in the shallow-water flatfish complex under a Tier 5 assessment.

<u>Northern and southern rock sole assessment</u>

The SSC received a presentation on modelling developments for northern and southern rock soles for 2017. This assessment was well documented and thorough, making several improvements to the 2015 analysis that were supported by both the Plan Team and the SSC. Five models were presented, including:

- 17.1 - updating the 2015 model to include information through 2017
- 17.2 - eliminating the duplication of trawl survey age data by fitting only to conditional age-at-length and length data
- 17.2a-c – Alternatives exploring data weighting and treatment of the error distribution for compositional data.

The SSC supports the Plan Team's and author's preferred model 17.2, as well as the resultant calculation of the contribution of these two species to the aggregate OFL and ABC of the shallow-water complex, which are shown in the table above. There do not appear to be any conservation or other concerns for either species at this time, or in the immediate future, and they are lightly exploited stocks.

The SSC offers the following recommendations on the northern and southern rock sole assessment:

Spawning biomass reference levels were based on average age-0 recruitment for the period 1977-2017. Reference points should not include terminal years since there are no data for age-0 recruits in 2017, and the Plan Teams have developed a method for determining how many terminal years to remove from the reference point calculations, which should be applied in the future.

In the next full assessment in four years, the author is requested to provide an equation and rationale for the input sample size calculation applied to the conditional age-at-length data; it was not clear how this calculation was performed or why this would be a function of the length samples and not purely the age samples.

The SSC has several comments specific to the northern rock sole assessment. The SSC noted that the scale of the standardized residuals (particularly for the fishery length data) was large; further efforts to improve data weighting/model tuning are warranted. There appears to be a systematic lack of fit reflected in the comparison of variance about the conditional age-at-length data. The SSC supports the Plan Team's recommendation to explore spatially differing growth (similar to the "growth morph" analysis provided in the rex sole assessment) as a possible method for addressing this and other lack of fit in the length data. This model also showed a strong retrospective pattern, which represents a source of uncertainty not adequately captured in the results for management use and warrants additional investigation.

The partitioning of fishery catches into northern and southern rock sole components remains problematic, and the current approach of assigning 50% of the catch to each species represents a strong assumption that could be improved. The SSC supports a special project, or further analysis, to more accurately speciate catches in the historical time-series. Further, the mis-match between length composition data from the fishery and survey noted by the authors for northern rock sole suggests that mis-identification could be affecting some model parameters. Geographically explicit separation of these species on a biologically relevant scale could result in better fits by ensuring that datasets include only a single species. In addition, as noted by the author, further consideration of the best methods for modelling these species either separately or simultaneously are encouraged.

The authors also note that catch data used in the model do not currently incorporate estimates of error or variability, and the SSC supports efforts to rectify this.

<u>Other shallow-water flatfish</u>
Biomass of species other than northern and southern rock sole were estimated using the same random effects model that was used in the 2015 assessment. Catch data were updated through October 1, 2017, and the model was fit to survey biomass for 1984 to 2017, except for 2001 when the eastern area was not surveyed. Estimated biomass increased for all species except for English sole, which remained virtually unchanged. The survey biomass for each year was summed over all non-rock sole species.

<u>Harvest specifications</u>
A change in this year's assessment was to apportion ABC by area by fitting the random effects model to the survey biomass summed for all species (including northern and southern rock sole) by area and then estimating the percent biomass in the ending year by area. Resultant apportionment by area was estimated to be 46.09% Western, 46.29% Central, 4.10% Yakutat and 3.52% Southeast. The SSC endorses this change in methodology.

The SSC supports the authors' and Plan Team's recommendations for ABC and OFL in 2018 and 2019, and associated area apportionments, using combined Tier 3 (northern and southern rock sole) and Tier 5 (other flatfish species) calculations for this stock complex.

<u>Deepwater Flatfish Complex</u>
A partial assessment was conducted for deepwater flatfish. Dover sole dominates the landings of this complex. Dover sole is assessed with an age-structured assessment under Tier 3, whereas the other species (Greenland turbot and deepsea sole) are assessed under Tier 6. For Dover sole, a single-species projection model was run using parameter values from the accepted 2015 assessment model with updated catch information for 2015-2017. For Greenland turbot and deepsea sole, ABCs and OFLs are based on historical catch levels, which were not updated. ABCs and OFLs for the individual species in the deepwater flatfish complex are determined and then summed for calculating complex-level OFLs and ABCs.

