Minutes of the
Bering Sea Aleutian Islands Groundfish Plan Team

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

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BSAI Team members	
Dana Hanselman	AFSC ABL (co-chair)
Grant Thompson	AFSC REFM (co-chair)
Diana Stram	NPFMC (Coordinator)
Kirstin Holsman	AFSC REFM
Jennifer Cahalan*	Pacific States
Chris Siddon	ADF&G
Alan Haynie	AFSC REFM
Jane Sullivan*	ADF&G
Brenda Norcross	UAF
Mary Furuness	NMFS AKRO
Cindy Tribuzio	AFSC ABL
Allan Hicks	IPHC

*initial meeting

General

Administrative

The Team agreed upon some consistent text for both partial assessments as well as non-assessments for purposes of the introduction summaries for this year's SAFE report.

Policy on acceptance of non-previewed models

Except in emergency situations, if a new model is presented in November but was not previewed in September of that year or requested by the Team or SSC in September of that year, the Team will consider accepting the new model only if the author demonstrates that the new model passes the test for average difference in spawning biomass as described in the SAFE chapter guidelines, regardless of the author's designation of the new model as a major or minor change. In all cases where an author recommends a change from the current base model, all reference points and harvest specifications as estimated by the current base model must be provided to the Team in writing, preferably as part of the SAFE chapter.

Policy on unscheduled assessments

If a partial or full assessment is provided when none has been scheduled, the Team will take no action on it unless the authors have identified an immediate conservation concern.

Northern Bering Sea surveys

The Team engaged in many discussions of the comparison between the new 2017 Northern Bering Sea (NBS) survey results and the results from the 2010 survey.

The Team recommends that more NBS surveys be conducted in the near future, as a time series of such data may be essential for understanding changes in the abundance of some individuals stocks as well as the overall ecosystem. Some species, such as pollock and Pacific cod, exhibited enormous changes in NBS survey biomass between 2010 and 2017, both in absolute terms and relative to the NBS+EBS total, while others, such as Alaska plaice, exhibited very little change. The Team also recommends that assessment authors evaluate data from the NBS survey to determine if they should be included in their respective assessment models, particularly if more surveys are conducted, recognizing that it may be appropriate to include these data in some assessments but not others, and that the methods used to include these data may vary between assessments.

Team actions on recommended models and harvest specifications

The Team agreed with the authors' recommendations regarding preferred models and harvest specifications for all assessments except EBS Pacific cod, AI Pacific cod, and Greenland turbot. The Team's recommended models and harvest specifications for those three assessments are identified with stand-alone paragraphs and bold font in their respective sections below.

EBS Ecosystem Status Report

Elizabeth Siddon presented the 2017 Ecosystem Status Report (ESR) for the Eastern Bering Sea. Notable changes from previous years included updates or new development of 50+ indicators in the report, addition of human dimensions indicators, and a new Table 1 that links indicators to national and regional mandates. The Team commented that this was a helpful table especially as a tool for highlighting where we have coverage and gaps. The authors also highlighted a new opportunity for incorporation of citizen science observations through the LEO (Local Environmental Observer) network.

The Team recommends continued evaluation of approaches to incorporating local ecological knowledge into the ESR, particularly for helping to understand patterns in the Northern Bering Sea ecosystem.

The authors described some initial results from the second NBS survey conducted in 2017 (the first NBS survey was conducted in 2010 during a cold stanza); this snapshot revealed more cod and pollock in the NBS in 2017 relative to 2010. Species showing little difference between 2010 and 2017 in the NBS include yellowfin sole, Alaska plaice, and crab species. Blue king crab increased between years in the NBS; for all crab species, the mean size declined.

As in previous years, the content is divided into three sections ("Physical and Environmental Trends, Ecosystem Trends, Fishing and Human Dimensions Trends"), which helps to organize the information along expected lags in response to bottom-up or top-down forcing . The Team found this organizational structure helpful.

The Team supports continued refinement and development of ecosystem indicators across physical, biological, and socio-economic categories.

Team members asked if there were red flags in the 2017 ecosystem and Elizabeth pointed out that, while the system is physically returning to near neutral neutral conditions (while still slightly warmer than average), there are still notable anomalies in ecological patterns including:

- A potential red flag for the system includes reports across the EBS of dead and dying seabirds, with over 1,250 beached seabird carcasses documented since early August 2017 as well as 70

dead birds reported by USFWS and the University of Washington in the northern Bering Sea (as compared to only a few typically reported during these June to September surveys). Necropsies on 20 carcasses from across the system indicate drowning and severe emaciation.
- Walleye pollock, Pacific cod, yellowfin sole, and flathead sole are all lighter than average for a give size, especially in the south Bering Sea (Fig. 65). These species as well as Alaska plaice, arrowtooth flounder, and age 1 pollock, all experienced reduced condition in 2017 relative to 2016 and may be a leading indicator of poor overwinter survival and the potential for smaller stocks in 2018.
- Some anomalous physical signals from 2016 persist, including a "disproportionately large positive-magnitude NPI occurred in winter of 2016-2017, considering the weak amplitude of La Niña in late 2016." The implications of this anomaly are not evident.
- Sea level pressure patterns set up persistent winds from the south that prevented sea ice formation in the Gulf of Anadyr creating an unusual retraction of ice extent over the northwestern shelf. As a result, the NBS responded more along the lines of what would be expected in a "warm year," whereas ice coverage over the southern middle domain led to more moderate conditions in the southeast.
- There is a ~50/50 chance that there will be a weak La Niña during fall through winter 2017-2018. Slight cooling of SST is predicted for the EBS based on 3 month forecasts. Summer predictions for 2018 are for a larger than average <=2 ºC cold pool, but a smaller than average 0-1 ºC cold pool.

There was also discussion of the need to link ecosystem indicators to individual assessments in order to help understand potential leading indicators of change. For example, the current ESR discusses indicators of pollock recruitment and revisits past performance of those indicators. It was pointed out that this type of analysis could be extended to other species of interest.

The Team recommends that assessment authors be more fully integrated into the prioritization of AFSC ecosystem research, in order to: 1) develop methods and approaches (where appropriate) of linking ecosystem indicators to individual species; 2) identify species-specific ecosystem "red-flags;" and 3) track indicator performance retrospectively, as is done for some of the pollock recruitment indicators.

EBS Pollock

Jim Ianelli presented the EBS pollock assessment and a brief summary of the appendix pertaining to the CEATTLE multi-species model.

There were no changes to the assessment model. Other than routine updating, the only change to the data was extension of the acoustic-trawl survey data to include the 0.5-3.0 m depth range. This change had been previewed in September of last year, but the age composition data for the extension were not available at that time. At that time, the Team had recommended that the extension be implemented once the necessary data became available.

