Minutes of the Bering Sea Aleutian Islands Groundfish Plan Team

North Pacific Fishery Management Council
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Ecosystem considerations (BSAI)

Stephani Zador presented the Bering Sea and Aleutian Islands Ecosystem Assessment reports and report cards. This year, for the first time the report was presented separately for each large marine ecosystem (LME).

The Status of the Bering Sea Ecosystem

Multiple indicators expressed a decline in productivity consistent with ecosystem responses to anonymously warm conditions. Mean summer bottom temperature on the shelf was the warmest on record with an average bottom and surface temperatures across stations (and weighted by the proportion of their assigned stratum area) during summer surveys of 4.5 and 9.5 ^{o}C, respectively. The cold pool was much reduced to a “cold puddle” and did not cover the shelf. Small copepods dominated Zooplankton Rapid Assessments, euphausiids were scarce across the shelf, and biomass indices were at an all-time low. There may be a spatial mismatch between larval pollock and large, preferred copepod prey.

Brittle stars and other echinoderms appear to be increasing in abundance as evidenced by continued increasing CPUE in summer bottom trawl surveys. 2016 exhibited average recruitment conditions for winter spawning flatfish (Arrowtooth, N rock Sole, Flathead Sole). Benthic forager biomass increased to the long-term average this year whereas pelagic forager biomass declined from above average to average. Apex predator biomass is above the 30 year mean, driven primarily by increases in Pacific cod starting in 2009. Seabird and fur seal pup production continues to decline. Structural epifauna and jellyfish CPUE continues to decline from a peak in 2011. Fish condition was above average for all groundfish species except pollock and arrowtooth flounder (average). Multispecies model estimates of age 1 mortality were highest for the time series (1979-2016) for all three species (pollock, Pacific cod, and arrowtooth flounder). The groundfish community exhibited higher richness and diversity in 2016 relative to 2015, and was distributed shallower and to the NW as compared to previous years. There was a slight increase in bycatch of seabirds in 2015, predominantly fulmars and gulls, and might be indicative of poor “natural” food supply in 2015. The Fish Stock Sustainability Index is at 93% of max for the BSAI and has been increasing since 2006.

Two new indicators were introduced; a new geostatistical indicator provides estimates of herring abundance and another indicator was included this year that considers cumulative impacts of all gear types as well as recovery rates to derive spatial estimates of highest fishing impacts on benthic habitats.

Projections

Warm conditions are forecasted for the region and the 9 month prediction is for a slightly larger, but still much reduced from average-sized, cold pool. The slightly unusual maintenance of positive PDO conditions with La Niña conditions could reflect extra heat content of North Pacific surface and near surface waters. There was no consensus among 3 recruitment indices for the age 1 recruitment of the Bering Sea 2015 pollock year class as indices indicated high, average, and below average recruitment. Age 3 recruitment of the 2015 pollock year class (2018) is predicted to have intermediate recruitment (based on fall condition of YOY index) and small size of zooplankton this year portends a poor 2016 year class.

Status of the Aleutian Islands

The Aleutian Island (AI) system cooled late in 2015 to near normal conditions before warming in the spring and summer 2016 to some of the highest temperatures observed in the time series, including warming of surface waters across the entire region and to a depth of greater than 100 m. Biological conditions in the AI were approximately average. In the western region planktivorous auklets had above average breeding success, age-0 gadids and hexagrammids were approximately average, and pelagic foragers declined. Sea lion abundance estimates (2015) remain low. In the central AI there was no change in forager biomass 5 year means or trends while in 2016 pelagic and apex predators decline slightly. In the eastern AI, all forage fish increased in puffin diets, but gadids were still declining from the peak in 2012. Pelagic and apex predators declined slightly from 2014, school enrollment dropped sharply, and sea lions continue to increase.

The Team expressed support for the separate ecosystem reports for each LME. Various assessment authors continue to include ecosystem considerations in their assessments (e.g., qualitative assessment of future EBS pollock productivity given current temperatures and lower trophic level productivity; temperature-specific multispecies model appendix to EBS pollock, AI pollock and bottom temperature discussions, appendix for N rock sole delineating recruitment as a function of cold pool and wind). Also, there was some discussion of the low 2016 pH measurements on the shelf –contributing authors had cited equipment issues and cautioned against between-year comparisons.

Pollock

EBS pollock

Jim Ianelli presented the EBS walleye pollock assessment.

New data in this year’s assessment include the following:

- The 2016 NMFS bottom-trawl survey (BTS) biomass and abundance at age estimates.
- The 2016 NMFS acoustic-trawl survey (ATS) biomass and abundance at age estimates.
- Observer data for catch-at-age and average weight-at-age from the 2015 fishery.
- Updated total catch as reported by NMFS Alaska Region for 2015 and estimated catch for 2016.

The authors recommended switching from the base model (Model 15.1) to a new model, labeled Model 16.1. Model 16.1 involves the following methodological changes from Model 15.1:

- The model was fit to survey biomass rather than survey abundance (numbers of fish).
- Sample sizes specified for the size composition data were revised, based on the “Francis method.”

- The method for estimating current and future year mean body weight at age was improved.
- For purposes of estimating biological reference points (BRPs) and making projections (but not for estimating historical or current non-BRP parameter values or derived time series), the model was re-run with greater weight given to the prior distribution for the stock-recruitment "steepness" parameter. (This was done as an initial step toward responding to the Team's request—from the September meeting—that the authors "develop a better prior for steepness, or at least a better rationale, and perhaps consider a meta-analytic approach.")

Jim drew the Team's attention to some minor errors in the document that had been posted, and noted that these would be corrected in the Council review draft and that some new tables and clarifying text would also be included.

As estimated by Model 16.1, spawning biomass in 2008 was at the lowest level since 1980, but is now 2.52 times the 2008 value, with a further increase projected for next year, followed by a decreasing trend. The 2008 low was the result of extremely poor recruitments from the 2002-2005 year classes. Recent and projected increases are fueled by recruitment from the very strong 2008 and 2012 year classes (2.31 and 2.58 times the average, respectively), along with reductions in average fishing mortality (ages 3-8) from 2009-2010 and 2013-2016. Spawning biomass is projected to be 2.12 times B_{MSY} in 2017.

The authors recommended setting ABC for 2017 at 2018 at the maximum permissible levels under Tier 3a rather than the maximum permissible levels under Tier 1a, and listed nine concerns in support of their recommendation. Some of these involved ecosystem considerations, specifically:

- The conditions in summer 2016 were the warmest recorded over the period 1982-2016; additional precaution may be warranted since warm conditions are thought to negatively affect the survival of larval and juvenile pollock.
- The multi-species model suggests that the B_{MSY} level is around 3.6 million t instead of the ~2 million t estimated in the current assessment (noting that the total natural mortality is higher in the multi-species model).
- The euphausiid index decreased from the 2014 estimates and has declined since the 2009 peak. This may negatively affect survival rates of juvenile pollock prior to recruiting to the fishery.
- Pollock are an important prey species for the ecosystem; there's been a 12% decline in St. Paul Island fur seal pup production from 2014-2016 which, when combined with information on the other population components (Bogoslof and St. George Islands), indicates an estimated 2.5% decline in the overall Eastern Stock fur seal population. Maintaining prey availability may provide better foraging opportunities for the fur seal stock to reduce further declines.

Also in the area of ecosystem considerations, the Team received a presentation on a multi-species model ("CEATTLE," see next section in these minutes) prior to making its ABC recommendations.