To compute the area apportionments of ABC, a random effects model was used 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 in 2018 and 2019 was used as the basis for apportionment of the Dover sole portion of the ABC for the deepwater complex. For Greenland turbot and deepsea sole, proportions were based on average survey biomass for each species since 2001, which is the most recent year for which any catch of turbot and deepsea sole occurred.

The SSC endorses the Plan Team's and authors' recommendation to use the combined ABC and OFL for the deepwater flatfish complex for 2018 and 2019, as well as the associated area apportionments of ABC.

Rex Sole

A substantially updated, full age-structured assessment of rex sole was completed for this year's assessment, with the goal of elevating the stock assessment to Tier 3. The most notable changes were the addition of fishery age data for numerous years between 1990 and 2016 and the use of separate model fits for the Eastern and Western-Central GOA to account for differences in length-at-age ('growth morphs'). Adding the fishery age data resulted in a much more realistic selectivity curve. Four models were fit to the data including the 2015 base model (15.0), an identical model that included newly available historical age data (17.0), a model that estimated growth internally using a conditional age-at-length approach (17.1), and finally the two-area model (17.2) that includes a non-time-varying recruitment allocation parameter to distribute recruitment between the Eastern GOA and Western-Central GOA. Fishery selectivity was estimated only for the Western-Central region as there is no fishery in the Eastern Gulf.

The addition of the age data and the split into two areas resulted in much improved model fits. The author and Plan Team recommended using model 17.2 and moving the stock from a Tier 5 to a Tier 3a, which nearly doubles the ABC from last year's Tier 5 assessment. **The SSC concurs with the Plan Team recommendation regarding the OFL and ABC** because $B_{40\%}$ and $B_{35\%}$ appear to be reliably estimated by the new model. The SSC also agrees with the area apportionment based on a random effects model applied to GOA bottom trawl survey biomass in each area.

The SSC recommends that the author prioritize the inclusion of an aging error matrix in the model for next year, which might further improve the fit to the age composition data. As a minor comment, the column heading "standard error" in Table 7 seems to be mislabeled, as the values appear to reflect the coefficient of variation rather than standard errors.

Arrowtooth Flounder

A full assessment was prepared for arrowtooth flounder, including updated catch data from 2015-2017 and NMFS bottom trawl data from 2015. The SSC thanks the authors for their responsiveness to previous comments by the Plan Team and SSC. Thirteen alternative models were explored that included several changes to the assessment methodology. The length-age conversion matrix was estimated from length-at-age data over the period from 1984-2013. Weight-at-age was recalculated for males and females using age data over the period from 1977-2013 based on lengths-at-age obtained from the updated length-age conversion matrix by fitting the length data to weight-at-age. An ageing error matrix was included to account for age reading errors. The model series also includes data weighting (fishery and survey length compositions, survey age composition) using the Francis method. Finally, alternatives to fixed M for males and females were explored, but not used in the final model.

Model 17.0e was chosen as the authors' preferred model because it incorporated many improvements to the model suggested by the Plan Team, SSC, and CIE reviewers. This preferred model includes an improved length-age conversion matrix and updated weight-at-age that takes into account population lengths. Inclusion of an ageing error matrix improved the fit to the age composition data. Application of the Francis method resulted in a down-weighting of the age and length composition data. Changes to the model resulted in a 24% decrease in projected spawning biomass and a 32% decrease in total biomass versus the prior assessment model.

A retrospective analysis was performed, whereby data were sequentially removed from the preferred model and spawning biomass was re-estimated. A retrospective bias was apparent, as estimates of spawning biomass were successively higher for each previous retrospective fit compared to the current 2017 assessment.

In the preferred model, M is fixed over age but differs among the sexes (0.2 for females and 0.35 for males). Modeling natural mortality as a function of age or size within each sex was evaluated, but these model versions produced similar trajectories of estimated biomass and they degraded fits to the age data. **The SSC notes that maximum age increased over time (Figure 7.15, lower panel), which might provide some evidence for reduced M over time. In next year's assessment the SSC requests that the assessment authors evaluate the evidence for a time trend in M and explore the ability of alternative model(s) with such a trend to address the retrospective pattern in spawning biomass.**

In the last couple of assessments, there has been ongoing consideration about how to treat survey data from 1961-1962 (IPHC trawl survey) and 1973-1976 (NMFS exploratory trawl survey), given the use of different gears, survey designs, etc. The current assessment noted significant issues with survey design. Removal of these surveys leads to biomass estimates in the 1960s-1970s that are relatively similar to those of the 1980s-early 1990s; including these early surveys results in lower estimates of biomass in the 1960s-1970s and a greater increase in biomass over time.