Discussion points included the following (these are comments/questions made/asked by individuals present at the meeting and do not necessarily reflect Team consensus):

- Why does survey selectivity vary over time? Response: Although the methods used in conducting the survey are standardized, the survey personnel cannot control the behavior/distribution of the fish, which can vary over time.
- The biomass estimate from the northern Bering Sea (NBS) survey is very large, and constitutes a significant proportion of the combined NBS+EBS biomass. Response: This may be similar to the

transboundary question (with respect to Russia); we do not know the extent to which the fish go back and forth between the two areas.

- Does Russia have any restrictions on the amount of catch taken from the northern part of its waters? Response: No. While they have TACs, Jim's understanding is that there are no closed areas along a northern boundary that would be analogous to the NBS zone on the US side.
- The 2012-2013 year classes seem to "flip-flop" in the survey data; the 2013 year class has not yet contributed significantly to the fishery. Response: Age 2 fish are largely off bottom, so it makes sense that a year class can appear strong at age 1, weak at age 2, and strong again thereafter.
- Should the dependence of the fishery on only 1 or 2 dominant year classes be a concern, and whatever happened to the index of "year class diversity" that used to be reported in the assessment? Response: It is still calculated, but not reported.
- Fishermen reported good catches of large fish near shore; the fleet is not having to go north to find enough fish.
- What accounts for the substantial increase in this year's estimate of F_{MSY}? Response: As in other Tier 1 assessments, F_{MSY} is based on fishable biomass, so the value can change if the age structure of the stock changes; also, estimated fishery selectivity shifted toward younger ages in 2016, which may have also contributed to the increase.
- One of the reasons listed by the authors in support of setting an ABC lower than the maximum permissible level is that this year's NBS survey biomass estimate is large; why is this a reason to set ABC below the maximum permissible level? Response: It is not the current estimate of NBS biomass *per se* that is a reason; rather, if this reflects an emigration out of the EBS survey area that is going to continue in the future, the biomass in the EBS survey area will decrease.

The Team accepted the model. The Team also accepted the authors' recommended harvest specifications, in which ABC was based on a Tier 3 approach, along with their reasons for setting the ABC below the respective maximum permissible level (as clarified in the last discussion point above), noting that the ABC has been based on a Tier 3 approach since the 2014 assessment, even though the stock qualifies for management under Tier 1.

As a reminder, the Team is still interested in seeing a response to its September 2016 request that the authors develop a better prior for steepness, or at least a better rationale, and perhaps consider a meta-analytic approach.

The Team requests that the "year class diversity" index that had been reported in previous assessments be included in future assessments.

The Team recommends that the authors compare fishery CPUE and survey CPUE in the core fishery area.

The Team recommends that next year's assessment include additional projections based on fixed levels of catch rather than fixed levels of fishing mortality, with the number of additional projections and the levels of fixed catch to be chosen by the author.

AI Pollock

Steve Barbeaux presented a partial assessment for AI pollock. The next full assessment for AI pollock will be conducted in 2018. A full assessment was conducted in 2016 and can be found at (https://www.afsc.noaa.gov/REFM/Docs/2016/AIpollock.pdf). There were no changes made to the assessment model inputs since this was an off-cycle year. New data added to the projection model included an updated 2016 catch estimate and new catch estimates for 2017-2019 (the 2017-2018 values were modified slightly from the values used in the 2016 assessment). The 2017 catch was estimated by increasing the official catch as of October 29, 2017 by an expansion factor of 3.1%, which represents the average fraction of catch taken after October 29 in the last three complete years (2014-2016). The 2018 catch was set at the 3-year average for 2014-2016 of 1516 t. There were no changes in assessment methodology since this was an off-cycle year. TAC for this stock is well below ABC, and the stock is neither currently overfished nor approaching an overfished condition.

The Team had no new recommendations for this assessment.

EBS Pacific cod

Grant Thompson presented the Pacific cod assessment for the Eastern Bering Sea. Many comments from the Plan Team subcommittee, the Groundfish Plan Team, and the SSC have been addressed throughout 2017. Some of those comments were to investigate data from the Northern Bering Sea, consider model averaging and methods to weight models, revise the prior for natural mortality (*M*), explore weight-at-age and the potential to use it in the assessment model, clarify with the Joint Plan Teams the preferred measure of central tendency (mean or median), and do not allow weighting multipliers to exceed one when iteratively reweighting composition data. Responses to these comments can be found in the assessment document.

Many different types of data from various sources were presented, but not all were fit to in the assessment. An economic performance report (Appendix 2.2) was provided by Ben Fissel. It showed that price per pound has declined since 2012, and has fluctuated since. Total catch for 2017, which was incomplete at the time the assessment was presented, was less than the ABC. The longline catch in 2017 is currently considerably less than 2016. To account for the incomplete 2017 catch data in the determination of CPUE, a model with year and month effects was used to predict 2017 CPUE for the longline fishery. The model estimate of the 2017 longline CPUE was down 8% from 2016.

There are many surveys in the Bering Sea that encounter Pacific cod, and even though all are not used in the assessment, they provide useful external information to help interpret the trends. The 2017 EBS trawl survey estimates declined from 2016 in both biomass (-37%) and numbers (-46%), and were the biggest percentage declines in the history of both time-series. There has been a decline in the last three years of abundance estimates, but only the last two years of biomass estimates. Estimates from two additional surveys that are not surveyed annually (NBS and Norton Sound) both showed significant increases in density. The NBS increased 902% between 2010 and 2017, and the Norton Sound survey, which does not usually catch a significant amount of Pacific cod, also increased considerably between the 2010 and 2017 surveys. The NMFS longline survey was stable and the IPHC fishery-independent setline survey decreased relative to 2015 estimates.The NMFS longline survey samples the EBS slope every other year and the IPHC survey data is delayed by one year, thus comparisons were not made to 2016.

The Pacific cod in the northern areas appear to be generally longer than the Pacific cod in the EBS. The Team was not certain, however, whether there is much else to infer from this observation without additional research and better understanding of the relationships and connectivity between the two areas. The Team notes the value of the survey to the BSAI stock assessments and encourages NMFS to increase the frequency of the survey to more than once every seven years.

While the historical, poorly sampled, fishery age compositions were not used in the 17.X series of models, new more recent fishery age compositions (2013-2016) were used. A bridging analysis from Model 16.6 to Model 17.6 was initiated and included examining the effect on spawning biomass estimates of adding individual features. However, a different conclusion could be made when removing an individual feature from Model 17.6. The bridging analysis was incomplete because the SSC recommended against conducting a bridging analysis.