Questions and comments from Team members and others during the discussion included the following:

- The constraints on fishery selectivity may merit further exploration.
- Many years ago, the authors explored the possibility of dome-shaped survey selectivity, but were troubled by the lack of an explanation as to the location of the "missing" fish; in the current model, allowing dome-shaped survey selectivity would likely make it harder for the model to estimate a believable value of M.
- Perhaps increasing the lower bound of the "age-plus" group should be explored.
- Model 16.1 incorporates suggestions that have been made, and improves the fits to the surveys.

- There are still quite a few CIE recommendations left to explore.
- Is the stock-recruitment curve reasonably stationary?
- Why should stock-recruitment stationarity be an issue if the assessment is conducted annually?
- Stock-recruitment stationarity is important because the optimality of the Tier 1a maxABC harvest rate is based on the assumption that it will be applied over the long term; annual estimation of a long-term rate is different from annual estimation of quantities that are expected to vary over the short term, such as recruitment and spawning biomass.
- Is there work to be done that can reconcile the apparent conflicts in the data between bottom trawl survey age data, fishery age data, and the information regarding *M*?
- Is it the case that the model is not adequately fitting the age data (fishery or survey), or that *M* is simply hard to estimate?

The Team agreed with the authors' recommendation to switch to Model 16.1.

During the period 2010-2013, the Team and SSC based their ABC recommendations on the most recent 5-year average fishing mortality rate. Beginning in 2014, however, the Team and SSC felt that stock conditions had improved sufficiently that an increase in the ABC harvest rate was appropriate. Specifically, the Team and SSC recommended basing the ABCs on the harvest rate associated with Tier 3, the stock's Tier 1 classification notwithstanding. The Team agreed with the assessment authors that this approach should be continued for setting the 2017 and 2018 ABCs.

The Team recommends that the authors explore the relationships between selectivity, the natural mortality rate, and the fits to the age data.

The Team recommends that the authors continue to make progress on the remaining comments from the 2016 CIE review.

Multi-species assessment model (CEATTLE)

Kirstin Holsman presented results from a multi-species model ("CEATTLE") involving walleye pollock, Pacific cod, and arrowtooth flounder (CEATTLE is the subject of an appendix to the EBS pollock chapter). At this time the authors view CEATTLE as a "strategic" model rather than a model that would be used for setting annual harvest specifications. CEATTLE can be run in either multi-species or single-species mode (unless otherwise specified, all statements in this section apply to the model in multi-species mode).

Per request of the Team at this year's September meeting, CEATTLE was re-run with lower residual M for pollock at ages 1 and 2 (the values of M for pollock at these ages in the main assessment chapter had already been increased to account for predation unlike the values of M for Pacific cod and arrowtooth flounder in their respective assessments, where M is constant across age). Lowering these residual values of M in the multi-species model (i.e., the M1 parameter in the model) resulted in the following changes:

1. lower estimates of recruitment, which were more similar to values obtained by running the model in single-species mode; and
2. slight decrease (2% decrease) in unfished spawning biomass for pollock and slight increases in unfished spawning biomass for Pacific cod and arrowtooth (~1%);
3. slight increases in ABC proxies 5%, 0.5%, and 1.4%, for pollock, P. cod and arrowtooth, respectively).

Survey and catch data were also updated between Sept. and Nov. and this resulted in slightly higher estimates of ABC proxies for pollock from multi-species than single species models (the opposite pattern was seen in Sept.). When CEATTLE is run in multi-species mode, estimates of ABC can be either higher or lower than when run in single-species mode. Differences between multi-species and single-species modes were: 27%, 5%, and 7.5% lower for unfished Biomass under multi-species than single-species modes but 1.2%, 1.2% and 6.8% greater for ABC proxies for multi- versus single-species modes).

A comparison of recruitment strengths from the just-completed assessments and CEATTLE, in both single- and multi-species modes, revealed a high degree of similarity (this comparison was made after the CEATTLE appendix had been posted, so is not in the document).

With respect to EBS pollock:

- Both CEATTLE and Model 16.1 estimate increased spawning biomass between 2015 and 2016.
- Both CEATTLE and Model 16.1 estimate the 2012 cohort to be exceptionally strong.
- CEATTLE estimates a decline in age 1 recruitment between 2016 to 2015 due to anomalously high predation mortality in 2015-2016 (the highest during the estimated time series), but Model 16.1 does not.
- CEATTLE estimates a slight decline in total biomass between 2015 and 2016, but Model 16.1 does not.
- When run in multi-species mode, CEATTLE estimates lower “steepness” for the stock-recruitment relationship than when run in single-species mode, although the estimate is still higher than would be the case in Model 16.1 without the prior distribution.

Aleutian Islands pollock

Steve Barbeaux presented the Aleutian Islands (AI) pollock assessment. Most estimates were similar to those from the 2015 assessment. The distribution of pollock remains approximately the same. The warmest bottom temperatures on record were observed for the entire AI and warming was deep – to approximately 350m. No age class data were available yet from the 2016 survey.

Two different models were evaluated in 2016 as part of the assessment. Model 15.1 is unchanged from the previous assessment and an alternative, Model 15.2 is the same, but has age-varying natural mortality. The authors recommend retaining the base model (15.1), as the alternative model (15.2) was intended to be exploratory only, and the Team concurred. There was a directed fishery in 2015 of 62 tons. There was no directed fishery in 2016 but 1,288 t were captured in the arrowtooth fishery. Because there was no directed fishery, there are no new directed fishery data (age composition or catch).

In recent years, both recruitment and biomass remain low. Mohn’s rho is equal to 0.09. The author suggested that it might be worth moving this stock off of Tier 3 to Tier 5 because there are no age or length composition data from the bycatch fishery and there is no directed fishery. The sensitivity of model estimates to natural mortality might be a potential future research area.

The Team recommends reviewing Team recommendations from Nov 2015 (i.e., “The Team recommends examining alternative models with higher M (compared to the low M coming out of the estimation procedure), and further recommends exploring the unscaled estimates of selectivity with respect to the survey’s low apparent catchability.”)

Bogoslof pollock

Jim Ianelli presented the Bogoslof Island pollock stock assessment. The 2016 acoustic-trawl (AT) survey conducted in March was included in the analysis. Preliminary 2016 survey age composition data were compiled and provided. Two methods for computing the survey average were provided: one using the random effects model and the other using a simple 3-survey average.

The model for harvest recommendations was based on using a Tier 5 approach, which requires survey estimates of current biomass. This year's AT survey resulted in a biomass estimate of 506,228 t. The random effects model was applied to survey data to derive a smoothed average biomass for the stock and resulted in an estimate of 434,760 t, compared to the 2016 survey observation estimate of 506,000 t. As an alternative method, the three-survey average approach gives an estimate of 228,000 t from which to make the Tier 5 calculations.

The authors evaluated alternatives and recommended the random effects estimate for the purpose of calculating OFL and the maximum permissible ABC, but the 3 year survey average for the purpose of recommending ABC, because it would be desirable to obtain another year of survey data to confirm the large increase in biomass observed by this year's survey. There was some discussion about alternative methods such as the stair step approach, which will also be presented to the SSC along with the 3 year survey average estimate. In the 2015 assessment the estimate of natural mortality was re-evaluated using an age structured model and the value of 0.3 was determined to be a reasonable estimate for this stock given the time series of survey age composition data. The Team confirmed that rerunning the model to estimate M is not a high priority unless changing Tiers is an objective.