In this regard, the SSC supports the Plan Team's recommendation that the assessment authors continue to reevaluate the use of these early survey data. The Plan Team recommended documenting the survey design and spatial distribution in 1961 and 1975 to evaluate the comparability of these early surveys to recent surveys. The Team also recommended evaluating the cooperative US-Japan longline surveys, as they may provide information on stock trends over the period from 1979 – 1992. **In addition, the SSC recommends that the authors look into the availability of ADF&G bottom trawl surveys in the central and western Gulf of Alaska to see if any of them span the years in question.**

The SSC endorses the Plan Team's and authors' recommended ABC and OFL for arrowtooth flounder for 2018 and 2019 using Tier 3a calculations, as well as the recommended area apportionments of ABC. Area apportionments were calculated by applying the fraction of the survey biomass in each management estimated by a random effects model.

<u>Flathead Sole</u>

A full assessment was provided for flathead sole, based on the most recently accepted model (2015 model), updated with new data. The 2018 spawning biomass estimate is well above *B40%*, hence the flathead sole stock is determined to be in Tier 3a. **The SSC concurs with the author's and Plan Team's recommendation to use the maximum permissible ABC under Tier 3a. The SSC also concur with the area apportionment based on the random effects model applied to GOA bottom trawl survey biomass in each area.**

The SSC is concerned about a fairly strong retrospective bias, which suggests that SSB and survey biomass may be overestimated by the model. The SSC was encouraged to see attempts to estimate natural mortality (M) and survey catchability (Q) within the model. Likelihood profiles for M suggest a somewhat higher mortality than currently specified (M=0.26 vs. a fixed value of 0.2 in the current model). In contrast, Q is not very well estimated in the model as the likelihood is very flat and decreases with increasing Q over the entire range of values included in the profile ($-0.7 \leq \ln Q \leq 0.4$). The SSC suggests bringing forward at least one model variant in next year's assessment that estimates M while fixing survey catchability at Q=1, unless there is a strong rationale for why catchability for this flatfish stock should deviate from unity.

GOA Rockfish

Pacific Ocean Perch
Julie Bonney (Alaska Groundfish Data Bank) and Chris Woodley (Groundfish Forum) gave public testimony. They noted that the population has increased to a level where the fishing fleets are having a difficult time avoiding incidental capture of POP.

A full stock assessment was provided for GOA POP. GOA POP are assessed on a biennial cycle and the last full assessment was conducted in 2015. This assessment incorporated the following new data sources: NMFS trawl survey biomass estimates for 2017, survey age compositions for 2015, fishery age compositions for 2014 and 2016, and final catch for 2015 and 2016 and preliminary catch for 2017-2019. The 2017 NMFS trawl survey biomass estimate is the largest on record, and the last three consecutive survey biomass estimates were larger than 1 million tons. In addition, the author explored the implications of two changes to the input data:

1. The GOA Plan Team and SSC requested that the author explore the impact of changing the length bins to 1 cm and setting the plus length group to 45 cm (see Model 15a);
2. The 1984 and 1987 bottom trawl survey biomass and age composition was removed from the time series in some models.

The author explored the implications of two changes to the assessment methodology:

1. The bottom trawl survey biomass is fit with the log-normal distribution.
2. An additional fishery selectivity time period is added (2007 – present) to coincide with the Central GOA rockfish program and the availability of older fish to the fishery.

The authors introduced seven models to fully depict the implications of the changes to the treatment of the data and model structure:

- 15.0: 2015 model with data updated through 2017 (Model case M3 in 2015);
- 15.0a: 15.0 with 1 cm length bins and a plus length group of 45 cm;
- 15.0b: 15.0a with 1984 and 1987 bottom trawl survey biomass removed;
- 15.0c: 15.0a with 1984 and 1987 bottom trawl survey biomass and age composition removed;
- 15.0d 15.0c with log-normal distribution used to fit the bottom trawl survey biomass;
- 17.1: 15.0d with dome-shaped fishery selectivity estimated for all years and time blocks. The GOA Plan Team and SSC requested this model be added;
- 17.2: 15.0d with additional dome-shaped selectivity time block starting in 2007 to coincide with the Central GOA rockfish program. In this model an additional dome-shaped fishery selectivity for the period 2007 to 2017 was included in addition to the selectivity time blocks estimated in previous assessments.