The prior distribution for natural mortality (*M*) was updated to exclude estimates from EBS models. This resulted in a more diffuse prior that had little effect on the estimates.

The author provided a thoughtful look at model weighting in response to SSC recommendations. In addition to the calculation of model weights using a measure of effective sample size per parameter (introduced in September 2017), weightings based on retrospective behavior, convergence behavior, and general plausibility were developed and presented. Final model weightings were calculated by averaging the various quantities within each weighting approach listed above using the arithmetic, harmonic, or geometric mean, and then r combining all of the approaches. The best model, determined from the highest final weight, depends on the method used.

When choosing a final model, the author considered the weighting as well as some qualitative considerations. The weightings suggested that either 17.2 (arithmetic) or 16.6 (geometric and harmonic) was the best model (i.e., highest weight based on the quantities considered). Qualitatively, a number of concepts were considered. First, the 17.X series of models included many new features that were in response to past Plan Team, SSC, and P-cod Subcommittee recommendations. Second, the estimated EBS shelf bottom trawl survey biomass was 37% less than in 2016, and the reduction predicted by model 17.2 was the most similar to the decline in survey biomass from 2016 to 2017 (-28%). A third consideration was avoiding drastic reductions in the ABC that may prove unnecessary in the future, which support models 16.6 and 17.2. However, it is possible that the other models suggesting much lower levels of current biomass are consistent with the current state of the stock.

The assessment author recommended Model 17.2 for many quantitative and qualitative reasons. The Team noted that Model 17.2 showed a retrospective pattern that overestimates the terminal biomass. Mohn's rho was within the range of acceptable Mohn's rho values according to the approximation to the study of Hurtado-Ferro et al. (2015), but was slightly higher than Model 16.6. Estimates of recruitment in the most recent three years were much lower than average, but were above average before then. The historical estimated spawning biomass in Model 17.2 is lower than in Model 16.6, which changes the phase plane, indicating historical higher F's that suggested there was a long period of overfishing.

Empirical weight-at-age data were not used in these assessment models for several reasons. These data are not available for every year, beginning of the year values would need to be determined from mid-year observations, and the known ageing bias would result in biases in the empirical weight-at-age. A comparison of fishery weight-at-age calculated using three different methods (empirical, an age-length-key, and predictions from Model 17.2) showed similar trends for the ages which have large sample sizes (4-6 years). The youngest fish in recent years have a lower weight-at-age than fish in other years.

The SSC requested that model averaging use the full uncertainty associated with each model, and because the AFSC's standard projection model (*proj*) only includes future uncertainty from recruitments, the projections in the Stock Synthesis model (SS) were used instead, producing slightly different results than *proj*. Normal distributions of predicted ABC's estimated from the Hessian were provided for model averaging. Tables of all possible model combinations for averaging the 2018 and 2019 ABC's and OFL's are provided in an Appendix. However, the values in these tables are different than the values in the main text because they use the SS projections.

Under ecosystem considerations, the author has presented the correlation of recruitment with average NPI (North Pacific Index) from October to December for many years. The 2016 estimate of recruitment falls below the lower 95% confidence interval.

Ingrid Spies presented a proposal for a genetic analysis of NBS Pacific cod that is based on work started by Lorenz Hauser and Dan Drinan and the University of Washington. Length frequencies collected from the NBS surveys showed high proportions of small and large fish in 2010, but more medium-sized (typical in the EBS) fish in 2017. It was noted that the population abundance in the NBS was estimated to be much smaller in 2010. The Team thought that it would be useful to compare 2010 NBS lengths to 2010 EBS lengths, and 2017 NBS lengths to 2017 EBS lengths.

Ingrid showed that there are many existing samples in the BSAI that could be used to help determine where the cod in the NBS originated. Loci have been identified that can discriminate distinct spawning populations, and past work has identified an isolation by distance pattern in Pacific cod. Funding of approximately $200,000 would be needed for this proposal, and work could be completed in approximately one year.

Discussion

The Team discussed whether the NBS Pacific cod are the same stock as the EBS or if they are distinct stocks, and the resulting implications for the assessment. If the two areas are comprised of the same stock, the population would be bigger than estimated in just the EBS, and this should be reflected in the assessment in terms of catchability and selectivity. If it is a distinct population, this could be a large concern, but the amount of fishing in the NBS is relatively small and hence may not negatively impact the stock.

The Team had a lengthy discussion of the models presented and what should be used to provide management advice. The Team appreciates the advances in model averaging, but before model averaging is used to replace a single model entirely, the Team would like to make sure that model averaging is a valid substitute. The SSC minutes from the February workshop suggested that an assessment should consider model averaging, but also encouraged a “go slow” approach. The Team supports the “go slow” approach, and the subsequent discussion focused on the choice of a single model for management.

The differences in predicted ABC between the models were a big concern. Model 17.2 was seen as an improvement in some aspects based on first principles. It included more specific data weighting and fishery time-varying selectivity, which may or not improve the model. However, 16.6 is the status quo model, is more parsimonious, is structurally simpler than the 17.X series, and provides stability to the choice of the assessment model. None of the 17.x series of models were a clear and obvious improvement over Model 16.6. Therefore, Model 16.6 was chosen as the model to determine management quantities.

Models 16.6 and 17.2 had the highest Mohn’s rho values. Although Mohn’s rho is within the range of acceptable values (according to linear interpolation from the Hurtado-Ferro et al 2015 paper) the positive value and the plot suggest that these models may be overestimating the biomass. The survey abundance was similarly fit (visually) in each model.

The discussion of models led into a discussion on which (if any) of these models are appropriate for inclusion in a suite of models to use for model averaging. The Team noted that 17.7 and 17.6 are similar models (17.7 is 17.6 with a constraint on data weighting) and thus at most, one should be part of the suite. It is possible that the constraint could be limiting and there was support for keeping 17.6 as a contender. Model 17.2 is an obvious contender and it was felt that Model 16.6 was structurally different and thus its inclusion would help to encompass model uncertainty. The Team was not certain if Model 17.1 and 17.3 were useful models for an ensemble.

However, the Team felt that the models presented here do not represent the range of models that should be considered for model averaging. Therefore, no specific recommendation was made about which models should be included for model averaging. Instead, a recommendation was made for a subcommittee to meet to discuss the range of models that would be most appropriate for an ensemble.