The Team discussed and accepted the authors' recommended ABC of 51,300 t.

Pacific cod

Eastern Bering Sea Pacific cod

Grant Thompson presented the EBS Pacific cod assessment. Many changes were made to the Eastern Bering Sea (EBS) Pacific cod data and assessment models for consideration by the Team in 2016. Changes to the data, relative to 2015, are described in the SAFE document. From the six assessment models presented to the Team in September 2016, two were presented again in November along with four new models. One model (11.5) was the accepted model since 2011. Model 16.1 is a single-gear, single-season model using empirical weight-at-age and time-invariant, asymptotic selectivity with M and Q estimated inside the model. Length-at-age was also estimated in this model to fit to length compositions (see Tables 2.14a and 2.14b in the EBS assessment document[1]). Models 16.6 through 16.9 were based off Model 16.1 with the following differences

Model 16.6: Model 16.1 without empirical weight-at-age
- Time-varying, externally estimated weight-at-length

Model 16.7: Model 16.6 with NMFS longline survey
- Logistic selectivity assumed for NMFS longline survey, no extra estimated standard error

Model 16.8: Model 16.1 with time-varying survey selectivity
- Very large sigma for A50% deviations
- Parameter governing difference between A95% and A50% fixed at 0.01, with no deviations

Model 16.9: Model 16.1 with time-varying fishery selectivity
- Very large sigma for deviations on both selectivity parameters

The analyst addressed many CIE, SSC, and Team recommendations, and it was noted that the Team will schedule a Spring 2017 [C1] meeting to discuss mid-year Pacific cod model specifications.

Parameters were estimated for each model and Models 16.8 and 16.9 contained many deviations for the survey or fishery time-varying selectivities. The analyst noted that estimated deviations for the 'a95 to a50' parameter in Model 16.8 were challenging and that this parameter was fixed at a value of 0.01 in only this model (see the first full paragraph on page 19 discussing the 'a95 to a50' parameter).

The six models span a wide range of possibilities and all the models showed good fits to the size composition data. However, only models 16.7, 16.8, and 16.9 had good fits to the age composition data based on the ratio of the harmonic mean of the effective sample size to the arithmetic mean of the input sample size. None of the models gave a good fit to the trawl survey abundance data, but Model 16.8 fit the survey abundance best (time-varying survey selectivity). Retrospective performance was best in Model 16.8 (lowest Mohn's rho), and similar between Models 16.6 and 16.7, which were ower than the remaining models.

Time-varying selectivity for the fishery is expected because the different gears likely have different selectivities and the proportion of catch from each gear has varied over time, yet the fishery catches are modelled as a single gear. The analyst looked at the correlation of the deviations to the proportion of longline catch, and the results were opposite of what was expected (results not shown).

Advantages and disadvantage of using empirical weight-at-age were presented. An advantage of empirical weight-at-age is that changes in weight-at-age do not have to be estimated internal to the model through the length-age and weight-length relationships. Some disadvantages are that smoothing was not applied to the weight-at-age observations and only survey data were used to calculate empirical weight-at-age due to few observations from the fisheries. Additionally, empirical weight-at-age does not have ageing error applied, thus could be biased.

The analyst provided a discussion of model averaging and suggested a short-term approach that is not specifically model averaging, but a move in the direction towards model averaging that will still fit within the current management framework. The advice was to choose a model that provides management advice similar to the management advice averaged over all of the potential models. This suggests choosing Model 16.6. The analyst also reiterated the comments from the SSC that a workshop on model averaging may be useful as well as how to use this approach within the current harvest control rules.

The analyst concluded the presentation with an analysis fitting recruitment deviations to the October through December average NPI. Two outliers, 1990 and 2002, tended to reduce the slope of the relationship, thus reducing the significance of the relationship.

A considerable amount of the discussion focused on the differences between models with empirical weight-at-age and models without (estimating length-at-age in the model and using an externally derived weight-length relationship). A member of the public noted that modeled weight-at-age (Model 16.6) was mostly heavier (possibly about 20% heavier) than the empirical weight-at-age used in the other models, which means that the model with the heavier weight-at-age would need fewer numbers of fish to achieve the same catch. It was suggested that Model 16.6 is inconsistent with the observed weight-at-age data.

The Team was concerned about this discrepancy and was unsure how much to trust the empirical observations of weight-at-age since 1) they are mostly only available from the survey, 2) they are not available for all years, and 3) ageing error is not included in empirical weight-at-age (realized after the Team discussion, but discussed privately among a smaller group, including the member of the public making the comment).

Another major point of discussion was the model averaging approach described by the analysis and how to choose a base model. Some concern was expressed over what would a base model be if model averaging was used, and how would that fit into the NPFMC management system. It was noted that the Mohn's rho's from the retrospective analyses were lowest in Models 16.6 through 16.8. The differences between Models 16.1 and 16.6 seemed to be largely due to the differences in weight-at-age (empirical vs. model-based). And, is there evidence for a departure in survey catchability from an accepted value of 0.77 (0.61 in Model 16.1 and 0.88 in Model 16.6). The Team noted that this may be a good case for model averaging, but strict rules will be needed for the choice of the suite of models.

The Team decided to adopt the Author's approach for this year and accepted Model 16.6 as the preferred model for harvest specifications for 2017. The Team also encourages the analyst to continue investigating these models and new models, as suggested in the Recommendations below.

The Team recommends comparing model predicted weight-at-age in Models 16.6 and 16.7 to the empirical weight-at-age used in Model 16.1.

The Team recommends weighting (tuning) composition data using the Francis method or the harmonic mean of the effective sample size (McAllister & Ianelli approach).

The Team believes that time-varying selectivity is important and recommends continued investigation of time-varying fishery selectivity for use in future models. In addition, the Team recommends investigating methods to determine the variance of the penalty function applied to the deviations (i.e., tuning the deviates).

The Team recommends comparing the estimated recruitment variability (σ_R) to the root mean squared error (RMSE) of the estimated recruitment deviations over a period of years that is well informed (i.e., when the variance of the estimated recruitment deviation is small). See Methot and Taylor (2011) for more information. Also, r4ss provides an RMSE table in the list returned from the SS_output function (also output to the screen) where the RMSE for the "main" period of recruitment is reported.

Aleutian Islands Pacific cod

The assessment for Aleutian Islands Pacific cod was presented by Grant Thompson and it was noted that in September 2016, the Team recommended that this assessment remain in Tier 5 to allow more time to focus on the EBS stock assessment models, but also encourage the author to continue making progress on age-structured models for the AI Pacific cod stock in the future.

The author presented sources of information that suggested the stock has been increasing. The survey biomass and numbers showed increases in 2016 of 15% and 59%, respectively, and that survey numbers increased more than biomass. The trawl fishery CPUE increased in 2016, but the longline fishery CPUE slightly decreased.

The author addressed the SSC's comment #5 (investigate weight-at-age by area) and showed that for ages 6 and greater, the weight-at-age was greatest in the Western Aleutian Islands and lowest in the Eastern Aleutian Islands.

The Tier 5 biomass for this assessment was estimated using the random effects model, which appears to fit the survey data well. The summary table for Tier 5 status used a natural mortality (M) of 0.36 to match model 16.6 for the Eastern Bering Sea. The OFL and ABC values are 28,700 t and 21,500 t, respectively. If an M of 0.34 was used (as in previous assessments) the OFL and ABC would be 27,100 t and 20,300 t, respectively.