As noted in the general comments, the SSC encourages that author to carefully consider the tradeoffs in adding model complexity to improve model fit.

The SSC agrees with the authors and the Plan Team on the use of Model 17.2 as the base model for 2017. For the 2018 fishery, the SSC accepts their OFL and ABC recommendations and the associated area apportionments.

The recommended 2018 ABC is a 22% increase from the 2017 ABC, and the 2018 ABC is 24% higher than would have been derived if the author had used Model 15.0.

The SSC supports the authors' and Plan Team's recommendations for future research including:

1. Investigating natural mortality: the current estimate of 0.066 is higher than the expected value from the prior distribution (0.05) (see SSC comment below).
2. Re-evaluating the age-plus group: changes to the model and input data have occurred since this was previously evaluated
3. Continuing to evaluate methods for weighting for the compositional data as new models are developed and/or changes are made to input data.

With respect to research item 1 above, the SSC also encourages the authors to consider how changes in abundance may have impacted the full suite of vital rates including the maturity schedule and growth rate. This stock has exhibited a remarkable recovery and estimates of maturity schedule from the 1990s and 2000s show different schedules. The SSC also learned that POP is likely to be added to the GOA CEATTLE model. If this occurs, the SSC encourages the authors to strive to incorporate top down and bottom up drivers in this assessment.

The SSC also supports the application of the geostatistical delta-GLMM approach, if recommended by the working group that is currently investigating alternative methods for estimating the bottom trawl survey biomass. A workshop in January 2018 is planned to explore these methods.

<u>Northern Rockfish</u>
A partial assessment was performed for northern rockfish in 2017. The estimates of ABC and OFL for 2018 and 2019 reflect updated catch information but the stock assessment was not re-run. The SSC accepts the authors' recommended ABC and OFL as well as the area apportionments for this stock. The stock is projected to drop below B_{40} in the upcoming year.

The SSC reviewed the author's plans for the 2018 full assessment. The SSC agrees that the author should explore the following changes:

1. Changes to the plus-group specification for length composition data and alternative length bin designations.
2. The application of the geostatistical delta-GLMM approach, if recommended by the working group that is currently investigating alternative methods for estimating the bottom trawl survey biomass. A workshop in January 2018 is planned to explore these methods.
3. As noted in our comment to the POP assessment, the SSC continues to support investigations of time-dependent maturity.

<u>Shortraker Rockfish</u>
Shortraker rockfish are a Tier 5 species for specifications where FABC = 0.0225, M = 0.03, and $FOFL$ = 0.03. The assessment was updated with catch and survey data through 2017. ABCs and OFLs are based on the random effects model using an estimated survey biomass. There was a 49% decrease in survey biomass from the 2015 survey, with a 33% decrease in RE modeled biomass from 2016. However, in 2017 the longline survey showed a 28% increase in relative population number. The biggest change in area apportioned ABC is a 46% decrease in the EGOA. **The SSC accepts the Plan Team's and authors' recommendations for ABC and OFL as well as the area apportionments.**

The SSC agrees with the PT recommendation of revisiting the trawl survey and longline survey (within depth strata) for the purposes of improving the area apportionment and understanding of spatial structure

Other Rockfish (Combination of Slope Rockfish and Pelagic Shelf Complex Species)

This was a full assessment with updated catches and survey biomass. Random effects models were updated for Tier 4 and 5 species, and an updated method for Tier 6 calculations was employed. The author separated the complex into two subgroups; slope and demersal, with the slope subgroup assessed with Tier 4 and 5 and demersal subgroup assessed with Tier 6. The structure of the RE models was unchanged and they were updated with new data. For the Tier 6 species the SSC had recommended in Oct 2017 to use the 2003-2016 time series of catches instead of the shorter 2013-2016 time series. The author calculated and recommended using the 2003-2016 time series and using the maximum catch because the subgroup is primarily bycaught and patchily distributed in catches. The Plan Team supported these changes to the assessment. The SSC notes that this modified Tier 6 approach is an interim solution but should not be considered a long-term approach to management of the demersal subgroup as an unlimited increase in catch rates would be allowed under this approach. **The SSC accepts the Plan Team's and authors' recommendations for ABC and OFL as well as the area apportionments.**