The Team spent a significant amount of time discussing ecosystem considerations, and while there are observations that suggest the stock may be low, there are also indications that the stock could be high. The negative indicators include the recent estimates of low recruitment, recent high age 1 mortality from the multispecies model, recent low weight-at-age in young ages, recent warming of ocean temperatures, recent bird die offs, recent low crab abundance in the BS, and other environmental indicators. Positive indicators are the high abundance in the north, relatively high Fulton’s condition values in 2016 and 2017, and predictions of cooler temperatures in future years. Bottom and surface temperatures in the EBS were the highest on record in 2016, and more than 1 SD greater than the mean of the time series, yet EBS in 2017 appears to be returning to a near-neutral condition, although still slightly warmer than average in 2017. In July-August 2017 an anomalously large EBS-wide bird mortality event was observed and necropsy of 20 carcasses revealed emaciation (starvation) and drowning as primary causes of mortality. Bottom trawl survey biomass of multiple other groundfish species was down in 2017 relative to 2016, although the drop was greatest for Pacific cod. Mean weight per length, an index of fish condition, was low for many species including Pacific cod, especially in the inner domain. New work by Duffy-Anderson suggests the small cold pool in 2016 may have provided a thermal and foraging refuge for other groundfish species (e.g., pollock) during warm water conditions. The 2017 cold pool was narrow but extended south and is projected to be around average in 2018 (for area based on <1 deg C). The motile epifauna guild remains above the long-term mean and the trend is increasing (driven by brittle stars, urchins/dollars/cucumbers), except for crab (important prey of Pacific cod) which have been declining in recent years and were down again in 2017. These contrasting observations make it difficult to assess the Pacific cod stock in the EBS, but the Team felt that the ABC should be reduced from the maximum ABC in 2018 and a reduction in 2019 should be considered next year. The Team did not want to provide an ad hoc reduction in the ABC, so suggested averaging the ABC from models 16.6 and 17.2 (with equal weighting) as the recommended ABC. The method is explained in detail in the recommendation below. It is generalized so that unequal weightings could be used, if needed, and corrects for the SS projection results.

The discussion of the EBS Pacific cod assessment was reopened Thursday morning to plan for 2018. The Team reiterated that it was disinterested in continuing the subcommittee indefinitely to continue reviewing, selecting, and recommending new operational models for Pacific cod as a unique case, while other stocks do not get this added benefit of additional review. There has been a general consensus that continuing the status quo has become counterproductive as both the Team and members of the public have been interested in some model stability. If the SSC and interested members of the public desire that this interim meeting continue, the Team discussed what might be some additional topics that could be explored. The discussion focused on what a subcommittee meeting in the spring might accomplish, and the Team determined that identifying models that span a range of hypotheses would be useful. Meeting topics could include: what ecological hypotheses should be considered (drawing on other models such as CEATTLE and FEAST, and having the people involved with ecosystem analyses present at the meeting to help identify hypotheses), how to choose models for inclusion in the suite of models (statistics, goodness of fit, plausibility, etc.), which first principles and standard practices of assessment models should be considered, identifying models for the suite as opposed to models that are sensitivity analyses, which models are useful for management, and how to link the ecosystem status report to the assessment (potentially involving other ecosystem researchers within the AFSC).

Additionally, there was a desire to understand why the models presented in 2017 show large differences. Completing the bridging analysis may help to understand what is driving these differences.

Finally, when should an ABC be reduced from the maximum, and if warranted, how to determine that reduction, were discussed. There is no standard method for reducing the ABC from its maximum, but there are times when it may be justified. Reducing the ABC is not an annual concern, but it does occur and having guidance on how to reduce the ABC, and by how much, would be useful. The concerns that indicate a potential reduction may include uncertainty in the assessment, ecosystem considerations, as well as economic considerations. However, it was realized that the Teams have traditionally provided guidance on ABCs that are based on biological concern, but is also allowed to do so for other considerations related to optimum yield.

There are three broad topics that the Team believes could be useful for Pacific cod and the broader AFSC assessment realm that could be discussed at a subcommittee meeting: 1) investigating the variability in the data, 2) determining what types of models should make up the ensemble, and 3) when and how should the ABC be reduced from its maximum. The Team thought that it may be useful to draft an agenda for this subcommittee meeting to be approved by the SSC at the February NPFMC meeting.

The utility of the NBS survey and its use in assessments was discussed. Verbal confirmation was received that the NBS survey data can be used in assessments beginning in 2018. It may be a useful survey if it is continued in the future.

EBS Pacific cod recommendations

The Team recommends making a direct comparison between the EBS trawl survey length compositions and the NBS survey length compositions for 2010 and 2017, within each year.

> The NBS survey showed different length compositions between 2010 and 2017, and this comparison would provide a better understanding of the relationship between the stocks in the two areas.

The Team recommends presenting in the next assessment document, the fishery CPUE for each of the separate sectors (pot, trawl, longline), as has been done in the past.

> This information would be useful to compare to estimated trends from the assessment.

The Team recommends reporting the fishery CPUE by area in the NBS areas to provide a context for the genetics proposal.

> A better understanding of the fishery CPUE in the northern areas would provide insight into population trends in these areas that would supplement the occasional surveys in those areas. The Team leaves it up to the analyst to determine the areas based on personal preference and data availability.

The Team recommends investigating the utility of dropping the first five years in the EBS shelf survey (starting the series in 1987) and thus allowing for the incorporation of the northwest strata (areas 82 and 90) into the survey index time-series.

> The Pacific cod abundance has potentially increased in the northwest strata, these areas are becoming more important to the fishery, and this change may provide an improved index of abundance for Pacific cod.

The Team recommends funding the genetics proposal presented by Ingrid Spies as soon as possible.

> This proposal will answer questions related to the genetic relationship of Pacific cod caught in the NBS relative to other areas. In addition, the Team would like to understand how the results of this study may affect the assessment and management paradigm, and assumptions of spawning connectivity (or lack thereof) between EBS and NBS Pacific cod.

The Team recommends that Model 16.6 be used for determining stock status and setting management quantities.

> Model 16.6 is the current base model. It was the chosen model after a CIE review, is a parsimonious model, fits the data reasonably well, and produces plausible results. Choosing this model also adds stability to modeling choices and reduces variability due to changing models.

However, the Team does not want to lose the momentum of the exceptional work done by the author to address the many concerns raised, and the Team recommends that models 17.2 and 17.6 remain as candidate model structures for continuing to understand the relationships between data and model choices. **Models 16.6, 17.2, and 17.6 are structurally different models that represent a range of model uncertainty.**

The Team recommends a maximum permissible 2018 ABC of 201,000 t, based on the recommended Model 16.6. However, the Team recommends that the ABC should be below the maximum permissible because of many concerns related to the dramatic declines in the EBS shelf survey index, recent poor environmental conditions, lack of incoming recruitment, and recent small size-at-age of young Pacific cod.