It was pointed out that the mean weight-at-length and the mean length-at-age were used to calculate the mean weight-at-age. However, this may not be the correct way to do this because of the cubic relationship between weight and length, and the variability in length-at-age may have to be accounted for.

The Team concurs with the authors' recommendations and the harvest specifications for 2017, which uses a value 0.36 for M.

The Team recommends that the analyst propose age-structured models for consideration at the Spring model specification meeting to be used in Tier 3 calculations.

BSAI Yellowfin sole

Tom Wilderbuer presented the yellowfin sole assessment. The model was updated with most current survey and fishery data available. In addition, changes were made to the fishery weight-at-age where the average of the fishery-aged samples from 2008-2014 were used for 2008-2016, replacing previous values that were time-invariant. In general, the model fits the survey biomass estimates quite well. Yellowfin sole female spawning biomass is ~1.8 times above Bmsy, but has been declining since the 1990s. Total biomass was stable compared to 2015, but 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. Most notable this year was the 48% increase in survey biomass, which suggests changes in Yellowfin behavior. There was discussion regarding the experimental results to examine the relationship between temperature and catchability (q); results showed a stronger correlation between sea-state (wave height) and q. Research will continue on this topic. Model retrospective patterns were poor, but further examinations by the author did not improve patterns.

The Team recommends that the author explore q and M to examine the retrospective patterns further.

BSAI Greenland turbot

Steve Barbeaux presented the Greenland Turbot stock assessment. Four new models were introduced this year (in addition to last year's accepted model). The new models were put forth to improve overall model fit and one model (16.6) attempted to incorporate climate effects on turbot. The authors' recommended model (16.4) was also accepted by the Team due to its good fit and retrospective pattern. This model differed from the base model by: 1) combining size bins lower than 52 cm for both sexes, 2) modifying survey selectivities (see SAFE for details), and 3) removing the ABL longline survey size composition data. The author also recommended a reduced ABC from the maxABC due to concerns about continued low recruitment and the likelihood of entering into an overfished status in the near future. The Team discussed this approach for setting ABC, but ultimately decided that it was not appropriate at this time and thus decided that the ABC be set at the max ABC. There was further discussion about the relationship between temperature and turbot recruitment. This relationship was the impetus to include temperature directly into a model (16.6) and it stimulated a discussion on how the Team/SSC/Council should address stocks that are likely to decline in response to increased warming conditions. No conclusions were made, but the Team recognizes this discussion should continue. The

Team commended the author for his efforts especially for his effort to bring forward an explicit example of how climate change may affect stocks in the future.

The Team recommends that:
1) the consistency of time blocks across surveys be explored
2) a Stock Structure template be completed
3) the author explore the use of age comp data in the model.
4) the author contact ABL survey staff about getting sex specific lengths collected during future surveys

BSAI Arrowtooth Flounder

Ingrid Spies presented the 2017 BSAI arrowtooth flounder stock assessment. The distribution of arrowtooth flounder on the shelf in recent years has been broader, presumably due to the presence of above average water temperatures. Survey biomass estimates on the Bering Sea shelf has generally increased over the last three decades but has levelled off during recent surveys. Biomass estimates for the Bering Sea slope and the Aleutian Islands remains much lower and constant over the same time period. The proportions of females are greater on the Bering Sea shelf and slope and close to 50% for the Aleutian Islands.

Changes to the input data include:
- Survey size compositions from the 2015 and 2016 Eastern Bering Sea shelf survey, 2016 Eastern Bering Sea slope survey, and 2016 Aleutian Islands survey,
- Biomass point-estimates and standard errors from the 2015 and 2016 Eastern Bering Sea shelf surveys, 2016 Eastern Bering Sea slope survey, and 2016 Aleutian Islands survey,
- Fishery size compositions for 2015 and 2016,
- Estimates of catch through October 26, 2016, and
- Age data from the 1993, 1994, 2012, 2014, and 2015 Bering Sea shelf and 2014 Aleutian Islands surveys, as well as the 2012 Eastern Bering Sea slope survey.

Changes to the assessment methodology were:
- Multiplicative weights were set on an ad hoc basis for the survey index data and fixed at 1.0 for the size composition data,
- A likelihood component was added to incorporate the 2012 slope survey age data, and
- The model uses an improved length-age conversion matrix that corrects for stratified sampling.

In September, the Team recommended bringing forward the original 2014 model along with a model, model A, with new length-age conversions. Five models were proposed based on the final 2014 model. One model incorporated the new weights only (15.0a) and a second included the new data without the weights (15.0b). Model 15.1 included the new data and added the new likelihood component; model 15.1a was the same as 15.1 with the new age-length conversion matrix; and model 15.1b added the weights to 15.1a. The performances of the candidate models were presented and model 15.1b was the authors' model of choice due to its better fit to the survey biomass time series. The authors were concerned that some of the selectivity parameters were at or near their boundaries. The authors suggested ways they would address this, such as considering alternatives for the degree of dome-shaped curves in the EBS survey.

The estimated female spawning biomass shows a slight decline in the last few years but is well above $B_{40\%}$ and recruitment was estimated to be generally high for 2001-2010 but has declined to below average. Retrospective plots were presented with a Mohn's adjusted rho equal to 0.246. The biological reference points for 2017 estimate female spawning biomass to 485,802 t, a 9% decrease from the 2015 estimate for 2017. The recommended 2017 OFL is 76,100 t and the ABC is 65,371 t. The Team accepted the authors' model selection and the estimates of OFL and ABC it produced.

The Team recommends the authors consider smoothing the age length conversion matrix and ensure that selectivity parameters are not on bounds without reason.

BSAI Kamchatka Flounder

Tom Wilderbuer presented the Kamchatka flounder assessment. This is a full update of the 2014 stock assessment as the 2015 assessment was off-cycle using a projection model with updated catch information only to provide estimates of ABC and OFL for 2016 and 2017. Changes to input for the current assessment included:

- catch for 2015 and estimated catch for 2016,
- 2016 Bering Sea slope survey length compositions and biomass and standard error estimates,
- 2015 and 2016 Bering Sea shelf survey length compositions and biomass and standard error estimates, and
- 2015 Aleutian Islands survey biomass and standard error estimates and 2016 length composition.

There were no changes to the assessment methodology.

Trends in the biomass estimates from three surveys show slight decreases from the last surveys. The proportion of total survey biomass has increased for the Bering Sea shelf survey over the past decade, while the proportion of biomass for the Aleutian Islands has decreased over the same time period; the Bering Sea slope biomass proportion has remained nearly constant. From the model, estimates of total and female spawning biomass are up with the female spawning biomass being 18% above $B_{40\%}$. Estimates of recent age 2 recruitments also look promising. The Team accepted the authors' recommended OFL and ABC.

BSAI Northern Rock sole

Tom Wilderbuer presented the 2017 northern rock sole stock assessment. This is a Tier 1 stock because there is a lot of information and a reliable S/R relationship. There were no changes to the method. The catch continues to be less than the TAC which is less than the ABC. There has been a downward trend of ABCs over the years; The biomass is up 4%; 2015 was the lowest ever. There was a distinct lack of recruitment 90s and 2000s. Most fish are >10 years old, however the shelf OSCURS model predicts that the 2016 year-class strength should be good. The length range is large and variable over time, with small sizes from the mid-1990s to the mid-2000s. Next year, the author plans to calculate weight at age from survey length at age for each year rather than using a three-year average.