In October 2017 the SSC asked the assessment authors to bring back the stock structure template for this complex to assess the level of concern with the current grouping as a precursor to splitting the Other Rockfish group and moving the demersal subgroup into a GOA-wide group that would include the current DSR stock that is currently in the EGOA/SEO area. The authors reviewed the stock structure template that was provided in the 2015 Other Rockfish SAFE and concluded that the concern should be "moderate" (level two of four possible levels) and the Plan Team agreed with this assessment. It makes sense to group all of the demersal species to be managed together rather than combining demersal species with slope species as is done in the current Other Rockfish complex. The demersal species differ in biology, distribution, and fishery interactions from the slope species of this stock complex. **The SSC agrees with this assessment of stock structure and urges the Council to consider step 2 of the Stock Structure and Spatial Management Policy.** The SSC notes that there will likely be numerous management implications to consider if step 2 of the process is undertaken by the Council. Public testimony from Julie Bonney and Chris Woodley from the Alaska Groundfish Forum also indicated that a complex set of management considerations will likely play a large role in the decision to split this stock and combine parts of it with another stock.

Dusky Rockfish

A partial assessment was done for dusky rockfish. There were no changes to the assessment or apportioning methodology. New data added to the projection model included updated 2016 catch (3,328 t) and new estimated catches for 2017-2019. The recommended ABC is slightly lower than last year's projection.

The SSC endorses the Plan Team's and authors' recommended ABC and OFL for dusky rockfish for 2018 and 2019, as well as the associated area apportionments of the ABC.

Rougheye and Blackspotted Rockfish

A full assessment was presented for the rougheye and blackspotted stock complex (RE-BS). No new model formulations were presented in this assessment. The assessment is updated with realized fishery catch estimates for 2016, projected catch estimates 2017-2019, new fishery ages for 2014 and 2016, new fishery lengths for 2015, new trawl survey biomass estimates and ages for 2017, and new longline survey relative population numbers and length information for 2016 and 2017. The 2017 longline survey estimate is 26% above average and the 2017 trawl survey is 11% below average but is up 16% from the 2015 estimate. Spawning biomass is well above $B_{40\%}$ and projected to be stable.

The authors addressed the SSC's comment from December 2015 to investigate a strong retrospective pattern in the model. The authors fixed a coding error in the model and the retrospective pattern does not pose a concern.

The SSC concurs with the authors' and Plan Team recommended ABC and OFL, and the recommendation to use the same apportionment method as the last assessment. Both the SSC and Plan Team recommended using the random effects method that is fit to the survey biomass; however, the authors note this assessment uses multiple gear indices that are highly variable. The authors suggested waiting for a potential switch in apportioning methods until recommendations from the Survey Averaging Group are available, and further evaluation of new genetics research.

The SSC has several recommendations for the next assessment:

- Species identification continues to be a problem both in the survey and fishery data. The SSC appreciates the authors continued work on this issue, and highlights the importance of improving species composition information. As noted in the assessment, there appears to be continued improvement for correctly identifying blackspotted rockfish in the field (from 31% to 9%), while the opposite seems to be occurring for rougheye rockfish with increased misidentification rates over the three surveys (6% to 25%). In addition to genetic methods, otolith morphology identification methods would be useful for evaluating historical and future data collections- near-infrared reflectance (NIR) spectroscopy maybe one area of further investigation. The SSC also looks forward to results on the AFSC observer program special project that collected multi-spectral images, paired with genetics, from survey samples of BS/RE for development of an image analysis application for species identification.
- The SSC supports the Plan Team recommendation for an analysis that provides a more realistic range of management risk of combining RE/BS in one stock than is currently in the assessment. A variety of methods could be used, including catch composition analysis, genetic vs visual survey ids, maturity curve differences, etc.
- The SSC continues to be concerned about grouping species in the assessment without considering important differences in life history. Specifically, Conrath (2017) found age at maturity for the species fork length at 50% maturity was similar for rougheye rockfish (45.0 cm) and blackspotted rockfish (45.3 cm), but the age at 50% maturity was considerably younger for rougheye rockfish (19.6 years) than for blackspotted Rockfish (27.4 years). The SSC supports the authors' recommendation to evaluate maturity information and explore fitting separate maturity curves. This would allow treatment of the differences in maturity between the species within the assessment.
- The authors should clarify how the fishery age data by gear type is being incorporated into the model. It appears that longline and trawl ages are being combined. However, these fisheries have different sampling methods, catch characteristics, and sampling rates (e.g., full coverage versus partial coverage) that influence sample size for each gear type. A description of sample sizes from each gear-type, and the years for which age data by each gear-type was used for the model would provide additional information on this potential issue.