There was a lengthy discussion whether a reduction from maxABC was necessary and if so, how to choose a reduction from the maximum permissible ABC from Model 16.6. Some of the options considered included a 10% reduction, the ABC from model 17.2, or some version of the averages given in the appendix on model averaging. Since the Team really considered accepting only Models 16.6 and 17.2 for management quantities and these two models had the highest final weightings, a combination of 16.6 and 17.2 was used to adjust the ABC downward. The third model, 17.6, was not included because it had a very low final weight, showed some implausible results (measured by the plausibility weighting) and the reasons for its extreme difference from the status quo were not completely understood. To determine the 2018 ABC, the arithmetic approach of calculating the effective sample size within a model was used for Models 16.6 and 17.2, and the average ABC was calculated assuming equal weights. Table 2.5.2 was used and the method presented here so that other options (e.g., unequal weighting) could be used to determine a recommended ABC. Table 2.5.2 uses projected ABC's from Stock Synthesis, which is slightly different than the AFSC projection model. Therefore, a calibration was done using the ratio between the averaged value with equal weighting in Table 2.5.2 (200), the maximum ABC from Model 16.6 in Table 2.5.2 (214), and the maximum ABC from the projection model (201):

(maxABC(M16.6,Proj)/maxABC(M16.6,SS))×maxABC(Table2.5.2,SS) = (201/214)×200 = 188

The recommended 2018 ABC is 188,000 t.

> Note that the simple average of the AFSC projection model ABC's (201,000 t and 172,000 t) from these two models is 187,000 t, and is different due to rounding.

The Team recommends a 2019 ABC equal to the maximum 2019 ABC from Model 16.6 (170,000 t).

The Team recommends continuing an investigation of why the various models show very different results.

> This could be accomplished by looking at the effect of model outputs when including individual features (expanding on the evaluation of effects presented). From this work we may gain a better understanding of both the range of model structural uncertainty and the linkages from the model back to the biology and ecology of the stock. Using Model 16.6 as the base model, the Team would like to see the effects of the features included in Models 17.2, 17.3, and 17.6. The effect can be measured with the average difference in spawning biomass, the relative change in the 2016 spawning biomass (not absolute value), the change in the estimate of natural mortality (M), and the unfished equilibrium biomass ($B_{100\%}$). Additionally, and if possible, a look at Mohn's rho for some of the features (at the author's discretion) would be helpful to understand which features affect the retrospective behavior. This investigation could be done in preparation for the Subcommittee meeting recommended below.

The Team recommends that if the SSC requests an EBS Pacific cod subcommittee meeting, the meeting should contain at least these three topics on the agenda:

- The first topic should be to consider the results of the investigation of the effects of different features on the model outputs (see above).
- The second topic would be to examine ecological hypotheses related to the EBS Pacific cod stock, model assumptions that address those hypotheses, and potential models that would be included in an ensemble of models to represent structural uncertainty.
- The third topic would be to investigate what external indicators or thresholds may indicate a need to reduce the ABC from the maximum ABC.

AI Pacific cod

Grant Thompson presented the Tier 5 assessment for Aleutian Islands Pacific cod. The only changes to the assessment included updating the catches from 1991-2016, and providing a preliminary catch for 2017. The preliminary 2017 catch (14,673 t) is less than the ABC. With the incomplete 2017 catch records, the CPUE declined from 2016 for both the trawl and longline fisheries. There were no new survey data in 2017, but the estimated survey biomass has been increasing since 2010. The model fits the survey observations very well.

The Team recommends using the estimate of natural mortality (*M*) from the EBS Pacific cod model 16.6 since it was selected as the model to provide management advice for that stock.

> This value of *M*, 0.36, is the same as specified last year for AI Pacific cod; therefore the quantities in the management table would carry forward to 2018 and 2019.

Specifically, the Team recommends a maximum ABC of 21,500 t.

The Team recommends using the same percentage as last year for area allocation of harvests.

BSAI Yellowfin sole

Tom Wilderbuer presented the yellowfin sole assessment. The model was updated with the most current data. In general, the model fits the survey biomass estimates quite well. Yellowfin sole female spawning biomass is ~1.9 times above B_{MSY}, but has been declining since the 1990s. Total biomass has been generally declining since the 1980s. However, the average exploitation rate (1978 – 2016) is only 0.04 and the catch is only, on average, 75% of the ABC. Team discussion focused on three general topics: 1) a strong residual pattern from 1984 – 2005 in the survey fit, 2) the similar proportion of fish caught in the NBS surveys in 2010 and 2017 (~15%), and 3) continued exploration of survey catchability (*q*, including temperature effects) and *M* and their influence on retrospective patterns.

The Team recommends plotting the estimated spawning biomass trajectory with a fixed pair of *M* and *q* values that reduces the retrospective pattern (e.g., *M*=0.09 and *q*=1.0) on top of the estimated spawning biomass trajectory, with confidence intervals, from the base model run. This comparison will help to determine if the different combination of *M* and *q* values is within the estimated uncertainty of the base model, or is describing a completely different population size.

The Team recommends continuing to explore the retrospective patterns in relation to values of *M* and *q*, with fixed values of *M* and fixed values of *q*, reporting values of Mohn's rho for each combination (range to be decided by the authors). Additionally, using those same model runs, report the total likelihood for each combination to create a bivariate likelihood profile for those parameters. Realizing that this will require a considerable number of model runs, the Team leaves it up to the authors to decide whether using the model runs done for the 2017 assessment will suffice, or if important differences arise from a 2018 model that warrant redoing those model runs.

BSAI Greenland turbot

Meaghan Bryan presented a partial assessment for Greenland turbot. In addition to re-running the projection model with updated catch, catch-to-biomass ratios were reported. The mean ratio between 1984 and 2017 was 0.04. Recruitment continues to be low and while the OFL is predicted to increase slightly next year the biomass is likely to start a marked decrease in the near future.

The authors recommended a reduction of the max ABC to 7,000 tons (as last year's authors did), but the Team did not think there was a sufficient rationale for this reduction and continued to recommend the maximum permissible ABC.

The Team noted that the two-year stair-step adopted by the SSC last year puts the SSC on track to set the 2018 ABC at the maximum permissible level also.

BSAI Arrowtooth Flounder

Ingrid Spies presented a partial assessment for arrowtooth flounder. The next full assessment for arrowtooth flounder will be in 2018. The projection model from the last full assessment was run forward through 2019 with the following changes to the input data:

- 2016 catch was updated
- 2017 catch was estimated as the product of the inverse of the average proportion of catch between January 1st and September 21st from the previous 5 years (i.e., 1/90.2%) and the 2017 catch through September 21st.
- 2018 catch is estimated as the average catch over the past four years (including the 2017 extrapolated total catch).