The author recommends modeled 15.1 (last year's model) with q fixed at 1.4. He ran additional models, 16.2 – 16.7, to explore catchability including varying over time with temperature. There was limited discussion about the alternate models, but no suggestion to accept any except 15.1. The Team accepted the authors' model selection and the estimates of OFL and ABC it produced.

The Team recommends that the author continue to explore ways to work with RACE scientists to examine catchability.

BSAI Flathead sole

Carey McGilliard presented the Flathead sole – Bering flounder stock assessment. This was a full assessment year of a biennial assessment. The most notable changes for this assessment were: 1) estimates of the length-at-age, length-weight, and weight-at-age relationships, and the length-at-age transition matrices were updated by adding data from 2001 to 2015 and 2) all age- and length-composition data were weighted using methods described in McAllister and Ianelli (1997). These changes were incorporated into Model 14.1c, which is the author's and Team's recommended model. The author suggests that the shallow survey selectivity curve is a weakness of the model and that a number of survey parameters seem to have the most influence on the retrospective patterns. The Team noted that Table 9.13 was an informative way to present the results from the retrospective analysis. Another minor discussion topic was that temperature no longer improved the model fit with the incorporation of the last two years of data. The author proposed finishing the stock synthesis model and to explore the mismatch of model fit to survey and fishery length comps for future work.

The Team recommends examining the use of time blocks in selectivity due to changes in fishing practices.

BSAI Alaska Plaice

Tom Wilderbuer presented the 2017 Alaska plaice stock assessment. Alaska plaice is assessed on an alternate year cycle; this was a full assessment year. The catch continues to be less than the TAC which is less than the ABC. The exploitation rate is 2.7% with very small catches. The discard rate has been greatly reduced from 0.97 down to 0.08. The 2010 survey included the Northern BS, where 38% of Alaska plaice were; the CIE review said as that area is not sampled every year, the data should not be included in the stock assessment estimates. There has not been much good recruitment since early in 2000s. However, the female spawning biomass is well above $B_{40\%}$. During the planned January 2017 prioritization of assessment discussion, the Team will recommend how often this stock should be assessed. The Team accepted the authors' model selection and the estimates of OFL and ABC it produced.

BSAI Other flatfish

Liz Connors presented the 2017 "other flatfish" stock assessment. As in other years, the composition of other flatfishes was almost all starry flounder, rex sole, and Dover sole. The catch was very low. In the EBS, other flatfishes were caught incidental to trawl and longline flatfish fisheries. In the AI, catches of rex sole and some Dover were incidental to Atka mackerel catches. The biomass relatively stable, but very small. The are no time trends indicating conservation concerns.

Biomass for the complex was calculated by adding nine random effects models together: rex sole, Dover sole and others (including starry flounder) for each of the three survey areas – EBS shelf, AI, and EBS slope. Unlike previous assessments, this year's input data for the EBS slope and AI did not include linearly interpolated estimates for years in which no survey took place. The survey estimates have large confidence intervals on the EBS shelf and AI, and smaller intervals on the slope. The trend, which is driven by rex sole and starry flounder, is relatively smooth, except for 2014 on the shelf. The Team accepted the author's choice of OFL and ABC based on the random effects model.

BSAI Pacific ocean perch

Paul Spencer presented the BSAI Pacific ocean perch assessment. He said the bottom line conclusion to his assessment is that there are a lot of POP out there. The catch has been shifting more toward the western and central areas. It was the highest survey index on record and similar to the last few surveys, but the precision has increased. The abundance has also increased in the EBS slope survey but the spatial distribution is very patchy and has a very high CV. He included the 2016 EBS survey in the POP assessment, despite some limited density sampling in the southern portion of the survey because he did not think the low density of tows affected the POP estimate. The 2008 year class appears to be the newest year class showing up in the AI, whereas the year classes seem similar across year classes in the EBS. About 80% of the POP biomass appears to be in the AI.

Paul presented the 2014 model in addition to 5 new models that examined using the EBS slope survey, removes the CPUE index, and some new data weighting methods. The fishery CPUE data's origin is somewhat unknown and is quite old (1968-1977). Removing the fishery CPUE gave a slightly higher trajectory of biomass. Catchability decreased for the AI survey when removing the fishery CPUE which resulted in a small increase in spawning biomass over time. Paul recommended removing these historic CPUE data.

All of the new models fit the recent high survey biomass estimates better. Using the Francis method resulted in the closest fit to the survey biomass index. A Team member noted the residual pattern in the survey fits seemed to imply differing catchabilities in recent years compared to earlier years, or some other model misspecification.

Paul compared the different weights on data components from models 16.3 – 16.5 compared to the 2014 model. The model had a retrospective of -0.35 which is about the same as 2014. A Team Member said that it looked like a strong retrospective pattern. Paul said that he thought it was a data-driven pattern. He is recommending model 16.3 which uses the McAllister-Ianelli tuning (harmonic mean of effective sample size). The 2016 model is showing higher recruitment lately. The survey ages seem to track the cohorts better than the rougheye model. The catchabilities for the two surveys were 1.37 – 1.88 for AI and EBS, respectively (when not adjusted for availability parameters). Fishery selectivity is fit with a spline which was highly dome-shaped in the past and much closer to asymptotic in recent years.

A Team member asked about size-targeting POP. An industry member responded probably not. The management phase-plane plot showed a healthy stock and fishing well below F_{OFL}. His harvest recommendations show an increasing POP stock since last year. All areas appear to be increasing at the same time. The EBS survey adjustment made little difference to the apportionment.

Paul showed that the M tends to go much higher relative to the mean of the prior distribution, so perhaps that quantity should be revisited. A Team member asked about natural mortality being estimated without a prior. There is some tension between the age compositions and the survey biomass estimates. The proportional EBS apportionment seems to work better for POP than rougheye rockfish because all areas seem to be increasing similarly. A Team Member asked whether something could be learned by comparing the rougheye apportionment to the POP apportionment.

The Team recommends examining the residual pattern in the fit to the AI survey to see if there was a substantial change in the survey design or potential model misspecification that would explain the change in sign of the residuals between 2006 and 2010.

BSAI Northern rockfish

Paul Spencer presented the BSAI northern rockfish assessment. Northern rockfish appear to be decreasing in the Western areas and are down overall in the AI in 2016. However, the survey is down from a high estimate in 2014. There have been few strong recruitments since 1998. The EBS slope survey was not considered for inclusion for northern rockfish, because they are infrequently encountered in either of the EBS surveys. There were fewer models than POP because there were no changes in abundance indices.

The fit to the AI survey looked similar to the POP fits, with a residual pattern above early and below later. The new data-weighting models put high emphasis on the AI survey lengths. The Mohn's rho was -0.18 for this stock. A Team Member noted that this was much lower than either the POP or BS/RE assessment.

The fishery selectivity curve shows that the fishery catches older fish than the survey. The management phase plane plot showed that the stock is healthy and not fishing over F_{OFL}.

Initial estimates of growth curves across areas were shown. Generally, the western area has lower values of L_infinity and kappa. Since much of the catch comes from a different region than most of the growth data it might be useful to explore the implications of area growth differences on model results.

Future research plans are to: 1) Examine size at age across AI subareas; 2) Compute an ageing error matrix specific to the AI

A Team Member asked whether the large increase was based mainly on new data and which sources were causing the increases. Paul said it looked like there was some new recruitment coming into the age compositions. A Team member suggested looking at the mean age and mean length predictions versus the observed quantities over time as a way to evaluate process error and data weighting as would be done by the Francis method. In a model with process error (e.g., patterns in annual residuals or a single year that seems to be an outlier), the Francis method may not be able to determine an appropriate weight for these data. Looking at these mean age and length plots across years can help to identify unmodeled processes.