<u>Demersal Shelf Rockfish</u>
A partial assessment was done for demersal shelf rockfish. There were no changes in assessment methodology. Catch information and the average weight of yelloweye rockfish caught in the commercial fishery were updated for 2017. Estimated yelloweye rockfish biomass increased from 10,347 t to 11,508 t from 2017 to 2018. The increase was driven by the Central Southeast Outside (CSEO; an area closed to

directed commercial fishing), and an increase in mean fish weight in the CSEO and Southern Southeast Outside. Of note is that density in the Eastern Yakutat was at the lowest since 1995.

The SSC endorses the Plan Team's and authors' recommended ABC and OFL for demersal shelf rockfish for 2018 and 2019, as well as the associated area apportionments of the ABC.

Plan Team minutes indicate there are plans to survey the SSEO in 2018 (last surveyed in 2013), and hopefully survey the CSEO and NSEO (last surveyed in 2016) subdistricts as funding allows. The SSC strongly supports these survey efforts.

Thornyhead Rockfish

This was a partial assessment with catch and survey biomass updated through 2017 and the RE model updated through 2017 in this Tier 5 assessment. 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 1984-2017 trawl survey biomass estimates. **The SSC agrees with Plan Team and authors' recommendations for ABCs, OFLs, and area apportionments.**

GOA Sharks

There was no assessment for GOA sharks this year. **Sharks are managed as a Tier 6 stock and the SSC agrees that the current 2016-17 OFL and ABC will be used until the next full assessment in 2018.** The SSC appreciates the author's work to address Pacific sleeper shark declining survey indices, representativeness of observed average weights in the longline fishery, and, species vulnerability and looks forward to the 2018 full assessment.

GOA Skates

The SSC reviewed a full assessment for GOA skates. GOA skates are managed under Tier 5, where OFL and ABC are based on survey biomass estimates and natural mortality rate, which is currently set at 0.1. Maximum retainable amount for all skates in the GOA is 5%. In this assessment fishery and survey data were updated but there were no changes to the assessment methods.

The skate survey biomass trend was mixed between the species. Big skate biomass decreased, longnose skates increased and the other skates decreased. Estimated catch did not exceed any Gulf-wide OFLs. **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.** Notable changes in the survey include the increase in small-sized big skates in the central GOA and the increase in longnose skate in shallower water.

The SSC concurs with the author's recommendation that values of M be explored in the next assessment. The SSC looks forward to the forthcoming length-based stock assessment for longnose and big skates in the GOA.

GOA Sculpins

The SSC reviewed a full assessment for GOA sculpins. This is a group of benthic-dwelling predatory fishes that include 48 species in waters off the coast of Alaska; 39 of these have been identified on NMFS GOA research surveys. Sculpins are broadly distributed throughout the shelf and slope regions of the GOA, occupying all benthic habitats and depths.

GOA sculpins are managed under Tier 5, where OFL and ABC are based on survey biomass estimates and natural mortality rate. The mortality rate is an average for the sculpin complex calculated as a biomass-weighted average of the instantaneous natural mortality rates for the four most abundant sculpins in the GOA. In this assessment, fishery and survey data were updated, but there were no changes to the assessment methods.

There was a small decrease in the estimated 2018 total GOA sculpin complex biomass compared to the last full assessment in 2015. The overall biomass trend for the complex is stable. **The SSC concurred with the author and Plan Team recommended ABCs, OFLs and continued use of the random effects model.**

The SSC appreciates the authors' responsiveness to our 2015 recommendations to investigate the declines in bigmouth and plain sculpin. The SSC concurs with the Plan Team recommendations that analysis of fishing mortality (catch/RE biomass) be expanded to the whole time series and done individually for bigmouth, great, plain, and yellow Irish lord.

Beginning in 2017, the assessment schedule was changed from a 2-year to a 4-year schedule; the next full assessment will occur in 2021.