The estimated total catch for 2017 (5,698 t) in the assessment had already been exceeded by November 9, 2017 (6,189 t). The 2018 estimated catch is 11,797 t. The estimate of total biomass in 2018 is higher than was estimated in the 2016 full assessment, 784,989 t vs. 772,153 t due to lower catch in 2017 than was predicted in the 2016 assessment (17,045 t was predicted in 2016 vs. 5,698 t extrapolated from partial catches in 2017). There was some discussion about whether the CEATTLE model could assist in making better predictions of catch in future assessments. The stock is not overfished, and is not approaching a condition of being overfished.

The catch to biomass ratio is the lowest on record. With input from industry and AFSC economists, the author speculated about the 2017 decline in arrowtooth flounder catch, including arrowtooth not being highly concentrated, fleets not targeting arrowtooth until the more valuable Kamchatka flounder TAC was reached, and the A80 share of the Greenland turbot TAC being reached.

BSAI Kamchatka Flounder

Meaghan Bryan presented a partial assessment for Kamchatka flounder. The next full assessment for Kamchatka flounder will be in 2018. The projection model from the last full assessment was run forward through 2019 with the following changes to the input data:

- 2016 catch was updated
- 2017 and 2018 catch was estimated as the product of the 2017 TAC (5000 t) and the average fraction of the TAC captured over the past two years (86.9%)
- Fishery selectivity was updated
- 2016 numbers-at-age were updated

The fishery selectivity and numbers-at-age were updated because they were previously estimated using natural mortality (M) equal to 0.09, whereas the accepted model uses $M = 0.11$. As a result, the projection estimated a slightly larger number of younger fish. Biomass reference points remained the same; however, the previous assessment rounded values to the nearest 100 t (e.g., $B_{100\%}$ = 127,00 t), whereas this year's assessment rounded values to the nearest 1 t (e.g., $B_{100\%}$ = 126,954 t).

Because this was a partial assessment of a Tier 3 stock, the full model was not updated to reflect the new EBS shelf survey biomass estimate. The biomass estimate from the 2017 shelf survey was down 13% from last year's survey and continued the decline that began last year. However, current biomass estimates from the survey are well above historical lows.

Kamchatka flounder were specifically identified in 2007; previously the species was combined with arrowtooth flounder. Prior to it being specifically identified, the species was assumed to be 10% of the total arrowtooth/Kamchatka flounder complex catch, which resulted in low estimates of exploitation rate (catch:biomass). After identification, the exploitation rate increased rapidly for three years, to a peak of ~13% in 2010, and has declined thereafter (currently, around 2%).

The Team had no recommendations for this assessment.

BSAI Northern rock sole

Tom Wilderbuer presented a partial assessment for northern rock sole, a Tier 1 stock. The only change was in the method used to project the 2019 ABC and OFL. Due to unforeseen technical complications involved with extending the projection range in the Tier 1 assessment model from 2 to 3 years, the authors retained last year's 2018 projection values and computed the 2019 projection values by assuming that the percentage change from 2018 to 2019 would equal the percentage change from 2017 to 2018. The authors anticipate that the technical complications will be overcome before the next partial assessment is conducted. The partial assessment also presented the new 2017 survey biomass estimate and 2016 age composition information from the survey and fishery, but the assessment model was not updated with these data, which is standard procedure for partial assessments of stocks in Tiers 1-3.

The Team recommends that the authors proceed with their plans to modify their model so as to allow for 3-year projections prior to the next partial assessment, which is scheduled for 2019.

BSAI Flathead sole

Carey McGilliard presented a partial assessment for flathead sole. In addition to re-running the projection model with updated catch, catch-to-biomass ratios were reported. While the survey biomass has gone up for the past 3 years, catch has gone down. The catch/biomass ratio is extremely low at 0.02. .

BSAI Alaska plaice

Tom Wilderbuer presented a full assessment for Alaska plaice, a Tier 3a stock. The survey biomass up and females SSB are up slightly. There has not been an excellent year class since 2005, thus a gradual decline in biomass is expected. The discussion centered around the NBS survey. In 2017, 40% of the Alaska plaice were caught in the NBS survey, which is comparable to the 38% there in 2010, unlike the dramatic increases seen in Pacific cod and walleye pollock. A Team Member said it appears that Alaska plaice is moving northward because of recent presence of young plaice north of the NBS; its abundance is inversely related to bottom water temperature. It is unknown if Alaska plaice is all one stock throughout the Bering Sea and northward into the Chukchi Sea; however, it is likely, as plaice has antifreeze proteins and cold water is not a deterrent. The issue is that, as NBS survey data are currently unavailable for use in the stock assessment; 40% of the biomass was not included in this assessment. At present this is not a problem because the biomass is above $B_{40\%}$, but it could be a problem in the future if migration out of the EBS survey area is mistakenly interpreted as implying a large reduction in stock size. The implications of fish stocks' movement northward is not the same for all species. This is likely to be a continuing concern and may warrant a management strategy for Alaska plaice that includes the NBS.

BSAI Pacific ocean perch

Paul Spencer presented a partial assessment for POP. There was a very small change in ABC and spawning biomass from 2017 to 2018. The 2017 and 2018 catch estimates are about 10% higher than those estimated last year. The catch predictions have been pretty good, and there are hardly any changes to spawning biomass based on these changes in catch predictions. Paul showed exploitation rate by area and all of them were well below the proxy for the $F_{40\%}$ exploitation level. The EBS slope POP biomass has been increasing and has begun to be exploited at levels similar to those of other subareas. Future research tasks were to look at prior distributions for catchability and natural mortality. The SSC was critical of the retrospective pattern and Paul will look further into the model to try to explain some of the causes of the bias. Paul noted that trawl survey catchability is estimated in the model with a relatively broad prior distribution, and some of the retrospective pattern may be explained by different estimates of catchability between the retrospective runs as recent data are removed. This may suggest that the availability/catchability has not remained constant over time. A Team member commented that the model, which has a relatively low natural mortality, cannot explain such a rapid increase in biomass. The apportionment did not change. The Team agreed with the SSC comment on the retrospective pattern.

A Team member asked if the SSC-approved apportionment was the one presented in the document. Paul said that it was. Paul had presented a different option in 2016, that the SSC did not recommend. Paul had recommended a different apportionment scheme because, given that the different surveys may have different catchabilities and selectivities, they should not be just simply added.

A Team member asked which feature of Model 16.5 made the survey fit better. Paul said it was the Francis method. Some Team members commented that use of the Francis method usually fits the survey better, but not always.