The Team recommends that the authors present plots of the predicted mean age and length compared to the observed age and length means over time (with confidence intervals). The Team recommends examining the residual pattern in the fit to the AI survey to see if there was a substantial change in the survey design or potential model misspecification that would explain the change in sign of the residuals between 2006 and 2010.

BSAI Blackspotted/rougheye rockfish

Paul Spencer provided the overview of the full assessment for 2017-2018 specifications. He noted that bycatch catch rates have been declining due to increased avoidance by the fleet, and that catch for the WAI was significantly below the MSSC after having exceeded it the last two years. The Team commended industry for cooperating to ensure that catch did not exceed the WAI MSSC. A larger portion of the catch occurred earlier in the year in 2015 and 2016.

The EAI survey biomass was very low in 2014 but moved to a high point in 2016. The 2016 estimate is more consistent with the longer-term, slight downward trend.

The 2016 survey doesn't pick up the 1998 YC significantly, especially in the WAI which had shown indications of being very strong; this has a significant impact on this year's models relative to 2014. Fish are smaller overall; there are much younger fish recently than in 1990s, although they were somewhat bigger in 2016 in the AI survey. There was also an equipment failure in the EBS slope survey in 2016 so it was excluded for the 2016 assessment because a number of the stations in the south where BSRE have been in previous years.

Paul discussed the adjusted methods for reweighting composition data. Weighted using the inverse of residual variance, the McAllister-Ianelli method, and "the Francis method" and chose the MI method because the "Francis method" sharply downweighted the compositional data, possibly because of particularly noisy data for BS/RE and because the MI is commonly used in other Alaska assessments. Paul showed the results of 9 models – updated versions of the old models with new data, several models with reweighted survey data, and full, combined BSAI models. The recommended model had a strong retrospective pattern with a large positive Mohn's rho (0.715) which was similar to last year, but he did not compare it to the other model alternatives.

Exploitation rates have come down since 2013 (the last three years). All areas down below sub-area "U(F40%)" levels including the WAI in 2016.

There was a meeting held this year to discuss possible new tools to address the management of the WAI component of this stock (Report available here: http://npfmc.legistar.com/gateway.aspx?M=F&ID=f6432459-1231-4b60-9c60-852e43859c26.pdf). This built upon a 2013 workshop on stock structure (Report available here: http://www.afsc.noaa.gov/REFM/stocks/Plan_Team/2013/Sept/C4a_Spatial%20Structure%20Workshop%20Proceedingsv6.pdf).

The Team recommends that, in the next assessment, the author explore the interplay of catchabilities with availabilities in the incorporation of the slope survey into the model. The Team also recommends that the author revisit whether a single age-structured Bering Sea/Aleutian Islands model is the most appropriate approach.

The Team recommends that the 2017 MSSC in the WAI be set at a value of 31 t, as calculated in this year's assessment. In September, the Team recommended that catch continue to be monitored relative to the MSSC.

Members of the public expressed that it may be difficult stay under the further reduced MSSC. There was extensive discussion regarding the objective of the MSSC, whether genetic studies would provide more insight into whether the current split between the WAI and CAI is appropriate, and whether other options or tools should be considered in advance in case the MSSC is exceeded. If the MSSC is exceeded next year, the Team anticipates that alternative management tools for use in 2018 will need to be evaluated (e.g., subarea TACs, ABCs, or OFLs).

The Team recommends that the Council task staff with further analysis of possible alternative management measures if such analysis is desired.

BSAI Shortraker rockfish

Ingrid Spies presented the shortraker rockfish assessment, incorporating the most recent catch data for 2015 and 2016 (as of Oct. 19, 2016). This is a full update of the 2014 stock assessment, as the 2015 assessment was off-cycle, using a random effects model with updated catch information only to provide estimates of ABC and OFL for 2016 and 2017. Changes to the inputs for the current assessment model include:

- Catch data for 2015 and 2016, and
- Biomass estimates from the 2016 Aleutian Islands and eastern Bering Sea slope surveys

The author presented separate biomass estimates for each of the four management regions, as well as the southern Bering Sea which has shortraker rockfish bycatch in the arrowtooth flounder and “other rockfish” fisheries but is not considered a distinct management area. The 2017 biomass estimate is based on the Aleutian Islands survey data through 2016 as well as the 2002-2012 and 2016 eastern Bering Sea slope survey data. Prior to the 2012 assessment, the EBS slope survey data had not been included in biomass estimates for this species.

Although a stock structure template was completed by the previous assessment author, Ingrid offered to update the template due to interest in the exploitation rates in the five areas.

The Team accepted the author’s choice of OFL and ABC

The Team recommends that the author exclude years prior to 1991 from the AI survey because of changes in survey methodology and to be consistent with other AI stock assessments.

BSAI Other Rockfish

Liz Connors presented an update of the other rockfish complex stock assessment. New data in the 2016 assessment included updated catch and fishery lengths through 2016. Biomass estimates, CPUE, and length frequency compositions were also included from the 2016 Aleutian Island (AI) and eastern Bering Sea slope (EBS) trawl surveys and the 2015 and 2016 eastern Bering Sea shelf survey.

There was no change in the assessment methodology in this assessment. A random effects model is run for the biomass time series in each region. Further, the model is run for short-spine thornyhead (SST) separate from the remainder of the complex. SST are very rare in the EBS shelf survey, thus the model is not run for that group and region. The results of the five models are then combined for the full FMP biomass estimate for setting ABC and OFL. The recommended ABCs are increases of approximately 14% and 3% over the previous assessment.

Team discussions brought up some general questions regarding the random effects model, which are not specific to this assessment only. In the case of assessments where the biomass data may not support the random effects model (i.e., a flat line, process error not estimable), should it still be used? An example would be the EBS slope survey non-SST biomass. A further question was how to deal with zero biomass values in the model. These questions may be more appropriate for the survey averaging working group.

The Team accepted the authors’ recommended ABCs and OFLs.

The Team recommends that the authors examine the M value, and explain why the preferred value of M=0.038 as stated in the text, is not used and a value of M=0.03 is used instead. Finally, the Team recommends that the authors include a discussion of survey catchability and detection limits.

BSAI Atka mackerel

Sandra Lowe presented the Atka mackerel assessment. The following new data were included in this year's assessment:

- Total 2015 year-end catch was updated, and the projected total catch for 2016 was set equal to the 2016 TAC.
- The 2015 fishery age composition data were added.
- The biomass estimate from the 2016 AI bottom trawl survey (down 38% from the 2014 estimate) was added.

Methodological changes included the following:

- In the assessment model: input sample sizes for compositional data were set proportional to the number of sampled hauls containing Atka mackerel, rather than the number of sampled Atka mackerel. The average sample sizes (across years) were held constant at the values used in last year's assessment, however.
- In the projection model:
    - The selectivity schedule used for projections was equal to the average of the most recent five years for which model estimates are available, rather than the most recent five years (with the current year set equal to the previous year). The estimated fishery selectivity pattern for 2015 is noticeably different from the estimated patterns for other recent years.
    - Catches for 2017 and 2018 were assumed to equal 62% of the BSAI-wide ABC, based on an analysis of the effect of the revised Steller Sea Lion Reasonable and Prudent Alternatives that were implemented in 2015, rather than the 80% rate that was used in last year's assessment.