GOA Squid

Squids (15 species) in the GOA are managed as a complex. This is the last SAFE report assessment for GOA Squid because the complex is being moved to Ecosystem Component status and in the future the SSC will, instead, be provided with an annual report similar to that provided for forage fish. Squid are currently managed as a Tier 6 stock with OFL set equal to the maximum historic catch and ABC set at 75% of the OFL. New catch data and new survey data from 2017 were added this year but there were no changes to the assessment methods. The 2017 catch did not represent the maximum historical catch for this complex, thus the OFL and ABC remain unchanged from the last full assessment (2015). This assessment noted that squid CPUE dropped on the shelf in the 2017 survey compared to the 2015 survey and the depth distribution of squid covered a wider range than in the previous three trawl surveys. **The SSC supports the OFL and ABC recommended by the author and Plan Team.**

GOA Octopus

The seven recognized species of octopus caught in the GOA are managed as a complex under Tier 6, though giant Pacific octopus makes up the majority of the estimated biomass. Octopuses are caught incidentally in trawl, longline, and pot fisheries with catches from 2003 through 2017 mainly in CGOA and WGOA off western Kodiak and around the Shumagin Islands. The whole-complex survey estimates for biomass in this year's assessment dropped precipitously from 13,008 t in 2015 to 1,049 t. Survey data are considered to be highly uncertain measures of octopus abundance due to a lack of information on gear selectivity. In this assessment the author demonstrated that the fishery catch trend was similar to the trawl survey observations suggesting that the survey biomass reduction may be real. This was taken into consideration in determining ABC/OFL specifications this year.

Octopus harvest recommendations have used a modified Tier 6 approach and beginning in 2015 the random-effects model was employed to provide a minimum estimate of biomass. In 2016, both the Plan Team and the SSC expressed concern that this approach might follow the survey data "too tightly" given the large amount of process error. Along these lines, the Plan Team judged the 2017 biomass based on the random-effects model to be a poor predictor for future octopus abundance and recommended using the Tier 6 maximum catch approach to set OFL. ABC is 75% of OFL. The rationale put forward was: 1) there are no directed fisheries for octopus; 2) there is no evidence of any conservation concern given they are highly fecund and robust; 3) the random effects model illustrates that process error (natural variability) in abundance is very high and that year-to-year changes are difficult to predict with any accuracy; and 4) incidental catch varies greatly also, which supports the variability in biomass estimates. The SSC further notes that, because octopus growth is sensitive to food availability, metabolic rate, temperature, and other environmental parameters that can rapidly change over the short life span of an individual, abundance during a given year may serve as a poor predictor of biomass in subsequent years without taking these factors into account.

The SSC agrees with the Plan Team and supports the recommended OFL/ABC.

C6 Small Sideboards

The SSC received a presentation by Jon McCracken (NPFMC) of the draft RIR/IRFA document for the proposed actions that would revise the federal regulations to close directed fishing for those species with sideboard limits that are not large enough to support directed fishing. No public testimony was provided.

The purpose of this issue is to reduce the administrative burden of annually closing small sideboard fisheries that are unlikely to open. The sideboard fisheries being considered for prohibiting directed fishing under this issue have never been opened since their inception because the sideboard species have had insufficient sideboard limits historically to support directed fishing, are fully allocated to other programs (i.e., Amendment 80), or have insufficient halibut PSC sideboard limits. These sideboard fisheries are not expected to open in the near future unless the TACs for these closed sideboard species were to increase dramatically or Amendment 80 allocations were to change in the future. If directed fishing in these sideboard fisheries is prohibited, regulatory action would be required to reopen these sideboard fisheries in the future if directed fishing were to become viable.

The analysis identifies the benefits of prohibiting directed fishing in small sideboard fisheries under Alternative 2 as reducing the annual costs associated with developing and publishing the annual harvest specifications in the Federal Register. In particular, NMFS staff spends considerable time calculating new sideboard limits based upon the annual TACs, incorporating those limits into the sideboard tables, and cross-checking such tables for accuracy. Prohibiting directed fishing for small sideboard fisheries in regulation would remove the need to annually calculate these sideboard limits and simplify the creation and publication of AFA and CR sideboard tables. The analysis estimates that condensing the sideboard limit tables in the harvest specifications could yield annual savings in publishing costs of $3,339, in addition to savings in NMFS personnel costs.