BSAI Northern rockfish

Paul Spencer presented a partial assessment for northern rockfish. The next full assessment for northern rockfish will be in 2019. He showed an evaluation of the accuracy of the catch estimation method for the full year and future year's catch for the last five assessments. The estimates of next year's catch in the 2014 and 2015 assessments were inaccurate, around +/-50% for these two years because catch had a big change in one year and the averaging method included that high catch. The method for estimating catch for the assessment year has been pretty accurate, however. He showed exploitation rates by area, and all areas were below the nominal $U_{F40\%}$. This stock has a "poor" retrospective trend (SSC's characterization), but it is not as problematic as POP. A Team member calculated the retrospective bounds suggested by Hurtado-Ferro et al. (2014) and the lower bound was -0.10 and -0.09 for POP and northerns respectively, which would mean that northerns were outside of these guideline levels and POP was far out of bounds.

Paul showed a plot of size at age by area that were quite different. Slow-growing fish could cause the AI subareas to have different ageing error matrices. Paul talked about splitting up the data into subareas to see if the differences in growth are meaningful. A Team member asked if there were enough age data to split these by area. Paul thought that there were a few hundred samples and could be done. Paul wanted feedback about whether to pursue this. The Team said they would consider any efforts to have a weighted length-at-age that included these spatial dimensions. A Team member asked what the curve would look like in the model, and Paul replied that it would be one curve that is based on a weighted average of subarea growth curves, with weights derived by some average proportion of biomass in each subarea. If there were any changes in the length-age relationship over time, time-varying growth curves may need to be considered.

BSAI Blackspotted and Rougheye rockfish

Paul Spencer presented a partial assessment of the BSAI blackspotted and rougheye rockfish (BS/RE) stock complex – a full assessment will be presented in 2018. BS/RE is on the sloped part of the control rule so the adjusted fishing mortality is increasing as spawning biomass increases. The stock expected to move from Tier 3b to 3a in 2019 as the stock moves above B40%.

Paul showed exploitation rates by area. The area that has been of concern (WAI) has shown a considerable decrease in annual exploitation rate since 2013, and for 2017 the WAI exploitation rate was near the reference rate $U_{F40\%}$ (the exploitation rate obtained from fishing at $F_{40\%}$). In the future, Paul will consider returning to separate EBS and AI models and will re-evaluate the inclusion of EBS slope data.

Paul talked about how current stock projection is based on uncertain year class strength and that we are uncertain about many of the more recent year classes. Potentially including this uncertainty in projections could produce a distribution of projected ABC values. This is done for sablefish and some GOA rockfish and is reported in the assessments. A Team member noted that doing this for the OFL would be useful for the P* approach.

The Team concurs with the author's research plans to evaluate the strong retrospective patterns.

Because of the high uncertainty in recruitment, the Team recommends that the author consider updating the ageing error matrix, as it is currently based on the GOA and may be contributing to the uncertainty about recruitment.

BSAI Atka mackerel

Jim Ianelli presented the Atka mackerel assessment.

Routine updates to the data were made. There was no Aleutian Islands trawl survey in 2017, thus the survey biomass time series was not updated.

The assessment includes the current base model (Model 16.0) and three other models that the authors consider to be only minor changes from the current base model (Models 16.0a, 16.0b, and 16.0c). The distinguishing features of the four models are as follows, where the term "Francis weights" refers to Equation TA1.8 of Francis (2011):

- Model 16.0: current base model, in which:
  - The constraint on the amount of time variability in fishery selectivity is set to the value estimated in the 2013 assessment by the method of Thompson and Lauth (2012).
  - The fishery age composition sample sizes are proportional to the number of sampled hauls.
  - The survey age composition sample sizes are proportional to the number of sampled hauls.
- Model 16.0a: same as Model 16.0, except that:
  - The constraint on the amount of time variability in fishery selectivity is tuned using Francis weights.
- Model 16.0b: same as Model 16.0, except that:
  - The constraint on the amount of time variability in fishery selectivity is tuned using Francis weights.
  - The survey age comp sample sizes are tuned using Francis weights.
- Model 16.0c: same as Model 16.0, except that:
  - Fishery selectivity varies by six time blocks.
  - The fishery age comp sample sizes are tuned using Francis weights.
  - The survey age comp sample sizes are tuned using Francis weights.

In Models 16.0a and 16.0b, the use of Francis weights to tune the constraint on the amount of time variability in fishery selectivity required specifying the mean sample size for the fishery age composition data *a priori*. The authors chose a value of 100 for this purpose, which they viewed as "a reasonable specification of overdispersion in fitting composition data" and "a defensible way to arrive at a balance between process and observation error."

Although Model 16.0a did involve tuning the constraint on the amount of time variability in fishery selectivity, the authors did not consider it to be a viable option, because it did not involve tuning either the fishery or survey age composition data sample sizes.

Model 16.0 also did not involve tuning either the fishery or survey age composition data sample sizes; nor did it involve tuning the constraint on the amount of time variability in fishery selectivity.

The authors deemed Model 16.0c to be "too preliminary for further consideration" because:

- Significant recruitment events were obscured.
- Estimated selectivity for a given block sometimes seemed to reflect the pattern for only a subset of the years in that block.
- Allowing selectivity to vary annually allows the model to fit the fishery age composition data better.

The authors therefore recommended adoption of Model 16.0b, because it tuned the sample sizes of at least one of the compositional data types (*viz*., the survey age compositions), and it addressed the desire for a statistical method for tuning the constraint on the amount of time variability in fishery selectivity.

Discussion points included the following (these are comments/questions made/asked by individuals present at the meeting and do not necessarily reflect Team consensus):

- It is unclear whether the survey index is assumed to be normally or lognormally distributed.
- Why is there such a large difference between the numbers of otoliths collected in the fishery (~1800) and the survey (~300)? Response: This may be due to the difficulty of maintaining a representative sample (e.g., not collecting too many otoliths from a single small subarea).
- Is this the first known use of Francis weights to estimate the constraint on the amount of time variability in selectivity? Response: Yes.
- The novel use of Francis weights in Models 16.0a and 16.0b is a clever idea.
- In the retrospective analysis, the historical scale of the population seems to change unidirectionally with the number of peels (becoming higher with successive peels).
- For Model 16.0b, how sensitive are the results to the assumed mean sample size (100) for the fishery age composition data? Response: Unknown at present, but could be evaluated.
- Does the time-varying selectivity pattern make sense, or is it just chasing noise? Response: Both VPA and pure separability are too extreme; this model is a reasonable middle ground.
- Is the fishery targeting strong incoming year classes, or does it concentrate on the full age range of mature fish and so is somewhat insensitive to incoming year classes?
- Steller sea lion restrictions affect how the fishery operates, which may differ from unconstrained profit maximization.
- With respect to estimation of selectivity, is it better to use time blocks that are linked to identifiable changes in the fishery than to allow annual variability?
- There were anomalously high water temperatures observed in the 2016 trawl survey. Are there known temperature effects on recruitment or survey catchability? Response: Unknown, but could be a factor.