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

Ecosystem considerations included the following:

- Temperature may affect recruitment of Atka mackerel and availability to the bottom trawl survey.
- Atka mackerel is the most common prey item of the endangered western Steller sea lion throughout the year in the Aleutian Islands. Steller sea lion surveys indicate continued declines, particularly in the western Aleutians (area 543). Regulations implemented in 2015 re-opened area 543 to directed fishing for Atka mackerel (but with a maximum TAC of 65% of the area

ABC), removed the TAC reduction in area 542, and re-opened areas in 541 and 542 that were previously closed to directed Atka mackerel fishing.

Questions and comments from Team members and others during the discussion included the following:

- Despite large CVs, the trends in the area-specific survey biomass estimates are similar, despite the fact that Atka mackerel are not thought to move very far; perhaps the trends are a temperature effect.
- Recruitment trends also seem to be similar across areas.
- Of the three areas, survey biomass estimates in the EAI tend to be both the most variable (between years) and the most imprecise.
- Area-specific growth is taken into account when computing age compositions, but is not addressed in the apportionment scheme.
- The authors have considered switching to area-specific models.
- It would be interesting to know how many fish are required to constitute a ton of catch in each area.
- Perhaps survey selectivity in the model should be time-varying.
- Time-varying fishery selectivity may disguise recruitment signals, particularly in years with no survey.
- The authors plan to investigate selectivity further.
- The changes in age composition between 2014 and 2015 may have been due to reopening various areas in 2015 (including, but not limited to, the WAI); this might help to explain the change in estimated selectivity between 2014 and 2015.
- A member of the public was concerned about the lack of fit of the random effects model used for apportionment and why it was considered the best model. In the past, the Team and SSC have preferred the random effects model for making apportionments because the annual weightings are estimated statistically rather than specified subjectively, and because the random effects model was evaluated thoroughly over at least a couple of years before being adopted as a standard. The authors continue to recommend it this year.
- Although the CAPAM workshop on model tuning (the results of which the SSC has asked all of the assessment authors to consider) did not reach consensus, both harmonic mean tuning and the “Francis method” merit consideration for compositional data.
- Groundfish assessments from the west coast are also a place to look for ideas on model tuning, specifically the rougheye and widow rockfish assessments.
- The likelihoods between the two models are not comparable; the fact that the two models have the same average sample size is insufficient for comparability.
- Perhaps the fishery age compositions are being over-fit; it would be advisable to tune the average sample sizes.
- Returning to the use of time blocks for defining time-varying fishery selectivity (as was the practice during the intervening years between the two most recent CIE reviews) may be advisable, perhaps with the blocks based on regulatory changes.
- The new model was not previewed at the September Team meeting, and there is no emergency requiring a change of model. On the other hand, the new model was quite similar to last year’s model and last year’s model was not available for selection.
- The new model could be supported on the basis of first principles, in that number of hauls is generally considered to be a better measure of sample size than number of fish.

The Team accepted the authors’ new model and the accompanying harvest specifications.

For next year’s assessment, the Team recommends that the authors explore:

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

BSAI Skates

Olav Ormseth presented the skate complex stock assessment. The skate complex consists of the Alaska skate (Tier 3a) and all other skates (Tier 5, 14 species), with ABCs and OFLs set for the complex as a whole. For Alaska skates he presented the previously accepted model, 14.2, as well as two new alternative models as a result of discussions during the September Team meeting. The random effects model was used for the Tier 5 species, where each of the survey areas is run separately.

This year’s assessment updated catch data through October of 2016, included the 2015 and 2016 eastern Bering Sea (EBS) shelf survey biomass and the 2016 EBS and Aleutian Islands (AI) trawl survey biomasses. The Alaska skate model was also updated with EBS shelf survey size compositions, fishery length compositions through 2015 and an additional length-at-age dataset from vertebrae collected during the 2015 EBS shelf trawl survey. There were no changes to the assessment methodology.

The EBS shelf survey, which is generally at least 80% of the total BSAI skate biomass, has been increasing since 2012 and is dominated by Alaska skate. The EBS slope has the greatest species diversity, but is predominantly Aleutian skate, has also shown increasing biomass, which is mostly Aleutian skates. The AI survey biomass increased until 2010 and has been decreasing since. This complex is composed mostly of whiteblotched skate. The leopard skate, which is endemic to the AI has been showing a steep decline, since 2010.

Catch of skates had been increasing since 2010, however it has been relatively stable the last few years. Skate catch generally occurs in NMFS area 521 and mostly from the Pacific cod fishery. Catch has been below the TAC and well below the ABC.

Olav presented the previously accepted Model 14.2, a new Model 14.3 (14.2 with asymptotic selectivity) and Model 14.4 (starting the model in 1977). The author continued to recommend Model 14.2, as neither of the new alternatives improved the overall model output. One concern was how changing the length of the time series would impact the retrospective pattern, however, the older catch data does change the model results, probably due to limited information input into the model prior to 2009.

In discussions of the Alaska skate model (Model 14.2) it was pointed out that the model fit to the survey biomass doesn’t match recent trends in biomass, which could be because the model doesn’t capture the peak in the larger fish (large plus group). The numbers at age suggest that there could be recruitment events working through the population, but the model may not be picking up these events. The retrospective analysis is complicated in this model because of limited data prior to 2009.

The random effects model was used for the remaining species in the complex, which consists primarily of Aleutian and whiteblotched skates. The model is run with the combined biomass of the non-Alaska skates and separately for each survey area, and then summed for the total FMP biomass. The only change in the models was that the EBS shelf survey model fit improved dramatically with the addition of the 2015 and 2016 survey data, owing to the increased contrast in the data.

The Team accepts the author's recommendations for continuing with Model 14.2 for Alaska skates and the random effects model for the Tier 5 species, and accepts the recommended ABC and OFL.

Following up on a concern from its November 2014 meeting, in September the Team requested that the author provide an appendix detailing how the model and data changes (between the 2013 and 2014 assessments, where the 2013 assessment was just a partial update based on the 2012 model) which resulted in a decreased 2015 spawning biomass (down 35%) and a decreased F_{OFL} (down 20%) could also result in an increased 2015 OFL (up 32%). Specifically, the Team requested a demonstration of exploitation at age using F_{OFL}, selectivity, and biomass at age. The Team commends the author for including the requested appendix, but individual Team members expressed concern that it did not fully resolve the paradox.

The Team recommends that the author:

1. **Investigate appropriate Bmsy proxies for skates and relate the values to current harvest recommendations, for example, most elasmobranchs have Bmsy >= B50%, less productive species have been documented to have Bmsy=B79%. The BSAI skate species are likely between these two extremes. See Simpfendorfer et al. 2008 (http://www.iccat.int/Documents/Meetings/Docs/SCRS/SCRS-08-140_Simpfendorfer_et_al_REV.pdf) and Cortes et al. 2007 (http://www.publish.csiro.au/MF/pdf/MF06191) for starting places.**
2. **Examine the utility of including IPHC and AFSC longline survey indices in both Model 14.2 and the random effects model for the Tier 5 species.**
3. **Expand on appendix 2 of the SAFE document by reconciling more explicitly the differences between the results of the 2013 and 2014 assessments with respect to the substantial decreases in F_{OFL} and 2015 spawning biomass and the substantial increase in 2015 OFL.**

BSAI Sculpins

Ingrid Spies presented the sculpin stock complex assessment, incorporating the most recent catch data for 2015 and 2016 (as of Oct. 11, 2016). This non-target species complex is assessed biennially with a full assessment in 2016 for this Tier 5 stock complex to coincide with the frequency of the trawl surveys. The standard Tier 5 random effects model is used to provide estimates of ABC and OFL for 2016 and 2017. Changes to input for the current assessment model include:

- Catch and retention data for 2015 and 2016, and
- Biomass estimates and length composition from the 2015 and 2016 eastern Bering Sea shelf survey and 2016 Aleutian Islands and eastern Bering Sea slope surveys

The random effects model was run for each of the six most common species and each region to calculate the biomass estimate for the entire BSAI area. Although there are 48 sculpin species in the BSAI region, the OFL is the product of the biomass-weighted natural mortality M and the random effects biomass of the six most abundant BSAI sculpin species only.