The SSC commends the analyst for constructing a concise and comprehensible document. The SSC notes, however, that there is one deficiency with the analysis that must be corrected before being released for public review. The analyst states that there would be no adverse impact on any current sideboard-restricted participants under Alternative 2, relative to opportunities available to them currently, because directed fishing for these sideboard species has been closed historically. However, the benefits associated with prohibiting directed fishing in small sideboard fisheries also need to be compared to the expected cost of reopening these sideboard fisheries through regulatory action should conditions allow for directed fishing in the future. While the likelihood of such a situation may be low, the cost of the regulatory procedures associated with reopening these fisheries in the future could be large enough to offset the annual savings in publishing and personnel costs. These expected costs of Alternative 2 need to be included in the analysis (a qualitative assessment would likely be sufficient). If the probability of reopening these small sideboard fisheries in the future is sufficiently low such that the expected cost is negligible, the analysis should state this explicitly. **The SSC recommends that the RIR/IRFA be released for public review once this correction is made.**

D6 Chinook Salmon Excluder EFP

The SSC reviewed an Exempted Fishing Permit (EFP) request submitted by Gauvin and Associates, LLC that would allow testing of Chinook salmon excluders on pollock boats in the Bering Sea A Season (January 20 through June 10) over a three-year period (2018-20). There was no public testimony. The proposed fishing activity would build on prior work in both the GOA and BSAI to develop improved designs and rigging configurations to reduce Chinook salmon impacts in both the CV and CP sectors of the pollock fleet. For various reasons, excluders have been more effective during deployment on, generally smaller, vessels in the GOA. The permit requests a take of 600 Chinook salmon and 600 non-Chinook salmon annually.

The permit would provide coverage for three vessels, yet to be selected: 1) a CV under 1800 hp; 2) a CV over 1800 hp; and 3) a CP (all of which are over 1800 hp). Both a "small" and "large" CV are included because prior experience has shown that net shape, tow speed, and excluder performance vary substantial with vessel horsepower. The selected vessels would be allowed to fish inside closed areas, including the Steller Sea Lion Conservation Area, where Chinook salmon encounter rates are high. Additionally, they would be allowed to fish without observer coverage (during EFP-covered fishing), and catch would not count against TAC or PSC totals for the year. Catch would be sold to defray the costs of fishing efforts.

Salmon, and other fish, escapement from the excluders will be monitored during fishing with custom-designed cameras that have already been shown to have adequate field performance. Review of video recordings from these cameras will examine fish behavior and evaluate excluder efficacy. Time-stamped, georeferenced data will also be recorded to quantify total fish "flow" through the net, and a variety of environmental and fishing logistics parameters will be recorded as covariates. Nets may have as many as a dozen excluder apertures, requiring significant rigging time prior to deployment and necessitating extensive post-processing of video files.

John Gauvin provided a summary of the permit application, as well as providing an update on activities that have occurred since the application was submitted. At a May 2017 workshop, several pollock vessel captains provided advice on excluder design and rigging, which was followed by a series of flume experiments to validate net performance and shape under simulated field conditions.

The SSC supports the collaborative nature of the proposed experimental design, appreciates the dedicated effort to reduce PSC of salmon, and supports approval of the proposed EFP. While reducing salmon bycatch is the primary goal of the proposed experiment, and knowing how many fish were effectively excluded is the focus, the SSC notes that video recordings made during the project could be used to better understand nuances of fish interactions with the excluders that go beyond "caught" or "escaped." To this end, the SSC makes the following recommendations:

- Testing the established design of an excluder by quantifying effectiveness is one step. Designing an excluder that truly minimizes PSC, however, requires a detailed examination of fish behavior in the vicinity of the excluder, and as they escape. Video recordings should be post-processed to determine the travel path, startle response, and other attributes of salmon and pollock movement as they interact with the net.
- The abundance of pollock moving into the net when salmon are being excluded should be quantified using a maximum instantaneous count, or other method, to ensure the excluder is effective under high-capacity fishing conditions.
- The rate of water flow at the mouth of the net should be measured to ensure that vessel speed and effective flow speed (as influenced by currents and net effects) can be adequately disentangled as correlates of excluder performance.

- A method should be devised to evaluate changes in the cross-sectional shape of the net and the excluder during fishing. This could include marked twine in the view of the camera to serve as reference points for evaluating three-dimensional geometry.