The Team also engaged in considerable discussion as to whether Model 16.0b constituted a new model, whether it should have been previewed in September, and whether it would be better to retain Model 16.0 for this year and revisit Model 16.0b again next year. The authors consider all four models to have the same "configuration," but they also identify Model 16.0b with a model number distinct from that of the base model. This discussion led to development of the Team policy on acceptance of non-previewed models that appears under the heading "General" at the beginning of these minutes.

Ultimately, the Team accepted the authors' recommendations regarding adoption of Model 16.0b and harvest specifications for 2018-2019.

The Team recommends that the authors undertake the following during one or more future assessments (as this is a long list, the Team does not expect all items to be addressed by next September, and understands that the authors can prioritize the list as they see fit):

- Investigate which parameters (including derived quantities) are changing in the retrospective peels that might contribute the relationship between historical scale and number of peels.

- Consider dropping the 1986 age composition from the analysis, to be consistent with the policy of not using pre-1991 survey data.
- Improve documentation for the process of using Francis weights to tune the constraint governing the amount of time variability in fishery selectivity.
- Continue to investigate fishery selectivity time blocks, with blocks linked to identifiable changes in the fishery.
- Evaluate the sensitivity of model results to an assumed average sample size of 100 for the fishery age composition data, or better yet (if possible), find a way to tune the sample size and the constraint governing the amount of time variability in fishery selectivity simultaneously.
- Investigate whether a larger number of survey otoliths can be collected in a representative fashion.
- Continue the investigation of age-dependent natural mortality.
- Continue to include (and update) Figure 17.5.

BSAI Skates

Olav Ormseth presented a partial assessment for the skate complex. The next full assessment for skates will be in 2018. Alaska skate is the primary species in the BSAI skate complex and is a Tier 3 species. The remaining species are Tier 5. The projection model for Alaska skate from the last full assessment was run forward through 2019 with the following changes to the input data:

- 2015 and 2016 catch data were updated
- 2017 total catch was estimated by multiplying the partial 2017 catch (as of October 31) by a correction factor based on the proportion of additional late-season catch in the previous 5 years.

The 2017 EBS shelf trawl survey biomass estimates were also included in this partial assessment. However, the stock assessment model was not re-run (standard procedure for a partial assessment of a Tier 3 stock) and the random effects model for the Tier 5 component of the complex was also not re-run. The random effects model was not re-run because the species included in that model are primarily caught in the EBS slope and Aleutian Islands surveys, which did not occur in 2017.

On average, 88% of the skate biomass occurs on the shelf and >90% of that is Alaska skate. The Alaska skate biomass was down slightly in the 2017 EBS shelf survey. The biomass estimates of the remaining skates in the EBS shelf survey has been increasing since 2012, with a large increase in 2017 in the biomass estimates of Aleutian, Bering and big skates. Olav presented additional information beyond what is in the assessment document regarding the increasing biomass of big skates in the eastern Bering Sea. Big skates have been appearing in hauls near Unimak Pass and the southern Bering Sea. In the GOA, there appears to be an ontogenetic shift towards the west as the animal grows, and the hypothesis is that some of the GOA big skate population is spilling into the Bering Sea through Unimak Pass. The size distribution of big skates captured during the EBS shelf survey is similar to that in the WGOA and no small big skates appear in the EBS, lending support to the hypothesis. .

The exploitation rates of Alaska and other skates have been increasing since 2010, but remain below 6% for Alaska skate and below 3% for other skates. These exploitation rates are FMP-wide and there may be some variability between areas.

Olav pointed out that he is working on incorporating improved species identification into the assessment for the *Bathyraja* species. However, there has been some confusion about what at-sea observers record compared to what is used in estimating catch.

The Team recommends that the author work with FMA and AKRO staff to investigate species composition.

The Team requests that the author examine exploitation rates by species for the complex, in particular the endemic species in the Aleutian Islands (leopard and butterfly skates).

The Team notes that all three surveys in the Bering Sea (EBS shelf and slope, and Aleutian Islands) are critical for this assessment, as some species occur only in the Aleutian Islands and others are more abundant on the slope, meaning that the shelf survey does not adequately sample those species. Further, this is a large complex and, without the full suite of surveys, critical changes in biomass of the less dominant species may go unnoticed.

BSAI Sculpins

Ingrid Spies presented a partial assessment for sculpins. The next full assessment for sculpins will be in 2019. The annual Bering Sea shelf survey for 2017 updated the biomass estimates for the sculpin species found on the BSAI shelf: bigmouth, great, plain, warty, and yellow Irish lord. There was no Bering Sea slope or Aleutian Islands survey in 2017. The random effects model was run using the updated shelf survey data since it is the largest component of the three surveys used in the assessment. The biomass changed for one species, plain sculpin, which declined from 53,570 t in 2016 to 33,962 t in 2017. Catches appear stable, with 4,967 t in 2015, 4,892 t in 2016, and 5,035 t in 2017 (through November 4, 2017). Retention is low at about 2%. The catch-to-biomass ratio has been stable, with a value of 2% in 2016 and 2017. The OFL, ABC, TAC, and catch are updated based on results from the random effects model that included the new shelf survey data.

BSAI Forage Fish

Olav Ormseth presented the forage fish report. Per SSC request, this report will continued to be produced in conjunction with the biennial cycle in the SAFE instead of in the ecosystem considerations chapter. The Team discussed the utility of reporting the bycatch of these species in either this chapter or the Ecological Considerations chapter instead of in the individual species-specific chapters. There seemed to be some benefit to consolidating all discussions of bycatch of non-target species in the Ecological Considerations chapter as more applicable to a broader audience than within the species specific chapters as per present practice.

The Team discussed the current results for the examination of temperature and trends. The Team recommends the assessment author plot mean annual CPUE as a function of annual temperature and until the warm /cold relationship is established, remove “warm” and “cold” from the block names.

The Team discussed the herring savings area closures and potential mis-specificity of their application and locations The Team recommends that the assessment author examine catch inside and outside of the current herring areas in the next report. The Team also recommends evaluation of spatial population considerations to consider aspects such as herring migration and/or whether some core areas of abundance for herring and broader forage species locations have shifted over time. This could help to elucidate reasons for corollary issues such as broad scale seabird die-offs. The next forage fish chapter will be produced in 2 years.