There was a small increase in the overall biomass of the BSAI sculpin complex in 2016 and a slight decrease in natural mortality from 0.29 in 2014 to 0.283 in 2016 although ABC and OFL remain similar to those reported in the 2014 assessment. The team agreed with the author's recommendation for OFL and ABC.

BSAI Sharks

Cindy Tribuzio presented the shark assessment, incorporating the most recent catch data for 2015 and 2016 (as of Oct. 3, 2016). The 2016 SAFE looked at two new time series of catch for calculating OFL and ABC in addition to status quo of OFL = maximum catch from 1997 – 2007. The authors reviewed using the 2003-2015 time series (since Catch Accounting began) and the 2013-2015 time series covering the restructured observer program that increased observer coverage on small vessels, but determined three years was short considering the variability of shark catch. The Team also discussed using the status quo time series (1997-2007) with 2002 removed because of likely misidentified catch. In 2002, an observed haul reported a large extrapolated catch of basking shark by a longline vessel. This catch is highly unlikely because the species is planktivorous and the BSAI is well outside its normal range. Further, the large size of that single animal (recorded at the maximum size for the species) extrapolated out to an unreasonably large estimated catch, which when used in the pseudo-blend catch estimation procedure resulted in on overestimate of total catch for the “other” sharks in 2002. However, removing only this data point results in OFLs and ABCs that are similar to those for the 2003 - 2015 time series. The Team also discussed the alternative of setting OFL at the upper end of the 99% confidence interval for the data from 2003-2016 (based on an assumed normal distribution), which would have given an OFL of 800 t. The Team ultimately agreed with the authors proposed OFL = maximum catch for 2003 – 2015, and ABC = 0.75*OFL. This time series includes catch data that are calculated using the same reproducible methodology and provides a more representative estimate of catch.

There was a steep decline in the IPHC longline survey and incidental catch rates of sleeper sharks beginning around 2000 and continuing for several years, but in recent years catch rates have been low and stable in both the surveys and bycatch fisheries. In the case of sleeper sharks it is unknown if there is a conservation concern, because mature animals have not been reported in survey or incidental catch. It is unknown whether the past appearance of higher abundance was the result of one reproductively successful period with lots of juveniles, or an actual decline in abundance of all sleeper sharks. Swept area biomass estimates are calculated for the BSAI surveys, but are not reliable for any of the shark species. The authors continue to investigate catch of sleeper sharks by numbers and compare to catch weight estimates, but currently those estimates are calculated only back to 2010, and the authors need this information from the catch accounting system prior to 2010.

The Team recommends that the authors continue development of catch of sleeper sharks by numbers, if possible back to 2003, and examine the potential bias in average weight as applied to observed longline caught sleeper sharks.

BSAI Squid

Olav Ormseth presented the assessment for the BSAI squid complex. Additional information has been included in the assessment this year to cover updated survey information, catch patterns, environmental effects on squid in addition to harvest recommendations. The author indicated that squid is infrequently encountered by the slope survey, is primarily in the shelf and AI surveys and primarily encounters B. magister.

The Team discussed the updated spatial and temporal catch patterns on the shelf break and canyons. Temporal data on squid bycatch in the pollock fishery indicate large squid catches around the start of the B season. The squid box closure seems to consistently result in decreasing catch after is enacted by the pollock fleet.

The author also provided size composition data from the slope and AI surveys as well as the fishery. Some variability is seen by each but generally the mantle length (B. Magister only) leans toward a single mode around 20-21 cm length bin. Noticeably on the slope survey a second size mode 6-8cm, which is presumed to represent a second cohort (squid have multiple cohorts per year). The author noted that it is possible a 3rd cohort is present that doesn't show up in survey due to the timing and lack of consistent spatial coverage in all years. The Team recommends the author investigate spatially where this earlier cohort shows up in earlier slope surveys rage. The author noted that the AI survey has consistently slightly larger mode (>20cm) and slight hint of smaller cohort but not as pronounced as in slope survey. Fishery data shows 20cm size mode fairly consistently and no consistent evidence of a smaller size class which could be the result of lack of additional sampling later in the season in the directed pollock fishery.

The author provided information on environmental effects on squid. He noted the effect of warm temperatures on growth and maturation of squid, which are very sensitive to changing temperature. Squid are very fast growing, with a strong response to temperature. Warmer temperatures result in faster growth, shorter time to maturity, smaller size at maturity and senescence. Cooler temperatures result in life stages lasting longer. Squid are thus smaller sizes as adults in warmer conditions with the squid maturing quicker and at smaller sizes. He noted this high intrinsic growth rate is also dependent on dissolved oxygen and prey availability and may result in increased cohorts possible in warmer years.

The author presented an analysis (not in the assessment) relating mean July mantle length in the fishery with May SST anomalies to investigate the relationship between temperature and mean smaller lengths observed. The Team recommends that the author continue to evaluate this and include temperature data available from the survey (of continuous temperature sampling as well as bottom temperature data) and its relationship to mantle length. The Team also recommends considering a spatial analysis of mantle length and temperature.

In relation to SSC concerns on localized depletion potential in their review of the Squid to EC EA/RIR/IRFA, the Team discussed how to evaluate the potential impact of any localized depletion on predators. The Team discussed the potential to look at whale diet data for Bering canyon, and the size and depth considerations. Some discussion was held with respect to movement and that if prey are moving around a lot then the localized depletion would not persist. The Team discussed the persistent nature of spawning aggregations of squid with respect to whether temporal and spatial closures are effective at reducing bycatch. In relation to localized depletion concerns, however, there is no evidence that sperm whales are locally dependent on aggregations. A comment was made to consider whether eggs are attaching to specific substrate which could be locally important in order to better evaluate potential for localized importance and periods of predation. In general, inferences regarding localized depletion and impacts on the food web are likely to be somewhat speculative given the limited data available.

BSAI Octopus

Liz Conners presented the octopus assessment. The Tier 6 alternative consumption method (from 2011) was updated with new Pacific cod stomach data through 2015 (about 9,000 new samples). Recent increases in both Pacific cod and percentage of octopus in Pacific cod diet increased the annual consumption estimates from 2009-2015. The consumption methodology is based on extensive diet data and includes estimation of uncertainty. The 2015 and 2016 catches are low and well below the ABC. The 2012 and 2013 Pacific cod diet data were not available for this assessment. The author will include them when they become available. The ABC and OFL estimates increased as a result of the increase in

Pacific cod biomass and proportional increases in octopus in Pacific cod stomach samples. The 2014 - 2016 catch rates are stable at about 430 t with retention at about 17 percent. The Team accepted the author's choice of OFL and ABC.

Adjourn